SMD E/PO
PHASE IV EVALUATION:

INTRODUCTION

NASA Space Mission Directorate
Washington, DC

Written by:
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December 2005

PROGRAM EVALUATION AND RESEARCH GROUP
AT LESLEY UNIVERSITY

SMD E/PO Phase IV Evaluation:
Introduction

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From its inception in 1958, the National Aeronautics and Space Administration (NASA) has sustained an agency-wide commitment to education. During the period December 1993–February 1995, the NASA Office of Space Science (OSS)[1] developed *Partners in Education: A Strategy for Integrating Education and Public Outreach into NASA's Space Science Programs* (1995, referred to as the Strategic Plan). This publication articulated the goals of developing a variety of Education/Public Outreach (E/PO) resources and integrating them with existing efforts to create a coherent vision for education. *Implementing the Office of Space Science Education/Public Outreach Strategy* (developed May 1995–September 1996, referred to as the Implementation Plan) specifically addresses the methods by which the goals articulated in the Strategic Plan were to be realized.

PROJECT DESCRIPTION

The SMD E/PO Effort is dedicated to realizing the goals of the Strategic Plan, which was developed with the mission of making "education at all levels and the enhancement of public understanding of science integral parts of space science research activities."[2] The intent was to build a bridge between SMD and the public, particularly with the formal and informal educational communities. The NASA/SMD Education goals guide the work of the Support Network. Those goals are:

- Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.
- Engage the public in shaping and sharing the experience of exploration and discovery.
- To help create our 21st century scientific and technical workforce.

Virtually all SMD E/PO is funded through SMD flight missions,[3] through grants for Supporting Research and Technology,[4] and through the activities of the Support Network

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[1] NASA has undergone restructuring and OSS no longer exists as a separate enterprise, but is now part of the Science Mission Directorate (SMD). For simplicity's sake, SMD will be used throughout the report, rather than OSS, regardless of the time period described.

[2] *Partners in Education: A Strategy for Integrating Education and Public Outreach into NASA's Space Science Programs*, 1995, p. 1.

[3] Missions are large-scale, long-term research projects. The funding process for missions utilizes Announcements of Opportunity (AOs). The SMD E/PO Effort has mandated that all new missions allocate 1–2% of their budget for education and public outreach. Older missions, such as Voyager, are exempt from this mandate, although many do support some type of E/PO development.

[4] Grants for Supporting Research and Technology are smaller grants, covering relatively small, short-term research projects that provide basic research supporting the flight missions. The funding process utilizes NASA Research

(SN).[5] SMD guidelines require that scientific staff be involved with the development of E/PO related to their missions and research. Scientific staff are often supported by personnel dedicated specifically to development of E/PO resources.

One of the main actions of the SMD E/PO Effort was the development of the Support Network, which comprises four Forums and seven Broker/Facilitators (B/Fs). The Forums have been aligned with the SMD themes.

As each SMD mission is aligned with at least one of the themes, the Forums reach every SMD mission. The B/Fs are distributed throughout the country, working regionally with developers and users of SMD's educational products, identifying the needs of the populations served by the SMD E/PO Effort. The Forums and B/Fs (the SN), together with personnel from SMD and NASA's Office of Education, form the core of the SMD Education Council—the group created by SMD to ensure coordination of E/PO efforts and implement the SMD-wide plan. The SMD Education Council has met regularly to share information and experience, to develop the necessary infrastructure and resources to support the continuing activities of the SMD E/PO Effort.

The SN has provided a range of useful services since its inception, many of which are highlighted in the four PERG reports.[6] As a consequence of SN activity, the SMD E/PO Effort as a whole has increased in connectivity and integration. During the period covered by this report, the SN and its components continued and expanded the work it had been involved with over the previous years, including outreach to the educational, scientific, and underserved communities; development and implementation of educational resources and systems; refinement of the SN infrastructure; and coordination of activities with NASA's Education Division.

Recent activities of the SMD E/PO Effort have included efforts to reach more people across a wider range of audiences. E/PO leads, SN staff, and mission and research scientists have increased their distribution of materials, as well as the scope and content of workshops and other interactive experiences in the formal and informal education communities. The opportunities for interactive experiences occurred at schools and other community locations, museums, space science organizations, conferences, and a myriad of other sites. In addition, the space science community codified, catalogued, refined, and created an expanded range of products for their audiences, disseminating them through the Web and in hard-copy form for multiple groups including classrooms, libraries,

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Announcements (NRAs), and grants submitted in response to NRAs are not required to include funds for E/PO. While educational components are not mandated for Supporting Research, scientists working on Supporting Research are encouraged to develop E/PO resources in conjunction with the scientific content of the grants.

[5] There are a few smaller grants programs, such as IDEAS, that provide E/PO funding that is not tied to specific NASA missions or Supporting Research. These represent a very small proportion of the SMD E/PO budget. In addition, Guest Observer Grants (which support guest scientists on missions) may involve E/PO components.

[6] Available by request from Dan Woods (dwoods@mail.hq.nasa.gov).

museums, and science centers. The Space Science Education Resource Directory (SSERD) was completed and made accessible to the public through the Website http://teachspacescience.stsci.ed.

The SMD sponsored two conferences in Chicago. The first was held in June 2002, and was very significant. Convened by the SMD E/PO Support Network, it was dedicated to a three-day discussion about how to create effective space science and education partnerships to further the goals of the SMD E/PO Effort. Participants included scientists and other personnel from SMD and across NASA; representatives from a number of formal and informal education organizations; members of a range of minority professional organizations, and education and research faculty from a range of colleges and universities across the country. The conference fostered extensive dialogue about the array of interests, resources, issues, and conditions for each population that create both opportunities and challenges to partnerships and collaborations for all participating communities.

The second conference was held in June 2004. The *Workshop to Foster Broader Participation in NASA Space Science Missions and Research Programs* was intended to "seed personal contacts among a much more diverse community of investigators than has traditionally been active in NASA space science missions."[7] Like its predecessor, it was highly successful. Participants included scientists from NASA as well as universities and other settings not directly involved with NASA missions, including minority universities and professional organizations. The conference provided multiple opportunities for participants to dialogue about their work and interests, and connect for current and future missions and E/PO programs.

In March 2001, the Space Science Advisory Committee (SScAC) set up a Task Force to carry out an external review of the SMD E/PO Effort. The Task Force produced a report, *Implementing the Office of Space Science Education/Public Outreach Strategy: A Critical Evaluation at the Six-Year Mark* (2003). This report found the SMD E/PO Effort to be worthwhile and effective. The report included several substantive recommendations for the improvement of the SMD E/PO Effort. The SMD Administration has implemented several of these recommendations and has plans to implement more of them.

Partly as a function of the Task Force report and findings from PERG evaluation efforts, the Education Council meeting agendas have been modified to include a range of interactive activities and professional development (PD) opportunities for its members. The agendas have also included expanded opportunities to dialogue directly with

[7] *A Workshop to Foster Broader Participation in NASA Space Science Missions and Research Programs*: http://analyzer.depaul.edu/Chicago2004/

members of the NASA Office for Education, as well as with other groups such as the minority professional organizations and other NASA Enterprises.

In 2005, the Office of Space Science and the Earth Science Enterprise were partnered and newly named the NASA Science Mission Directorate (SMD). The resulting organization continues the E/PO work initiated by the preceding OSS E/PO Support Network, with notable focus on developing the E/PO professional development infrastructure. As mentioned previously, the E/PO work is dedicated to realizing the goals of the Strategic Plan, which was developed with the mission of making "education at all levels and the enhancement of public understanding of science integral parts of space science research activities." The intent of the new organization is to build a bridge between Space Science and the public, particularly with the formal and informal educational communities. The goals of the E/PO Effort as outlined in the most recent OSS Strategic Plan are:

- To share the excitement of space science discoveries with the public.
- To enhance the quality of science, mathematics, and technology education, particularly at the pre-college level.
- To help create our 21st century scientific and technical workforce.

EVALUATION

The NASA Office of Space Science contracted with the Program Evaluation and Research Group (PERG) of Lesley University in October 1998 to conduct an external evaluation to determine how effectively the SMD E/PO program is meeting the objectives laid out in the Implementation Plan. The PERG evaluation plan to date has been conducted in four phases presented in four separate reports. This report represents the work completed during Phase IV.

EVALUATION PHASES

- **Phase I**
  The first report focused on documenting and describing the **infrastructure** of the SMD E/PO Effort,[8] especially the Support Network (SN), a network of institutions acrSMD the nation that help achieve the goals of the SMD E/PO Strategic Plan. This report dealt with variables affecting the SN itself. Thus, the data analyzed were collected primarily from members of the SMD E/PO

[8] In this report, we use the term "SMD E/PO Effort" to refer to the individuals and organizations that participate in or contribute to the creation of SMD E/PO material, and all activities carried out in support of the SMDStrategic and Implementation Plans.

community. Data were collected between November 1998 and October 1999, and the report was delivered in May 2000.

- **Phase II**
  The second report focused on describing and explaining the total SMD E/PO Effort **implementation**, beyond the development of the Support Network infrastructure. Data for this report were gathered between January 2000 and May 2001, from both members of the SMD E/PO community and the communities it serves directly (educators,[9] scientists, and the rest of NASA). This report focused on the actions of the SMD E/PO Effort to meet the goals outlined in the Strategic and Implementation Plans, the successes of the program, and the challenges that it faced.
- **Phase III**
  The third report focused on examining the **impact** of SMD E/PO activities on those audiences for whom the products and services are designed (e.g., teachers who participate in SMD teacher training programs, visitors to SMD museum exhibits, etc.). Data sources included the audiences or "end-users," as well as those populations who were included in the first two reports. Phase III of the evaluation took place over a two-year period that began in October 2001.
- **Phase IV**
  The fourth report presents results of three in-depth studies that focused on selected E/PO activities and programs to understand their effects and value for their audiences and for the E/PO Effort. Audiences included public school teachers, students, NASA scientists, minority scientists, and informal education staff. In addition, the report includes results of a quantitative study of the attributes of E/PO resources in all categories, as well as an evaluation of the Chicago 2004: *Workshop to Foster Broader Participation in NASA Space Science Missions and Research Programs*.

EVALUATION METHODS

MUCERPI PARTNERSHIPS

The purpose of studying the MUCERPI Partnerships was to identify the strengths and challenges of the relationships and the conditions that enable successful partnerships with minority universities to grow and thrive.

Evaluators collaborated with the SMD E/PO leadership to identify the Minority University Education and Research Partnership Initiative grants (MUCERPI) that would be studied in depth:

[9] In this report, we use the term "educator" to refer to any individual or organization that is responsible for disseminating information to a larger audience. This includes (but is not limited to) classroom teachers, museum staff, librarians, Girl Scout leaders, speakers presenting to the public, etc.

1. Medgar Evers College, part of the City University of New York (CUNY) higher education system: African American
2. Southwestern Indian Polytechnic Institute (SIPI): Native American
3. University of Houston-Downtown: Hispanic

Data Collection Activities

Evaluators:

- Contacted the MUCERPI principal investigators
- Conducted site visits to each of the three institutions that received the MUCERPI grant and the partnering/collaborating institutions
- Observed selected program activities including partnership meetings
- Interviewed Principal Investigators (PIs) and Co-Investigators (Co-Is) both on site and through follow-up phone calls using a common interview protocol
- Reviewed documents including proposals and annual reports from both MUI and MUCERPI institutions

GAVRT AND SUNBEAMS PROGRAMS

Evaluators selected these two ongoing programs for in-depth studies to examine the triangular relationship of students and teachers working directly with scientists, and to consider the conditions that support success in such programs. Both programs have been active in schools for at least five years, one of the criteria that was central to the study.

Data Collection Activities

Evaluators:

- Conducted multiple onsite observations of the program; program activities included teacher professional development, observatory activities with students, and interaction with scientists in the classroom and other settings
- Conducted in-person and phone interviews with
  - Participating teachers and scientists
  - Program mentors
  - School principals
  - Program coordinators
  - Science PIs
- Solicited Student feedback in a questionnaire
- Reviewed program materials, activities, and documents
- Observed classroom activities and student presentations

QUANTITATIVE EVALUATION

The purpose of the quantitative study was to enable the evaluation to generalize to individuals beyond the sample queried and identify attributes of space science educational resources that are likely to meet the needs of the greatest proportion of users. PERG evaluators conducted a large-scale survey of the various populations involved in creating, supporting, and using NASA space science E/PO resources. The survey allowed evaluators to collect ratings from a large number of individuals on the attributes that had been identified in Phase III of the evaluation.

Data Collection Activities

- Data were collected via an interactive online survey. The majority of questions on the survey concern the importance of various attributes of educational resources and the availability of resources that exhibit these attributes. The attributes included in the survey were taken from qualitative data collected during the third phase of PERG's evaluation of the E/PO Effort.
- A total of 420 individuals completed the survey.

EVALUATION OF THE CHICAGO 2004: *WORKSHOP TO FOSTER BROADER PARTICIPATION IN NASA SPACE SCIENCE MISSIONS AND RESEARCH PROGRAMS*

The study examines the workshop from two vantage points: through data collected at the workshop itself, and through follow-up interviews and surveys 3–6 months later.

The goals of the workshop were to seed personal contacts among a more diverse community than had traditionally been active in NASA space science missions.

All participants were expected to gain insights and contacts leading to:

- A better understanding of how the NASA space science program is organized, planned, and conducted; how missions and research programs are conceived; how mission and research teams are formed; and how successful proposals are conducted
- Possibilities for effective new partnerships
- Greater involvement of minority universities and underrepresented minority scientists in missions and research programs, as well as on NASA review panels and advisory boards

Data Collection Activities

- Workshop observation, including plenary sessions, poster sessions, and breakout sessions
- Informal interviews at the workshop
- End-of-workshop participant surveys

- Follow-up interviews and email surveys

THIS REPORT

The full period of the Phase IV report is November 2003–December 2005.

The Findings section of each report focuses on answering the evaluation questions for the audiences impacted by the particular programs and activities under examination. For example, the report on the Chicago conference studied the short- and long-term effects on the conference participants. In addition, the Findings section includes a discussion of the data in relation to the purposes of the study and the SMD goals.

The data presented in each report are both qualitative and quantitative, with the exception of the Quantitative Study of Product Attributes.

Qualitative data allow for deep exploration of a variety of areas, including many that are uncovered during the data collection process. Analysis of qualitative data can uncover ideas, beliefs, attitudes, challenges, etc. that are present in the population of interest. Unlike quantitative analysis, qualitative analysis cannot be used to estimate the prevalence of any specific variable, because the data are not representative of the larger population beyond the participating sample. For example, the analysis can reveal beliefs that some scientists hold about education, but it *does not* indicate the *proportion* of scientists that hold a specific belief.

Quantitative data can estimate the prevalence of specific variables within a population and indicate the proportion of people who hold a belief or opinion.

Throughout the report, there are citations from the data. They are included to add context and richness to the discussions and to illustrate the perspectives of those engaged in the work. All data cited in the report have been selected to *represent the themes and trends* that emerged from the data and are characteristic of the *perspectives voiced by multiple respondents* and issues related to the project during the report period.

SMD E/PO Phase IV Evaluation:

Introduction to MUCERPI Case Studies

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INTRODUCTION TO MUCERPI CASE STUDIES

THE STUDIES

In the fall of 2004, as one component of the ongoing evaluation of the OSS/EPO program, OSS/EPO staff asked PERG evaluators to study three minority-serving institutions that had received and were implementing Minority University Education and Research Partnership Initiative grants (MUCERPI).

The three institutions identified by NASA, and the minority population with which each is identified, are:

1. Medgar Evers College, part of the City University of New York (CUNY) higher education system: African American
2. Southwestern Indian Polytechnic Institute (SIPI): Native American
3. University of Houston-Downtown: Hispanic

The goals of the three studies as defined by NASA and PERG were:

1. To learn about scientists at minority-serving institutions and their pathways into partnerships
2. To learn about each partnership individually within an integrated system that includes its context:
   - historical background
   - physical setting
   - economic, political, legal, etc. dimensions
   - informants through which it can be known
3. To gain insight into what factors contribute to a successful partnership

Study questions included:

- What was the existing infrastructure at the start of each partnership and how did it develop?
- To what extent/breadth has each partnership grown over time and in what ways? (What new partners have been involved and what roles do they play?)
- What factors contributed to the success of each partnership?
- What challenges did each partnership encounter?

In all three cases, the MUCERPI grants extended work initiated under the Minority University Initiative (MUI) grant program 2001–03. The MUI program funded 15 institutions for three years with the NASA Research Announcement (NRA) emphasizing, among other things, the development of research, academic *and/or* outreach capabilities. The MUCERPI program, in contrast, stressed scientific research.

MUCERPI PROGRAM

The MUCERPI program runs between the period January 1, 2004 and Dec. 31, 2006. It is described on the NASA website as follows:

> In April 2003, NASA issued a Research Announcement (NRA) soliciting proposals from minority institutions interested in developing their capabilities in NASA-related space science . . . [such as] research, undergraduate or graduate courses or degree programs, pre-college or public outreach programs, and/or teacher training in space science. Participation in this program as the lead institution on proposals [was] open to all categories of accredited postsecondary minority institutions according to the list maintained by the Department of Education [including] Historically Black Colleges and Universities, Hispanic-Serving Institutions, Tribal Colleges and Universities, and other minority educational institutions as defined by the Department of Education. NASA-sponsored space science researchers and research groups at non-minority universities, NASA Centers, or other research institutions are strongly encouraged to participate as partners on minority institution proposals. The 2003 MUCERPI awards included
>
> Eight Historically Black Colleges and Universities
> Five Hispanic-Serving Institutions
> Two Tribal Colleges and Universities
> One predominantly minority university

EVALUATION METHODOLOGY

In order to collect data for these three studies, site visits were made to each of the three institutions that received the MUCERPI grant. Partnering/collaborating institutions were visited; some program activities were observed, including partnership meetings, where possible; and Principal Investigators (PIs) and Co-Investigators (Co-Is) were interviewed, both on site and through follow-up phone calls. A common interview protocol was used for all PIs with a somewhat shorter iteration for Co-Is (see Appendix). Some questions were revised to reflect the specifics of individuals or partnerships.

Proposals and annual reports from both MUI and MUCERPI programs were read, and interviews were analyzed by question in order to understand the varying perspectives of the partners and emergent themes.

Findings for each partnership are reported individually and organized under the following topics:

- Phase I: 2000–03—MUI funding
- Phase II: 2004—MUCERPI
  - Goals
  - Partners
  - History of partnership
  - Management of partnership
  - Growth of partnership
  - What contributes to the success of the partnership?
  - Challenges
  - Outcomes Year I

PARTNERSHIPS

Based on our own previous evaluation experience evaluating partnership-based programs, and research into productive partnerships, we recognize that there are important attributes of successful partnerships that go beyond the development of a small group of decision-makers with a good communication system. These attributes include:

- Development of an honest and open relationship
- Clarity of purpose: a set of shared goals and a shared understanding of how they will pursue and achieve them
- Congruency of mission, strategy, and values: partners understand each other and how their missions and strategies fit together
- Recognition that partnerships are not without costs, but sharing the belief that the benefits of their collaboration are worth the price
- Dedication to continual learning: (1) there are opportunities for all partners to advance their own knowledge and skills; and (2) through their shared leadership they continue to adapt and improve the program
- Commitment to the partnership: partners are invested, committed to the effort, are accountable to one another, and follow through on their individual responsibilities

The partnerships described in the following three reports can be characterized by most, if not all, of these characteristics. Each has built, to a greater or lesser extent, on prior collaborations between some partners. And each has found ways to leverage different available resources to enhance their programs.

FINDINGS THAT CUT ACROSS ALL THREE STUDIES

There are several common themes that emerged from studying all three partnerships:

- **Success**
  All three minority-serving institutions are engaged in different kinds of, but successful, partnerships that fall under Gordon Kingsley's definition. There is one noticeable characteristic shared by some partners in each partnership that is not always found in partnerships—successful or otherwise. There are some partners in each of the three MUCERPIs I have studied that have a deeply felt *personal* commitment to the goals of their project, such as the commitment to helping minority students succeed in general, in their science courses, and/or become professionals in the field of space science.
- **Systemic change**
  These partnerships are engaged in developing new educational programs and courses in space science, not delivering programs that have been tested and proven successful. As such, they are engaged in systemic change.
- **Time**
  As with all partnerships, developing and sustaining these partnerships take time and is of central importance. Depending on prior relationships among partners, the time and effort that this takes varies from partnership to partnership. Partners must also continually work to establish networks with other individuals and institutions that extend and enrich the partnership.
- **Resources**
  MUCERPI funds are insufficient to support the activities of the partnerships. All three have secured, and continue to seek, other funds that can be used to supplement the MUCERPI grant itself, as well as piggybacking on other grants. While all three programs hope to expand, bringing in additional faculty and/or other partners, resources are not adequate to the task. At this time, they can only expand through the addition of faculty who do not need financial support, or by piggybacking on other funded programs.
- **Pipeline and recruitment**
  Partners in all three programs are highly invested in the research opportunities that the MUCERPI grants have afforded them. However, given what they know about the student populations and schools from which they draw, they believe that working with and actively recruiting pre-college students is crucial for enrollment in their programs. Recruitment is an issue for all three programs, and all report difficulty attracting adequate numbers of students to the courses they have developed and offer. Recruitment into STEM programs is a national problem.

- **Perceptions of the colleges**
  Interviewees at all sites believe that some scientists at other, larger institutions do not hold the courses and programs at their (interviewees') and other smaller, minority and/or non-Research 1 Universities in high regard, or view their programs as strong. While the students entering community colleges overall are often less well-prepared than those at other IHEs, these three MUCERPI-funded institutions believe that they *do* have courses/programs that are strong, with at least some courses that are competitive.

  > Some people do not like . . . our BA and BS programs because they are not strong, but our degree program was structured by scientists, and we made what we felt was a very strong academic program.

  One partner shared his belief that "people assume that a community college knows about teaching but nothing about research"—an attitude that would make it more difficult for community college scientists to attract research funding and possibly find scientists at other institutions interested in collaborating on research. In fact, there *is* little research carried out at community colleges for a variety of reasons (i.e. heavy teaching loads, little research support, inadequate equipment).

- **Access to NASA**
  Scientists reported different experiences resulting from their efforts to connect and work with NASA scientists and programs. Some seem to have found easy access, while others have been unable to make fruitful connections at this time. Of those who did make a connection, many had met a NASA scientist serendipitously, through a meeting or conference, or a mutual colleague who brought them together. Attending a conference in and of itself is no guarantee, and in two cases, MUCERPI partners attended several before they began to see familiar faces.

  > I don't think that a lot of minority college [scientists] go to major science conferences—that is how you start your network . . . You cannot get in the loop if you are not there. When we went to [science conference], we knew no one and did a poster session. [Did not meet anyone that year but went again.] Now we know quite a few people there, and if we do not know them, we know someone who knows them.

  One interviewee commented that it is hard to find/locate those NASA scientists and, once located, they have little incentive to work with him or others who are not a part of NASA itself.

  > So far I've never been able to find any way into NASA. The [program] scientists I have talked to are very interested. They may like your project, but they are so overwhelmed with their own responsibilities—unless you can offer them something they do not have, there is no point for them—they get little for it. You have to have just as much candy or they don't want to play. Also the goals set up in NASA are usually self-encapsulated. They leave other scientists out of the loop. There's no way to get involved in the inner circle collaborations. A lot of NASA is engineering-oriented—meet this deadline, or this product, and nothing should get in the way of getting that

> product delivered. A lot of science is trying to go figure things out a different way. They do not need us and we need them . . . The only thing I've been able to get from NASA that would help me is permission to download specific kinds of data. But no one told me that it was there. There is no one at NASA who is a mentor to help you with any of these projects at all . . . if you do not know who the scientists are, I challenge you to find out; and if you do, it is hard to get them to talk to you. They know it will be a waste of their time. On their side I could say that if a scientist is not careful, that person might get 1–3 calls a day from people who want to chat about their research and they do not have that time.

SMD E/PO Phase IV Evaluation:

New York City Space Science Research Alliance (SSRA)

Case Study

NASA Space Mission Directorate
Washington, DC

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This is a study of the partnership that created and developed the *New York City Space Science Research Alliance (NYCSSRA or SSRA)*. It was initiated under a NASA MUI grant in 2000 and extended under a MUCERPI grant in 2004.

PHASE I: 2000–2003

Drs. Leon Johnson and Shermane Austin (Medgar Evers) and Irving Robbins (College of Staten Island) developed and submitted a Minority University Initiative (MUI) grant proposal for the SSRA, which they received in 2000. Dr. Johnson was (and remains as) PI with Medgar Evers College (of CUNY) as lead institution. The focus of the grant was curriculum development. At that time, they proposed to "initiate a comprehensive approach to developing undergraduate degree and research programs at multiple campuses in the City University of New York (CUNY) system." With NASA's funding, they developed the New York City Space Science Research Alliance (NYCSSRA), described by them as a "multi-campus research center and a 'virtual' Department of Space Science."

CUNY is composed of 19 Colleges that serve over 400,000 students. The student body is very diverse, representing 167 countries and 119 languages. Thirty-one percent are African American, 29% are white, 26% are Hispanic, 14% are Asian and .1% are Native American. It was founded 150 years ago. As described on their website:

> CUNY traces its beginnings to the founding in 1847 of the Free Academy, which later became The City College, the first CUNY College . . . CUNY is the nation's largest urban university: 11 senior colleges, 6 community colleges, a graduate school, a law school and The Sophie Davis School of Biomedical Education. More than 450,000 degree-credit students and adult, continuing and professional education students are enrolled at campuses located in all New York City boroughs. In Fall 2003, 45% of all the college students in the City of New York were attending CUNY. An additional 40,500 students are enrolled in College Now, the University's enrichment program for high school students at CUNY campuses and more than 200 New York City high schools. Another 8,000 students are enrolled in CUNY-affiliated high schools . . . with more than 100 nationally recognized research centers, institutes and consortia.

PARTNERS

This Alliance was anchored by the following partners: CUNY, the Hayden Planetarium (of the American Museum of Natural History), and NASA's Goddard Space Flight Center. Dr. Leon Johnson was and remains the PI. The CUNY campus partners included:

Medgar Evers College
College of Staten Island

City College of New York
York College
Hostos Community College
LaGuardia Community College
Queensborough Community College
Hunter College
LaGuardia Community College
Borough of Manhattan Community College
Bronx Community College

Additional partners included:

South Carolina State University
Holyoke Community College
Johns Hopkins Applied Physics Laboratory
NASA's Goddard Institute for Space Studies (GISS), and Office of Education

OUTCOMES

Under the MUI grant, the partners:

- Created a space science major in the CUNY BS degree program and created space science concentrations on 3 CUNY campuses
- Developed or revised 20 courses in space science
- Integrated NASA-related faculty into the space science courses
- Created research opportunities for over 30 students
- Initiated faculty development
- Enhanced existing and established new research
- Created pipeline of research activities from high school through community college . . . to graduate school
- Initiated space science-related student and faculty activities hosted by the Hayden Planetarium
- Increased the number of faculty and student space science presentations at conferences
- Initiated recruitment activities with the Space Science Open House and symposium at the Hayden Planetarium.

(NASA OSS: Education and Public Outreach Annual Report 2003)

PHASE II: 2004–

In June 2003, Dr. Leon Johnson and the New York City Space Science Research Alliance submitted a proposal to NASA's Minority University and College Education and Research Partnership Initiative in space science program (MUCERPI) to extend the work of the Alliance; this proposal was funded and work initiated in January 2004.

GOALS

While the goals of Phase I centered on curriculum development and the establishment of college- and university-based programs in space science, the goals of MUCERPI are to "upgrade the research and get involved with NASA missions" and, as stated in the proposal, to:

- Collaborate in the establishment of a CUNY Solar and Planetary Institute (SPI) for research on data from NASA missions
  (This was the primary goal and, through direct linkages to NASA mission scientists and research, envisioned as one way to strengthen faculty research capabilities)
- Assist participating faculty in developing new and enhancing existing collaborations on research related to NASA missions and provide support for research activities
- Strengthen faculty research capabilities by creating a faculty preparation program [to] include workshops on tools needed for data analysis
- Provide more undergraduate and graduate, summer and academic year research opportunities at NASA centers and colleges and universities with NASA programs
- Increase greatly the ***number*** of under-represented students in the Space Science pipeline in order to help create a diverse Space Science workforce

(MUCERPI proposal)

OUTCOMES 2004

In Phase II, Year 1the Alliance:

- Created the Research Articulation Program that supports junior faculty in initiating space science research with 3 faculty (2 from community colleges) in the first year

- Recruited 12 CUNY faculty to attend Chicago 2004 to seek collaborations on space science missions and research
- Supported 2 faculty to attend a Space Hardware Workshop and 4 faculty to attend a Computational Science Workshop
- Assisted faculty in the mentoring of over 33 undergraduates in summer research experience on CUNY campuses, 2 at GSFC and 2 at the Hayden Planetarium with Dr. Liu; assisted faculty in mentoring 18 undergraduates and 4 graduate students in academic year research experience on CUNY campuses
- Collaborated in the establishment MECSAT: Edge of Space High Altitude Balloon Project
- Supported 9 faculty presentations at national conferences, 8 journal publications, 1 published lab manual and 7 IAU Minor Planet Center publications

(Year I Grant Report, 2004)

PARTNERS

The Phase I partners have continued as partners in Phase II, with the addition of NASA's Minority University Space Interdisciplinary Network (MU-SPIN) and younger faculty from the community colleges who were perceived as eager to get involved and able to mentor students. The PI saw the grant as one means of helping these young faculty members by including them in the SSRA community in which members help one another. The CUNY partners and a number of other institutions provide research fellowships, and summer and academic year experiences.

The partners in the SSRA are shown in the following table. Those who are key partners are starred (*).

Institution	Faculty
Medgar Evers College *	Dr. Leon P. Johnson, PI * Dr. Shermane A. Austin, Co-I * Dr. Ifeanyi Ekejiuba, Co-I; Dr. John Flowers, Co-I Dept. of Physical, Environmental & Computer Sciences
Borough of Manhattan Community College, New York, NY – not key	Dr. Shana Tribiano, Department of Science
College of Staten Island *	Prof. Irving K. Robbins, Co-I * Department of Engineering Science and Physics; Director, CSI Astrophysical Observatory Dr. Charles Liu, Co-I — also at Hayden Planetarium
City College of New York *	Dr. Jeffrey C. Steiner, Co-I * Department of Earth and Atmospheric Sciences
Goddard Institute for Space Studies	Dr. Michael Allison Dr. Barbara Carlson Dr. Armando Howard
Hayden Planetarium	Neil Tyson Co-I, * Director Hayden Planetarium Department of Engineering Science and Physics and Astrophysics Dept. Dr. Charles Liu, Co-I
Holyoke Community College	Prof. Bart Estes, Department of Mathematics
Hostos Community College	Dr. Humberto Canate, Department of Mathematics
Hunter	Dr, Steven Greenbaum, Co-I Department of Physics
LaGuardia Community College *	Dr. James Frost, Co-I * Department of Computer Information Systems Prof. Byron Storck, Co-I Department of Natural and Applied Sciences
Queensborough Community College	Dr. Donald Cotten, Co-I * Department of Physics (retired) Dr. Paul Marchese, Co-I; Dr. Tak Cheung, Co-I; Dr. George Tremberger, Co-I Department of Physics Dr. Dona Boccio Department of Mathematics
York College	Dr. Martin Spergel; Dr. Tim Paglione Department of Physics Luis Montenegro Department of Physics and Technology

HISTORY OF THE PARTNERSHIP

Scientists from different CUNY campuses had worked with one another on various other projects prior to MUI:

- Dr. Johnson had attended graduate school with Irving Robbins; he had met Dr. Tyson at conferences
- Dr. Austin met Drs. Johnson and Frost through GISS in 1994
- Dr. Austin met Drs. Steiner, Cotton, and Frost through MU-SPIN in 1995

GROWTH OF THE PARTNERSHIP

Most partners agree that the partnership is large and efforts must be made to consolidate and build upon what they have established: adding new partners or collaborators at this time is not a goal. In addition, SSRA does not have the resources to fund activities/supplement salaries of additional individuals. At the same time, the partners continue to seek new research opportunities for their students. The PI would like to bring in NASA mission scientists in the future. Some individuals have been added to the original MUCERPI partnership, or their expertise has been tapped: Dr. Cotton has brought in/draws upon four other scientists to supplement the work of SSRA at his campus. This project has also collaborated with the University of Vermont as well as the Alaska Space Consortium. Scientists at other universities, who are interested in Medgar Evers' Balloon project, have contacted Medgar Evers (for example Penn State and the University of Puerto Rico).

MANAGEMENT OF THE PARTNERSHIP

SSRA is managed by a group of key partners who meet formally twice a semester and communicate by e-mail between meetings. Drs. Johnson and Austin serve as the 'cement' for the Alliance and are in close contact with all the other partners between meetings, facilitating their work, securing equipment when possible, and providing support for students, among other activities.

COMMUNICATION

Dr. Johnson describes the structure of the Alliance as similar to that of a department: "We sit together in meetings and try to set up policy and collaborate on various issues." These are the formal partnership meetings and are well attended. Partners develop new ideas for the SSRA, discuss funding opportunities, and address issues that arise. "Our meetings are the incubator." At the meeting I observed, partners discussed a wide range of important

issues including the Alliance website; undergraduate summer research opportunities and different sources of funding for students, as well as strategies for facilitating their participation; challenges of, and strategies for, recruiting students for SSRA courses; communication channels for students seeking information; equivalencies for courses taken at different CUNY campuses; ways to support/mentor students who struggle with courses at the Hayden Planetarium; and strategies for building administrative support within CUNY itself.

Dr. Johnson and Dr. Austin are in contact with all partners. Some other partners, while remaining in close contact with Johnson and Austin, more rarely communicate with one another. Frequent communication is not necessary, as each partner contributes his/her piece to the whole SSRA program, operating on a somewhat individual basis. Getting together for mini-meetings is constrained by the distances between the campuses as well as time.

COMMITTEES

While committees were described in the proposal, the partnership has not felt a need to establish them. When the partners meet, they discuss what needs to be done and various individuals volunteer for different tasks.

WHAT CONTRIBUTES TO THE SUCCESS OF THIS PARTNERSHIP?

Many factors contribute to this seemingly united and harmonious partnership. Several Co-Is commented that SSRA is unlike almost all other collaborations in which they have participated, which have not functioned as well and included 'back stabbing' and competition.

PREVIOUS COLLABORATIONS

Productive partnerships often include individuals who have previously collaborated on other projects, with a history of good working relationships: SSRA falls into this category.

> The reality is, we came in with people we already knew, faculty we had worked with. We had already formed a community of minority scientists interested in ways to increase their participation in NASA research and education.

Irving Robbins and Leon Johnson had been seeking an opportunity for collaborating with each other on a project for 20 years. Partners' previous collaborations were described previously under *History of the Partnership*.

COMMON GOALS

The partners share the common goal of engaging more minority students in science in general, and space science in particular, which includes facilitating research opportunities for them. Many also have a *personal* stake in their work, not always present in partnerships, which is based on their political beliefs or values, as well as a dedication to educate minority and under-represented students and introduce them to the field of science and scientific research.

> Everyone knows that they are working with the future demographics of America and that awareness carries through in the commitment I see in the participating faculty. They all know they are trying to do something good.

EVERYONE GAINS

Another aspect of successful partnerships is that each partner both *gets* something out of, and *contributes* to, the collective work. Each partner in SSRA brings different expertise to the project, such as planetary space science, radio astronomy, computational space science or geology, to mention several. Some campuses house scientific equipment that other campuses do not, such as observatories or weather instrumentation, which are shared among the institutions in SSRA. SSRA as a whole has the capacity to offer courses that no one campus can offer.

In addition, each partner has profited from the partnership. Several scientists have been enabled/supported to conduct research for the first time in many years. On one campus, SSRA has opened up the only research opportunities available to students. It has invigorated professors who believe that their own excitement and interest is being transferred to their students. Other partners value new opportunities to work with students. And others have received grant-supported equipment. Several scientists commented that until SSRA, they had worked in a somewhat isolated fashion: "For a long time, I was the only person interested in astronomy in my college. Now that has grown." And Medgar Evers itself has gained stature within CUNY. And, of course, students engaged in the SSRA curriculum and research opportunities have benefited.

LEADERSHIP STYLE

In many partnerships, there is one critical individual who organizes, nurtures, and facilitates the collaboration. In the case of SSRA, every interviewee identified Dr. Leon Johnson as central to its success, with Dr. Shermane Austin also playing a key role. Data suggest that other partners completely trust Johnson's decision-making: "He almost has Carte Blanc—he has our blessing." Dr. Johnson is in continuous contact with each partner. His leadership style is supportive, flexible, and enabling. He believes that the partnership should build on and support each partners' expertise and, as leader, he looks for ways to do this. Partners commented that, "Each goes towards their interest and builds

within their college that particular aspect of space science." "The Alliance allows us to do research and follow our own curiosity." "He's flexible, and let's people figure out how they would like to participate, what they can bring, and then tries to give them the support to do it."

Dr. Johnson believes that his role is to be an advocate for the partnership, helping his fellow partners when he can. During my site visit to several CUNY campuses, other partners discussed their questions and needs (such as equipment) with Drs. Austin and Johnson, in some cases coming up with immediate solutions/allocation of resources. Johnson and Austin also told Co-Is about research their colleagues were doing and/or available equipment at other campuses that might be of interest. At one campus, two scientists discussed sharing equipment and data. At another, one partner learned about a specific kind of data collection lab that s/he had not know about and could make use of. One partner commented that my site visit had been useful because it was a catalyst for networking among the scientists.

PERSONALITIES/RELATIONSHIPS

Every interviewee mentioned that the *individuals* in this partnership are *nice.* Partners look forward to getting together and enjoy their meetings. At times they attend conferences together, and go out to dinner socially. Several interviewees volunteered that members' egos are not involved in the collaboration—people do not compete with each other. "We are interested in helping one another; there is no ego trip to outdo each other." They share a sense that their group effort is greater than any one of them could have managed individually, if at all.

> I want to emphasize that more good work is done by people getting together in groups, than working on their own and then getting back together again. We really cross-fertilize each other. No one of us would do all this good stuff if we were alone.

The disagreements that have arisen have all been resolved through discussion at the meetings. One partner commented:

> They all have different problems and all are candid about their problems. Some are more prestigious than others, but none of this matters in their meetings. No one is snooty. They all feel and know that a single umbrella covers them all.

CUNY CULTURE

Historically CUNY has had a collaborative culture, built in part on the belief that not individual, but collaborative efforts can make a difference. This collaborative culture exists among the campuses at this time, likely contributing the spirit of collaboration to this partnership.

THE HAYDEN PLANETARIUM

Being in partnership with the Hayden Planetarium and Dr. Tyson, Director of the Hayden Planetarium, as its representative has likely added stature to SSRA and its endeavors, and possibly increased its access to NASA resources, including funding. However, I lack solid data to support this observation. (Dr. Johnson notes that Dr. Tyson is hands-on and attends all meetings when he is in town.)

CHALLENGES

SSRA contends with multiple challenges, some more specific to this partnership and others more generally shared with other partnerships.

FUNDING

This is a large partnership that includes a number of CUNY and non-CUNY partners, and numerous individuals. Drs. Johnson and Austin try to spread out the grant resources to support faculty for travel to conferences, support their research, summer salaries, as well as release time from courses. In addition, the grant resources support student research. The funds are not adequate for such a large project. Partners also find that the three-year funding cycle is too short: It takes time to network both within CUNY and with scientists at other universities and colleges as well as NASA; identify research projects and opportunities for students; find/purchase/share equipment; and coordinate this large partnership. It is necessary to begin looking for new grant opportunities in Year II. One partner commented that a major challenge is "continuing to do what we are doing: finding students and finding funding; writing grants takes time with busy schedules. After this grant, what next?" Some partners recommend a five-year grant period. "If we are doing something good, support us."

RECRUITMENT

Recruitment is a major challenge that SSRA faces, and is exacerbated by the size of CUNY, the lack of knowledge about and appeal of space science for some students, as well as the level of preparation of many entering freshmen. Partners report that the numbers of students in the SSRA courses are lower than anticipated. "It's like pulling teeth to find these students."

Low enrollment in SSRA courses has particular implications for the Hayden Planetarium where some courses are held: while interested in supporting both SSRA and minority student education, if the courses are not cost effective in terms of administrative and/or other resources, Planetarium staff may have to reconsider their participation in/support for the project.

PRE-COLLEGE PREPARATION

Many students entering CUNY are ill-prepared for college (a fact that is true for many community colleges). Many students are very poorly prepared in mathematics, a gatekeeper for participation in the sciences. Some students have been forced to drop out of SSRA classes because they were unable to handle the math. CUNY has remediation programs, and CCNY has traditionally had such a program for an immigrant population. Within CUNY, the community colleges have to offer remediation programs, not the senior colleges. Students at CUNY may take seven to eight years to get a degree, as compared to the more traditional four years—a combination of time initially spent in remedial courses as well as carrying jobs. At this time, the board of trustees is cutting back on remediation programs, which may exacerbate this issue.

MARKETING THE CURRICULUM

Getting the curriculum known to CUNY students and faculty at all campuses is a challenge. The system is huge, and partners continue to look for effective means of communicating what SSRA has to offer.

SUPPORTING ALL STUDENTS

Being government-funded, SSRA is not able to provide financial support to foreign students: forty-three percent of the CUNY student body were born outside the USA. However, most of these students are citizens or have permanent residence status.

GEOGRAPHY

CUNY has a sprawling campus, and utilizing public transportation to travel from some campuses to others can take a significant amount of time (such as Staten Island to Manhattan/Hayden Planetarium). This affects both students and faculty. Given travel time, it can take partners much of a day to attend a formal meeting (at the Hayden Planetarium where most meetings are held). Students at one college on Long Island have never attended courses at the Hayden Planetarium, for example. CUNY faculty overall understand that distance learning is one strategy for overcoming distances by providing easy access to courses on different campuses. CUNY initiated a distance-learning project ten years ago, but it was dropped, staff left the system, and that program never developed. SSRA partners want to offer on-line courses that are more accessible to students than classroom-based courses, but it has proven difficult to get them up and running.

STUDENT TRANSFERS OUT OF CUNY

Funding for CUNY faculty at any *one* campus is dependent on the number of students who *graduate*. Credits given that college for graduating students affect the numbers of

courses and faculty supported by the system. When students transfer outside of CUNY, the campus they leave receives no credit for that student.

ROUTES INTO NASA

Some of the partners began to work with NASA scientists and programs in different past programs, and some have found it difficult if not impossible to 'find a way in.' The different routes that some of the partners have taken are described earlier in this report and most have been the result of attendance at conferences or meetings where there have been serendipitous initial contacts with scientists and others who work for NASA.

SMD E/PO Phase IV Evaluation:

Space and Terrestrial Applied Research Studies (STARS)

Case Study

NASA Space Mission Directorate
Washington, DC

Written by:
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December 2005

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CONTENTS

This is a study of the STARS partnership, an extension of the NASA Minority University Initiative (MUI) program titled *Stars on Earth, Providing Underrepresented New Mexico High School Students with Research Experience in Space Science, and Preparation for Math, Science, Engineering, and Technology Programs in College*.

PHASE I: 2000–2003

Ms. Cathy Abeita from Southwestern Indian Polytechnic Institute (SIPI) and Dr. Horton Newsom from the University of New Mexico (UNM) wrote the MUI grant proposal to NASA. The background leading up to this partnership follows.

BACKGROUND

Prior to this partnership, Dr. Newsom had an extensive background in both scientific research and science education, and had been involved with NASA over a number of years. He was connected with the NASA Broker/Facilitator Partnership to Serve the South Central, Southwest Region and Hawaii, and had received numerous NASA grants. He had worked with scientists and others at the Jet Propulsion Laboratory (JPL) and the Johnson Space Center, and contributed to the 33rd and 34th Lunar and Planetary Science conference. With the completion of a NASA-funded PACE grant, which enabled him to work with middle school Native American students, he looked for new opportunities to continue working with Native Americans and learned of the MUI NRA (NASA Research Announcement). Although initially interested in pursuing the MUI for his own work through UNM, his university, while minority-serving, held over 2 million dollars in NASA funds and was therefore ineligible. At this point, he contacted Cathy Abeita at SIPI, whom he did not previously know.

Ms Abeita had also been involved with previous NASA grants, most significantly through the American Indian Science and Engineering Society in Colorado, and had worked with Phil Sakimoto. In 2000, she was in charge of SIPI's Special Programs and administered the SIPI Upward Bound program. At this time, all SIPI math and science courses met in a small portable building with no lab facilities; for this reason, the geology course at SIPI was not transferable to other institutions, including UNM. However, SIPI had both the funds and plans to build a new science building. Also at this time, Ms. Abeita had just hired a new faculty member who was a geologist.

Dr. Newsom and Catherine Abeita "hit it off right away" and applied for, and received, the MUI grant, *Stars on Earth*, initiated January 1, 2001. Ms. Abeita understood that for "most Indian students" success depends on attending a community college before

transferring to a four-year college, and the opportunity to strengthen SIPI's relationship with UNM was important. The focus of the project was:

> To conduct a unique program that infuses space science knowledge into the successful Upward Bound format in a manner specifically designed to improve the educational attitudes of Native American students and their teachers about science, mathematics and technology. (2000 OSS/EPO annual report)

They proposed to develop a series of activities including summer residential programs; Saturday academies; and research activities for students, parents, and teachers. There was a significant focus on pre-college education through the Upward Bound program.

SIPI was thus the lead institution for this grant, with Catherine Abeita as PI along with partners:

- University of New Mexico (UNM), Albuquerque, Dr. Newsom, Co-I
- U.S. Department of Education Upward Bound Program

Stars on Earth began with a PI and a Co-I who respected each other, agreed on the project goals, and who enjoyed support from their respective administrations. Ms. Abeita hoped that SIPI's new science and technology facility would help to increase the college's support for Earth and space science, and knew that a dedicated classroom for Earth and space science was necessary. Dr. Newsom helped with the design of that room.

SIPI is one of two Tribal Colleges that is administered by the U.S. Bureau of Indian Affairs and is tuition free. While enrollment fluctuates, both between and within years, it is currently around 600 students from over 100 Native American tribes. SIPI's mission, as cited on its website:

> It is the mission of Southwestern Indian Polytechnic Institute, a National Indian Community College, to provide quality technical and higher education opportunities that meet the dynamic needs of federally recognized tribes. (http://www.sipi.bia.edu/about/mission)

SIPI was founded as a land grant vocational education college in 1971, becoming a two-year community college in 1993. As a result of the 2000 North Central Association of Colleges and Schools Commission on Institutions of Higher Education evaluation, it was accredited for ten years until its next review in 2010.

Peoples' perception of it as a vocational education school has persisted to some extent, according to interviewees, as well as an impression that it was/is "not tech savvy." The recently completed science building, new courses offered through STARS, a new robotics program, as well as updated equipment, have all contributed to its increased standing and credibility as a two-year STEM institution.

OUTCOMES

Under the MUI grant, the partners:

- Developed and offered new 101/102 Physical Geology and Astronomy courses and labs for students attending SIPI
- Maintained ongoing collaboration between the Institute of Meteoritics at UNM and the Meteorite Identification Laboratory at SIPI
- Contributed to the 32nd Lunar and Planetary Science Conference
- Offered Saturday Academies for high school students in science, math, and English that also provided college and skill development sessions (students attended a variety of science classes, developed research projects, and presented with professionals)
- Offered a six-week residential program for students during the summer

PHASE II: 2004–

In June 2003, SIPI submitted a proposal to NASA's MUCERPI program to extend the work of *Stars on Earth*. The new proposal—Space and Terrestrial Applied Research Studies (STARS)— was written by Cathy Abeita and Denise Chavez. Ms. Chavez was brought into the second grant with expertise in Geospatial Information Technology (GIT). Their proposal was funded and work initiated in January 2004. Around the time of the award, Ms Abeita undertook other responsibilities at SIPI and Kirby Gchachu moved from a position at UNM in education to SIPI, where he became the PI on STARS and assumed some responsibility for the college's Upward Bound program. The latter program ended in 2004.

GOALS

While the goals of *Phase I* centered on developing and offering new courses to SIPI students as well as a significant outreach program to students in grades 9–12, the goals of STARS, as described in the proposal, are to build up SIPI's STEM program and to:

- Inspire and motivate precollege-16+ Native American students to pursue careers in science, technology, engineering, and mathematics ("increase the number of Native American students enrolling and successfully completing STEM academic programs at the certificate and associate degree level") and greatly expand the research experiences available to Native American students.

- Engage the public in shaping and sharing the experience of exploration and discovery in the space sciences and the role of Native Americans in this experience "which will prepare them to pursue baccalaureate programs in STEM fields."

As detailed in the grant proposal, the design for STARS was informed by faculty experiences implementing *Stars on Earth* and their understanding that to be successful, the new program need to include:

- Introductory training and coursework
- Training in research techniques and advanced content related to research areas
- Facilities for lab and computer work
- Individual mentoring and research advisement
- Training in the use of advanced research and analysis techniques using UNM facilities

An additional, unlisted goal is to develop a pipeline between SIPI and UNM to make it easier and more attractive for SIPI graduates interested in STEM/GIS majors and careers to attend UNM.

PARTNERS

With lessons learned from the MUI grant, and in order to implement the new project's goals, STARS planned to build upon the *Stars on Earth* partnership through the inclusion of NASA-funded researchers at the New Mexico Museum of Natural History and Science and the astrogeology branch of the United States Geological Survey.

The roles of the different partners as described in the proposal are shown in the following table: those who are central and active at this time are in **bold**.

Institution	Key Faculty	Role
SIPI	**Kirby Gchachu**	PI: works with SIPI faculty to develop professional development, research visits to UNM, conferences
	Denise Chavez	Research coordinator/in charge of interns, bringing in speakers
UNM Institute of Meteoritics and Meteorite Museum	**Dr. Horton Newsom**	Co-I: weekly visits to SIPI
	Dr. Rhian Jones	Help SIPI expand meteorite identification program
	Dr Jim Karner Dr Michael Spilde Dr. Lou Scuderi	Technical support, applying GIT to planetary science
US Geological Survey (astrogeology branch)	**Trent Hare**	Technical support
New Mexico Museum of Natural History and Science	**Dr. Larry Crumpler**	Student research support
NASA OSS: MER		

HISTORY OF THE PARTNERSHIP

- Cathy Abeita met Dr. Newsom when they wrote the MUI proposal. Prior to STARS, Ms. Abeita had known Kirby Gchachu for many years through their mutual work in elementary education.
- Dr. Newsom knew Denise Chavez, Dr. Crumpler, and Trent Hare, as well as the other faculty at UNM.
- Although he had been at UNM, Mr. Gchachu had heard of, but did not know, Dr. Newsom.

MANAGEMENT OF THE PARTNERSHIP

SIPI developed a Memo of Understanding with UNM outlining their joint goals, grant administration, and program implementation. This was important (as well as unusual) since SIPI, a small community college, while partnering with a Research 1 University, was the recipient of, fiscal agent for, and administrator of STARS. Within SIPI, STARS falls under the Administrative Center for Special Programs.

Kirby Gchachu, Dr. Newsom, and other STARS collaborators meet formally once a month, as work schedules permit, and the two PIs meet informally approximately weekly: Dr. Newsom visits SIPI on close to a weekly basis. Dr. Crumpler is now beginning to be

an active partner; responsible for the MARS Rover project at JPL, he has had little available time to commit.

GROWTH OF THE PARTNERSHIP

Members of the partnership changed between the MUI and MUCERPI grants. Upward Bound is no longer a partner, and the New Mexico Museum of Natural History and Science has been added as part of an effort to increase research opportunities for students. At this time, the partners are bringing in, or planning to bring in, additional collaborators, resources, and program opportunities to enrich STARS.

Kirby Gchachu is considering the following:

- Further involving the Solstice Project
- Developing a grant in collaboration with a scientist in California to establish a center for Native American cultural research, which will then conduct research at SIPI on Native American cultural views of science
- Working with Dr. Crumpler at the LodeStar Planetarium to set up research internships for SIPI students in archeoastronomy
- Developing an on-line astronomy course with two Native American astronomers at Northern Arizona University followed by the creation of a similar course at SIPI
- Looking for a grant to release professors to do research on location at NASA

Denise Chavez:

- Is part of another NASA grant recently awarded to Salish Kootenai College in Montana; that grant's PI has contacts at NASA which Ms. Chavez hopes to use in order to set up JPL summer internships for SIPI students
- Hopes to work out the articulation between her courses at SIPI with those at Dr. Cadera's NASA-funded center at UNM where he studies thermal energies and remote sensing; if successful, she and Dr. Cadera may be able to create a pipeline for SIPI graduates to the center, where none currently exists

Dr. Newsom hopes to engage SIPI students in:

- A new MARS project and Mars lab at UNM
- The DAWN Mission (with asteroids training)

- A possible EPO center at UNM; Newsom has already posted science activities for high school students on a UNM website—he would like to arrange a program for SIPI to use these activities with Native American high schoolers
- An IDEA grant bringing together the New Mexico Museum, UNM, and SIPI

WHAT CONTRIBUTES TO THE SUCCESS THE PARTNERSHIP?

TRUST AND COMMON GOALS

As with many successful partnerships, the personalities of key individuals are critical. Both Kirby Gchachu and Dr. Newsom are highly committed to the same project goals, they trust and respect one another, and they search collaboratively for solutions to challenges that arise.

> We trust that we have common goals and that those goals are worthy goals, and that goes a long way even when things do not work out—people feel that you have their best interests in mind.

SENSITIVITY

Dr. Newsom is sensitive to differences between the two institutions and two cultures he and Mr. Gchachu represent. Dr. Newsom apparently attempts to learn what he can about Native American cultures, recognizing that each is different from the next. As he has learned more about SIPI and its students, he and Mr. Gchachu have strategized ways to adjust the STARS implementation plan to be most effective given existing challenges. According to one interviewee, individuals at some minority-serving institutions have felt 'used' by larger universities with which they have collaborated, and not treated as equals. This was not true with Stars on Earth and does not seem to be the case with STARS. Communication between the two of them has increased and improved over the first 18 months of the project.

RESPECT AND SUPPORT

Based on the data, Dr. Newsom supports SIPI and respects its students; "He believes that they are quality students" and is an advocate for SIPI with NASA. The staff at both institutions are supportive of the goals of the project and are working to overcome the administrative and cultural barriers that have arisen.

ADVANTAGES TO BOTH PARTNERS

It is important that the members of any partnership 'get' something out of it. This partnership meets the needs of both UNM and SIPI, as well as the more personal goals of Mr. Gchachu and Dr. Newsom. (We lack data about Dr. Crumpler and/or his institution.)

As a state university, UNM must serve the entire state population, but this has been somewhat difficult given that it is a research institute in a poor rural state. Working with SIPI has helped the university towards fulfillment of this mandate, which is of particular interest to the acting provost. In addition, and important for this partnership, is Dr. Newsom's personal commitment to engage more minorities, including Native Americans, in STEM disciplines and "to broaden the diversity of science and of NASA." Dr. Newsom has led previous education outreach initiatives in the Native American community.

SIPI depended on UNM to build its program in geology and space science, and provide its students with access to scientists (both NASA and others), researchers, lab facilities, mentors, lectures, seminars and other activities, networks, and resources they might not have had otherwise. Students have opportunities to attend and present at national conferences. And, according to one interviewee, "Verbal interactions with people of this caliber is a really big deal for (SIPI) students." As a two-year college, it is difficult for SIPI to attract grants. Dr. Newsom brought research-based lab work to SIPI via the meteor identification program and enhanced the geology course. Denise Chavez has expanded her work to oversee the research interns who work with UNM mentors and has set up the speaker series. Kirby Gchachu continually investigates science-based initiatives that will benefit SIPI and the Native American population. Clearly each partner has already gained a lot from the partnership.

The partnership is working somewhat differently than either PI anticipated, although their goals remain the same. While Ms. Abeita wrote the MUCERPI proposal with Dr. Newsom, Mr. Gchachu became the PI. Coming from UNM, he was unfamiliar with the Bureau of Indian Affairs (BIA) bureaucracy, and unaware of certain barriers he later encountered, but he has received support from his colleagues when he has needed it. This project was the first time he had written an MOU, again something he had to learn about, as has been the administration of the grant itself.

Although Dr. Newsom had previously worked with Native Americans, including through *Stars on Earth*, he continues to encounter unexpected cultural differences, and to realize that some of his assumptions were misguided. He had anticipated that STARS would be more active at the UNM campus than has occurred and, given reality, has worked with Mr. Gchachu to change the location for various project activities originally situated at UNM in the plan. Participation of the third partner, Dr. Crumpler of both the New Mexico Museum of Natural History and Science and NASA OSS: MER, is just beginning.

CHALLENGES TO THE PARTNERSHIP

TRANSPORTATION

Transport is an issue that makes it difficult for many SIPI students to go to UNM in order to attend lectures, seminars, work in labs, or for any other purpose. Students attend the college from across the United States, many from isolated rural areas, and many do not bring cars with them. Many other students also lack cars. While there are students who can drive to UNM, the public transportation system is inadequate and slow for others. Transport problems are compounded by BIA regulations: only faculty who are federal employees may drive students in their own cars, as well as NASA employees who are also federally funded. While it is possible to drive students to UNM in one of the vans that SIPI leases for such purposes, faculty are required to follow BIA procedures and reserve in advance. The situation has been exacerbated by recent cuts at SIPI that have reduced the total number of vans.

Because of these constraints in part, SIPI and UNM now hold seminars and lectures at SIPI and bring UNM faculty and mentors to conduct research with students on site. In and of itself, this means that students have fewer opportunities to mingle with undergraduate and graduate students as well as faculty at UNM; take advantage of opportunities at that university; as well as function in an academic and scientific environment that is less insulated, larger than, and different from their own. The serendipitous meetings and conversations that can take place in the university environment occur much less frequently. In addition, Dr. Horton has undergraduate research fellowships available to STARS interns, but SIPI students who are unable to get to the campus on a regular basis are not eligible.

ALIGNMENT OF COURSES

Cathy Abeita's goal was to enhance and revise the geology course, adding a laboratory component and making it transferable to other institutions such as UNM. While the course has been revised and the laboratory exists in the new science building, UNM will not yet accept the course. The process has been more difficult that she anticipated: transferability is a greater challenge in the field of science than in some others. Dr. Newsom believes that this situation should improve if UNM science faculty members visit SIPI. A second stumbling block has been that SIPI students take some classes, such as GIS, in their second year, while seniors at UNM take an equivalent course. UNM does not accept SIPI's GIS course as a substitute for their own, even though the course content is identical, according to the SIPI instructor.

PREJUDICE ABOUT SMALLER INSTITUTIONS

According to interviewees in the STARS program as well as at other universities, some faculty at Research 1 Universities question the rigor of science courses offered at other institutions, and some question the competence of their instructors. Working with interested professors within specific *programs* at UNM has helped and should continue to help SIPI to overcome such stereotypes, as well as to build the pipeline between UNM and SIPI.

NASA INTERNSHIPS

It is difficult for SIPI students to participate in summer NASA internships if they are able to locate them, due to SIPI's academic year which runs longer than at many other colleges and universities.

CULTURAL FACTORS

There are several beliefs and taboos within Native American cultures that are not paralleled in Western ones. For example:

- STARS research currently is based on meteor identification, but this research is somewhat problematic at SIPI. Native Americans "do not see meteors as isolated but part of an integrated concept." They are also perceived as animate and 'with a soul.'
- While some students were more excited by meteor identification research last year, fewer are interested this year. As explained, Native Americans do not see meteors as relevant to their lives and have little interest in identifying them.
- Some scientific methodologies involved in collecting, gathering, and analyzing data 'go against' the Native American culture.
- While there are on-line space science courses available at SIPI, this mode of learning is not a good cultural fit for some Native Americans, and SIPI students overall are reluctant to participate. Also, while there are on-line research opportunities, SIPI students are not currently availing themselves of this opportunity, although others have in the past.

SIPI ADMINISTRATION

Several factors at SIPI hamper faculty participation in STARS. SIPI hires many adjunct and non-permanent faculty members who are not always available to work during the summer or in addition to their course loads. The challenge of faculty involvement is currently compounded by the fact that SIPI has made recent budget cuts, and many staff members are on furlough one day a week (i.e. are being paid for four days a week but do five days of work).

SIPI is also undergoing administrative change. About twenty-three of the faculty have been let go recently, a large proportion for a college of 600 students, and there is a new

president, among other new administrators. At such times, it is important that new administrators understand and buy in to programs such as STARS, and support plans for implementation and institutionalization that are already on the table, agreed upon, or described in the funded proposal.

RECRUITMENT

SIPI would like an increase in enrollment, but other colleges in the area compete for Native Americans including the University of New Mexico, Crown Point Technical Institute, a second Albuquerque-based community college and a college in Shiprock, NM. As a two-year community college, SIPI does not appeal to all students. It has also proved difficult to attract students to the field of geoscience/meteoritics. According to the PI, students who have never been exposed to this area are reluctant to sign up for courses. Many students are also unaware of the breadth of career opportunities within NASA, including careers that are related to, but not purely about, space science itself. Those who are interested in NASA opportunities do not know how to become involved, a problem SIPI is trying to address.

NEW MEXICO

Dr. Newsom believes that in New Mexico and other parts of the Southwest, the environment, distances, multiple cultures, and poor rural base make it very challenging to move forward on projects such as STARS: establishing the necessary networks takes time, and programs do not develop quickly. For this reason, in part, he believes that grants should cover more than three years.

ROUTE INTO NASA

Mr. Gchachu does not believe that it is difficult for minority scientists to find a way 'in' to NASA as long as they do this through institutions and not as individuals. However he was involved as a science educator and not as a scientist. He has participated in several NASA initiatives since the 1980s. He began by participating in a Teaching Opportunities Promoting Science (TOPS) workshop at which he met Gene Vosicki from the Jet Propulsion Laboratory, who maintained contact with him over time. Later on, his elementary school students conducted primary research, growing tomato seeds that had been in space. The seeds were provided by the Kennedy Space Center, and students sent their data back to NASA. Most recently he served as a facilitator for NASA education workshops. He is currently working with the Sun-Earth Connection studying cultural components of science education.

OUTCOMES 2004

During the first year, STARS:

- Developed new faculty positions at SIPI (which the administration will support at the end of the grant) in Liberal Arts combined with Physical Geology; Astronomy; GIS/GPS; Advanced Field Techniques
- Developed new introductory courses in Physical Geology; Astronomy; GIS/GPS
- Offered new concentrations in Global Information and Advanced Field Techniques leading to associate degrees
- Offered introductory-level courses Geology 101 and 101L
- Presented seminars to SIPI students, faculty, and the general public in preparation for a course specific to 'Indigenous Knowledge'
- Held the Saturday Academy with monthly activities at the LodeStar Planetarium

SMD E/PO Phase IV Evaluation:

An Educational and Research Outreach Program in Space Science—

A Collaborative Effort to Reach Underrepresented Groups

Case Study

NASA Space Mission Directorate
Washington, DC

Written by:
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December 2005

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SMD E/PO Phase IV Evaluation:
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This is a study of the partnership that created and developed *An Urban Outreach Program in Space Science: A Collaborative Effort to Reach Underrepresented Groups* or *An Urban Outreach Program* for purposes of this report. It was initiated under a NASA MUI grant in 2000 and extended under a MUCERPI grant in 2004.

PHASE I: 2000–2003

The University of Houston-Downtown as lead institution, and Dr. Penny A. Morris Smith as PI, applied for and received a NASA Minority University Initiative (MUI) grant, *An Urban Outreach Program in Space Science,* in 2000. The primary project goal was to share space science with underrepresented students and educators.

The partnership proposed to "bring space science content to a variety of educational activities at all levels" (Year 1 report) including:

- Undergraduate research internships at Johnson Space Center
- A Space Science Ambassador "training program" for minority high school students to enable them to provide demonstrations and short classes to museum visitors, school classrooms, and clubs
- Inservice teacher workshops on the origin and evolution of life and on the solar system

The University of Houston system includes four separate campuses, of which the University of Houston-Downtown is one. Growing out of a community college, it became an autonomous state university in 1974. Originally a teaching institution, it has evolved into a teaching-research institution. Sixty-three (63%) percent of the student population is minority. Of the total student body, 26% are Black and 37% Hispanic.

PARTNERS

The University of Houston-Downtown (UHD) was, and continues to be, the anchor for this program. Other partners originally listed in the grant included:

- Interfaith Ministries for Greater Houston*
- Klein Independent School District*
- NASA Johnson Space Center (JSC)
- Raul Yzaguirre School for Success (RYSS)
- Society of Hispanic Professional Engineers* (SHIPS)
- Society of Mexican American Engineers and Scientists*
- Texas Southern University (TSU)

- Houston Museum of Natural Science (HMNS)

Those partners that are starred (*) did not become active in the partnership and were dropped during the first year.

OUTCOMES OF MUI GRANT

Under their MUI grant, the partners laid the groundwork for a collaborative program "flexible enough to adapt to changing community needs." According to their Year 2 Cumulative Progress Report, the partnership:

- Designed and offered interactive space science demonstrations and presentations in a variety of public settings
- Trained Space Science Ambassadors from minority-serving high schools and colleges to present space science programs and activities in local venues
- Implemented an internships program between minority university students and NASA JSC scientists
- Conducted in-service programs for science teachers who attended minority-serving institutions
- Designed and offered first graduate course in geology at TSU, taught by UHD geologist

PHASE II: 2004–

In June 2003, the MUI partners and prospective partners, led by Dr. Smith, submitted a proposal to NASA's Minority University And College Education And Research Partnership Initiative program to extend the work initiated through *An Urban Outreach Program in Space Science*. The new proposal—*An Educational and Research Outreach Program in Space Science: A Collaborative Effort to Reach Underrepresented Groups*—was funded and work initiated in January 2004. One of the several issues that propelled the partners to apply for funding was the new science and literacy test, TAKS, (Texas Assessment of Knowledge and Skills) that students in Texas took for the first time in 2003: Students did not do well, and teachers now to pursue in-service training in the sciences.

GOALS

During Phase II the partners planned to build on their earlier successes, improving and expanding the earlier MUI program, and adding two new components. The partners planned to include

- In-service workshops for teachers (with added workshop partners, workshops, and space science topics)
- Space science-related courses for college students (**new** Astrobiology course)
- Faculty/student research internships at JSC (modified from the MUI internship program to include faculty, serving under NASA mentors)
- Space Science Student Ambassador (SSSA) outreach projects for promoting space sciences in informal settings for K-12, families, and the public (increased coordination of efforts and new activities)
- Space Science Explorer, a project-based science career exploration for tenth grade students (**new** program)

An additional goal, as described in the proposal, was to increase communication between the partners as well as between the partners and other collaborators (for example, between NASA and the Brownsville area of Texas.)

PARTNERS

The MUCERPI partnership was built on that of *An Urban Outreach Program in Space Science* with added partners, Rice University and the Raul Yzaguirre School for Success. The partners and their representatives are listed in the following table.

Institutional Partners, Collaborators, and Their Representatives

Institutional Partner	Individual	Role
University of Houston-Downtown Minority serving university (Hispanic)	Dr Penny A. Morris Smith Dr. Glen Merrill Ms Sangeeta Gad	PI Co-I Co-I
Texas Southern University Minority serving university {HBI)	Dr. Victor Obot Dr. Bobby Wilson	Co-I Co-I
Houston Museum of Natural History	Dr. Carolyn Sumners Mr. James Wooten	Co-I Co-I
Rice University Space science partner	Dr. Patricia Reiff	Co-I
Raul Yzaguirre School for Success Charter school predominantly serving K-12 Hispanic students	Ms. Olivia Garza	Collaborator
University of Texas at Brownsville Minority serving university (Hispanic)	Mr. Javier Garcia	Collaborator
Johnson Space Center, NASA Space science partner	Ms. Jaclyn Allen Dr. Gordon McKay Mr. Charles Galindo Ms. Andrea Mosie	Co-I Co-I Collaborator Collaborator
NASA Headquarters (initially at JSC)	Dr. Marilyn Lindstrom	Co-I
Passport to Knowledge	Dr. Geoffrey Haines-Stiles	Collaborator

HISTORY OF PARTNERSHIP

This has been an active group with an interesting history. Prior to their grant, the partners had not worked *together*, although there were several earlier collaborations between partnering institutions and individuals. The following description covers the development of both the MUI and MUCERPI partnerships.

- Dr. Smith worked as an astrobiological researcher at NASA JPL through which she knew Dr. Marilyn Lindstrom and Ms. Jaclyn Allen. She also met Charles Galindo at JSC.
- Drs. Smith and Reiff had worked together informally for some years.

- Dr. Smith already knew Dr. Merrill at UHD. She met Ms. Gad at a University meeting during the grant proposal development at which time Smith learned about Gad's summer program for teachers at the Center of Computational Science and Advanced Distributed Simulation, which both of them believed to be well aligned with the proposal.
- Ms. Sangeeta Gad had previously collaborated with Dr. Reid and Carolyn Sumners.
- Ms. Allen had worked with Charlie Galindo and Andrea Mosely at NASA on other educational outreach programs. She had also worked with Dr. Reiff, Carolyn Summers, and James Wooten.
- Charles Galindo was connected with a number of groups and organizations including the YES Academy, LULAC, and SHIPS (Society of Hispanic Professional Engineers). He was on the board of the Raul Yzaguirre School for Success, which he brought into the MUCERPI partnership as a collaborator. He also knew Javier Garcia at the University of Texas at Brownsville (UTB) through a prior NASA collaboration, and brought him into the partnership as a collaborator.
- As she began to develop the MUI proposal Dr. Smith contacted Dr. Wilson from TSU who believed that *An Urban Outreach Program in Space Science* fit with TSU's mission. Dr. Wilson assigned active project participation to Dr. Obot, who wrote those proposal sections that pertained to TSU.

GROWTH OF THE PARTNERSHIP

Resources constrain the growth of this partnership as they do the other MUCERPI partnerships in this study. However, different members of the partnership are working through their contacts at other organizations and institutions, seeking ways to include them in the *Urban Outreach* program. The following set of points illustrates the web-like manner in which partnerships can, and this one may, expand.

- Charles Galindo has been involved with several Hispanic- serving professional organizations. He would like to train members of SHIPS in effective outreach strategies as well as gain access to SHIPS own outreach network. (SHIPS has participated in partnership activities to a minimal extent.) He would like to formalize a currently informal relationship with LULAC. Mr. Galindo knew Javier Garcia and brought TSUB in as a MUCERPI partner as well as Mainland Preparatory School and the YES Academy, area schools with which the partners now work. He would also like to integrate other grassroots organizations. In addition, Mr. Javier Garcia and Mr. Galindo attended a Mars Festival sponsored

by the St. Louis Museum at which he met several NASA scientists whom he would like to bring to Brownville. Their trip to St. Louis was funded by Passport to Knowledge.

- Andrea Mosely brought Madison High School students into the High School Students Exploring College Opportunities program. She plans to tap NASA scientists to talk with students at area high schools.
- Louisiana State University (LSU) has an NSF funded graduate student program for promoting and increasing minority participation in geosciences. Dr. Glen Merrill and one of Dr. Obot's students who works for NASA, were able to include Dr. Obot in the program. This link now enables TSU to send its graduates to LSU for graduate school and preparatory geosciences summer programs. According to Obot, LSU is seeking students from TSU because they are well prepared for the LSU program: LSU has encountered challenges in finding students who are interested in studying geophysics. The LSU program is an important asset for TSU as TSU has no undergraduate or graduates degrees or programs in the geosciences.
- Dr. Obot has also established a connection with a NASA scientist at Prairieview University, a Historically Black College that is part of Texas A & M. Dr. Morris-Smith, with whom he will be collaborating on research in radiation transport modeling. Dr. Smith would like to take high school students to visit Prairieview.

Some members of the *Educational and Research Outreach Program* would like to further extend program activities within the Black community, but those at TSU with the necessary connections do not have the time to devote to this outreach effort.

MANAGEMENT OF THE PARTNERSHIP

A management team composed of partners from all institutions in the partnership works with Penny Morris Smith to manage and implement the project.

COMMUNICATION

The partnership holds formal meetings every 4-6 weeks. The PI develops the agenda for, and facilitates each meeting and project planning and implementation are routinely discussed. As an example, during my site visit partners discussed the following topics: Schedules and logistics for coming activities as well as contributions each partners could make

- The SSSA's activities and new Ambassadors for MUCERPI Year 3, their roles in upcoming events as well as the *appropriate* roles they should play within partnership activities
- A possible future workshop in Brownsville and which partners would/could serve on its faculty,
- Budget constraints related to implementation;
- TSU plans for their new program in radiation transport modeling.

COMMITTEES

In addition, separate project teams oversee the faculty/student internship program, Space Science Student Ambassadors, Teacher Education and the new Astrobiology course. Team members meet on an as-need basis.

WHAT CONTRIBUTES TO THE SUCCESS OF THIS PARTNERSHIP?

Based on the data, this partnership has matured over time and is functioning well. The partners discuss all aspects of their program and appear able to negotiate when necessary. Several factors have contributed to the success of this partnership, some more unique and others generally found in all successful partnerships.

COLLABORATIONS

This partnership has undoubtedly gained from its history of earlier collaborations between some of its members. Partnerships in which individual representatives do not know each other often need to expend more time and energy establishing the *partnership* and developing good communication and working relationships than do others in which partners know one another. Even with their history, the partners in this MUCERPI had to spend time getting to know one another as well as each member's strengths and limitations within the context of *this* particular project. What they learned in the process was valuable in moving the partnership and its activities forward.

SHARED GOALS

The partners share the goal of serving minority populations and sharing 'the excitement' of science and space science in particular, as well as informing the public (including teachers and students) about NASA its related careers. "We share a drive to share space science with the public at whatever levels." An additional goal is to interest minority students in, and help them attain advanced degrees in space science. Three interviewees spoke of their personal commitments to 'pay back' for the educational and other

opportunities available to them while growing up. Several interviewees mentioned a dedication to bring Hispanic women into universities as well as science. This runs counter to the Hispanic culture in this Latino community according to several partners. One partner commented on the necessity of involving 'faculty members of color' in the sciences, as well as the necessity of working in pre-college education.

> I specifically think that reaching minorities is critical to the long-term health of the field. As a college professor we may want more faculty members of color but you cannot suck on a dry bottle. You have to get to the pipeline further down. To me I think that the pipeline is slowing and I think that it is critical to infuse energy at all levels of the process.

The partners also recognize that each institution has particular educational strengths that strengthen the partnership in different ways. As in most partnerships, each institution also has its own mission and agenda, which must be served by the partnership in part.

LEADERSHIP STYLE

Almost all of the interviewees credited the PI with holding the partnership together—"She is the cement". The PI, understanding that communication and collaboration are essential to the effective functioning of the partnership, talks with, and emails partners between meetings to address issues and disagreements that were raised. As she noted, "Sometimes I have to go in and smooth feathers and give people reasons to stay in the program". With background experience working with non-profit organizations she understands that she must tailor her approach to different partners. She has developed "tactics to get people to buy into the program". She may barter with one partner and emphasize the unique thing that only a different partner can contribute.

All partners have input into group planning and program revisions. Decisions are usually made within the meetings, but Dr. Smith as PI, with the most comprehensive view of the project, makes some final decisions herself.

> We all have ideas and input. If it won't work we modify it to make it better . . . we all have different things we can bring in. The core group works well. The way Penny runs it she gives us free rein. We all give suggestions and then we go forward. That is a rare asset.

PARTNERS' GAINS AND CONTRIBUTIONS

It is critical that each partner gains something in any partnership, usually something unattainable individually. As the PI commented: "They agree on one agenda because they are going to get something they want." While there were times when the PI felt that she had to 'sell' the project to some partners, in each instance it was clear that each partner gained from being associated with *An Education and Outreach Effort in Space Science.* One professor has had an opportunity to teach graduate students for the first time in over 30 years as well as gaining access to NASA equipment for his own research. TSU has

increased the pool of students for their science programs. Through membership in the partnership NASA TSU has been able to establish a research center due to NASA's interest in ongoing research at the university. Obot developed knowledge and expertise in the field of radiation transport modeling through his NASA internship, and as a result is now teaching courses in that area and has established a program in radiation transport modeling. Other partners, such as NASA and UHD, are now more able to bring space science activities to minorities in the area through individual partner's networks and contacts, and have been able to increase the *numbers* of students and teachers they can reach. NASA employees have met colleagues they had not known previously. Students have benefited from visiting places "they would not normally ever go'" such as downtown Houston and HMNS.

The partners bring different educational strengths and expertise, contacts, and resources to *An Education and Outreach Effort in Space Science.* Some are good grant writers, and others bring many relevant contacts. NASA scientists have expertise in space science as well as an internship program. Some partners have expertise in specific scientific areas, or equipment, such as the HMNS portable planetarium.

UNDERSTANDING ONE ANOTHER'S STRENGTHS AND LIMITATIONS

It took the partners time to appreciate each other's strengths and weaknesses. One administrative and programmatic change reflected that understanding and was a strategy to increase the efficiency and effectiveness of a project component. As one partner stated,

> It has been a real interesting evolution of learning to work together and across the various partnerships and learning what our limitations are . . . it has been a very healthy evolution . . . Part of it is learning how to work as a team and to see each person's strengths and weaknesses and learning the limitations of some partners.

PERSONALITIES AND RELATIONSHIPS

Because of the collaborations between some of the institutions and individuals prior to the grant, some partners brought their joint good working relationships and friendships with them to the MUCERPI. Most interviewees credited the success of this partnership to the fact that "The personalities work most of the time", "People tend to be pretty open in discussions", and "We work together in a professional way without a big 'I' and little 'You'". While some tensions and issues exist between some of the partners, which is normal, there is no evidence that this has hampered the work of the group:

> This group is very committed. I have seen times when there is friction but people are committed and we resolve friction among ourselves.

CONTACT WITH NASA

Because of Dr. Smith's prior collaborations with Dr. Lindstrom and Ms Allen, they were in a position to be (and were) instrumental in developing the first MUI grant proposal. In

fact, her NASA colleagues informed Dr. Smith of the NRA. NASA has been an active contributor to this project and participates in numerous activities including facilitating internships at JPL. Charles Galindo's network of Hispanic professional organizations has provided partners access to these organizations that might have otherwise been difficult, if not impossible, to establish.

ADDING RESOURCES

Similar to other partnerships, the members of *An Education Outreach* scrape together resources from other sources when possible in order to supplement their grant. As one partner commented, "We have a team. We talk about what we want to do, where the resources are, and then where can we lick the pots."

CHALLENGES

An Urban Outreach Program works with and around a set of challenges. Some are context-based and others more generally shared with other partnerships.

STUDENT/INTERN PREPARATION

TSU has found that many entering freshmen are ill prepared in mathematics—even to the extent of being unable to work with fractions. With such a limited knowledge of mathematics these students are unable to take many science classes.

The MUI design for NASA student internships was revised for the MUCERPI as a result of lessons learned from the first grant: Students who had been accepted into those internships, unlike students from some other universities, were not well enough prepared to undertake independent research and their NASA scientist-mentors were unable to mentor them to the necessary extent for them to succeed. In Phase 2 a new mentoring system was put in place. Internships are now team based between a student intern, a faculty scientist, and a NASA mentor.

PROFIT AND NON-PROFIT PARTNERS

Several partners believe that at times it has been challenging to work within a non-profit/profit partnership. Although they mentioned the HMNS, it is not clear that the Museum is actually a for-profit organization. However, as reported, it functions and approaches the bottom line differently from the universities. One partner commented:

> We are non-profits working with for-profits. The vision is always different. They want publicity, and to bring in money. For us the customer is the kids, versus whoever comes in the door.

Another added that while *none* of the partners is for profit, HMNS, for example, must be more conscious of the bottom line and has "a different approach to dealing with business

issues." And the Museum has to demonstrate that the money coming in from an activity covers its costs. These differences (or perceived differences) have contributed tension to some partnership discussions and negotiations.

POLITICS

Politics play their part. The astrobiology course was not offered in 2004-spring 2005 for political reasons internal to UHD. Faculty in universities try to secure funding on an ongoing basis as well, and there were administrators at UHD who tried unsuccessfully to house *An Educational and Research Outreach Program* within their own programs. There have been other political issues within institutions, but in each case the partners have dealt with them successfully.

HISPANIC CULTURE

As described by several individuals, the Hispanic culture in the Houston area makes it more difficult to engage Hispanic students than others in higher education (This challenge cannot be generalized to Hispanic cultures in other areas of the country.) This is especially true for women. One interviewee referred to "bucking the culture of the Hispanic population in which girls do not leave there home town and do not go into higher education . . . there is only one role for women." Another described a case in which the father of a female university undergraduate burned all of her university course texts as a protest against her attempts at further education. In another instance a young man told his family that he was involved for several years in some other activity while instead he attended college. And in a third case, a female Hispanic graduate of UHD, who received a full scholarship to attend the University of California, turned it down because her parents denied her permission to go.

COMPETING PROGRAMS FOR STUDENT ENGAGEMENT

Certainly some, if not most, students who are interested in space science are eager to become interns at NASA. However, one interviewee commented that some students have turned to other summer employment opportunities because they were able to earn more that the internship paid them.

FULL COST ACCOUNTING AT NASA AND NEW ACCESS RULES

Newly instituted cost accounting measures at NASA have made it more difficult for some NASA scientists to partner with scientists outside of NASA. Full cost accounting can drive up a project's costs significantly.

Post 9/11 NASA guidelines and rules have decreased access to JPL: Partners who could once take groups of students and teachers to visit are no longer able to do so for security

reasons, although, on the other hand, there are days when *any* member of the public is allowed to visit JPL.

DEFINING THE ROLE OF SSSA

The role of the SSSAs and the venues in which they work was an issue that the partnership has and continues to address. Some of the first community venues that hosted the Ambassadors did not treat them well. In some instances when the Ambassadors met with participating students the supervisory adult, such as a teacher, left the room and the partners had to clarify that Ambassadors are not in charge of discipline. At other times the space provided for the program was inadequate. While there has continued to be some friction and disagreement between the partners about the appropriate roles for the Ambassadors within the project, the program is still very active.

OUTCOMES: 2004–EARLY 2005

In the first year of the grant the following were accomplished, according to the first year report:

- 10 multi-week space science enrichment programs to K-12 institutions,
- Development of a new course in astrobiology: biology/geology 4190
- Five teacher workshops
- Fifteen students engaged in High School Students Exploring College Opportunities (HSS-ECO)
- Space Science Student Ambassadors offered science summer enrichment programs
- Public outreach events: Mars Festival, Sun-Earth Day, Bright Futures Fair, Space Science Family Day
- Two student-faculty-NASA internships
- The Redd School Images Mars project culminating in a family science fair
- Involvement in the development of a video produced by Passport to Knowledge

SMD E/PO Phase IV Evaluation:

Quantitative Analysis

NASA Space Mission Directorate
Washington, DC

Written by:
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December 2005

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SMD E/PO Phase IV Evaluation:
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EXECUTIVE SUMMARY

Data were collected via an online survey from 420 individuals who use or help develop NASA space science educational resources. The majority of questions on the survey concern attributes that had been identified as relevant to users and developers of space science E/PO resources during earlier phases of the evaluation.

The sample included formal and informal educators, members of the general public, E/PO developers, and scientists. Respondents could identify themselves as members of more than one group. Users were asked about attributes that were relevant to them. E.g., formal educators were asked about attributes that other formal educators had identified as important; scientists were asked about attributes that other scientists had identified. More than four-fifths of the respondents reported that they had used E/PO resources and approximately one-third said they had helped develop resources. Approximately one-fifth of the respondents identified themselves as members of a group that was underserved by existing space science educational resources.[1]

For each attribute, respondents were asked about its importance to them and the availability of resources that embody the attributes. Gathering data about both importance and availability allowed the evaluators to compute an estimated "gap" between the users' needs (operationalized as importance of each attribute) and how well that need is met (operationalized as availability of resources with each attribute). The larger the computed gap, the stronger the need for resources with that attribute because:

- It is important to respondents that resources have the attribute; or
- The respondents say there are few resources with the attribute; or
- Both of the above are true.

SALIENT FINDINGS

- For almost all attributes, ratings for importance are higher than ratings for availability (a positive gap), which indicates an opportunity to meet a variety of existing needs.
- Scientific accuracy is the most important attribute overall; it is also among the most available attributes: respondents report that many existing space science education resources are scientifically accurate.

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1 Evaluators did not define "underserved" but let respondents identify themselves. The largest group of underserved respondents identified as African American, followed by non-native English speakers, women, and Native Americans.

- Gaps are larger for end-users (formal and informal educators, and members of the general public) than for those involved in creating resources (scientists and E/PO developers).
- The largest gaps for the attributes rated by all users are for materials that are engaging and easy to find/get access to.
- Publicity is the least available attribute overall; only members of the general public were asked about this attribute; they report they want publicized resources and relatively few exist.
- Scientists report that there are quite a few resources that respect their time and other constraints; this is an improvement over data gathered in the first phase of the evaluation, in which scientists reported many barriers to their participation in education resource development; the largest gap for scientists is for resources that allow them to receive recognition for their work.
- Formal educators report the largest gap for resources that focus on general science and the smallest gap (one of the few negative gaps in the study) for resources that focus on mission details.
- The two biggest gaps are both for informal educators—they want resources that are available at a range of costs and are easy to update; the cost issue is especially salient for smaller institutions.
- Respondents who identify as members of underserved groups rate resources that are appropriate for diverse audiences and resources that respect their culture as both more important and less available than do respondents who do not identify as underserved.

RECOMMENDATIONS

- Availability reflects not just whether appropriate resources exist, but whether respondents are aware of such resources; increasing communication to users about resources would increase perceived availability, thus lowering gap scores—without the need to create additional resources; it would also specifically decrease two of the largest gaps: resources that are easy to find and access (one of the largest gaps, rated by all respondents), and resources that are well-publicized (the least available attribute, rated by members of the general public only).
- Continue to provide support for scientists who want to work in education; there has been great movement forward in this area, reflected in both the increased number of scientists in E/PO and the smaller gaps that scientists report for most attributes; there is opportunity to make further inroads by providing recognition for scientists who contribute to E/PO.
- There is an opportunity to better serve formal educators by providing materials that focus on general science concepts rather than mission details.
- NASA can expand its reach to informal venues, especially smaller venues and those in rural areas, by creating resources that are available at a range of costs and

technological complexity, and that are easy to update as new information becomes available.

- NASA has been working to reach members of underserved audiences; data from earlier phases of the evaluation indicate that they have been somewhat successful in this attempt; NASA can build upon this success by providing resources that are appropriate to diverse audiences and that respect and reflect various cultures.

INTRODUCTION

PROJECT DESCRIPTION

From its inception in 1958, the National Aeronautics and Space Administration (NASA) has sustained an agency-wide commitment to education. During the period December 1993–February 1995, the NASA Office of Space Science (OSS) developed *Partners in Education: A Strategy for Integrating Education and Public Outreach into NASA's Space Science Programs* (1995, referred to as the Strategic Plan). This publication articulated the goals of developing a variety of Education/Public Outreach (E/PO) resources and integrating them with existing efforts to create a coherent vision for education. *Implementing the Office of Space Science Education/Public Outreach Strategy* (developed May 1995–September 1996, referred to as the Implementation Plan) specifically addresses the methods by which the goals articulated in the Strategic Plan were to be realized.

In 2005, the OSS merged with NASA's Earth Science Enterprise, forming the NASA Science Mission Directorate (SMD). The SMD E/PO Effort is continuing the work initiated by the OSS E/PO Effort; it is dedicated to realizing the goals of the Strategic Plan, which was developed with the mission of making "education at all levels and the enhancement of public understanding of science integral parts of space science research activities."[2] The intent was to build a bridge between OSS and the public, particularly with the formal and informal educational communities. The goals of the Effort as outlined in the most recent OSS Strategic Plan are:[3]

- To share the excitement of space science discoveries with the public
- To enhance the quality of science, mathematics, and technology education, particularly at the pre-college level
- To help create our 21st century scientific and technical workforce

Virtually all NASA space science E/PO is funded through flight missions,[4] through grants for Supporting Research and Technology[5], and through the activities of the

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[2] *Partners in Education: A Strategy for Integrating Education and Public Outreach into NASA's Space Science Programs*, 1995, p.1.

[3] *The Space Science Enterprise Strategic Plan*, 2000, p. 23. Note that the original Implementation Plan had four goals, which have been reframed into the current goals as a result of input from the larger space science and educational communities. The SMD has not yet articulated specific education goals; current efforts align with the existing OSS goals.

[4] Missions are large-scale, long-term research projects. The funding process for missions utilizes Announcements of Opportunity (AOs). All new missions are required to allocate 1–2% of their budget for education and public

Support Network (SN), a network of institutions across the nation that help achieve the goals of the E/PO Strategic Plan.[6] NASA guidelines require that scientific staff be involved with the development of E/PO related to their missions and research. Scientific staff are often supported by personnel dedicated specifically to development of E/PO resources.

EVALUATION

The NASA Office of Space Science contracted with the Program Evaluation and Research Group (PERG) of Lesley University in October 1998 to conduct an external evaluation to determine how effectively the E/PO Effort is meeting the objectives laid out in the Implementation Plan. The PERG evaluation plan to date has been conducted in three phases:

- **Phase I** focused on documenting and describing the **infrastructure** of the E/PO Effort, especially the SN.
- **Phase II** focused on describing and explaining the E/PO Effort **implementation**, beyond the development of the SN infrastructure.
- **Phase III** focused on examining the **impact** of E/PO activities on those audiences for whom the products and services are designed (e.g., teachers who participate in NASA-sponsored teacher training programs, visitors to museum exhibits developed by NASA space science staff, etc.).

As part of the Phase III evaluation, various audience members identified attributes of space science educational resources that are important to them. Because the analysis in Phase III was primarily qualitative, the data were not projected onto a larger audience. Specifically, no predictions could be made about which attributes are most important to the populations served by the E/PO Effort.

To allow evaluators to generalize to individuals beyond the sample queried and identify attributes of space science educational resources that are likely to meet the needs of the greatest proportion of users, PERG conducted a large-scale survey of the various populations involved in creating, supporting, and using NASA space science E/PO

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outreach. Older missions, such as Voyager, are exempt from this mandate, although many do support some type of E/PO development.

[5] Grants for Supporting Research and Technology are smaller grants, covering relatively small, short-term research projects that provide basic research supporting the flight missions. The funding process utilizes NASA Research Announcements (NRAs), and grants submitted in response to NRAs are not required to include funds for E/PO. While educational components are not mandated for Supporting Research, scientists working on Supporting Research are encouraged to develop E/PO resources in conjunction with the scientific content of the grants.

[6] There are a few smaller grants programs, such as IDEAS, that provide E/PO funding that is not tied to specific NASA missions or Supporting Research. These represent a very small proportion of the E/PO budget. In addition, Guest Observer Grants (which support guest scientists on missions) may involve E/PO components.

resources. The survey allowed evaluators to collect ratings from a large number of individuals on the attributes that had been identified in Phase III of the evaluation.[7]

DATA COLLECTION ACTIVITIES

Data were collected via an interactive online survey. The majority of questions on the survey concern the importance of various attributes of educational resources and the availability of resources that exhibit these attributes.

Gathering data about both importance and availability allowed the evaluators to compute an estimated "gap" between the users' needs (operationalized as importance of each attribute) and how well that need is met (operationalized as availability of resources with each attribute).

The attributes included in the survey were taken from qualitative data collected during the third phase of PERG's evaluation of the E/PO Effort.

- Eleven attributes were identified as relevant to all audiences.
- Eight attributes were identified as relevant primarily to formal educators.
- Seven attributes were identified as relevant primarily to informal educators.
- Five attributes were identified as relevant primarily to the science-interested public.
- Five attributes were identified as relevant primarily to scientists, researchers, and engineers.
- Eight attributes were identified as relevant primarily to E/PO developers.

The structure of the survey was as follows:

- Respondents identified their role in regards to space science E/PO (formal educator, informal educator, E/PO developer, etc.).
- Respondents were asked about the attributes of resources:

  first they were asked about attributes relevant to all audiences;

  then they were asked about attributes relevant to their roles.
- Respondents completed basic demographic questions.

For each attribute, respondents were asked two questions, each with a four-point Lykert scale for responses:

- How important is the attribute? ("Not at all important" to "very important")
- How many resources with the attribute are available? ("There are enough resources" to "I am not aware of any resources")

[7] See Cohen, S., Gutbezahl, J., Griffith, J., Lee, S., & Sandler, J. (2004). *Office of Space Science Education and Public Outreach: Phase III Evaluation Report* for a fuller discussion of how these attributes were identified.

The full text of the survey (including all attributes rated) is given as Appendix A. Data were collected between January 12, 1005 and May 31, 2005.

PARTICIPANT AUDIENCES

Evaluators sent email to E/PO leads or PIs who were involved with programs identified in the 2003 OSS E/PO Annual Report,[8] on NASA web pages, or by PERG staff during earlier stages of the evaluation. The email explained the goals of the evaluation, directed the recipient to the web page that hosted the survey, and requested contact information for end-users of the resource. A sample letter is given as Appendix B.

After gathering contact information for end-users, evaluators sent email to 3,272 individuals, including both resource developers and users of E/PO resources. The email explained the purpose of the evaluation and directed the recipient to the survey web page. A sample letter is given as Appendix C.

A total of 420 individuals completed the survey. Table 1 below indicates the breakdown of respondents by self-reported role. Note that respondents could identify with more than one role.

- Nearly one-half of the respondents indicated that they were involved directly in formal education.
- More than one-quarter of the respondents reported that they identified as scientists, with a similar number identifying as E/PO developers or informal educators.
- Slightly more than one-tenth reported that they interacted with space science E/PO as members of the general public.

Table 1: Respondents by Role

Role	Percent
Formal educator	47%
Scientist/engineer	29%
E/PO developer	26%
Informal educator	26%
General public	11%

N=420; Note that respondents could give more than one response

Informal educators indicated what type of institution they are affiliated with. As shown in Table 2 below, the sample includes respondents from a range of institutions.

[8] *NASA Space Science Education and Public Outreach Annual Report,* 2003.

- Nearly one-half of the informal educators are affiliated with small science centers or museums.
- Just about one-third are affiliated with community groups.
- About one-fifth are involved with afterschool programs, and a similar number are affiliated with large science museums.

Table 2: Informal Educator by Type of Institution

Type of Institution	Percent
Small science museum	45%
Community group	31%
Afterschool program	22%
Large science museum	21%
Library	11%
Other science museum	5%

N=108; Note that respondents could give more than one response

Scientists and engineers were asked about their institution and their roles. Their responses are shown in Table 3 and Table 4.

- Approximately three-quarters of the scientists and engineers in our sample are employed by universities or colleges, with almost one-half working at research universities, and just over one-quarter at teaching institutions.
- Approximately one-third work for NASA-funded or NASA-affiliated institutions.
- Just over one-quarter work at teaching universities or colleges.

Table 3: Scientist/Engineer by Type of Institution

Type of Institution	Percent
Research university	43%
NASA-funded or affiliated research institution	33%
Teaching university or college	28%
Private space science research institution	7%
Other research institution	11%
Other	7%

N=122; Note that respondents could give more than one response

- Not surprisingly, more than one-half of the scientists and engineers completing the survey identify as space scientists.
- Slightly more than one-third identify as professors; note that more scientists and engineers report that they are working at universities than report that they are professors; the remainder may have purely research positions.

- Relatively few engineers completed the survey; fewer than 5% report being engineers on either space craft or instruments. The data in the report may not reflect the needs of engineers working in space science.

Table 4: Scientist/Engineer by Role

Role	Percent
Physicist (not SS)	6%
Professor	36%
Other scientist	17%
Engineer, instruments	4%
Engineer, space craft	3%
Other role	10%

N=122; Note that respondents could give more than one response

Respondents indicated the locations of the audiences with which they work. Some respondents work with audiences in multiple regions or communities. As shown in Table 5 and 6 below, our sample includes respondents who work with end-users throughout the United States in a variety of environments.

- Respondents are approximately equally distributed throughout the United States.
- Approximately 5% work in other parts of North America, and 5% work beyond North America.

Table 5: Respondents by Geographic Region Served

Region	Percent
Southwest US	29%
Northeast US	22%
Mid-West US	21%
Southeast US	20%
Mid-Atlantic US	13%
Other North America	4%
Beyond North America	5%

N=420; Note that respondents could give more than one response

- More than one-half of the sample report working with suburban populations.
- Slightly less than one-half report working with urban populations.
- Slightly less than one-third report working with rural populations.

Table 6: Respondents by Community Served

Community	Percent
Suburban	54%
Urban	47%
Rural	32%

N=420; Note that respondents could give more than one response

Respondents indicated how they have been involved with NASA space science educational resources. Table 7 shows their responses.

- The majority have been involved as end-users: Well over three-quarters have used resources, and one-half have attended workshops.
- Slightly fewer than one-third have helped develop or review resources.
- Fewer than one-quarter have led workshops.

The reader should consider this when interpreting the data: the point of view expressed is more representative of those who utilize space science resources than those who help create them.

Table 7: Respondents by Involvement with NASA Space Science Educational Resources

Involvement	Percent
Use resources	84%
Attend workshops	50%
Help develop resources	32%
Review resources	32%
Lead workshops	22%
Other	8%

N=420; Note that respondents could give more than one response

Finally, respondents were asked if they identified as members of an underserved or underutilized group. About one-fifth (19%) of respondents said they did. The survey did not define underserved, but asked respondents which group they identified with. The most common response was from African American respondents, followed (rather distantly) by non-native English speakers (primarily Hispanic) and then women and Native Americans. A handful of respondents identified as underserved because they are homeschooling, working with special needs populations, or working at community colleges. Other self-identification as underserved includes:

- Elementary school teacher
- Not-for-profit

- Chemistry teacher
- "The entire younger generation"

Note that the respondents comprise a self-selecting group and may not be representative of all users of NASA educational resources; our response rate was just under 13%. Research suggests that individuals who complete on-line surveys tend to be somewhat more comfortable with computers, and more motivated than those who do not complete such surveys. This potential bias should not invalidate the results of the study, because NASA markets many of its educational programs to educators and scientists who are motivated and computer-literate. The population of interest is similar to the sample, and results should be projectable.

ANALYSIS

The first step in analysis was to convert the verbal ratings given by respondents to numerical data. Respondents rated both importance and availability of resource attributes on a four-point scale; these were converted to numeric data as shown in Table 8 below.

Table 8: Numeric coding of rating data

Importance	Availability	Numeric
Very important	There are currently enough resources	4
Moderately important	There is a need for a few more resources	3
Slightly important	There is a need for many more resources	2
Not at all important	I am not aware of any resources	1
Not applicable	Not applicable	9 (treated as missing)

A gap score was computed for each attribute by subtracting the availability score from the importance score. A high gap score indicates that there are relatively few resources given the importance of the attribute (the attribute is perceived to be important and/or that respondents know of few resources that have the attribute). Thus, new resources that have attributes with high gap scores are more likely to fill existing gaps.

REPORTING

An overview of the most significant or actionable findings is given first, and then there is a detailed description of data for all attributes. Data are presented first for the attributes rated by all respondents, and then for each role (formal educator, informal educator, general public, scientist, and E/PO developer). Attributes with the largest gap scores are presented first, and scores with significant differences are indicated. Letters indicate the size of the gap: those attributes labeled A have the highest gaps (and these gaps are not significantly different); those labeled B have the second highest gap, etc. Some attributes are marked with two or more letters; this indicates that there are other attributes that are

significantly different from one another, but that neither is significantly different from the attribute with two letters. If Attribute 1 is marked (A), Attribute 2 is marked (A,B) and Attribute 3 is marked (B), the gap for Attribute 1 is significantly larger than the gap for Attribute 3, but that the gap for Attribute 2 is not significantly different from either. Data are also presented graphically, with the importance and availability scores given for each attribute. In some cases, qualitative data from the Phase III evaluation[9] are included to highlight the specific attributes.

For readers who want more detailed statistical information, a table of all means and statistically significant differences (for importance, availability, and gap) is given in Appendix D.

In the tables and in the body of the report, the criterion for significant differences is $p < .001$ (the observed difference in the sample would happen by chance—if there were no actual difference in the population—less than one time in one thousand). This is a more stringent criterion than the standard $p < .05$ (the observed difference in the sample would happen by chance—if there were no actual difference in the population—less than five times in one hundred). The more stringent criterion was used to avoid false positives with the large number of comparisons among the 48 attributes rated.

[9] Cohen, S., Gutbezahl, J., Griffith, J., Lee, S., & Sandler, J. (2004). *Office of Space Science Education and Public Outreach: Phase III Evaluation Report.*

FINDINGS

ALL AUDIENCES

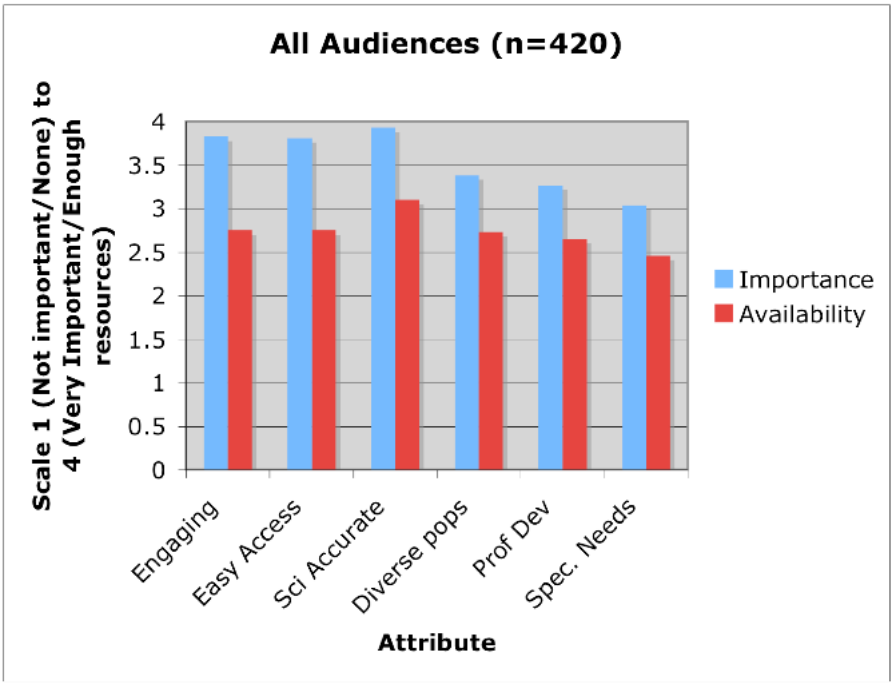
The survey included eleven attributes that had been identified as important to all audiences. All 420 respondents rated the importance and availability of the following attributes. Attributes with the largest gaps are presented first. Attributes that share a letter index are not significantly different from one another. See page 8 for a more detailed explanation of how significant differences are reported.

All audiences considered it important that space science resources:

- Are engaging (A)
- Are easy to find and get access to (A)
- Are scientifically accurate (B)
- Adapt easily to diverse populations (B,C)
- Are supported by appropriate professional development (C)
- Are accessible to users with special needs (C,D)
- Reflect current research (D)
- Are supported by their institution or organization (D)
- Are personally interactive (includes personal, face-to-face interactions) (E)
- Support partnerships between members of their institution or organization and others (E)
- Respect their culture, its traditions, and its characteristics (F)

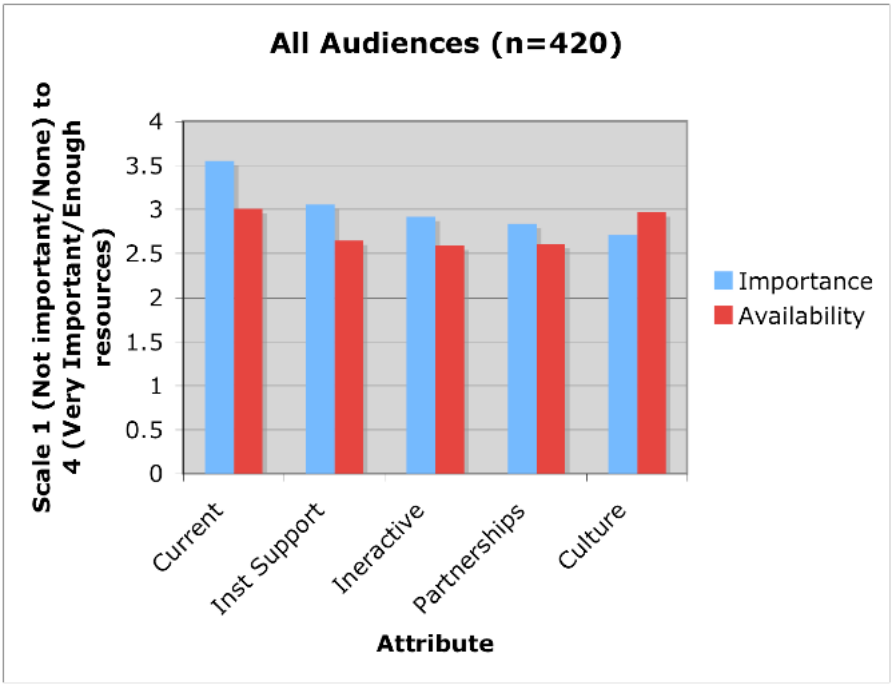
Figures 1 and 2 below show the relative importance and availability of these attributes as reported by all audiences.

Figure 1: Six largest gaps for all audiences



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

Figure 2: Five smallest gaps for all audiences



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

Respondents want resources to be scientifically accurate and engaging. Respondents report that many available resources are accurate, but that there is a greater need for resources that will engage users. They also report that resources are not as easily accessible as they would like.

- The largest gaps are for resources that are **engaging** and **easily accessible**, significantly higher than for any other attribute. Reported availability for resources with these attributes is relatively low; users report that they know few resources that they can find easily and that they find engaging.
- The next largest gap is for resources that are **scientifically accurate.** According to our respondents, scientific accuracy is both the most important attribute, and the attribute most likely to be embodied by existing space science resources. Ratings for both importance and availability are significantly higher for scientific accuracy than for any other attribute. The relatively high availability of resources with this attribute means that gap score is lower than for engaging and accessible resources, even though the attribute is rated as most important.
- The next largest gap is for resources that are **appropriate for diverse audiences**. Respondents interviewed during Phase III indicated that they wanted resources that reflected variation across ethnic, gender, and socioeconomic boundaries. There are significant differences in rating for this variable between respondents who identify as underserved and those who do not so identify[10]. These are discussed in more detail below.
- The next largest gaps are for resources supported by appropriate **professional development (PD)** and resources that serve users with **special needs**.
    - Respondents indicate that PD is as important as scientific accuracy or appropriateness for diverse audiences. They also report that many existing resources are supported by strong PD.
    - Respondents report that creating resources for those with special needs is less important; they also report that few such resources are available. Availability ratings for resources that serve those with special needs are lower than for any other attribute rated by all respondents.

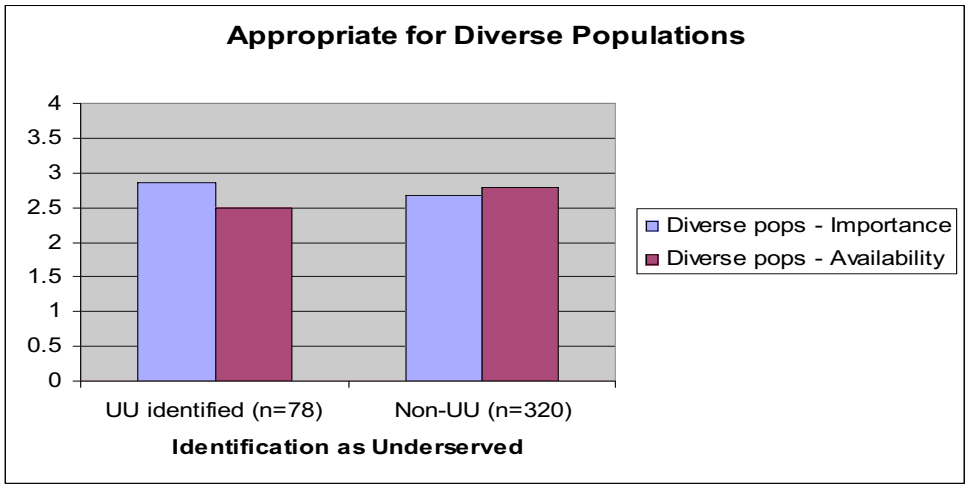
There are significant differences in two variables as a function of membership in underserved groups, with respondents who identify as underserved reporting larger gaps. Both these variables, appropriateness for **diverse populations**, and **respect for culture**, are related to the different needs of users who are not members of the mainstream. As one respondent from the Phase III evaluation put it:

[10] Recall that respondents were asked simply if they considered themselves to be part of an underserved group, and if so, which group. The survey did not specify any criteria for being "underserved." In our sample, most of the self-identified underserved respondents are African American, with some non-native English speakers. Other self-identified underserved groups include Native Americans, women, homeschoolers, community college professors, and teachers of special needs populations.

> Most mainstream science courses are grounded in mainstream culture. If you're not attuned to the culture you are at you don't realize that science is not culturally neutral. (Informal educator)

As shown in Figure 3, respondents who identify as members of an underserved group deem appropriateness for diverse audiences to be significantly more important and significantly less prevalent than do other respondents.

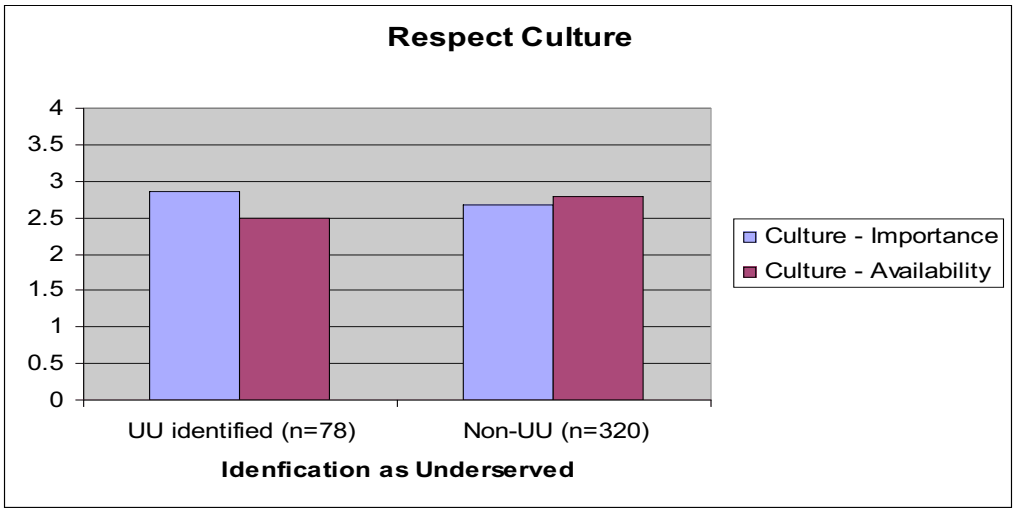
Figure 3: Ratings of Appropriateness for Diverse Audiences



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

As shown in Figure 4, a similar pattern can be found regarding the attribute, "Respects the respondent's culture," which has the smallest gap of the attributes rated by all respondents. Respondents who identify as underserved rate this attribute as more important and less available than those who do not so identify.

Figure 4: Ratings of Respect for Culture



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

Because of these differences, respondents who identify as underserved report a positive gap (i.e., the mean rating for importance is greater than the mean rating for availability), while non-underserved respondents report a small negative gap. This supports findings from the qualitative evaluation that suggest a need to tailor resources for diverse populations.

FORMAL EDUCATORS

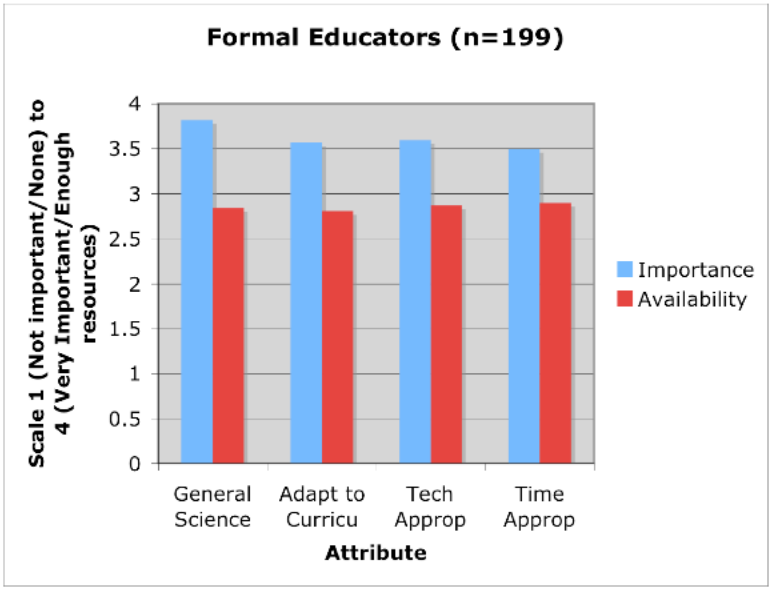
The survey included eight attributes that had been identified as important to formal educators. The 199 respondents who identified themselves as formal educators rated the importance and availability of the following attributes. Attributes with the largest gaps are presented first. Attributes that share a letter index are not significantly different from one another. See page 8 for a more detailed explanation of how significant differences are reported.

Formal educators considered it important that space science resources they work with:

- Focus on general science concepts (A)
- Adapt easily to various curricula (B)
- Are appropriate to their technology constraints (B)
- Are appropriate to their time (B, C)
- Align with local, state, and/or national standards (C)
- Are supported by appropriate professional development (D)
- Treat them and their students with respect (D)
- Focus on the details of a specific NASA mission (E)

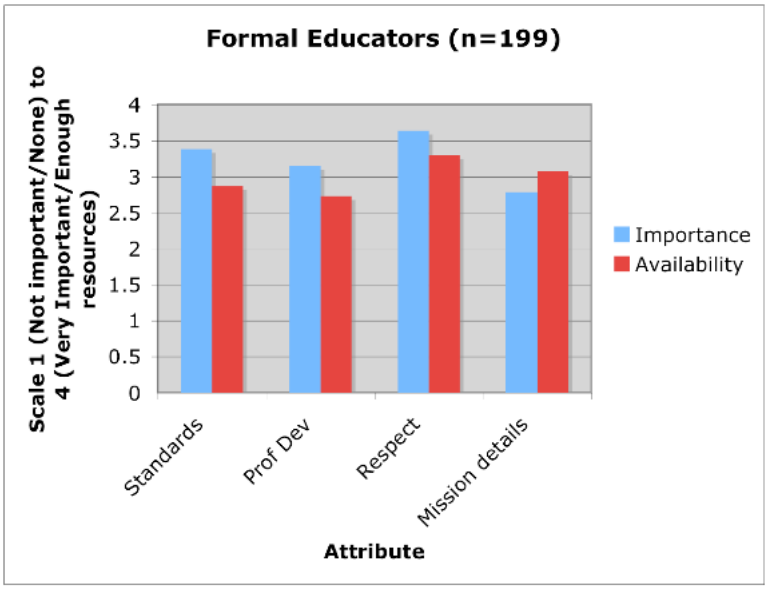
Figures 5 and 6 below show the relative importance and availability of these attributes as reported by formal educators.

Figure 5: Four largest gaps for formal educators



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

Figure 6: Four smallest gaps for formal educators



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

There is an opportunity to meet the needs of formal educators by focusing resources on general science concepts, rather than mission details. Quantitative data support earlier qualitative findings that there is a need for resources that meet the constraints that formal educators face: curriculum is proscribed, so resources must adapt to fit the curriculum; teachers' time and access to technology is limited, so resources must respect that; and there is increasing pressure to align with standards.

- The gap for resources that focus on **general science** concepts is significantly larger than the gap for any other attribute. Formal educators indicate that this is the most important attribute for resources that they use.
- The next largest gaps are found for resources that are **adaptable to curriculum**, that are appropriate to educators' **time constraints** and **technology constraints**, followed closely by the gap for resources that **align with standards**. These ratings support qualitative data collected over the course of the evaluation.
- The next largest gap is for resources that treat educators and their students with **respect.** Respondents in Phase III of the evaluation indicated that they want resources that are appropriate to learners, but not "dumbed down" for students. Respondents in Phase IV indicate that respect is extremely important (only general science concepts are rated as more important). They also report that current space science materials do a good job of meeting this need; availability ratings for respect are significantly higher than for any other attribute.
- The smallest gap is for resources that focus on **mission details**. Data indicate that focus on mission details is relatively unimportant to formal educators. Respondents indicate that there are more resources that focus on mission details than on general science concepts, while general science concepts are significantly more important to them than mission details.

INFORMAL EDUCATORS

The survey included seven attributes that had been identified as important to informal educators. The 107 respondents who identified themselves as informal educators rated the importance and availability of the following attributes. Attributes with the largest gaps are presented first. Attributes that share a letter index are not significantly different from one another. See page 8 for a more detailed explanation of how significant differences are reported.

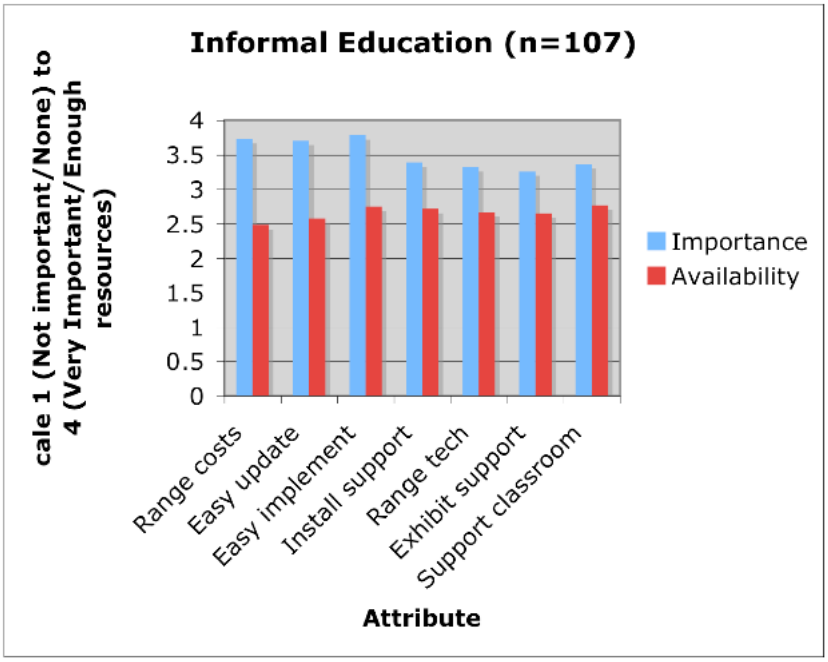
Informal educators considered it important that space science resources they work with:

- Are available at a range of costs (A)
- Are easy to update (A,B)
- Are easy to implement (B)
- Are supported during installation (C)
- Are available at a range technical complexity (C)

- Are supported during exhibition (C)
- Include supporting material for classroom use (C)

Figure 7 below shows the relative importance and availability of these attributes as reported by informal educators.

Figure 7: Gaps for Informal Educators



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

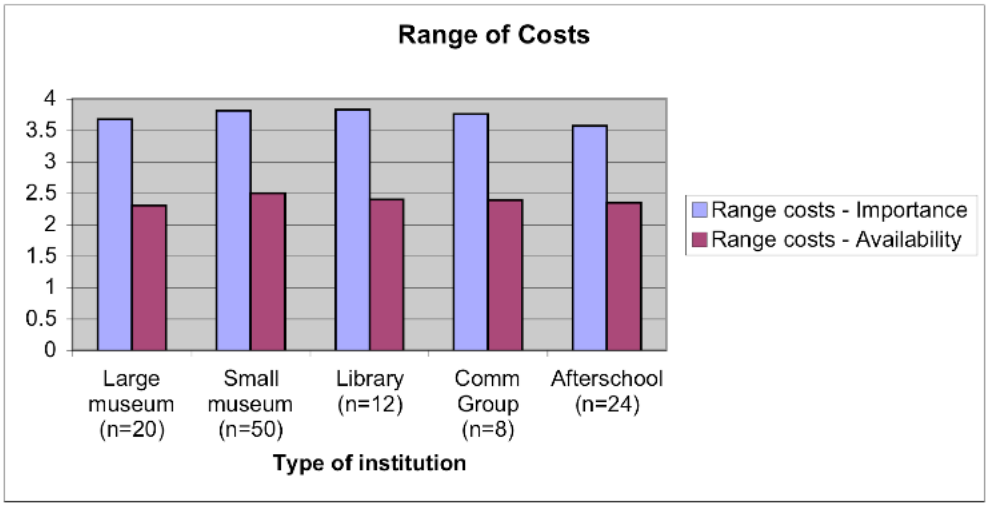
Data suggest that there is an opportunity to meet needs for informal educators, primarily by creating informal resources that are within the budgets of smaller institutions, and which are easy for the limited staff at the institutions to implement and update.

- The two largest gaps for informal educators are for resources that are available at a **range of costs** and that are **easy to update**. These gaps are larger than gaps for any other attribute, across all populations. Informal educators report that the most important attribute for space science resources is that they be available at a range of costs. This attribute is significantly more important for small museums than large museums, as will be discussed below.
- The next largest gap is for resources that are **easy to implement**. This gap is not significantly different from the gap for "easy to update."
- The remaining attributes have smaller gaps that are not significantly different from one another.

Data suggest that having resources available at a range of costs is more important to small museums and science centers than to larger institutions. Smaller institutions are

more aware of resources at a range of costs: respondents from small museums and science centers report greater availability of this attribute. There is an opportunity to reach smaller museums and other informal venues (such as libraries, community groups, and afterschool programs) by creating and publicizing resources that are available at a range of costs.

Figure 8: Ratings for Range of Costs



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

GENERAL PUBLIC

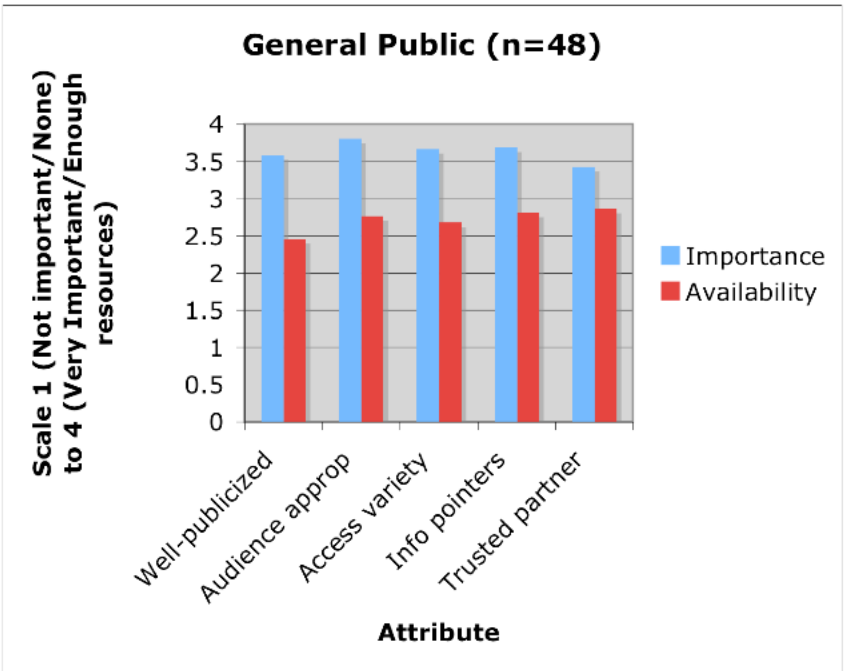
The survey included five attributes that had been identified as important to members of the general public. The 48 respondents who identified themselves as members of the general public rated the importance and availability of the following attributes. Attributes with the largest gaps are presented first. Attributes that share a letter index are not significantly different from one another. Note that the relatively small sample size for this audience yields little power to detect differences. See page 8 for a more detailed explanation of how significant differences are reported.

The general public considered it important that space science resources:

- Are well-publicized (A)
- Are appropriate to the audience (A)
- Can be accessed in a variety of ways (A)
- Provide pointers to more information (e.g., hand-outs with technical information, URLs, pointers to TV shows or magazine articles) (A,B)
- Are supported by or affiliated with a trusted organization or network (B)

Figure 9 below shows the relative importance and availability of these attributes as reported by the general public.

Figure 9: Gaps for the General Public



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

The findings suggest that there is a great opportunity to better meet the space science education needs of the general public.[11] Data indicate that simply increasing public awareness of NASA educational resources and events would help close the largest gap in the data.

- The largest gaps are for resources that are **well-publicized, appropriate to the audience, and accessible in a variety of ways.** The attribute "well-publicized" received the lowest mean availability rating of any attribute rated by any of the audiences.[12] Thus, although publicity is not perceived as one of the most important attributes by our respondents, the gap score for this attribute is quite high. This supports findings from early phases of the evaluation that suggest that users are unaware of the many space science educational resources available from NASA.

[11] The gaps are larger for members of the general public than for any other group; 4 of the 5 attributes rated by members of the general public have gaps greater than 0.85. Compare with ratings for all audiences, in which 2 of 11 gaps are greater than 0.85; formal educators, with 1 of 8 gaps; informal educators with 3 of 7 gaps; and E/PO developers and scientists, with no gaps this large.

[12] "Appropriate for users with special needs" (for all respondents) and "available at a range of costs" (for informal educators) were not rated significantly more available.

SCIENTISTS

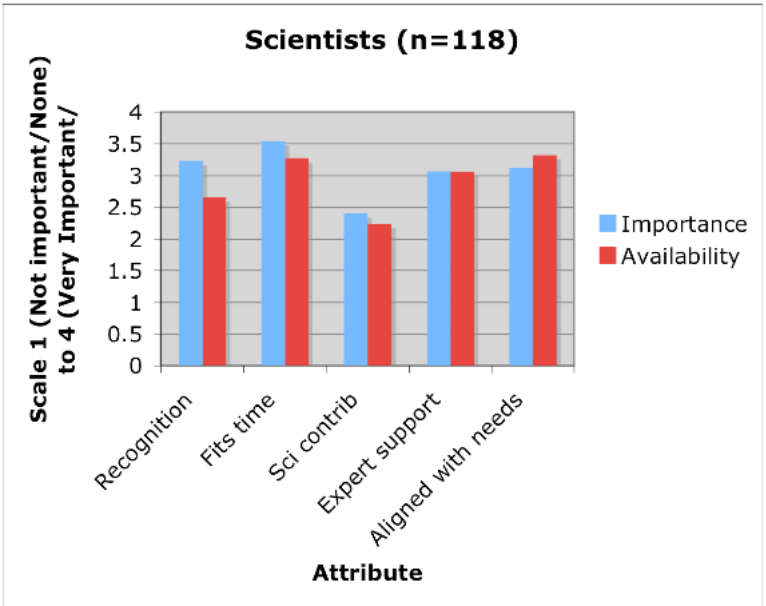
The survey included five attributes that had been identified as important to scientists. The 118 respondents who identified themselves as scientists rated the importance and availability of the following attributes. Attributes with the largest gaps are presented first. Attributes that share a letter index are not significantly different from one another. See page 8 for a more detailed explanation of how significant differences are reported.

Scientists considered it important that the E/PO work they are doing:

- Is recognized as important by the scientific community (A)
- Fits into the time they have available for education/public outreach (B)
- Contributes to the body of scientific research (C)
- Is supported by education experts (C)
- Is aligned with their personal needs and constraints (D)

Figure 10 below shows the relative importance and availability of these attributes as reported by scientists.

Figure 10: Gaps for Scientists



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

The scientists in our survey reported relatively small gaps. The largest gap for scientists is smaller than the smallest gap for formal educators. The relatively low gap scores may reflect a response bias (scientists give overall lower importance ratings than any other group) or may be related to the work that the E/PO effort has done. In particular,

scientists report that there are a fair amount of resources that **fit their time** and **meet their needs.** Earlier phases of the evaluation indicated that this was *not* the case when the current E/PO effort began.[13] The high ratings for availability may be a result of the work that the current E/PO effort and especially the SN have done in making E/PO work "scientist-friendly." For example, the menu of Regional Opportunities for Scientists in Education (ROSIE) provides scientists with the information they need to find E/PO opportunities that align with their time constraints.

- The largest gap is for resources that allow scientists to receive **recognition** from the scientific community. This aligns with findings from the qualitative research: scientists, especially those who are starting their careers, cannot take time away from their research to do work which will not enhance their standing among their peers.
- The next largest gap is for resources that **fit the time** that scientists have available. This is rated as the most important attribute; it is also one of the two most available attributes (the other is alignment with scientists' needs).
- The next largest gaps are for resources that **contribute to scientific research** and are **supported by experts.**
- The smallest gap is for resources that **align with scientists' needs**. This attribute has one of few negative gaps (i.e., ratings for availability higher than ratings for importance).

E/PO DEVELOPERS

The survey included seven attributes that had been identified as important to E/PO developers. The 107 respondents who identified themselves as E/PO developers rated the importance and availability of the following attributes. Attributes with the largest gaps are presented first. Attributes that share a letter index are not significantly different from one another. See page 8 for a more detailed explanation of how significant differences are reported.

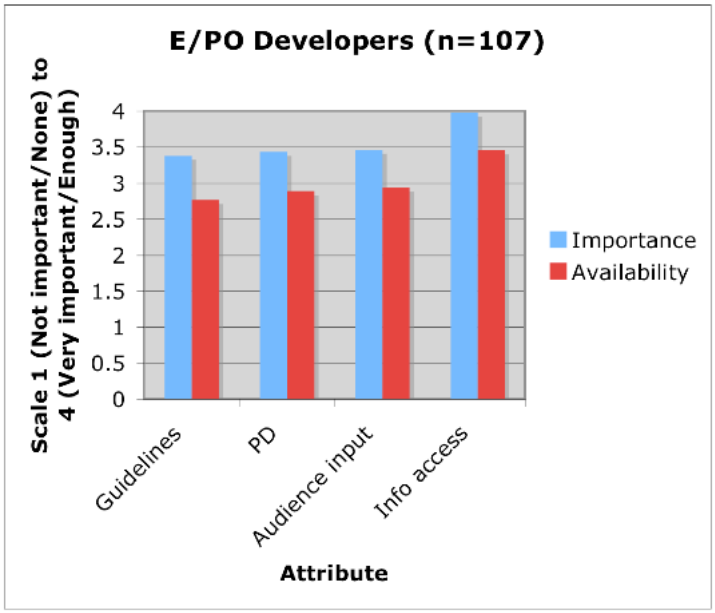
E/PO developers considered it important that:

- There are guidelines for effective decision-making (A)
- Users who get their resources also receive appropriate professional development (A)
- There is a predictable financial flow (A)
- Audience members have input into the resources developed (A)
- They have access to the information they need (A)
- There is good communication among all parties involved (A)
- Knowledge is shared among team members (B)
- Their work aligns with existing resources (B)

[13] See, for example, Cohen, S., Griffith, J., Gutbezahl, J., & Lynch, M. (2000). *Office of Space Science Education and Public Outreach: November 1998–December 1999 Evaluation Report.*

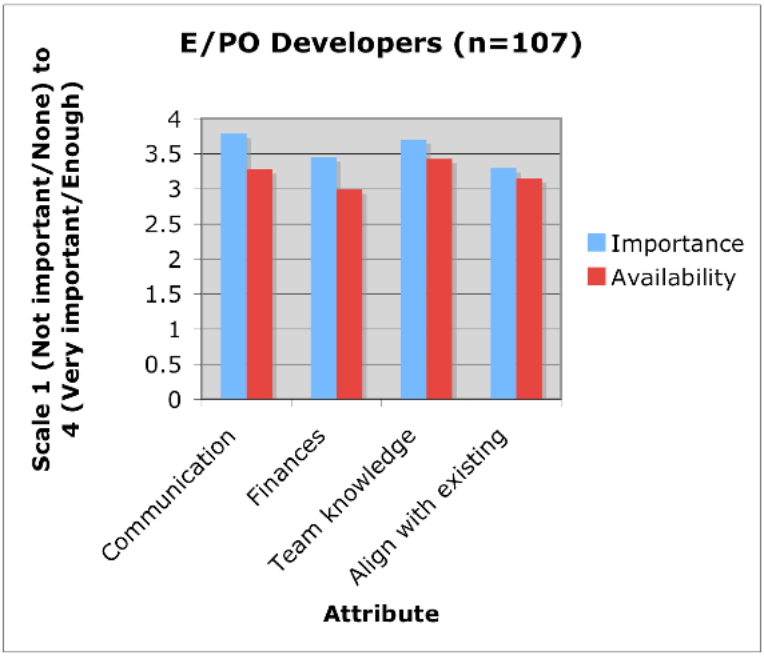
Figures 11 and 12 below show the relative importance and availability of these attributes as reported by E/PO developers.

Figure 11: Four largest gaps for E/PO developers



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

Figure 12: Four smallest gaps for E/PO developers



Note: Importance Scale: 1=Not at all important to 4 = Very important;
Availability Scale: 1= Not aware of any resources to 4=There are enough resources

Like scientists, E/PO developers report small gaps compared to the audience members in formal and informal education and members of the general public.

- The largest gaps for this audience are for **guidelines for decision-making, professional development, financial predictability, audience input, good communication,** and **access to information**. These gaps are not significantly different from each other, and are about as large as the median gaps for other audiences.
- The gaps for **sharing knowledge** with team members and **aligning with existing resources** are relatively low.

CLOSING REMARKS

The NASA space science E/PO community has been pro-active about assessing and meeting user and developer needs. This has led to growth on a variety of levels: increased scientist involvement, increased participation in PD activities, and a greater range of resources that fit the constraints of formal and informal educators. Data indicate that there are opportunities to better meet needs by attending to feedback about what types of resources are important, and what resources are available. By looking at the gaps between importance and availability, the space science E/PO community can better serve its various audiences . . . as only NASA can.

APPENDICES

APPENDIX A
ON-LINE SURVEY

NASA Education User Needs Survey

NASA's Science Mission Directorate devotes a portion of its budget, time, and expertise to creating educational resources. We received your name as someone who has used or contributed to NASA space science education resources. NASA wants to know how effective its resources are.

NASA has contracted with the Program Evaluation and Research Group (PERG), an independent consulting firm, to help assess and improve its educational resources. Your responses to this survey will only be seen by PERG staff, who will assemble all the responses and give feedback to NASA. Your responses to this survey will help NASA create more effective resources.

THANK YOU FOR YOUR TIME!!

Which of the following role(s) describe you. (Please check as many as are applicable)

- Formal educator (K-12 classroom teacher)
- Informal educator (at museum, science center, library, scout troop, after school program, or similar)
- Member of the general public with an interest in space science
- Scientist, engineer, or researcher
- Educational resource developer

[Note – the response to the above question determined which questions were asked]

[Note – the following questions were asked of all respondents]

How important is it that the space science education resources you work with or contribute to:

Are engaging

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are easy to find and get access to

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are personally interactive (includes personal, face-to-face interactions)

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Adapt easily to diverse populations

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are accessible to users with special needs

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are scientifically accurate

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Reflect current research

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are supported by appropriate professional development

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are supported by your institution or organization

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Support partnerships between members of your institution or organization and others

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Respect your culture, its traditions, and its characteristics

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

How many of the space science education resources you've worked with or know of:

Are engaging

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are easy to find and get access to

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are personally interactive (includes personal, face-to-face interactions)

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Adapt easily to diverse populations

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are accessible to users with special needs

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are scientifically accurate

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Reflect current research

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are supported by appropriate professional development

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are supported by your institution or organization

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Support partnerships between members of your institution or organization and others

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Respect your culture, its traditions, and its characteristics

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

[Note – the following questions were asked of respondents who checked Formal Educator in the first question]

As a formal educator, how important is it that the space science education resources you work with:

Focus on the details of a specific NASA mission

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Focus on general science concepts

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Align with local, state, and/or national standards

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Adapt easily to various curricula

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are supported by appropriate professional development

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are appropriate to your time

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are appropriate to your technology constraints

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Treat you and your students with respect

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

How many of the space science education resources you've worked with:

Focus on the details of a specific NASA mission

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Focus on general science concepts

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Align with local, state, and/or national standards

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Adapt easily to various curricula

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are supported by appropriate professional development

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are appropriate to your time

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are appropriate to your technology constraints

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Treat you and your students with respect

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

[Note – the following questions were asked of respondents who checked Informal Educator in the first question]

As an informal educator, how important is it that the space science education resources you work with:

Are easy to update

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are easy to implement

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are supported during installation

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are supported during exhibition

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are available at range of technical complexity

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are available at a range of costs

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Include supporting material for classroom use

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

How many of the space science education resources you've worked with or know of:

Are easy to update

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are easy to implement

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are supported during installation

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are supported during exhibition

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are available at a range of technical complexity

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are available at a range of costs

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Include supporting material for classroom use

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

[Note – the following questions were asked of respondents who checked Member of the General Public in the first question]

As a member of the public, how important is it that the space science education resources:

Are appropriate to the audience

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are well-publicized

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Are supported by or affiliated with a trusted organization or network

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Can be accessed in a variety of ways

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Provide pointers to more information (e.g., hand-outs with technical information, URLs, pointers to TV shows or magazine articles)

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

How many of the space science education resources you've encountered in public places:

Are appropriate to the audience

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are well-publicized

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Are supported by or affiliated with a trusted organization or network

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Can be accessed in a variety of ways

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources

Not applicable Provide pointers to more information (e.g., handouts with technical information, URLs

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

[Note – the following questions were asked of respondents who checked Scientist, engineer, or researcher in the first question]

As a scientist, when you participate in, utilize, or contribute to educational resources, how important is it that the work you are doing:

Is aligned with your personal needs and constraints

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Fits into the time you have available for education/public outreach

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Is supported by education experts

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Is recognized as important by the scientific community

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Contributes to the body of scientific research

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

How many of the NASA space science education resources you've participated in, utilized, or contributed:

Aligned with your personal needs and constraints

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Fit into the time you have available for education/public outreach

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Were supported by education experts

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Were recognized as important by the scientific community

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Have contributed to the body of scientific research

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

[Note – the following questions were asked of respondents who checked educational resource developer in the first question]

As you develop educational resources, how important is it that:

You have access to the information you need

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

There are guidelines for effective decision-making

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Knowledge is shared among team members

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

There is good communication among all parties involved

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Audience members have input into the resources developed

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Users who get your resources also receive appropriate professional development

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

Your work aligns with existing resources

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

There is a predictable financial flow

- ❑ Very important
- ❑ Moderately important
- ❑ Slightly important
- ❑ Not at all important
- ❑ Not applicable

How many of the NASA space science education resources you've worked on were created under circumstances in which:

You had access to the information you need

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

There were guidelines for effective decision-making

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Knowledge was shared among team members

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

There was good communication among all parties involved

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Users who got your resources also received appropriate professional development

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Audience members had input into the resources developed

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

Your work aligned with existing resources

- ❑ There are currently enough resources
- ❑ There is a need for a few more resources
- ❑ There is a need for many more resources
- ❑ I am not aware of any resources
- ❑ Not applicable

[Note – the following questions were asked of all respondents]

In what area(s) do you work: [Check as many as apply]

- ❑ Northeast US
- ❑ Mid-Atlantic US
- ❑ Southeast US
- ❑ Mid-west US
- ❑ Southwest US
- ❑ Northwest US
- ❑ Other North American location
- ❑ Beyond North America

Do you consider your community/ies to be: [Check as many as apply]

- ❑ Urban
- ❑ Suburban
- ❑ Rural
- ❑ Other [explain]

Which of the following student populations (if any) do you work with: [check as many as apply]

- ❑ Elementary school (K-5)
- ❑ Middle school (6-9)
- ❑ High school (10-12)
- ❑ Undergraduate college students
- ❑ Post-graduate students
- ❑ Members of the general public
- ❑ Not applicable

[Note – the following questions were asked of respondents who indicated they work in informal education]

Which of the following best describes the informal education environment(s) in which you work: [check as many as apply]

- ❑ Large science museum or planetarium
- ❑ Small science museum, planetarium or science center
- ❑ Other museum
- ❑ Library
- ❑ Community group (e.g. girl scouts, or 4-H club)
- ❑ After-school program
- ❑ Other [allow text box to explain other

[Note – the following questions were asked of respondents who indicated that they work as scientist, engineer, or researcher]

Which of the following best describes the environment as which you work as a scientist, engineer, or researcher [check as many as apply]

- ❑ Research university
- ❑ Teaching university or college
- ❑ NASA-funded or NASA-affiliated institution
- ❑ Private space science research institution
- ❑ Other research institution [allow text box to explain]
- ❑ Other [allow text box to explain]

Which of the following best describes your role(s) as a scientist, engineer, or researcher: [check as many as apply]

- ❑ Professor
- ❑ Space scientist
- ❑ Physicist with focus other than space science
- ❑ Other scientist [Explain]
- ❑ Engineer working on space craft
- ❑ Engineer working on instruments
- ❑ Other engineer [Explain]
- ❑ Other [Explain]

[Note – the following questions were asked of all respondents]

How have you been involved with NASA space science educational resources?

- ❑ I have helped develop NASA space science educational resources
- ❑ I have reviewed NASA space science educational resources
- ❑ I have led NASA space science educational workshops
- ❑ I have attended NASA space science educational workshops
- ❑ I have used NASA space science educational resources
- ❑ Other [Explain]

Do you consider yourself to be a member of a group underserved by existing space science resources?

- ❑ Yes
- ❑ No

[If checked yes to above question]

What underserved group do you identify with?

APPENDIX B
EMAIL REQUEST TO E/PO LEADS

Dear [E/PO lead name],

For the past 5 years the Program Evaluation and Research Group (PERG), at Lesley University has been evaluating the NASA OSS E/PO. As part of this years' evaluation, we are conducting a study to determine what different types of resource users and developers look for. The data will be used to inform the E/PO community about audience needs and gaps in the space science resources. We are requesting your participation in the study. You can access the survey on-line at ENTER WEB SITE. Please complete the survey by **February 14th**.

In addition, we need your help identifying other individuals. Please send us any contact information you have for any person who has used, implemented, participated in developed, and/or distributed E/PO resources. For example,

- Participants, presenters, and facilitators in workshops, professional development sessions, conferences, seminars, college courses, pre-service and in-service training
- Recipients of activities and curriculum materials (lessons and kits)
- Recipients of DVD's, videos, planetarium shows, and the individuals who viewed them
- Recipients of other workshops
- Resource developers, including scientists, engineers, mission team etc.

Please include their name, address, email, and the resource(s) they participated in. We realize that you may not have this information, but any names you can provide will be helpful. If you sent us contact information for users in the past, we still have that information in our database, and are requesting additional contacts.
We also recognize that the individuals were not informed of this evaluation activity, and will make sure we are explicit that their participation is voluntary. Please be assured that **any** information you provide is **confidential** and will only be shared with PERG staff. Our deadline for collecting contact information is **February 4th.**

If you have any question or concerns regarding this request, please contact Jodi Sandler, Research Associate (617) 349-8139 or jsandler@mail.lesley.edu.

Your help is *greatly* appreciated.

Sincerely,

The Program Evaluation & Research Group
Susan Cohen, Director
Jenny Gutbezahl, Senior Research Associate
Sabra Lee, Senior Research Associate
Jodi Sandler, Research Associate
www.lesley.edu/PERG/htm

APPENDIX C
EMAIL REQUEST TO END-USERS

Dear Colleague,
For the past 5 years the Program Evaluation and Research Group (PERG), at Lesley University has been evaluating the NASA's Space Science Mission Directorate, Educational and Public Outreach (E/PO) program. We are requesting your participation in a survey. The purpose of the survey is to inform the NASA E/PO community about audience needs, and gaps in the space science resources.

The following are examples of ways that you may been involved with the NASA's E/PO efforts:

- Participants, presenters, and facilitators in workshops, professional development sessions, conferences, seminars, college courses, pre-service and in-service training
- Recipients of activities and curriculum materials (lessons and kits)
- Recipients of DVD's, videos, planetarium shows, and the individuals who viewed them
- Recipients of other workshops
- Resource developers, including scientists, engineers, mission team etc.

Please be assured that your participation is voluntary and confidential. You can access the survey on-line at http://ds9.ssl.berkeley.edu/pergsurvey/survey.aspx. Please complete the survey by **March 4th**.

Please forward this to anyone else that you think would be interested in completing this survey. If you have any question or concerns regarding this request, please contact Jodi Sandler, Research Associate (617) 349-8139 or jsandler@mail.lesley.edu.

Your help is *greatly* appreciated.

Sincerely,

The Program Evaluation & Research Group
Susan Cohen, Director
Jenny Gutbezahl, Senior Research Associate
Sabra Lee, Senior Research Associate
Jodi Sandler, Research Associate
www.lesley.edu/PERG/htm

APPENDIX D
MEANS, STANDARD DEVIATIONS, AND SIGNIFICANT DIFFERENCES

	Importance	Availability	Gap
	All Audiences (n=420)		
Engaging	3.83$_{a}$	2.75 $_{a,b}$	1.08 $_{a}$
Easy Access	3.81 $_{a}$	2.75 $_{a,c}$	1.06 $_{a}$
Sci Accurate	3.93	3.10	0.83 $_{b}$
Diverse pops	3.38	2.73 $_{a,b,c,d}$	0.65 $_{b,c}$
Prof Dev	3.27	2.65 $_{c,d,e}$	0.62 $_{c}$
Spec. Needs	3.04 $_{b}$	2.46	0.58 $_{c,d}$
Current	3.55	3.01	0.54 $_{d}$
Inst Support	3.06 $_{b}$	2.65 $_{b,f}$	0.41 $_{d}$
Interactive	2.92	2.59 $_{e,f}$	0.33 $_{e}$
Partnerships	2.84	2.61 $_{d,f}$	0.23 $_{e}$
Culture	2.71	2.97	-0.26
	Formal Educators (n=199)		
General Science	3.82	2.84 $_{a,b}$	0.98
Adapt to Curriculum	3.57 $_{a,b}$	2.81 $_{a}$	0.76 $_{a}$
Tech Approp.	3.60 $_{a,c}$	2.87 $_{a,b}$	0.73 $_{a}$
Time Approp.	3.50 $_{c,d}$	2.90 $_{b}$	0.60 $_{a,b}$
Standards	3.38 $_{d}$	2.87 $_{a,b}$	0.51 $_{b}$
Prof Dev	3.15	2.73	0.42 $_{c}$
Respect	3.64 $_{c}$	3.30	0.34 $_{c}$
Mission details	2.79	3.08	-0.29
	Informal Educators (n=107)		
Range costs	3.73 $_{a}$	2.48 $_{a}$	1.25 $_{a}$
Easy update	3.71 $_{a}$	2.58 $_{a,b}$	1.13 $_{a,b}$
Easy implement	3.79 $_{a}$	2.75 $_{c,d}$	1.04 $_{b}$
Install support	3.39 $_{b,c}$	2.72 $_{c,d}$	0.67 $_{c}$
Range tech	3.33 $_{b,c}$	2.67 $_{b}$	0.66 $_{c}$
Exhibit support	3.26$_{b}$	2.65 $_{b,c}$	0.61 $_{c}$
Support classroom	3.37 $_{c}$	2.77 $_{d}$	0.60 $_{c}$

Means within the same column that share a subscript are not significantly different at $p < .001$. Given the large number of comparisons, a stringent criterion is used. Note that, especially for smaller sub-samples (such as member of the general public) power to detect differences at this level of confidence is relatively low.

	General Public (n=48)		
Well-publicized	3.58$_{a,b}$	2.46	1.12$_{a}$
Audience approp	3.81$_{c}$	2.77$_{a,b}$	1.04$_{a}$
Access variety	3.67$_{a,c,d}$	2.68$_{a}$	0.99$_{a}$
Info pointers	3.69$_{b,d}$	2.81$_{a,b}$	0.88$_{a,b}$
Trusted partner	3.43$_{d}$	2.87$_{b}$	0.56$_{b}$
	Scientists (n=118)		
Recognition	3.23$_{a}$	2.66	0.57
Fits time	3.54	3.27$_{a}$	0.27
Sci contrib.	2.40	2.24	0.16$_{a}$
Expert support	3.07$_{a}$	3.06	0.01$_{a}$
Aligned with needs	3.12$_{a}$	3.32$_{a}$	-0.20
	E/PO Developers (n=107)		
Guidelines	3.38$_{a,b}$	2.77$_{a}$	0.61$_{a}$
PD	3.44$_{a,b}$	2.89$_{a}$	0.55$_{a}$
Finance Predict	3.45$_{a,b}$	2.99$_{a,b}$	0.54$_{a}$
Audience input	3.47$_{a}$	2.94$_{a,b}$	0.53$_{a}$
Info access	3.98	3.46$_{c}$	0.52$_{a}$
Communication	3.79	3.28$_{d}$	0.51$_{a}$
Team knowledge	3.70	3.43$_{c}$	0.27$_{b}$
Align with existing	3.30$_{b}$	3.15$_{b,c}$	0.15$_{b}$

Means within the same column that share a subscript are not significantly different at $p < .001$. Given the large number of comparisons, a stringent criterion is used. Note that, especially for smaller sub-samples (such as member of the general public) power to detect differences at this level of confidence is relatively low.

SMD E/PO Phase IV Evaluation:

GAVRT and SUNBEAMS

Case Studies

NASA Space Mission Directorate
Washington, DC

EXECUTIVE SUMMARY

Written by:
Jenny Gutbezahl, Senior Research Associate

Program Evaluation and Research Group
Susan Baker Cohen, Director

December 2005

Program Evaluation and Research Group
at Lesley University

GAVRT and SUNBEAMS
Executive Summary

Program Evaluation and Research Group
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Evaluators studied two programs, the Goldstone-Apple Valley Radio Telescope (GAVRT) program, and the Students United with NASA Becoming Enthusiastic About Math and Science (SUNBEAMS) program. Each of these programs:

- Has been in existence for more than five years
- Features interactions between researchers, teachers, and students
- Include involvement in active, current research and hands-on scientific experience
- Target formal education, one of the areas NASA's E/PO effort has been working to reach
- Has positively impacted those involved with the program

The GAVRT program is a national program that trains teachers to operate a radio telescope, collect data, and analyze data, and provides teachers with content knowledge and resources for other science topics, such as the electromagnetic spectrum. Trained teachers, with phone support from JPL engineers, supervise their students as they use the Internet to remotely operate a 34-meter radio telescope located at Fort Irwin in Goldstone, CA. Data from the telescope are used by space scientists for current research. Students also have access to the data and can perform their own analyses.

The SUNBEAMS program pairs sixth grade teachers from Washington, DC Public Schools (DCPS) with researchers at the Goddard Space Flight Center (GSFC). Each teacher spends five weeks at GSFC working with a GSFC mentor to create a curriculum based on the mentor's research. This curriculum is implemented in the teacher's classroom in the following school year. In addition, the teacher and his or her students spend a week at GSFC for a highly focused math and science experience. At the end of their SUNBEAMS experience, students make presentations to the community on what they learned and experienced as part of the SUNBEAMS program.

PERG evaluators have been studying each of these programs for at least four years, including multiple visits to sites involved in the programs; interviews with administrators, researchers, and teachers; surveys distributed to teachers and students; and classroom observations.

SALIENT FINDINGS

The following findings are supported by data from both case studies. Readers interested in findings related to the individual programs are directed to the more detailed findings sections for each.

- Teachers and students report that their interactions with scientists and engineers are engaging, motivating, and educational:
  - Teachers report that these interactions are exciting for them and for their students.

    - Both teachers and students say that meeting scientists in person makes the scientists seem more "human," and students indicate that they feel confident that they could become scientists themselves.
- Teachers and students report that being directly involved in current science, and participating in the scientific process, makes the experience more meaningful to them.
- Researchers say that working with teachers and students is intrinsically rewarding, gives them a better understanding of the constraints of the classroom, and provides them access to expertise which is useful in the development of E/PO resources.
- Designing programs that allow teachers to contribute their own experience and knowledge provides multiple benefits:
    - Teachers have direct understanding of their own needs and the needs of their students, and can support the development of appropriate resources.
    - Teachers become more confident of their ability to do science when their contributions are taken seriously.
    - Researchers benefit from teachers and students who provide research or data collection support.
- Both programs include a period of intense training for teachers, followed by support and continued activity during the school year:
    - Teachers report that this continued support provides them with the skills and confidence they need to comprehend complex science concepts and share these concepts with their students.
    - The SUNBEAMS program provides fewer opportunities for teachers to connect with researchers and program staff during the year; some SUNBEAMS teachers indicated that they wanted more support.
- Program staff are invested in the programs and provide a variety of resources and other input: in GAVRT scientists and engineers volunteer a great deal of their time; in SUNBEAMS the program coordinator is available and supportive at all times.
- Participation in both programs is largely voluntary; a few teachers joined the GAVRT program due to fairly strong pressure from their principal: these teachers dropped out of the program after two years.

LESSONS LEARNED

- Programs that provide direct interaction among researchers, teachers, and students provide benefits to all parties; while time constraints make regular interactions difficult, providing one or more opportunities for face-to-face meetings can greatly increase the motivation and understanding of all parties.

- Teachers can make important contributions to the development of educational programs, scientific research, and the scientists' experience in education; programs that support such contributions benefit both teachers and scientists.
- Teachers and students are excited and motivated by the opportunity to be actively involved in the scientific process; inquiry-based hands-on activities, working with researchers, and collecting live data are more engaging than reading or pre-fabricated lab assignments.
- Data suggest the model of a multi-day intensive training, followed by support throughout the school year, is an effective way of providing teachers with the skills, knowledge, and comfort they need; other programs could benefit from such a model.
- The good will and support of staff and participants are extremely important:
  - Program staff who are motivated and motivating can provide the impetus the program needs.
  - Voluntary participation that builds on existing enthusiasm among researchers and teachers will likely lead to more positive outcomes than attempting to engage teachers and researchers who are less willing to support the program.

SMD E/PO Phase IV Evaluation:

GAVRT—
Goldstone-Apple Valley Radio Telescope Project

Case Study
Fall 2002–Spring 2005

NASA Space Mission Directorate
Washington, DC

Written by:
Jenny Gutbezahl, Senior Research Associate

Program Evaluation and Research Group
Susan Baker Cohen, Director

December 2005

Program Evaluation and Research Group
at Lesley University

SMD E/PO Phase IV Evaluation:
GAVRT—
Goldstone-Apple Valley Radio Telescope Program
Case Study

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CONTENTS

INTRODUCTION

PROJECT DESCRIPTION AND HISTORY

The Goldstone Apple Valley Radio Telescope (GAVRT) project is a partnership involving NASA's Jet Propulsion Laboratory (JPL) and the Lewis Center for Educational Research (LCER). The GAVRT project utilizes a decommissioned 34-meter radio telescope at the Goldstone tracking station in California's Mojave Desert.

- Teachers attend a 6-day training at which:
  - They learn the fundamentals of radio astronomy;
  - They are given instruction in how to use the telescope remotely to collect data, analyze these data, and share the results;
  - They receive guidelines for using a variety of activities and curriculum units covering space science areas related to space science in general and radio astronomy in particular.
- The teachers use their new knowledge to teach their students about space science and radio astronomy.
- The students have the opportunity to collect data via the Internet using the radio telescope under the guidance of their teacher and with remote support from GAVRT operators.
- Scientists at JPL and other sites use data collected by GAVRT students to augment their own research. For example, in 2003 and 2004 GAVRT students assisted in the radar mapping of the area around Gusev Crater, where the Mars Exploration Rover, Opportunity, landed.

THE TELESCOPE

The radio telescope is nine stories high. It weighs over one million pounds, with 850,000 pounds of movable parts; its dish is 34 meters (110 feet) in diameter.

The telescope is located at the Goldstone Deep Space Communications Complex in the Mojave Desert at Fort Irwin, which houses the American complex of telescopes for the Deep Space Network (DSN). The telescope had been used to communicate with distant spacecraft, such as Voyager 1 and 2, until it was decommissioned in the mid-1990s.

In 1996, staff at LCER proposed that the decommissioned telescope be used for educational purposes, and suggested a plan whereby scientists provide support for teachers and students to learn science by using radio astronomy to observe and collect data they then provide to those scientists. JPL operators and LCER staff worked together

to develop software to allow teachers and students to operate the telescope remotely. NASA has co-ownership of the software. NASA has provided funding to maintain the telescope; several scientists and operators have donated time to the project, while others have funding to support their work with the GAVRT project.

THE GAVRT PROJECT

Funding for the project comes from LCER and NASA's JPL. Department of Defense Education Activity (DoDEA) pays for their teachers to receive training in the GAVRT project. LCER is responsible for operation of the antenna, curriculum development, and teacher training. JPL provides telescope maintenance and science direction.

The first GAVRT curriculum project, Jupiter Quest, involved students in gathering data for an ongoing JPL Jupiter database looking at variations in the radiation belts around the planet. Over time, the GAVRT project has expanded to include other campaigns: one studying the atmosphere around Uranus, another measuring the variability of quasars. Students also assisted with radar imaging to obtain information on the Mars Exploration Rover landing sites.

The GAVRT project was established in 1996 through a pilot program in a middle school in Detroit. Over time, GAVRT has expanded to include teachers in 27 states, 14 countries, and 3 U.S. Territories. DoDEA teachers at American schools around the world who have been trained as GAVRT participants expand the scope of the GAVRT project. The project was originally directed at middle- and high-school (6–12) classrooms, but has broadened to offer age-appropriate content to elementary students in K–5 classrooms, as well.

Teachers attend training during the summer or during the school year. The majority of teachers come to Lewis Center, but there are trainings off-site, as well. During the training teachers learn about radio astronomy, including a visit to the telescope (if they are at Lewis Center); learn how to gather and record data; and engage in hands-on activities related to space science, the electromagnetic spectrum, and radio astronomy. Teachers interact and learn from space scientists and operators who support the GAVRT project. At the end of the training, teachers leave with a notebook of activities and related resources to use in their classrooms, in addition to the standards-based curriculum provided.

During the school year, teachers incorporate the GAVRT curriculum into their space science programs. Each teacher contacts LCER to schedule time for students to take control of the telescope and gather data for the campaign they have selected.

EVALUATION

The NASA Office of Space Science contracted with the Program Evaluation and Research Group (PERG) of Lesley University in October 1998 to conduct an external evaluation to determine how effectively the OSS E/PO program is meeting the objectives laid out in the Implementation Plan. The first three phases of the evaluation focused on Implementation, Infrastructure, and Impact. For the fourth phase, the evaluation focuses on specific programs that have been successful in addressing the OSS E/PO goals of sharing the excitement of space science discoveries with the public; enhancing the quality of science, mathematics, and technology education, particularly at the pre-college level; and helping create our 21st century scientific and technical workforce. [1]

The GAVRT project was chosen for further study because it has existed and grown for over five years; because it reaches scientists, teachers, and students in a variety of locations; and because it creates partnerships between scientists and educators, one of the strategies endorsed by the OSS E/PO program.

EVALUATION METHODS

Evaluators employed a suite of data collection methods including formal and informal interviews and surveys; observations; and document review. This report reflects data collected in 2002/2003 and data collected in 2005. The data comprise observations, interviews, surveys, a focus group, and document review.

Observations

Evaluators visited the Goldstone Apple Valley area three times during the data collection period:

- 1 visit to the Lewis Center to meet with administrators in fall 2002
- 1 visit to the Lewis Center and GAVRT facility to meet with staff, observe classes, and visit the telescope in spring 2003
- 1 visit to the Lewis Center, GAVRT facilities, and schools in San Diego and La Verne in spring 2005, to meet with staff, observe teacher training, observe classes, and hold a focus group with teachers

During these observations, evaluators had both formal and informal conversations with a variety of individuals involved with the GAVRT project.

[1] Goals taken from *The Space Science Enterprise Strategic Plan*, 2000 (p. 23)

Interviews

Interviews were conducted in person and by phone with:

- 7 scientists (3 in 2003; 4 in 2005)
- 3 operators (2 in 2003, 1 in 2005)
- 10 teachers (5 each in 2003 and 2005)
- 9 administrators, including the E/PO lead and the internal evaluator (5 in 2003; 4 in 2005; some of these were interviewed twice)

Interview protocols are given as Appendices A–D.

Surveys

A survey was distributed to all teachers who participated in the Spring 2005 training at LCER. Ten (10) teachers completed and returned surveys. A copy of the survey is given as Appendix E.

Focus Group

A focus group was conducted with 3 teachers who had completed the GAVRT training and used it in their classrooms, but who are not currently engaged in the project. The focus group protocol is given as Appendix F.

Document Review

Evaluators reviewed a range of documents related to the GAVRT project, including the web page, promotional material, instructional material for the training, and the curriculum book shared with teachers.

THIS REPORT

This report is the first of several reports that are being prepared based on the GAVRT case study.

The data presented in this report are primarily *qualitative*. Qualitative data allow for deep exploration of a variety of areas, including many that are uncovered during the data collection process. Analysis of qualitative data can uncover ideas, beliefs, attitudes, challenges, etc. that are present in the population of interest. Unlike quantitative analysis, qualitative analysis cannot be used to estimate the prevalence of any specific variable, because the data are not representative of the larger population beyond the participating sample. For example, the analysis can reveal beliefs that some scientists hold about education, but it *does not* indicate the *proportion* of scientists that hold a specific belief.

Throughout the report, there are citations from the data. They are included to add context and richness to the discussions and to illustrate the perspectives of those engaged in the work. All data cited in the report have been selected to *represent the themes and trends*

that emerged from the data and are characteristic of the *perspectives voiced by multiple respondents* and issues related to the project during the report period.

FINDINGS

PARTNERSHIPS AND INTERACTIONS

From the beginning, one of the goals of the OSS E/PO has been to create partnerships between scientists and educators. One of the essential components of the OSS E/PO program was the development of a Support Network (SN) of Educational Forums and Broker/Facilitators. The SN is charged with supporting partnerships among scientists, resource developers, and educators. Data suggest that such partnerships support the development of pedagogically and scientifically appropriate educational resources.

> We need more teacher/scientist partnerships so that we can remain on the cutting edge of new technologies. (Teacher)

Data indicate that the GAVRT project develops and utilizes partnerships to expand the reach and impact of the project. The design of the project allows each member of the team to contribute from his or her area of expertise.

> I get a chance to work with teaching professionals, rather than science professionals. What GAVRT does that's really nice is match up scientists, who know the science, with teachers who can say what will work in the classroom and what won't. (Scientist)

Much of the research on group dynamics suggests that the best way to forge relationships is to work toward a common goal.[2] Many of the partnerships within GAVRT are structured in a way that allows participants to achieve more as part of a group than they would be able to achieve individually.

> It has to be mutually beneficial. You have to find that. You have to decide: Is there something I can do that will benefit them and is there something they can do to benefit me? Are we stronger together than alone? (GAVRT administrator)

The GAVRT project provides a significant benefit to scientists, students, and teachers. As part of the project, students gather real scientific data. This benefits scientists, who use

[2] See, for example, Sherif, M. (1966) *In common predicament: Social psychology of intergroup conflict and cooperation*. Boston: Houghton-Mifflin, and Gully, S.M., Devine, D.J, & Whitney, D.J. (1995). A meta-analysis of cohesion and performance: Effects of level of analysis and task interdependence. *Small Group Research, 26, 497–520*

these data in their research, and students, who are actively and directly engaged in the scientific process.

By utilizing a range of classrooms across the country, researchers report that they are able to gather more data than they would be able to collect on their own.

> It's the first educational program I encountered where they said one of their goals was to do publishable science. (Scientist)

> Sometimes I think I get more out of it than they get out of me. Of course, I haven't heard any complaints, so maybe they feel the same way. (Scientist)

Teachers and students report that they find the project intellectually stimulating and are enthusiastic about working with scientists and collaborating on primary research. Students understand that they are contributing to the scientific process, which makes the experience more engaging and meaningful.

> Personally, it has been one of the most gratifying experiences I have had professionally. It has pushed me to learn new things. (Teacher)

> It was interesting and fun to contribute to something so big and work with an actual scientist. (Student)

Data from the ongoing evaluation of the NASA E/PO program suggest that face-to-face interaction between scientists and teachers can be rewarding for both parties.[3] Many teachers report being somewhat intimidated by scientists, and meeting one in person helps bring home the humanity of people in the profession.

> They had a scientist from JPL come and talk to us, and that made it kind of personal. (Teacher)

Scientists report that they benefit from personal interaction with teachers and students. They report that it gives them direct information about what teachers and students need and want.

> I have a better sense of what does and doesn't work in the classroom because I have contact with teachers. (Scientist)

> It gives me an opportunity to talk to students regularly, which I really value. (Scientist)

Data indicate that scientists appreciate discussing their challenges and successes in the classroom with others who have more experience with teachers and students.

> After [I lead a session], I get together with [other GAVRT personnel]. They often watch my presentations and give me feedback. (Scientist)

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[3] Cohen, S., Gutbezahl, J., & Griffith, J. (2001). *Office of Space Science: Education/Public Outreach Phase II Evaluation Report*. Cambridge, MA: Program Evaluation and Research Group.

Data suggest that the combination of providing mutual benefit and extended interpersonal contact supports and amplifies the learning process and commitment of all parties involved in GAVRT.

TEACHER TRAINING

The first point of contact for teachers getting involved in the GAVRT project is the training. Data indicate that the enthusiasm and motivation of LCER staff and JPL scientists and operators inspires teachers to meet the intellectual rigors of the training.

> The passion that the instructors have for the GAVRT program is inspiring. (Teacher)

> There were awesome scientists who were dynamic speakers. (Teacher)

Teachers report that the project provides them with a framework for introducing inquiry-based activities into their classrooms.

> It's given me a model of how to focus my curriculum toward authentic inquiry. (Teacher)

Many of the teachers who have participated in GAVRT training have taken on leadership roles, expanding the reach of GAVRT. Some have joined the GAVRT training team; others have shared with colleagues at conferences or in their schools.

> I've shared with professional groups; I've shared at college symposia where you talk about what you do with new teachers. Within my own teaching area, I've tried to draw in my colleagues. (Teacher)

> When I became an assistant principal, three of my teachers became GAVRT teachers. (Teacher)

Several teachers who have changed schools say that the GAVRT project continued at their original institution, and that they have brought the project with them to their new school. One former GAVRT teacher has become a principal and provided support for the project at his new school.

> At one school . . . I'd do hands-on lessons [with the teachers]; teach them how I'd administer them, so they could continue to use them. (Teacher)

Radio astronomy is very complex; many teachers come to the training feeling underprepared. LCER provides a great deal of support, but some teachers still feel unsure of their ability to understand and communicate the material. They suggested several changes to the project that would increase their comfort with the material.

- A sample telescope run early in the session to give teachers a sense of what they would be doing with their classes and how to apply the content of the project

> Give us a mini-radio telescope session early in the week to give us a feel for what we were going to learn about, provide the training, then finish up with the actual radio telescope session. (Teacher)

- More practice with the computer programs

> [I'd like] more time on the computer: simulated runs where each trainee is required to participate and gather data. (Teacher)

- Additional follow-up support

> I've done many a training that you get all excited about, and then it gets lost in the shuffle of standards and all the other things; there's no follow-up. It would be great if you had someone contact us a month later to say, "What are your questions? Do you need anything?" And six months later, a reunion. (Teacher)

> I've always wanted them to have a chat room or something—you write a letter or note in an area and people respond. So I could find someone who's like me, who's doing things like me, and we could share information. (Teacher)

IN THE CLASSROOM

The curriculum notebook that teachers get at the end of the training is quite extensive, and provides detailed instructions for activities appropriate for a range of ages and preparedness. Most of the activities can be done individually or as part of a sequence, allowing teachers more options in fitting the project into their schedule.

> I think that flexibility is a real selling point. I can teach an entire section on the solar system, have kids research the Galilean moons, and do an entire three or four week thing—or I can use the antenna experience by itself and it can be a three-day lesson if I need it to be. It's more than that, but incorporating three days is better than incorporating none. (Teacher)

Data suggest that many of the resources are designed to meet the needs of students of various ages and levels of preparedness. During the training, teachers develop the skills needed to adapt activities to their own classrooms.

> I adapted [activities designed for younger students] for my students; it was easy to do. The labs for younger students provide a lot of information. I took some of the information out and had the students do their own research on the Internet. (Teacher)

As discussed earlier, one of the hallmarks of the GAVRT project is that students have the opportunity to participate in current active research. Data from each of our populations (scientists, teachers, and students) support the project's claim that this is an effective way to engage students.

> The students are doing observations and gathering science data that are going to be used, as opposed to a make-believe thing where they're doing "experiments" that have already been done. (Scientist)

> I like that we were doing something that actually mattered, not something pointless. (Student)

Students report that engagement in actual research allows them to better understand what scientists do.

> I thought scientists would just be doing experiments all the time. Now I know they do different things, like collect data and do research on specific topics they're working on. (Student)

> Just doing it made us more comfortable. We have a feeling of what it's like to be scientists on a radio telescope. (Student)

Teachers report that students are excited by this participation, even students that had previously expressed little interest in science. Observation data indicate that students have a great deal of energy that they direct toward both the telescope runs and class activities related to radio astronomy and Mars exploration.

> A lot of my students . . . are disinterested in school in general and science in particular. I'm hoping it will fire their imagination. (Teacher)

> My students said, "It has made school somewhat worthwhile; learned what actual astronomers do." (Teacher)

Some students are deeply affected by the project. Several teachers shared stories of students who appeared to be energized by their involvement in the GAVRT project.

> I had a special needs student. He was intimidated, counting the time sequence on his fingers. When he was done, you could see his little chest swell. I could see this special needs student feel so good about himself. (Teacher)

Data suggest that increased excitement leads to students' increased interest in science and willingness to apply themselves to the task of learning.

> Their thirst for knowledge has increased tremendously . . . they can actually feel like they're a scientist and what they do matters. They're not afraid of big words like "Perturbation" and "Synchrotron emission." (Teacher)

> It wasn't just book knowledge. It was actually doing something real, making a contribution to something real. There was a level of seriousness to it that wasn't typical. (Teacher)

Some teachers report that students' sense of efficacy in science has increased as a result of their involvement with the GAVRT project.

> I think they're getting a better understanding of how it works and what it is. Much more confidence in their ability to do science. (Teacher)

Research conducted by internal evaluators[4] suggests that students who participate in the GAVRT project say that they feel qualified to do scientific research, debate scientific topics, and use complex equipment. They also believe that professional scientists value their work.

Teachers reported some challenges in integrating the project into their classrooms:

- Several teachers mentioned the time constraints imposed by the need to meet local and national standards.

  > There's just not enough time. This is a problem teachers face daily. (Teacher)

  Support from administration can help with the challenge of finding time to include GAVRT in the project. Some schools are more open to the possibility of using material beyond the standard curriculum; teachers at these schools have an easier time integrating GAVRT into their classrooms.

- Some teachers, especially those with large classes or many classes, commented that it was not possible for them to include all their students in the project.

  > We need to reach everyone; we were reaching a small percentage. It will be wonderful for those kids. They will always remember that experience, but it's a small percentage. (Teacher)

- Other teachers involved all their students in the project. This could lead to more students present at the telescope runs than could be directly involved at any one time. Teachers tried to address this by having hands-on activities for students to do when they weren't on the computer. However, the teacher was needed to help with the data collection, leaving the activities unsupervised.

  > A lot of people only got on one time. By the time my group got to go at like 6:00 in the morning, we were really tired. Each group got about 10 minutes on the 'scope, and there were like 8 groups. (Student)

  > We need more activities designed to keep students occupied while others are online. (Teacher)

- Timing was a challenge for some teachers
  - Some teachers noted that they needed to arrange telescope runs outside of regular school hours to accommodate both the constraints of antenna availability and the movement of the planets under observation.

  > It's been a real challenge scheduling runs with 7th graders at strange times. My students have shown up at 5AM on school days to be able to connect. (Teacher)

[4] Ibe, M. (2003). *The Role of the Goldstone Apple Valley Telescope Project in Promoting Scientific Efficacy among Middle and High School Students.* Apple Valley, CA: Lewis Center for Educational Research.

- Other teachers reported that they had to arrange the curriculum around telescope availability; some teachers were unable to adapt their curriculum and did their runs while they were teaching topics other than astronomy.

  > When we do a lab, it's related to the chapter. This wasn't as connected to the rest of what we were learning. (Student)

- Both students and teachers suggested that it is difficult for students to understand the numbers and comprehend what they mean.

  > The thing I really didn't like about this project is that it was just a mess of numbers. You didn't get to see the outcome. If we found out at the end what the numbers told us, it would be better. (Student)

  - Several teachers and students suggested that the radio transmission be augmented with visuals.

    > You'd need pictures to tie them in; not just the blue screen, but the picture of the telescope, and cool pictures of the planets. (Teacher)

  - Others suggested allowing students more opportunity to analyze data themselves.

    > A more interesting way of analyzing the data would help. Students are often not sure what the data means after they've collected it. (Teacher)

- Finally, some teachers mentioned technical challenges. Many earlier technical challenges (such as the need to install specific software) have already been addressed by GAVRT staff. However, there are still areas where teachers face problems.
  - Control of the telescope requires a firewall-free Internet connection. Some schools are understandably uncomfortable removing the firewall.

    > Our district was very reluctant to allow us through the firewall on our Internet server. (Teacher)

  - Some schools simply don't have enough dedicated lines to allow teachers to be both online and on a conference call from the same location.

    > Teachers need to really understand that they will have to have a separate telephone line to use. The cost of a phone line was a hurdle. (Teacher)

  - Teachers reported that they had difficulty obtaining speakerphones, which they needed to allow all students to participate.

    > I got a sense of how difficult it is to get even the simplest things in the classroom. Like a telephone. (Scientist)

Teachers reported various ways in which they were supported in their efforts to address these challenges.

- GAVRT staff help by providing direct, real-time support to teachers and their students whenever they're operating the telescope.

> Knowing that [the operators are] going to be there, walking you through the program, it's HUGE! (Teacher)

> Some things are very difficult to communicate by email or website, requiring a personal contact. It is a challenge to find a convenient time to call teachers. They have very specific constraints as to times for telephone communication, especially our overseas teachers. We will not compromise this most important aspect of GAVRT. (GAVRT administrator)

- Several teachers reported that having the support of school administrators and the larger community helped them face technical or logistical challenges that they would have been unable to surmount alone.

> Our school community really pulled together to help make the antenna run happen. The people in the main office provided time and space to set up our GAVRT computer, and the technology specialists and librarians got into the act providing support. (Teacher)

- One teacher noted that working through the technical challenges could be rewarding and educational in itself.

> Internet, Excel, e-mail skills get developed along the way. Teachers who are weak, it encourages them to learn those areas. The technology is a powerful piece.

SUMMARY

The GAVRT project engages scientists, teachers, and students by providing each of them with an opportunity to contribute their own expertise and to benefit from the expertise of others.

- For scientists this means:
  - An opportunity to help create the 21st century workforce by sharing their knowledge with students and educators
  - Support in gathering data for their primary research
- For teachers this means:
  - An opportunity expose scientists to the realities of the classroom and to afford students the chance to participate in real research
  - Training in complex technical and scientific content
- For students this means:
  - An opportunity to help gather data that are used by scientists and others to understand our universe

- Exciting and engaging activities, such as controlling a radio telescope

Teachers report that the training is interesting and engaging, and provides them with the support they need to understand complex scientific concepts. Some teachers say they would benefit from further support, such as follow-up sessions. Many teachers say they appreciate the interactions with scientists and other teachers; they suggest having some type of listserv or chat room where they can continue and deepen these relationships.

Students express a great deal of interest in the subject matter and are enthusiastic about using the telescope. Some students may benefit from additional support (perhaps visual) in understanding the meaning of the data they collect. Teachers enjoy leading the students through the GAVRT curriculum, but face some challenges related to fitting it into the schedule. These challenges include:

- Combining the GAVRT activities with other material they need to incorporate to meet national and regional benchmarks
- Leading telescope runs outside of class hours
- Aligning the semester's curriculum with telescope availability so that students can do observations while they are studying astronomy

Overall, the GAVRT project meets the needs of the scientists, teachers, and students who participate in it. Each population has had the opportunity to contribute to the development of the project, and this has both increased the ability of the project to meet user needs and enhanced motivation on the part of participants.

APPENDICES

APPENDIX A:
2003 SCIENTIST INTERVIEW PROTOCOL

How did you hear about the GAVRT project?

What interested you about it?

Please describe your participation in the GAVRT project.

Did you receive any training?

How did your actual experience compare with what you expected?

Please describe your relationship with the GAVRT teachers.

Probes: Have you been in contact with them throughout the year?

What, if any, impact has being involved with the project had on you?

What, if any, impact did the project have on the teachers you worked with?

In what ways did the teacher participate in your science research?

What have been the benefits of being involved with the GAVRT project?

What have been the challenges of being involved in the GAVRT project?

Do you have any suggestions to improve the project?

Would you recommend other scientists to become involved with the project? Why or why not?

APPENDIX B:
2003 TEACHER INTERVIEW PROTOCOL

How did you hear about the GAVRT project?

What interested you about it?

What did you expect the project would be like?

How did your actual experience compare with what you expected?

Please describe your participation in the GAVRT project.

What have been the benefits of being involved with the GAVRT project?

PROBE: What did you learn?

What have been the challenges of being involved in the GAVRT project?

How do you anticipate your experience with GAVRT will affect your classroom/teaching?

Do you have any suggestions to improve the project?

Would you recommend other teachers to become involved with the project? Why or why not?

APPENDIX C:
2005 SCIENTIST INTERVIEW PROTOCOL

How long have you been involved with the GAVRT project?

What, if any, experience did you have working in science education prior to GAVRT?

Can you tell me a little about your involvement—what do you do? Work with teachers etc. # of classroom visits, teacher training etc

How has your involvement in GAVRT affected you?

> PROBE: Attitudes about science education, Knowledge of science education, Interest in science education

What aspects of GAVRT stand out to you? [PROBE for scientist/teacher interactions, difference in experience of different aspects of project]

How have the teachers you work with responded to being involved with the GAVRT project?

> PROBE for evidence/vignettes

How have students responded to being involved with the GAVRT project?

How have you shared what you've learned by being involved in GAVRT with others?

> Who have you shared with?
>
> What has been the response to this sharing?

How has your institution and its administration responded to your involvement in the GAVRT project?

> PROBE FOR SUPPORT What additional support needed?
>
> PROBE FOR IMPACT (funding, support, release time for education)

How, if at all, has GAVRT helped you achieve personal or professional goals?

Anything else I should know?

APPENDIX D:
2005 TEACHER INTERVIEW PROTOCOL

How long have you been involved with the GAVRT project?

What, if any, experience have you had working with scientists prior to your involvement with GAVRT? Had scientists worked with teachers in your school?

Can you tell me a little about your involvement—what do you do? Work with scientists, number of classes involved with GAVRT, etc.

How has your involvement in GAVRT affected you?

> PROBE: Attitudes about science, knowledge of space science, approach to teaching
>
> PROBE for anecdotes, specific examples

What aspects of GAVRT stand out to you? Why? How have they affected you? [PROBE for scientist/teacher interactions]

How have your students responded to being involved with the GAVRT project?

How has being involved with the GAVRT project affected your students?

> PROBE: Attitude toward science, understanding of science
>
> PROBE for anecdotes, specific examples

What aspects of the GAVRT project are most engaging to your students?

> PROBE: How do you know this? Vignettes, examples

How have you shared what you've learned by being involved in GAVRT with others?

> Who have you shared with?
>
> What has been the response to this sharing?

How has your school and its administration responded to your involvement in the GAVRT project?

> PROBE FOR SPECFIC SUPPORT:
>
> What additional support do you need?
>
> PROBE FOR IMPACT ON SCHOOL (changes in curriculum focus, PD, etc.)

How, if at all, has GAVRT helped you achieve personal or professional goals?

Anything else I should know?

APPENDIX E:
TEACHER SURVEY

This survey was prepared the by Program Evaluation and Research Group (PERG) of Lesley University, an external evaluator working for NASA's Science Mission Directorate to evaluate its education and public outreach program. We are looking at GAVRT as part of this larger evaluation, rather than assessing GAVRT as an individual project. *All responses are confidential and will be seen only by PERG staff.*

State:
Grade(s) taught:
Subject(s) taught:

How did you get involved with the GAVRT project?

Please describe three things that stick out from the training as meaningful to you.

How has the GAVRT training affected your **attitude** toward science? Please mention any specific attitudes that have changed.

How has the GAVRT training affected your **understanding** of science? Please mention any specific things you have learned

What aspects of the GAVRT training were challenging to you?

How well did the training prepare you to use GAVRT materials and activities in your classroom? [Circle One]

VERY WELL SOMEWHAT WELL NOT VERY WELL NOT AT ALL

Please explain why you answered as you did.

How do you plan to use what you learned this week in your classroom?

Which specific GAVRT activities or materials, if any, do you think you'll be most likely to use in your classroom?

How could the training be changed to better meet your needs?

Is there anything else you'd like add?

THANK YOU.

APPENDIX F:
FOCUS GROUP PROTOCOL

INTRODUCTION (5-10 minutes)

Good afternoon. I'm Jenny, from the Program Evaluation and Research Group (PERG). I'm the moderator of today's focus group. I'm an external evaluator for NASA's Science Directorate Education effort. We're looking at GAVRT because it's one of NASA's educational programs. I would like to hear your impressions of the project, what worked and didn't work about it, and what would make you more likely to incorporate it into your classroom.

I'm taping today's discussion, so that I have an accurate record. I want to be sure to represent your ideas and opinions accurately. Only my colleagues at PERG working on this evaluation will see the notes or hear the tape. Your participation is voluntary and confidential, and you may choose not to give a response to any question asked. Nothing you say will ever be reported or made public in any way that could identify you. We don't work for NASA, and we're not assessing GAVRT in particular—we're looking at NASA overall. There are no "right answers."

Because we're taping this, I may ask you to repeat a comment, and I may interrupt if two or more people are talking at once. Also, because we have limited time, if we have "topic drift," I may try to steer the discussion back to the specific issues we want to know about.

Does anybody have any questions at this point?

OK, I'd like to start with introductions. So what I'd like to do is go around the table and have each of you give your name and what grades and subjects you teach.

OVERALL IMPRESSION OF PROJECT (10 minutes)

How did you first get involved with the GAVRT project?

What aspects of GAVRT stand out to you? Why?

IMPACT (15 minutes)

Can you tell me a little about your involvement—what did you do? Work with scientists, number of classes involved with GAVRT, etc. For how many years did you incorporate the GAVRT material into your classroom?

How did your involvement with GAVRT affect you? [PROBE attitudes, understanding, behavior]

How did you incorporate the GAVRT project into your classroom?

How did your students respond to being involved with the GAVRT project?

PROBE: Attitude toward science, Understanding of science

PROBE for anecdotes, specific examples

What were the benefits of being involved with the GAVRT project?

PROBE: Knowledge, understanding, teaching strategies, impact at school

CHALLENGES (20 minutes)

What would you say are the main reasons you're not currently using the GAVRT project?

PROBE: What barriers or challenges did you face in using GAVRT materials? Materials, students, administration, scientist interaction

What would make it easier for you to incorporate the GAVRT project into your classroom?

What changes would you suggest to make the project more sustainable?

CLOSING (5–10 minutes)

Is there anything else you'd like to add?

Thank you so much for your time!!

SMD E/PO Phase IV Evaluation:

SUNBEAMS—
Students United with NASA Becoming Enthusiastic About Math and Science

Case Study
2002–2005

NASA Space Mission Directorate
Washington, DC

Written by:
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Susan Baker Cohen, Director

December 2005

Program Evaluation and Research Group
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INTRODUCTION

The Students United with NASA Becoming Enthusiastic About Math and Science (SUNBEAMS) program funded by the Living with a Star, Science Mission Directorate (SMD) E/PO program, is a partnership between NASA's Goddard Space Flight Center (GSFC), in Greenbelt, MD and the Washington, DC Public Schools (DCPS). The SUNBEAMS program has been in existence since 1998. As stated in the program description the goals of the program are:

> To provide a model of an urban intervention program for sixth grade teachers and students that empowers teachers and inspires students with the process and excitement of science and technology. SUNBEAMS:
>
> - Provides teachers with the time and resources to develop curriculum materials based on NASA research and National Standards.
> - Establishes meaningful, long-term partnerships between DCPS teachers and Goddard Technical personnel.
> - Fosters a positive attitude toward math and science in participating students.
>
> (Program document)

The SUNBEAMS program's long-term goal is to reach a 6th grade teacher in each DCPS school. At the time of the evaluation, the program had reached approximately 100 teachers, 2000 students, and 70 schools.

PROGRAM DESCRIPTION

SUNBEAMS SUMMER INSTITUTE

GSFC invites DCPS science and math teachers who work with 6th grade students to spend 5 weeks during the summer working with a mentor at GSFC. At the completion of the internship, teachers will have created a SUNBEAMS portfolio that includes lessons related to their mentors' research and aligned with their curriculum and national standards. These lessons are to be implemented during the upcoming year.

Over the five weeks, teachers are provided a schedule, which includes demonstrations and hands-on experiences of scientific concepts; given access to activities and resources to use in their classrooms; and have opportunities to share their learning with other teachers through large group discussions and presentations. In addition, there are large blocks of unscheduled time that teachers can decide how to use. During this time, teachers engage in a variety of activities including: meeting with their mentors; creating and/or modifying lessons to align with their curriculum; and conducting their own

research and independent learning activities (for example, improving computer skills through online trainings at GSFC's computer lab). In addition, resources are provided to participants to bring back to their school.

Mentors meet with teachers ranging from a few times a week to daily. These meetings involve discussions about the mentors' research and science content, and sharing of resources and ideas for lesson plans for the teachers' SUNBEAMS portfolio.

STUDENT WEEK AT GSFC

All of the SUNBEAMS teachers take 30 of their students to GSFC for one week during the academic year, immediately following their participation in the summer internship. Students travel back and forth each day on a bus provided by the school and bring their own lunch. The program coordinator holds high expectations for students' participation and behavior. While at GSFC, students meet their teachers' mentors and engage the mentors in a question answer session to learn more about their careers. The students participate in a number of math and science activities including hands-on activities, demonstrations, presentations, worksheets on various science topics, a tour of the GSFC facilities, and creation of a web page. There is some variation in the students' experience based on the teachers' research topics and mentors' interests. For example, one group of students did an experiment with a mentor where they put objects into a sounding rocket, launched it, and observed how the objects were impacted.

FAMILY SCIENCE NIGHT

Each SUNBEAMS teacher puts on an event called a Family Science Night where students share what they learned and experienced with the broader school community, including parents. The teacher's mentor and the SUNBEAMS program coordinator attend the Family Science Night when their schedules permit.

Each school schedules its own Family Science Night. The formality of the event varies among the schools. For example, one more formal presentation included group poster presentations and demonstrations of activities on a particular SUNBEAMS topic that those particular students had experienced. Another less formal event had students present what they remembered from their experience; prior to the Family Science Night, students had a brief review about their experience through discussion and looking at their SUNBEAMS notebooks from their week at GSFC.

NASA EDUCATORS' WORKSHOP

In 2005, all of the SUNBEAMS teachers who had participated since the inception of the program were invited to attend the NASA Educators' Workshop, funded by Living With a Star E/PO. Approximately 36 SUNBEAMS teachers attended, along with teachers who had participated in another Living With a Star E/PO program. In addition, other DCPS

teachers were invited to learn more about the programs. The one-day event included activities that were specific for the participants of each program, and other sessions that were shared. Workshops introduced space science-related educational activities and lessons, including one that was led by a SUNBEAMS teacher for SUNBEAMS teachers. There was a poster session and a reception during which teachers could interact. Throughout the day, information was provided about resources and opportunities available for the teachers.

PARTICIPANTS

SUNBEAMS TEACHERS

Teachers volunteer to participate and receive a stipend. Teachers are expected to attend the summer institute and create a portfolio of lessons to be implemented during the upcoming academic year; bring their students to GSFC for one week; and put on a Family Science Night. Approximately 10–15 DCPS teachers have participated in the SUNBEAMS program each year since its inception. Recently the number of participants decreased due to reduced funding. Initially the program allowed one teacher from each school to be a SUNBEAMS teacher for one year until the program reached all of the schools. Exceptions have been made regarding this structure: A few teachers have participated in the program twice; some schools have sent different teachers each year; and a few schools have had more than one teacher participate at a time.

SUNBEAMS STUDENTS

Although the majority of students who participated were 6th graders, student grade levels ranged from 4th–9th. This is often due to unanticipated changes in grade-level assignment. In addition, some program participants teach multiple grade levels (for example, librarians and science coordinators).

The number of students who could attend GSFC for a week was limited to 30. Due to this limitation, teachers used various criteria to select students for participation. Some SUNBEAMS teachers brought a specific science class, whereas others chose students based on academic achievement and good behavior.

PRINCIPALS OF SUNBEAMS TEACHERS' AND SCHOOL COMMITMENT

The SUNBEAMS program requires that principals sign a contract that ensures that they are aware of the teachers' participation. Schools are required to fund student transportation to and from GSFC. In order to ensure that their students are able to attend the week at GSFC, teachers require administrator support to ensure that logistics are taken care of, including scheduling and adherence to school guidelines (for example, informing parents about program activities).

SUNBEAMS MENTORS

Mentors are GSFC researchers, mainly scientists and engineers. Over 20 GSFC researchers have volunteered to participate in SUNBEAMS. Some researchers volunteer for a number of years. It should be noted that mentors often engage other team members to support the teacher during the summer internship. By becoming a mentor, the GSFC researchers agree to support a DCPS teacher during the 5-week summer internship by providing them with a work station and sharing their research. During the school year, they meet the students of their partner teachers during their visit to GSFC and attend a Family Science Night. Some mentors exceed the expectations of their participation and work more closely with their teachers. A few do not fulfill their commitment.

SUNBEAMS STAFF

The program coordinator leads the SUNBEAMS program with support from the principal investigator (PI). After the original PI retired, the position was filled by a GSFC researcher who was, and still is, a SUNBEAMS mentor. The program coordinator is very enthusiastic and holds high expectations for the teachers. She was a teacher in DCPS for over 30 years. Her familiarity with the DCPS bureaucracy, and experience in the classroom, contribute to her strong leadership. Throughout the summer internship, the program coordinator shares her knowledge with the SUNBEAMS teachers, including teaching strategies, educational philosophy, and classroom management techniques. She also acts as a resource for problem solving and is very capable at conflict resolution. In addition, the coordinator comes from a similar background as the majority of the DCPS teacher participants.

Over the years, the program has solicited feedback from all participants through surveys and questionnaires, completed when people began and/or completed the SUNBEAMS activities. Although attempts have been made to collect data about the long-term impact of the program on teachers and students, they have had limited success in getting responses.

EVALUATION

The NASA SMD, formally the Office of Space Science, contracted with the Program Evaluation and Research Group (PERG) of Lesley University in October 1998 to conduct an external evaluation to determine how effectively the SMD E/PO program is meeting the objectives laid out in the Implementation Plan. The first three phases of the evaluation focused on Implementation, Infrastructure, and Impact. For the fourth phase, the evaluation focuses on specific programs that have been successful in addressing the SMD goals of sharing the excitement of space science discoveries with the public; enhancing

the quality of science, mathematics and technology education, particularly at the pre-college level; and helping create our 21st century scientific and technical workforce.

The SUNBEAMS program was chosen for further study because it has existed and grown for over five years; because it reaches researchers, teachers, and students in a variety of locations; and because it creates partnerships between researchers and educators. In addition, the program takes place in an urban formal education setting; this was identified in previous evaluations as comprising a challenging end-user population for the SMD E/PO to reach.

What follows is a description of the SUNBEAMS program, the impact it has had on each audience group, and highlights of successes and challenges.

DATA COLLECTION ACTIVITIES

This study took place over four years, with extensive data collection during the 2003 and 2005 academic years. The data collection for the SUNBEAMS program included formal and informal interviews, questionnaires, and observations.

OBSERVATIONS

Evaluators observed the following during the data collection period:

- 1 multi-day visit to GSFC to observe the summer program (2003)
- 2 classroom observations (2005)
- 1 Family Science Night observation (2005)
- 1 observation of the NASA Educators Workshop (2005)

During these observations, evaluators had both formal and informal conversations with a variety of individuals involved in the SUNBEAMS program.

INTERVIEWS

Interviews, some formal and others informal, were conducted in person and over the phone with the following people:

	2003	2005
8 SUNBEAMS mentors	5	3
5 Principals of SUNBEAMS teachers	0	5
8 SUNBEAMS Teachers	5	3
5 SUNBEAMS Program Coordinator	3	2
2 SUNBEAMS PIs	2	2
Total	*12*	*13*

Protocols for the formal interviews are provided in the Appendix.

QUESTIONNAIRES

Questionnaires were sent out to all of the SUNBEAMS teachers (10) who participated in the program in 2005. Teachers were asked to have students who participated in the SUNBEAMS program complete the survey and return it to PERG in a self-addressed stamped envelope. A total of 57 questionnaires were returned from 3 schools.

A teacher questionnaire was sent out to all past participants in 2003. Responses were received from 12 teachers.

Copies of the surveys are provided in the Appendix.

DOCUMENT REVIEW

Evaluators reviewed artifacts related to the SUNBEAMS program, including program documents; a sample of teachers' SUNBEAMS curriculum and/or presentations; student work from their week spent at GSFC and a sample of their work completed in class; SUNBEAMS program participant surveys; and newspaper articles about the program.

THIS REPORT

The data presented in this report are primarily *qualitative.* Qualitative data allow for deep exploration of a variety of areas, including many that are uncovered during the data collection process. Analysis of qualitative data can uncover ideas, beliefs, attitudes, challenges, etc. that are present in the population of interest. Unlike quantitative analysis, qualitative analysis cannot be used to estimate the prevalence of any specific variable, because the data are not representative of the larger population beyond the participating sample. For example, the analysis can reveal beliefs that some researchers hold about education, but it *does not* indicate the *proportion* of researchers that hold a specific belief.

Throughout the report, there are citations from the data. They are included to add context and richness to the discussions and to illustrate the perspectives of those engaged in the work. All data cited in the report have been selected to *represent the themes and trends* that emerged from the data and are characteristic of the *perspectives voiced by multiple respondents* and issues that related to the project during the report period.

FINDINGS

DCPS

TEACHER IMPACT

Successes

Teachers responded positively to their experience in SUNBEAMS.

> Just the idea of having that experience, having to interact with scientists. Also, to have available to me the library, the opportunity to research, the hands-on . . . It was just a total . . . Even the freedom of having to work at my own pace. I can't describe it—it was wonderful!

Data indicate that the SUNBEAMS program provided teachers with a quality science professional development experience that impacted them in a number of ways.

Quality and Frequency of Science Teaching

- One of the most significant impacts revealed by the data is an increase in the frequency, and improvement in the quality, of science being taught in SUNBEAMS teachers' classrooms. One principal, who has had teachers participate in SUNBEAMS over the last few years, shared her observation of her teachers' science classes.

> My monitoring and regular daily [observation shows that there is] more time devoted to science. [Before teachers would] open a book and tell the children to read page 50–54. [Now, I see] a lot of hands-on, and teachers have hands-on science kits and teachers are feeling more comfortable to use the resources available to them. I believe it started in writing their own lessons, and implementing their own lessons, and using the tools that they receive from NASA. (DCPS principal)

Learned New Strategies and Content

- Teachers learned and utilized new approaches in their science teaching including strategies to implement hands-on science activities, integrate curriculum, lead discussions, and improve technology skills.

> I say [to students], not everything is on the Internet; you might be right and you might be wrong. They really critique things now . . . if I hadn't gone to SUNBEAMS, I wouldn't have asked them to ask and answer questions and do research. (DCPS teacher)

- Teachers' content knowledge and interest in space science has increased.

Teachers' Confidence Increased

- Teachers' confidence in teaching science appears to have increased. Teachers have indicated that they have implemented their lessons and believe they can teach science.
- Teachers come back to school enthusiastic and excited about teaching.

> When teachers come back, they are excited, want to share what [they] haye learned, the science they learned, the astronauts and relationships that they developed. The teachers are very enthusiastic about their products, the lessons, CDs that they develop, the programs that they develop. It's also provided them opportunities to use . . . resources at NASA Goddard; they have a firsthand opportunity to take advantage of it, for instance, getting materials for their classroom, software materials, support materials. They love the internships in the summer. It makes them feel special.
>
> (DCPS principal)

Teachers' Implementation of SUNBEAMS Lessons

- Teachers implemented SUNBEAMS lessons in their classrooms during their year in the program. A few teachers reported that they have continued to use some activities beyond their year as a SUNBEAMS teacher.
- Principals reported an increase in science displays in the classrooms of SUNBEAMS teachers.
- Teachers reported that they learned how to convey science ideas better to their students.
- Teachers received materials and resources for their classrooms from GSFC. One teacher received a number of old computers that are now located in the school's computer lab. Other teachers talked about the educational resources and supplies they received.

> I have a lot of print material, posters, supplies, kinds of different things I would not have gotten if I was not part of SUNBEAMS. [That] helped me improve my classroom environment. (SUNBEAMS teacher)

Teacher Empowerment

- Throughout the interviews and observations, teachers demonstrated pride in their work. During the NASA Educators Workshop observation, teachers brought their SUNBEAMS portfolios to share with each other. During the observation of the Family Science Night, the teacher had created a program to hand out to the audience that included all of the students' names, NASA's name, and the agenda of the presentation, which included an introduction by the school principal.
- Teachers felt valued during their experience at GSFC. Teachers gained confidence and were excited about having had the opportunity to work at GSFC and with their mentors.

> She was very supportive, she gave me all the supplies; if she didn't have it she gave me access to her staff who were available to help me in any way possible. (DCPS teacher)

- Teachers feel good about being able to provide their students with the week at GSFC.

> . . . it was probably one of the best experiences that I had, if not the best. I was able to learn, give to my students, parents, teachers . . .

- Teachers took on leadership roles.—for example, presenting their SUNBEAMS work during workshops and conferences, and were viewed as science resources in their schools.

Other Impacts on Teachers

- The program improved teachers' confidence in their ability to present, due to the requirement that teachers present their work to their mentors and peers at the end of the summer institute.
- It increased teachers' confidence in teaching *all* subject areas.

> Within teaching Earth science and space science, [we] do math, writing, and art activities. SUNBEAMS has helped across the board about being more creative about those . . . subject areas.

- Teachers used SUNBEAMS materials to motivate student learning in all subject areas.
- Teachers learned computer skills including how to conduct Internet research and how to create PowerPoint presentations.
- Teachers learned about what researchers do, and were exposed to the various careers in science.

> It has helped me widen my views as far as specific careers they can go into, not just rocket scientists or astronaut; a whole lot of people help make NASA run, and I can tell [my students] specific careers they can go into now. (DCPS teacher)

- The program provided teachers with a support system that included a network of peers, resources to help increase their science content knowledge, and information about other science education opportunities and resources.

Challenges

- There was inconsistent follow-through by teachers with all of the activities. For example, in 2005 a few teachers did not put on a Family Science Night.
- The data was not clear about how much of each teacher's SUNBEAMS portfolio was actually implemented in the classroom. Although many teachers indicated that they implemented specific SUNBEAMS lessons, some were unable to clarify how often they did this, or how many of the lessons were implemented. Also,

when some teachers reported they were implementing SUNBEAMS, they were actually teaching other curriculum related to their SUNBEAMS unit.

- A few teachers indicated that if a lesson was not successful the first time they used it, they did not try it again.
- Although teachers implemented the lessons, there is evidence that they need to continue to increase their science pedagogy and content knowledge.
- It was a challenge for the teachers that they had limited knowledge about space science content when they first entered the program. Teachers all said they had to do a lot of research so they could understand what their mentors' work was about. Only one teacher reported that they were directly involved with their mentor's research.

STUDENT IMPACT

The data suggest that the students' experience with SUNBEAMS had a very positive impact and that they were excited about participating in it.

> They are very excited about it, very serious; the anticipation is great. They think it's cool.

Providing students with an experience at GSFC broadened their horizons by exposing them to a new setting and expanding their concept of what a scientist does and possible careers that they can pursue.

> I mean, it's a wonderful program. I don't know of any other program like it; even though we're in close proximity, a lot of the students had never heard of [GSFC], and it's a very important site for NASA, and they may have seen the sign, but they never knew what was inside there. Now they know; now they're able to express that and share that with family and friends. They know they have access to use the visitors' center and other things there where they didn't know that before. Being in DC where we're so close, to not use it or know about it is a shame, and this program opens the doors of NASA GSFC, opens the doors to the children in the district. Word can be spread . . . reach all the schools in the district.

> In urban areas . . . students have limited scope, short horizons on what they can do in life. [They do] not have a sense of what work is possible outside their immediate neighborhoods, no role models . . . things such as science and technology come across totally as fiction. SUNBEAMS and the association with NASA helps make concrete for them that there are possibilities beyond their immediate communities.

Increased Student Interest in Science

The SUNBEAMS experience sparked students' interest. During an informal conversation with a 6th grade class 6 months after their week at GSFC, one student talked about how he tried experiments at home; others had questions:

> Is earth the only planet with humans on it?

> How long did it take the scientist to learn the planets and space?
>
> Does the rocket give off pollution when it goes up into space?
>
> How did they get the gasses to show like that, on the spectrum?

Principals indicated that the program provided an opportunity to increase student interest in science and encourage students to engage in science careers. Principals also reported that students demonstrated a positive attitude about science.

Students responded to a survey question that asked whether their interest in science increased or decreased as a result of participating in the program. Although one-third responded that their interest in science decreased after participating the program, two-thirds reported an increase in interest and one-third said that they could see themselves as space scientists or engineers.

Students' responses to the question about what they didn't like suggest that the SUNBEAMS program piqued their interest. Their responses included the following: they liked everything; they wanted more opportunities to engage in activities and explore science concepts; they wanted to learn more about particular parts of the GSFC campus.

Impact on Student Learning

SUNBEAMS increased students' understanding of science content, as well as their science vocabulary and communication skills.

> [It] increases the students' vocabulary, content focus; gives them something to think about, talk about and write about; and enhances their learning experience. It provides them more prompts, more opportunities for academic achievement.
>
> We have also seen our children's conversation . . . in the way [science] impacts their everyday lives; they talk and speak in the science vernacular, and certainly in a more positive way than previous to involvement . . .

Students reported that they learned about scientific content and got to experience hands-on activities. They mentioned the Alka-Seltzer rocket-launching activity and the nitrogen oxide demonstration most often. In addition, students mentioned science content that they learned included facts about the sun, moon, and solar system; measurement; how the days of the week/month were determined; general astronomy facts; and spectroscopy. Students also got experience in utilizing science skills. For example, students learned how to question and conduct research to answer their questions.

There were reports of the SUNBEAMS program improving the quality of science fair projects and increasing student participation. One student placed in the top three in a science fair, and shared her project at the Family Science Night.

> I can tell you one thing for certain, the science fairs are a lot more interesting and [contain more] information; [they are] more rigorous . . . more students submit their science projects . . . (DCPS principal)

One principal suggested that the combination of an increase in excitement on the part of the students and teachers, along with improved science teaching practice, has had a positive impact on student learning.

Improved Student Attitude and Behavior

The program's impact on the students reached beyond the science classroom. Principals and teachers indicate that they saw positive behavior changes in students that they attributed to the students' experience in SUNBEAMS.

> Students were very motivated, their behavior changed; they just started acting different when they came back . . . they came back feeling really valued, self-esteem improved, and they seemed to really value being away from school and being in a different environment that was very constructive for them.

The data suggest that students demonstrated an increase in self-confidence and morale. Students were proud to participate in the program. One principal reported that these students see themselves as a "cohort . . . of participants and . . . take on an identity of a SUNBEAMS student in the school." Other examples follow:

> [The program] has given them a more positive attitude about science and boosts their morale as far as . . . it made them feel special because they got a weeklong field trip and met actual scientists. The scientist came to our school and met their parents and teachers; made them feel special.

> Students came back excited; students came back with stories of what they saw, and this is a qualitatively impactful outcome.

One principal told the story about how their students responded during a Q & A session with Nobel Prize winners. SUNBEAMS students had more confidence in talking to professionals in other settings. He suggested that the cause was due to their experience at GSFC.

> I noticed those raising their hands were the students that had been on SUNBEAMS. [Those] students were more willing to ask questions.

Another principal shared the story of how the SUNBEAMS program impacted her relationship with a female student who she was mentoring as part of a school initiative to support adolescent girls.

> When I've spoken with her, she is a child of few words; [her experience at NASA] was a take-off point for us. She talked about the people she met, activities they engaged in, the rocket launch. (DCPS principal)

One teacher, who was a 2nd time SUNBEAMS teacher, reported that students who had participated in SUNBEAMS came back a few years later and shared with her that their experience at GSFC is an educational experience that still stands out for them.

SCHOOL IMPACT

> I talk about SUNBEAMS . . . with others all the time. I'm very proud of our involvement. (DCPS principal)

Principals had a positive response to the SUNBEAMS program. Some indicators of this are:

- Principals reported that the program had reasonable expectations of their involvement in and commitment of school resources to the program, which makes it possible for them to participate.
- Principals stated their interest in continuing their teachers' and students' involvement in SUNBEAMS, and expanding the program in their school.
- The SUNBEAMS program enhanced the schools' academic offerings and improved its reputation. For example, parents in one school identified the SUNBEAMS program as one of the outstanding opportunities that the school offers their children. Two schools name the SUNBEAMS program in their profiles to solicit new students. Students in one school included their SUNBEAMS certificate and experience in their learning portfolio on their junior high school applications.

  > We have regional meetings and we talk about what are positive efforts in our schools, and I've talked about SUNBEAMS in that light. (DCPS principal)

- Data indicate that there was an increased presence of science in the schools of SUNBEAMS teachers. Some of the principals reported that they believed the SUNBEAMS teachers were the catalyst for this shift.
- There is an increase in the quality of the science taught in their school.
- Students and parents of students who were not part of the program wanted to participate.
- The data also indicate that the program has increased community/family involvement in the school. For example, SUNBEAMS Family Science Nights were reported to have a higher parent turnout than any other community event. One principal also attributed an increase in parent support and interest in science fairs to having the SUNBEAMS program at their school.

GSFC

RESEARCHER IMPACT

Successes

All of the mentors spoke positively about the program. Many indicated that they valued the teachers' expertise in the area of education, especially their ability to communicate ideas to children. The benefits to GSFC researchers included:

- Meeting NASA's E/PO goals

  > I think it's helped NASA meet one of its goals, which is outreach. I think it's done it in a very constructive way.
  >
  > Teachers . . . seem to be always welcome; everyone is used to seeing lots of them around during the summer. I guess the scientists think of Goddard as a place where their research gets converted into something that the public can understand, partly because of the SUNBEAMS program. (GSFC staff)

- Increasing their ability to relay their research to the general population in simplified terms

  One mentor explained:

  > It helps me relate to students and other teachers when I talk to them.

  He elaborated that he shared the materials created by SUNBEAMS teachers with other teachers and students because he knew they would be appropriate.
- Increasing their knowledge and understanding of schools and teaching
- Receiving personal satisfaction
- Providing them with an opportunity to influence students

  > . . . you know it's [going to] go back to the public and contribute [to the] education of all the students that [those] teachers encounter.
  >
  > The incentive remains the same: [to] impact the scientific literacy of teachers and hope that they impart that to their students.

- Providing them with support for E/PO development

  Mentors who were involved in E/PO, sought out the teachers' expertise to revise education materials created for mission E/PO.

  > Seemed like if we wanted to develop lesson plans that teachers could use, we would need a teacher . . . best way is to work with teachers to develop these types of things that I certainly don't know how to do. Also get a teacher's perspective on what would be useful and the kinds of things those students would find interesting. (GSFC researcher)

> We had to make a list of what we considered to be good websites that were space science-related. And come up with a list of websites that they were going to use [in] an after school [program] . . . just good sites that were student-friendly, had information that was usable, and we were to [give them] our teacher education input . . . (DCPS teacher)

> I have learned some things about how teachers relate to students; they explain things better to the kids than I can. I have a better appreciation of that. When I wrote the booklet [of activities], [it needed a] different writing style; multiple people read through it, including the teachers. They made comments and I made changes on things based on what they said. (GSFC researcher)

- Leveraging their involvement in SUNBEAMS for E/PO funding

> In later EPO proposals [I] mention the SUNBEAMS program because it is large, it's somewhat well known and so I figure that means something to NASA HQ. (GSFC researcher)

Challenges

Mentors commented that they found it difficult to involve teachers in their research because of teachers' lack of exposure to the content of the researchers' work and their limited technology skills. A few mentors found it challenging to explain their research in terms that the teachers could understand.

> . . . several of the teachers that I've dealt with have very little exposure relating to computers and things like that . . . A lot of times we're talking about things that teachers haven't experienced, enhancing the teachers experience . . . takes time . . . there's a lot of hand-holding at the very beginning. (GSFC researcher)

> I thought the teachers would shadow us and get work experience that way. And I tried to come up with ideas for projects to do. I think the learning curve is too great for them. What works out best—give them ideas for things and [have them] develop lesson plans around it; point out references and resources and work on their own. (GSFC researcher)

Mentors mentioned the time constraints that they faced. A few immediately followed this statement up with how it was "worth it." Others are no longer mentors because they have too many other personal and professional obligations. Some mentors overcame this barrier by eliciting support for the teacher from other members of their team. Although mentors indicated that they had permission to participate in SUNBEAMS by their superiors, they were not provided any compensation for taking on this role.

THE PROGRAM DESIGN

Successes

Data suggest the design and organization of the teacher professional development and associated activities were effective.

> The program was organized; things went on schedule, on time; [there were] plenty of materials; logistics were well thought out to a 'T.' (DCPS Teacher)

- The program coordinator is a strong leader who has the background and skills to address the needs of participating teachers. She appeared to have fostered good will among many of the employees at GSFC. This included the ERC and museum staff, as well as scientists, librarians and other personnel at GSFC. During the site visit, GSFC staff had positive exchanges with the program coordinator and would readily supply her with resources that she requested.
- The program provided teachers with ample time during the summer institute to create and modify lessons that aligned with their curriculum, which could then be easily implemented in their classrooms the following school year.
- All of the participants (teachers, mentors, and students) engaged in experiences that are meaningful to them.
- The content of the program is appealing to participants. Principals and teachers mentioned the appeal of the "cutting edge science."
- The design of the program allows for flexibility in implementation, which promotes participation and follow-through in all components.
- The expectations for participation are clearly stated to everyone involved in the program. For example, initially teachers and researchers were informed of their roles and expectations of participation through program announcements. These were then followed up with addtional communication by the program coordinator, as necessary.
- Another indicator of the success of SUNBEAMS was that the SUNBEAMS model has been replicated at two other sites. These SUNBEAMS programs have been modified to fit within their specific contexts.
- The inclusion of the mentor/teacher collaboration in the design of the program was highly beneficial, with only a few challenges indicated. The impact of this particular relationship is discussed in detail below.

Mentor/Teacher Collaboration

Successes

Both mentors and teachers enjoyed the experience of working together. Teachers often stated that their relationship was one of respect. This sentiment was echoed by researchers.

> . . . I think it's a valuable program for both the scientists and teachers, and it's important that teachers who teach science get some understanding of how science is done. (GSFC mentor)

Most of the GSFC researchers involved in the program indicated that the mentor/teacher relationship was reciprocal: that they learned from the teachers and the teachers learned from them. They valued teachers' expertise in education, and saw themselves as the science content experts. In addition to creating a SUNBEAMS portfolio, some teachers supported mentors in designing mission E/PO activities.

> . . . we're a very informal group so we try and be very, very open to the teachers and try and meet them on even footing, even though they've come to us. I don't look at it as we're somehow above them. And they're trying to learn from us, but more, [it is] an equal type of relationship. They're trying to learn science and we're trying to learn education.

Challenges

There was some indication of challenges to teachers and researchers engaging in collaborations as equals. For example, one scientist described the experience as a one-way exchange: "I was helping them with their research." He said that he didn't learn anything from the experience, but benefited by getting satisfaction from helping people gain knowledge. One teacher expressed her fear of feeling inferior in front of the mentor.

> Not . . . a challenge, but a fear of seeming really shallow around such bright people. The challenge was trying to sound intellectual and not totally dumb-dumb . . . (DCPS teacher)

The program coordinator works very hard to support the relationship. For example, in recognizing teachers' inhibitions, increasing their confidence by acknowledging teachers' education expertise, restating that the expectation for participation is that teachers interact with researchers, and encouraging these interactions.

When challenges emerge regarding the mentor/teacher collaboration, the program coordinator will intervene to resolve the situation. For example, if a mentor is unavailable to support the teacher, the teacher will be paired up with another SUNBEAM's teacher and mentor. If a teacher finds the process difficult, the program coordinator will provide individual support to the teacher until they can successfully engage in the program.

SUMMARY

The SUNBEAMS program provided meaningful experiences and learning opportunities for teachers, students, and researchers. All of the audiences responded positively to the program.

Data suggest that teachers experienced an increase in interest, motivation, and excitement about teaching science. They also expressed being more confident in teaching science. There were reports of improved quality and greater frequency of science teaching in their classrooms.

The program has provided students with engaging science opportunities in the classroom through the implementation of the SUNBEAMS science lessons by teachers with improved science teaching skills and increase content knowledge. During their week at GSFC, DCPS students were exposed to a new environment and were immersed in science and math activities. The impact on students includes increased interest in science, as well as improved behaviors, attitudes, and motivation that impacted beyond the science classroom.

Mentors were personally rewarded through their participation. Those engaged in other E/PO efforts especially valued teachers' education expertise in helping them design activities for classroom use; they received support in translating their research into terms that could be more easily understood by the general population.

Primarily SUNBEAMS is a summer teacher professional development program, with associated activities to support the implementation of their learning. The program's success can be attributed to its design as well as the knowledge, experience, and enthusiasm of the project coordinator. It is designed in a way that provides a structure for the participation of all audiences, and has sufficient flexibility to exist within the context of the two collaborating institutions (urban formal education system and science research facility).

APPENDICES

APPENDIX A
SUNBEAMS TEACHER INTERVIEW 2003

School:
Role:
Grade Level:
Please circle the year you participated in Sunbeams Program:
2002

How did you learn about the Sunbeams program?

Why did you participate in the Sunbeams program? (Ex. Interested in space science, get to work with real scientists, administrator told you to go…)

Please describe the how the Sunbeams program has impacted…

- you.
  …bring me through the year as a sunbeams teacher.
- your teaching.

- your students.

- your school community.

What were the benefits of being a sunbeams teacher?

What were the challenges of being a sunbeams teacher?

Please describe your interactions with your mentor?
  How much contact did you have with your mentor…daily/weekly/during the school year?
What if anything did you learn from your mentor?

Please describe *how* you share(d) what you learned with others…

What changes would have improved the SUNBEAMS program for you?

Anything else?

APPENDIX B
SUNBEAMS TEACHER SURVEY 2003

School:
Role:
Grade Level:
Please circle the year you participated in Sunbeams Program:
1996 1997 1998 1999 2000 2001 2002

How did you learn about the Sunbeams program?

Why did you participate in the Sunbeams program? (Ex. Interested in space science, get to work with real scientists, administrator told you to go…)

Please describe the how the Sunbeams program has impacted…

- you.
- your science teaching.
- your students.
- your school community.

Please give examples of *at least two* benefits of being a Sunbeams Teacher.
1.

2.

Other(s)

Please give examples of *at least two* challenges of being a Sunbeams Teacher. (Ex. Summer workshop, incorporating content into your curriculum, support from mentor, school administrators etc…)

1.

2.

Other(s)

.

How much contact did you have with your mentor…	**How often?** (per week) (per month) (per year)	**Reason for contact**. (ie. classroom visit, content questions, friendly hello, …)
During the summer you participated in the program?		
During the school year?		
After the first year?		

Please list *at least two* things you learned from your mentor.
1.

2.

Other(s)

Please describe *how* you share(d) what you learned with others…(Ex. Conversation, teacher meetings, presentation to PTA, etc.)

What changes would improve the Sunbeams program for you?

APPENDIX C
SUNBEAMS SCIENTIST INTERVIEW 2003

Describe your role at Goddard.
How long have you been there?

How did you learn about becoming a mentor for the SUNBEAMS program?

How long have you been a mentor?

What interested you about it?
Why that over any type of E/PO?

What were your expectations of being a mentor to a SUNBEAMS teacher?
Your role as a mentor?

How did the experience differ from your expectations?

Please describe your experience in the SUNBEAMS Program?
Bring me through a year as a mentor.
Probe: How did you know what to do as a mentor?

How did the program support your mentoring work?
Probe: mentor training?

What was challenging about the mentor role?
Probe: Personally
Probe: Your research

Describe how you involved the teacher in your science research.

Describe your relationship with the Sunbeams teacher.
Probes: Have you been in contact with them throughout the year?

What, if any, impact has the program had on…
you?

- Your work/science research?
- Your ideas about education?
- Your institution?
- The teachers you worked with?

What do you see as the benefits of the SUNBEAMS program?

Do you have any suggestions to improve the program?

Would you recommend other scientists to become involved with the program? Why or why not?

APPENDIX D
SUNBEAMS PROGRAM COORDINATOR INTERVIEW 2005

I know we've talked about this a couple of times, but programs also change over time. Are the goals still the same?

> Probe: In a number of program documents I have, the idea of 'empowering teachers' from the program is stated.
>
> What do you mean when you say 'empower?'
> Is this still part of the program goals?
> In what ways are you empowering teachers?
> What evidence is there that teachers are empowered?

The OSS E/PO goals are (NAME them) to instill excitement in the future generations. In what ways does the SB program address these goals?

How do you know if the goals are being met?

What impact has the SUNBEAM's program had on

- the district?
- the individual schools?
- the teachers?
- the students?

- the scientist mentors ?
- other personnel involved in the program at GSFC?
- the institution [GSFC]?

Probe: (for all populations)

- What evidence do you have of this?
- Are there strategies in place to intentionally cause this?

Have there been any unexpected outcomes and impacts?

What are your long-term expectations for the SUNBEAMS program?

Probe: Please talk about it in terms of:

- the partnership
- the district
- the individual schools
- the teachers
- the students

- the scientist mentors
- other personnel involved in the program at GSFC
- the institution [GSFC]

Last time we talked you mentioned the program format and activities have remained pretty consistent since the time we last looked at your program. My understanding is the the program is as follows:

> 6-week course in the summer where teachers come to Goddard and are matched up with a scientist/mentor. The mentor provides a space for the teacher to work, and the teacher learns about the mentor's research. Then it's a conversation between the teacher and mentor about what area of the teacher's curriculum that they create at SB they will focus on. Teachers also receive support and training on how to use technology. At the end of the course the teachers present their work to the other teacher participants. They then bring the curricula they designed back to their schools and teach them the following year. Their students get to visit Goddard for a week and the mentor comes to their class. Then the students of SB's teachers present what they learned at a family night, which the mentor is supposed to attend.

Have there been any changes to the program since your involvement?

What challenges has the program encountered?

What strategies have you used to meet these challenges?

Partnership

In the descriptions of the program you describe the interactions between GSFC and DCPS as a partnership:

Please describe the partnership.

How effective has the partnership GSFC / DCPS been?

> What are the benefits of the GSFC/DCPS partnership?
> What are the challenges of the GSFC/DCPS partnership?

.---From past conversation I understand that participating DCPS schools provide the transportation for students' week at Goddard. And Goddard provides areas for teachers to work during the summer, materials and supplies for their classrooms, training in using computer technology. Are there any other supports that the SUNBEAMS program receives from the GSFC/DCPS?

Impact of PR

When we last talked you mentioned that there was a PR event about to happen and that a SB teacher was on Oprah.

Would you tell me about the PR event (not Oprah)?

Are their other PR events that have happened over the last year or so?

How do they impact the program, if at all?

Probe for positive and negative impact

Anything else that you want me to know?

APPENDIX E
SUNBEAMS MENTOR INTERVIEW 2005

Name:
Date:
Job title:

Why were interested in participating in the SB program?

How did you hear about the SB program?

How many years have you been a mentor for the SB program?

What stands out for you about your experience as a SB mentor?

Please describe any impact that SUNBEAMS has had on:….?
Your work: [research/GSFC]
You: [attitudes about education]

PROBE: Please provide examples

Mentor
What interaction did you have with the students of the SB program?
How would you characterize students' interaction?

What do you think the impact of your interaction with students was?

How did your teacher contributed to your experience as a SB mentor?
What did you have on the teacher?

(For multi-year participants)
The commitment for a SUNBEAMS mentor/teacher partnership is one year. I am curious if any of these relationships have continued beyond this period. Are you still in contact with your teachers? If yes, please explain:

Impact
Has your experience with SUNBEAMS had any unanticipated outcomes? [leadership position, promotions, present at conferences, receive grant money, etc.]

How has your institution and administration responded to your involvement in the SB program?

Have you shared your experience with your peers? How?
Outside your group?

Conclusion
What recommendations do you have for the SB's program?

Anything else?

APPENDIX F
SUNBEAMS PRINCIPAL INTERVIEW 2005

Date:
Name:
Contact info: #
School:
Interviewee:

How did you hear about the SB program?

What goals do you have for the SB program? (school, teachers, students, yourself)

How many years have you had SB teachers involved in program?

How many teachers from your school?

What impact has the SB program had to date?

Probe: your school?
your teachers? [probe: science attitudes, content and pedagogy]
your students? [probe: science attitudes, and content knowledge]
the district?

What long-term impact do you see the SUNBEAMS program having?
(school, teachers, students, district)

Have you noticed a difference in the science classes of the SB teachers?
Targeted version of question:
Have teachers' attitudes towards science changed? Please explain.
Have they increased the amount of science they are teaching to their students?
Have you noticed any difference in how they teach science (pedagogy)?
Differences in the students participating in their science classes (engagement, attitudes)?

Your role in program?

I know that the program requires that there is some interaction between the school and GSFC. Can you comment on your relationship with GSFC?

What has been challenging about participating in the SUNBEAMS program?

Anything else?

APPENDIX G
SUNBEAMS TEACHER INTERVIEW 2005

Name:
Date:
Grade level:

Why were interested in participating in the SB program?

How did you hear about the SB program?

What stands out for you about your experience as a SB teacher?

Please describe any impact that SUNBEAMS has had on:…
- You: [attitudes]?
- Your classroom: [science teaching]?
- Your students: [attitudes towards science]?
  - How do you know this?
  - [Multi-year Teacher] Impact on students you've had in prior years?
- Your school:

PROBE: Please provide examples.

How, if at all, are you using the activities/lessons, resources and/or information that you created during your summer at SB?

Mentor
How has your mentor contributed to your experience as a SB teacher?

(For multi-year participants)
The commitment for a SUNBEAMS mentor/teacher partnership is one year. I am curious if any of these relationships have continued beyond this period. Are you still in contact with your mentor/s? If yes, please explain:

Impact
Has your experience with SUNBEAMS had any unanticipated outcomes [leadership position in school, promotions, present at conferences, receive grant money etc.]?

How has your school and administration responded to your involvement in the SB program?

Have you shared your experience with your peers? How?

Conclusion
What recommendations do you have for the SB's program?

APPENDIX H
SUNBEAMS TEACHER SURVEY 2005

School:
Role:
Grade Level:
Please circle the year you participated in Sunbeams Program:
1996 1997 1998 1999 2000 2001 2002

How did you learn about the SUNBEAMS program?

Why did you participate in the SUNBEAMS program? (Ex. Interested in space science, get to work with real scientists, administrator told you to go…)

What did you expect to get out of the program?

Explain how the program did/did not meet your expectations.

Please describe the how the SUNBEAMS program has impacted…

- **you.**
- **your science teaching.**
- **your students.**
- **your school community.**

Please give examples of *at least two* challenges of being a SUNBEAMS teacher. (Ex. Summer workshop, incorporating content into your curriculum, support from mentor, school administrators etc…)

1.

2.

Other(s)

.

How much contact did you have with your mentor…	**How often?** (per week) (per month) (per year)	**Reason for contact**. (ie. classroom visit, content questions, friendly hello, …)
During the summer you participated in the program?		
During the school year?		
After the first year?		

Please list at least two benefits of working with a mentor.

1.

2.

Other(s)

Please provide *at least two* examples of challenges related to working with your mentor.

1.

2.

Other(s)

Please list *at least two* things you learned from your mentor.
1.

2.

Other(s)

Please describe *how* you share(d) what you learned with others…(Ex. conversation, teacher meetings, presentation to PTA, etc.)

What changes would improve the SUNBEAMS program for you?

LESLEY UNIVERSITY
CENTERS AND INSTITUTES
PROGRAM EVALUATION AND RESEARCH GROUP

APPENDIX I
SUNBEAMS STUDENT SURVEY 2005

THANK YOU VERY MUCH FOR PARTICIPATING!!!

Age:_____
Grade: ____
Have you participated in the following SUNBEAMS activities this school year?

	Yes	No	Don't Know
SUNBEAMS lessons during class			
Other space science lessons (NOT SUNBEAMS)			
Went to Goddard Space Flight Center for a week			
Talked to NASA scientists or engineers			
Presented your SUNBEAMS work at a Family Night			
Presented your SUNBEAMS work to parents			
Presented your SUNBEAMS work to other students			
Went to a SUNBEAMS Family night (NOT PRESENT)			

Did you participate in SUNBEAMS before this year? Yes No

If you answered YES, did you participate in the following SUNBEAMS activities?

	Yes	No	Don't Know
SUNBEAMS lessons during class			
Other space science lessons (NOT SUNBEAMS)			
Went to Goddard Space Flight Center for a week			
Talked to NASA scientists or engineers			
Presented your SUNBEAMS work at a Family Night			
Presented your SUNBEAMS work to parents			
Presented your SUNBEAMS work to other students			
Went to a SUNBEAMS Family night (NOT PRESENT)			

Please list three things that you learned from SUNBEAMS.

1. _____
2. _____
3. _____

What 3 things did you like most about SUNBEAMS?

1. _____
2. _____
3. _____

What 3 things didn't you like about SUNBEAMS?

1. _____
2. _____
3. _____

My interest in science has (Increased)(Decreased)(stayed the same) because of SUNBEAMS.

How did SUNBEAMS change the way you think about scientists and engineers?

Do you think that you could be a space scientist or engineer? Yes No

Have you shared what you learned at SUNBEAMS with your:
(check all that apply)
__Friends
__Family
__Teachers
__Other people outside of school

Is there anything else you want to tell me?

SMD E/PO Phase IV Evaluation:

Chicago 2004:

A Workshop to Foster Broader Participation in NASA Space Science Missions and Research Programs

Evaluation Report
June 2004–May 2005

NASA Space Mission Directorate
Washington, DC

Written by:
Sabra Lee and Jenny Gutbezahl
Senior Research Associates

Assisted by:
Toby Atlas, Research Assistant

Program Evaluation and Research Group
Susan Baker Cohen, Director

December 2005

Program Evaluation and Research Group
at Lesley University

SMD E/PO Phase IV Evaluation:
Chicago 2004:
A Workshop to Foster Broader Participation in NASA Space Science Missions and Research Programs
Evaluation Report

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CONTENTS

EXECUTIVE SUMMARY

Participants at the Chicago workshop were surveyed at the time, and asked if they were willing to be contacted either 3 or 6 months later for a follow-up interview or survey. One hundred twenty-four (124) respondents agreed to be contacted, however only 52 responded to our follow-up inquiries. Data were collected from approximately 25% of the 200+ participants at the workshop and provided either survey or interview data for this report.

Participants were asked a series of questions about the contacts they had made at the conference, if they were working in a partnership as a result, and, if so, the steps they had taken to establish those partnerships. In addition, we asked them about the factors that contributed to the success of, and challenges to, their partnerships. Most questions are analyzed qualitatively. In many cases, the sample size answering a specific question is less than 50, and data cannot be reliably projected on a larger population. In addition, many questions were in an open-ended format, which lends itself to qualitative analysis.

SALIENT FINDINGS

The Chicago workshop was successful in achieving several goals:

- Almost all (98%) of 50 respondents reported that they received contact information from at least one person they had not previously known.
- Almost all (90%) of 40 respondents reported that they had met a scientist or other professional relevant to their field, who shared his/her interests and needs.
- Two-thirds ($^2/_3$) of the 48 respondents had initiated, or were in early development of, partnerships within the first 6 months following the workshop. About $^1/_2$ described the steps they had taken to establish partnerships, including telephone and email contacts, joint conference presentations, proposal development, and reciprocal visits, among others.
- Of 20 respondents, about $^3/_4$ reported that they were actively partnering with a minority-serving institution.
- Workshop participants described factors that contributed to the success of their partnerships, including mutual interests and goals, complementary expertise, and a history of working together. Research has found that these factors are associated with successful partnerships.
- Twelve (12) respondents described the challenges they faced establishing partnerships. The major challenge, cited by 10 of them, was lack of resources, including funds, technical expertise, and time. In addition, differing cultures and experiences; forming a good team; balancing the partnership with other work; and

lack of follow-up were mentioned. Some challenges specific to working with minority-serving institutions were also reported, including support for travel, the effort and uncertainty that accompanies outreach to these institutions, and the need to combine resources.

- Twenty-eight (28) respondents described ways in which they felt that NASA could further support their efforts, including funding, additional programs similar to the Chicago workshop (which they found useful); a centralized clearinghouse/PIs or network of scientists interested in partnerships; assistance for participants in connecting with one another; more information about missions, grants, and PIs interested in partnering; assistance for individuals and partners in developing proposals; and taking into account the differences between Tier 1 Research Universities and others, including minority institutions and community colleges, when funding proposals.
- Eleven (11) respondents mentioned that the Chicago workshop affected how they work or plan to work in the future, including better ways to work with underrepresented populations and minority institutions, and expanding their own research.
- Those who were not yet successful in establishing partnerships reported several factors they considered contributory: time required; lack of follow-up with, or *being contacted by,* those whom they had met in Chicago; and not meeting anyone with similar research interests.

INTRODUCTION

This is an evaluation study of a workshop sponsored by NASA's Office of Space Science (OSS)[1] on June 28–29, 2004 and held in Chicago, Illinois. The workshop was entitled Chicago 2004: A Workshop to Foster Broader Participation in NASA Space Science Missions and Research Programs. Our study examines the workshop from two vantage points: through data collected at the workshop itself, and through follow-up interviews and surveys 3–6 months later.

The goal of the workshop was to seed personal contacts among a more diverse community than had traditionally been active in NASA space science missions. In addition, all participants were expected to gain insights and contacts leading to:

- A better understanding of how the NASA space science program is organized, planned, and conducted; how missions and research programs are conceived; how mission and research teams are formed; and how successful proposals are conducted
- Possibilities for effective new partnerships
- Greater involvement of minority universities and underrepresented minority scientists in missions and research programs, as well as on NASA review panels and advisory boards

The workshop was held at the Hilton Hotel in Chicago, Illinois, with the NASA OSS Broker/Facilitator at DePaul University acting as host.

PHASE I: AT CHICAGO

EVALUATION

OBSERVATION OF THE WORKSHOP

Three evaluators from the Program Evaluation and Research Group at Lesley University attended the workshop. This allowed for coverage and observation of all activities, including participation in each of the three main breakout groups.

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[1] Since the workshop, NASA has undergone some reorganization and the Office of Space Science does not exist as a separate entity, but has become part of the Science Mission Directorate (SMD).

INFORMAL INTERVIEWS AT THE WORKSHOP

Over the course of the workshop, evaluators held informal interviews with 32 workshop participants.

END-OF-WORKSHOP SURVEYS

Almost all (168) participants out of over 200 total completed a survey at lunch on the final day of the workshop. The survey appears in the Appendix.

WORKSHOP AGENDA

The workshop was divided into plenary sessions, break-out sessions, poster sessions, and a special event at the Adler Planetarium. In addition, there were relatively long breaks for meals and refreshments to allow time for participants to meet and interact informally.

PLENARY SESSIONS

Plenary sessions involved the entire audience and provided information on a variety of topics including:

- NASA's scientific priorities and future plans
- A scientist's personal experience on a NASA mission
- Organization, planning, and execution of the NASA space science program
- Conception and make-up of mission and research teams
- Development of successful proposals

BREAK-OUT SESSIONS

On the morning of the first day, there were three parallel breakout sessions, each aligned with a major theme in space science:

- Solar System Exploration
- The Sun-Earth Connection
- Structure and Evolution of the Universe and Origins

Each participant was able to select a theme-based breakout session. The details of the specific science objectives and methods were presented within each session. Breakout sessions started with a short panel discussion in which scientists explained the objectives and methods associated with that theme. After this, participants asked questions, made comments, and interacted with one another. Two of the breakout groups were broken into smaller groups to facilitate discussion, and the third was not subdivided:

- The Solar System Exploration group split into three groups:
    - Surface Investigations and Samples

    - Orbital Investigations and Remote Sensing
    - Astrobiology Within the Solar System
- The Structure and Evolution of the Universe group split into two groups:
    - Structure and Evolution of the Universe
    - Origins and Astrobiology Beyond the Solar System
- The Sun-Earth Connection group was not sub-divided.

POSTER SESSIONS

There were two poster sessions, each running 2–2 $^{1}/_{2}$ hours in length:

- Interests and Experience of Scientists Seeking to Join Teams
- Interests and Experience of Scientists Seeking New Partners

Hors d'oeuvres and a cash bar were provided, and there was ample opportunity for unstructured interaction.

PARTICIPANTS

Over 200 individuals attended, including:

- NASA space science researchers, comprising both research and education staff
- Current and prospective OSS-funded scientists
- Minority scientists and researchers, including faculty at minority universities, members of minority professional organizations, and other underrepresented scientists/educators seeking to work with NASA
- Scientists, educators, and others interested in supporting the workshop goals

FINDINGS

SURVEY BREAKDOWN

Of the 200+ attendees, 168 completed surveys at the end of the workshop. Of these, over half (54%) identified themselves as being members of groups that have been traditionally underrepresented in the sciences. As shown in Tables 1 and 2 below, participants were primarily professors and researchers from academic environments.

Table 1: Participants by Role (n=168)

Role/Position	Percentage
Professor	42
Researcher	35
Management	25
Educator	24
Technology	5
Student	1

Note: Respondents could mark more than one answer, so percentages total more than 100%

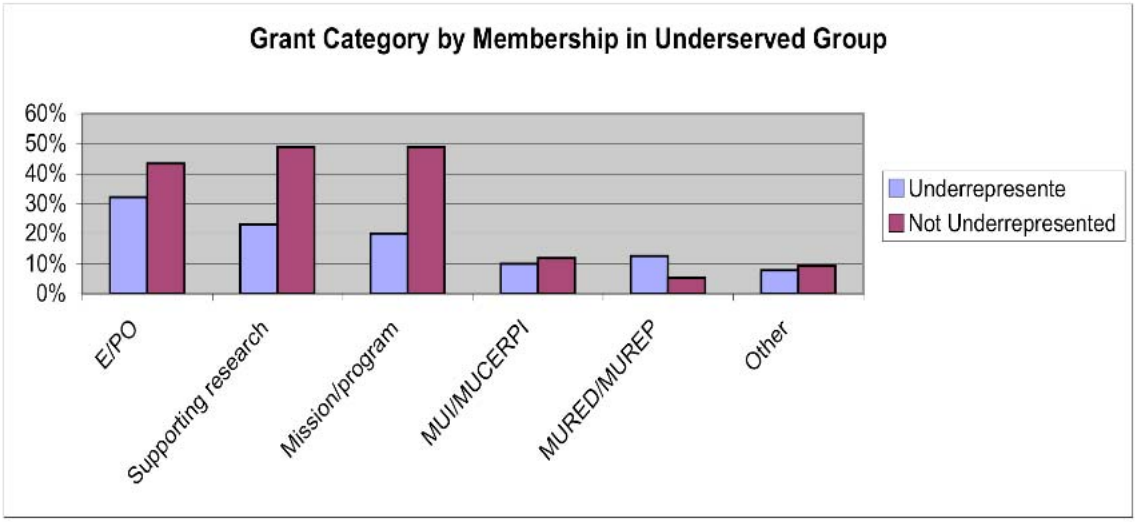
Table 2: Participants by Institution (n=168)

Institution/Organization	Percentage
University	69
NASA research center	21
Private research institute	7
Informal educ. center	2
Professional organization	1
General science organization	1

Note: Respondents could mark more than one answer, to percentages total more than 100%

As shown in Figure 1, approximately $^{3}/_{4}$ of the respondents reported that they had received some type of funding from NASA prior to the workshop.

Figure 1: Prior Funding



- About $^1/_3$ of all participants had received funding for each of the following types of work: missions (38%), supporting research (35%), and E/PO (33%); some participants received funding for more than one type of activity.
- About $^1/_{10}$ of all participants had received funding for each of the grants intended to support underrepresented groups: MUI/MUCERPI (11%) and MURED/MUREP (10%).
- Members of underrepresented groups were significantly less likely to have received prior funding.
  - This difference is greatest for research funding (Mission or Supporting Research).
  - There are no significant differences between underrepresented and non-underrepresented participants in terms of prior receipts of E/PO, MUI/MUCERPI, or MURED/MUREP grants.

IMMEDIATE REACTIONS TO THE WORKSHOP

Data gathered during the workshop suggest that participants were generally satisfied with the workshop. About $^3/_4$ (78%) of the participants who completed the survey at the end of the workshop said that it met or exceeded their expectations; more than $^1/_4$ (27%) said it exceeded expectations.

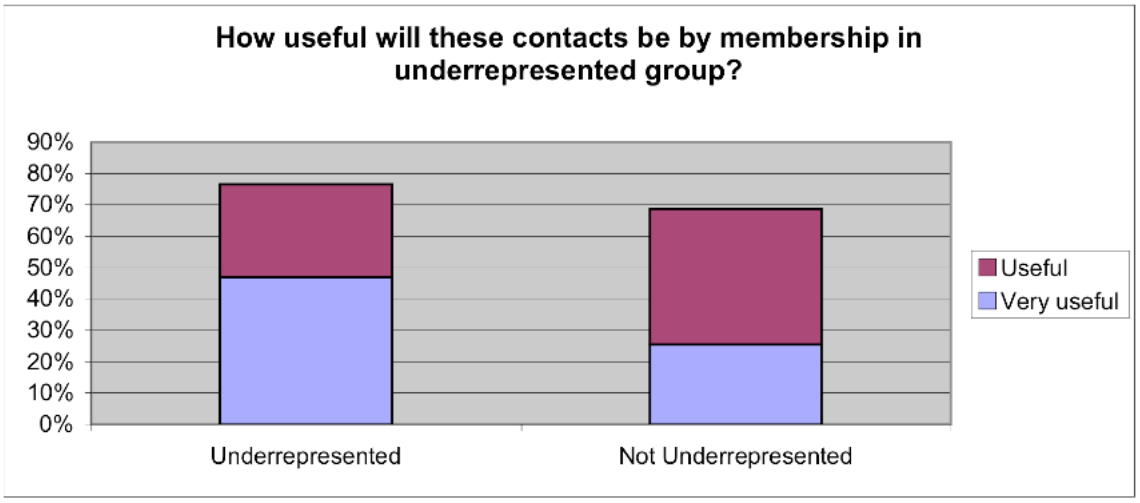
> I have been pleased and surprised by the number of contacts I have been able to make. (Workshop participant)

> I hope that some day, other astronomy and physics meetings will look like this, especially in terms of the diversity/mix of people. (Workshop participant)

Where the Workshop Was Effective

Data indicate that the workshop was extremely effective at providing opportunities for participants to make contacts. Virtually all participants (96%) said that they made new contacts at the conference. Two-thirds (65%) of these participants said the contacts would be useful or very useful. As shown in Figure 2 below, participants who are members of underrepresented communities are somewhat more likely to have made useful contacts, although this difference does not reach statistical significance.

Figure 2: Usefulness of Contacts



Comments from participants provided additional evidence of the usefulness of contacts; many participants said they intended to use these contacts to expand their research possibilities.

> I met so many good people that I ran out of cards (and I brought a bunch). I may have some really good research possibilities for collaboration.
> (Workshop participant)

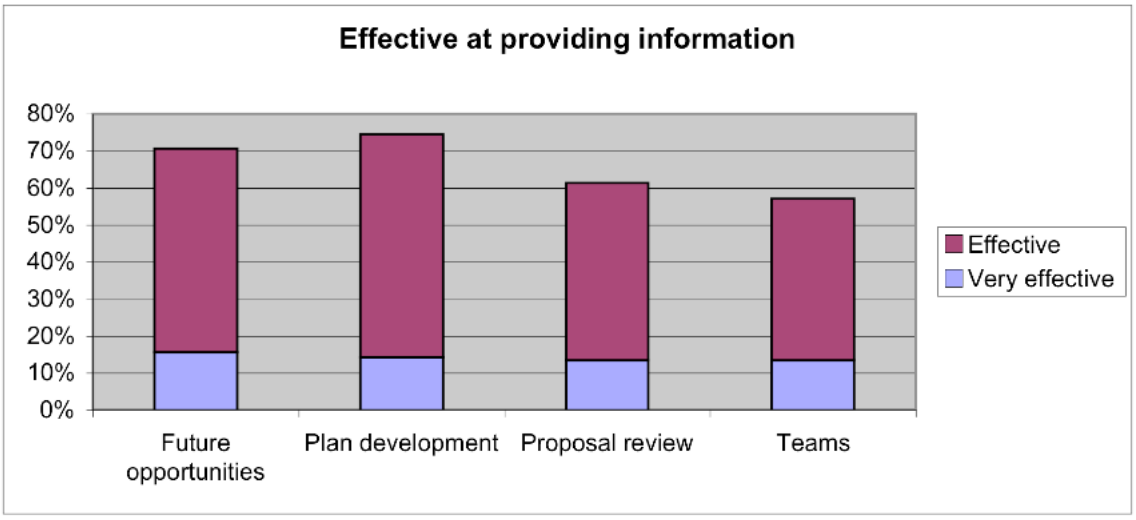
> The workshop was very beneficial for creating opportunities for contacts with NASA researchers. I expect to follow through with the plans I have initiated through the meeting. (Workshop participant)

Participants reported that the workshop was effective at providing information. As shown in Figure 3, between 50 and 75% of respondents reported that the workshop was very effective or effective at providing information on:

- How plans and solicitations for future OSS missions and research programs are developed and publicized (74%)
- Future OSS mission and research program plans and opportunities (71%)
- How proposals are reviewed and selected (61%)
- How successful mission and research teams are put together (57%)

There are no statistically significant differences on these variables as a function of prior NASA funding or of membership in underrepresented groups, although there is a trend that those who had not received funding and those who are members of underrepresented groups gave more positive scores regarding most types of information.

Figure 3: Effective Information



Members of underserved groups, and those who had not received prior NASA funding, gave slightly more positive assessments regarding all types of information, but this difference is not statistically significant.

As shown in Figure 4, respondents found the workshop effective at providing opportunities to share experiences and form partnerships:

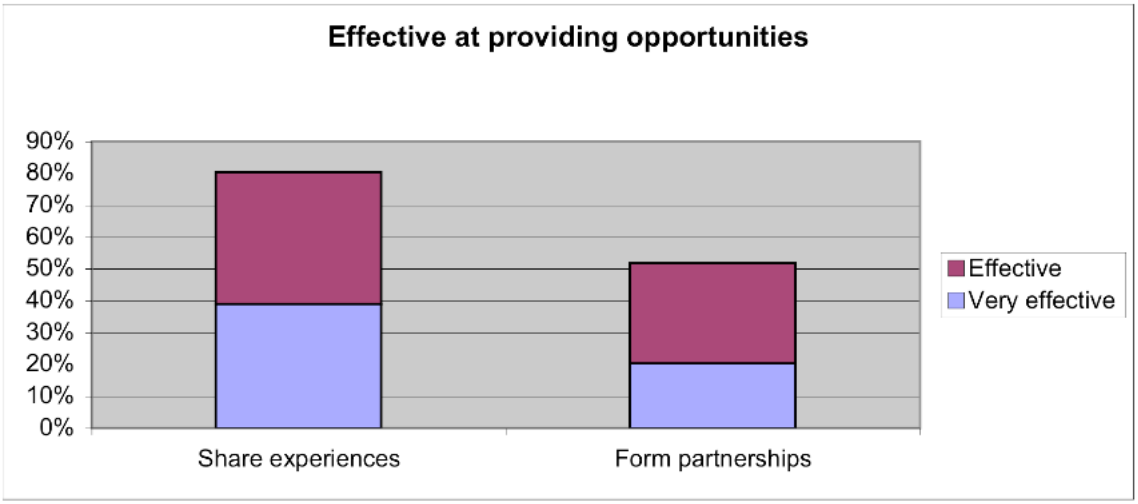
- More than $^{3}/_{4}$ (82%) said the workshop was effective or very effective at providing opportunities to share experiences and interests with others.

  > There were more people in my interest areas than I expected.
  > (Workshop participant)

- More than $^{1}/_{2}$ (53%) reported that the workshop was effective or very effective at providing opportunities to form partnerships leading to broader participation in future OSS missions and research programs. A few participants noted that it was difficult for them to find other researchers whose interests matched theirs closely enough to allow for fruitful collaboration.

  > The results of the workshop for people seeking to join collaboration seems black and white. You either find a project that fit you perfectly (unlikely) or you went away empty handed. There was very little gray area where there was actually hope for future collaboration if you didn't find them now.
  > (Workshop participant)

Figure 4: Effective Opportunities



Where the Workshop Needs Clarity

Several respondents indicated that the purpose of the workshop was unclear, as reported both in informal interviews and on the survey. In particular, they reported that they weren't sure if the workshop was meant to support collaboration in research or in E/PO.

> There are several potentially competing purposes of the meeting. Is it to involve people on major mission teams? In data analysis? In the feeder programs like rocket and balloon experiments? Is this an E/PO workshop? A lot of E/PO people attending think it is. (Workshop participant)

> If this is done again—and it should be—the focus needs to be better defined, with more emphasis on science and E/PO intersection. This would make an already good meeting better. (Workshop participant)

PHASE II: 3–6 MONTHS LATER

EVALUATION PLAN

The focus of the Phase II evaluation, reported in this section, was on the partnerships that developed between workshop participants subsequent to the workshop and, in particular:

- The steps that participants took to form these partnerships
- The factors that contributed to partnerships' success
- The challenges they faced

In addition, we wanted to know why those who had not succeeded in establishing partnerships had been unable to do so.

On the survey disseminated at the workshop itself, participants were asked to indicate if they were willing to be interviewed at a later date to discuss the impact of the workshop and, if so, whether they preferred to be contacted 3 or 6 months later. One hundred twenty-four (124) participants agreed to be contacted, of whom 35 indicated that they had had no affiliation or prior experience with NASA. The demographic breakdown of the respondents, as they reported, appears in Table 3. Slightly less than half (43%) chose not to provide this information.

Table 3: Self-Identified Demographic Breakdown of Participant Groups N=70

Group as Identified by Respondent	Number
African American (men and women)	32
Women (additional women in other categories)	24
Latino, Black Latino and Hispanic	9
Hawaiian	2
Native American	1
Other (1 learning disabled; 1 MBRS (minority biomedical researcher)	2
Total	**70**

Of the 124 participants, 52 or 42% responded to our follow-up inquiries several months later. Of these, we interviewed 14 workshop participants by phone and received email surveys from an additional 38. (See Appendix for survey and interview protocols). Those respondents who had not yet developed a partnership were directed to skip from question #4 to question #15 (*If you made contacts, but were not successful in establishing a partnership, please describe what happened*). Seventeen (17) or 33% of the respondents skipped. (Note that several of those who had formed partnerships nonetheless answered question 15.)

Data are broken down by question. For yes/no questions and demographics, we have provided the percentage of respondents who gave each answer. Other questions are analyzed qualitatively. Data from these questions cannot reliably be projected onto a larger population. First, in many cases, the sample size is less than 50. Second, these questions were presented in an open-ended format, allowing participants to identify aspects of the workshop that were most salient to them. The open-ended nature of the questions allows us to explore ideas, beliefs, attitudes, challenges, etc. that are present in the population of interest, but does not guarantee that all respondents will report on every aspect of the workshop. For example, some respondents might respond to the question, *If you are now working with a new partner as a result of attending the Chicago conference,*

what steps did you take to develop that partnership? by detailing specific means of interactions, such as phone calls, emails, and face-to-face meetings. Other respondents may give more general responses. Thus, even within our sample, the number of respondents mentioning phone calls may not accurately reflect the proportion of respondents who used that medium. Throughout the report, there are citations from the data, which enrich the report and allow the reader to hear participants' own words as they report their experiences.

To put the following discussion into perspective, it is important to note that establishing partnerships takes time and commitment; the fact that some of the respondents had not yet developed or been engaged in a partnership does not imply that a key goal of the workshop was not met. Negative answers to the questions, *What contacts/partnerships have you pursued since attending the workshop?* and *From your point of view, has your partnership been successful?* do not necessarily mean that the individuals and institutions involved will not proceed to develop a partnership sometime in the future. Some of our data is based on survey and interview responses only 3 months after the workshop which, in the of context of scientists' commitments to other jobs and responsibilities, is not a long time. Responses were collected 6 months later in anticipation that some participants would have initiated and developed partnerships to varying degrees.

SUMMARY OF FINDINGS

Approximately 25% of the 200+ participants at the workshop provided survey or interview data for this report.

The Chicago workshop was successful in achieving several goals:

- Almost all (98%) of 50 respondents reported that they had received contact information from at least one person they had not previously known.
- Almost all (90%) of 40 respondents reported that they had met a scientist or other professional relevant to their field, who shared their interests and needs.
- Two-thirds ($^2/_3$) of the 48 respondents had initiated, or were in early development of, partnerships within the first 6 months following the workshop. About $^1/_2$ mentioned telephone and email contacts, with others mentioning joint conference presentations, proposal development, and reciprocal visits, among other things.
- While only 20 workshop participants described factors that contributed to the success of their partnerships, research has found that many of the factors are, indeed, associated with successful partnerships overall.
- Twenty-eight (28) respondents described ways in which they felt that NASA could further support their efforts including: funding of additional programs similar to the Chicago workshop (which they found useful); a centralized clearinghouse/PIs or network of scientists interested in partnerships; helping participants connect with one another; providing more information about

missions, grants, and PIs interested in partnering; helping individuals and partners develop proposals; and taking into account the differences between Tier 1 Research Universities and others, including minority institutions and community colleges, when funding proposals.

FINDINGS BY QUESTION

QUESTION 1

Did you get contact information from at least one person you had not met before?

Of the 50 respondents, 98% made contacts and met scientists at the Chicago workshop.

QUESTION 2

Did you meet a scientist or other professional relevant to your field, who shared your interests and needs?

Forty-six (46) individuals answered this question, with 91% reporting that they had met researchers who worked in the same or similar field, a key workshop goal. Those from NASA indicated that they were not looking for other scientists, but rather institutions with which to partner. One individual mentioned looking specifically for a minority-serving institution with which to partner.

QUESTION 3

What contacts/partnerships have you pursued since attending the workshop?

Forty-eight (48) individuals responded to this question. Two-thirds ($^2/_3$) had already contacted individuals, institutions, or had established 'possible' partnerships at the time of the survey. While $^1/_3$ had not, or had not successfully, pursued/established a partnership, it is possible that over time some or all will be successful. Data provide evidence of the time involved in the process. For instance, individuals mentioned that they:

- "Had not gotten around to it"
- Needed to develop their own ideas further before moving forwards; one scientist commented:

  > I haven't aggressively pursued any, but I have spoken with people here and outside the University. Until you actually start working . . . it takes some time to form concrete ideas. You really have to get together and sit down with them and discuss things. Emailing is only a part of it.

- Had contacted individuals with no response

- Were in contact with individuals who jointly planned to write a white paper in order to get a "better understanding of what each does prior to moving forward with a joint proposal"
- Had engaged in several conversations, but a partnership had not yet developed

QUESTION 4

What partnerships do you plan to pursue in the future as a result of the workshop?

Fifty-two (52) individuals answered this question, of which 29% reported that they had no plans. Of those 37 individuals who described plans:

- More than $^1/_2$ plan to pursue individuals/institutions and cultivate partnerships
- Some described activities, such as writing grants, developing courses
- Some plan to approach NASA/EPOs, without specifying for what, while others plan to pursue partnerships with NASA E/POs or new missions

Some respondents actively pursued contacts they had made at the workshop, while a few participants were waiting for communication from the contacts they had made. Some established follow-up plans at the conference, such as dates for conference calls, and others left with nothing definite in mind. Bear in mind that any one respondent may have had other plans in mind that were not indicated on the survey. On their surveys, attendees mentioned a variety of partnerships they both hoped and planned to pursue, including:

- A partnership "with several HBCU professors and some officers from Space Science Broker groups to respond to NASA's recent Virtual Space Academy RFI, with the goal of competing for it as a team when the RFP is released"
- A possible partnership between scientists from CUNY, Elizabeth City College, South Carolina State University, and Tufts University
- A proposal to the NSF for a new REU program, to be carried out in partnership by TSU and Indiana University
- A partnership between the Center for Astrobiology (a member of the NASA Astrobiology Institute) and the National Organization Of Black Biochemists and Chemists
- A plan to speak with scientists at Goddard Space Center, as a strategy to meet mission scientists and develop collaborative work
- Contact with SOFIA about possible research collaboration
- Contact with Salish Kootenai College
- A planned proposal submission to the Sun-Earth program

QUESTION 5

If you are now working with a new partner as a result of attending the Chicago conference, what steps did you take to develop that partnership? (If you are not working with a partner, skip to #15)

Over $^1/_2$ of the 52 respondents did *not* skip to question 15.

Respondents described face-to-face and other steps involved in developing their partnerships (and may not have reported others). About $^1/_2$ mentioned telephone and email contacts. A few reported that old partnerships would continue. Others referred to the following:

- Visits to a partnering institution
- Grant proposal development
- Joint conference presentations
- Contact with one another
- Follow-up meetings
- Brainstorming "what we want to do"
- Collaborative course development
- Workshops offered

The following interview quotes are representative.

> **Teleconference:** We did a series of teleconferences where we each presented where our own organizations were at and what our goals were for the partnership. It really sort of slowed up from there, but it is moving forward.
>
> **Site visits:** We corresponded on email and tried to find if there was further interest in pursuing collaboration. I went from there. We decided one of the ways to do that was for me to visit their institution and present a seminar or colloquia, and vice versa.
>
> **Follow-up conference calls:** At the conference we decided we would have a quick follow-up call. In that call we had a fleshing out of what we would like to do with each other to make sure we were on the same page and that there were no misconceptions. That followed up with another conference call to identify what we would do over next few months.

One scientist described the preliminary work that he felt he needed to do before following up with his contacts.

> I want to get into missions but first I have to learn how to apply, what schools need, their existing equipment, and how to piggy back on another proposal in order to learn.

QUESTION 6

Does your partnership include a minority-serving institution (your own or your partner's)?

About $^3/_4$ of those 20 who responded to this question reported that they were actively partnering with a minority-serving institution. This was the central workshop goal and

this is a positive finding; however one cannot generalize from this given the small number of responses.

QUESTION 7

What activities have taken place as a result?

Only 17 respondents described the activities they and their contacts/partners had undertaken since leaving the Chicago workshop. About $^2/_3$ collaborated on proposal development, a few presented workshops, and individuals mentioned 3 additional partnership-building activities.

QUESTION 8

From your point of view, has your partnership been successful?

Twenty-six (26) individuals answered this question. Half ($^1/_2$) of them reported successful partnerships; slightly less than $^1/_2$ responded "don't know," "too soon to tell," or "somewhat"; and 1 individual said "no." It is important to note that "successful" was not defined in this survey, and therefore we are unable to interpret participants' responses. For example, one scientist might have indicated "yes" (successful) in relation to a partnership that was beginning to emerge, while a second might have responded "too early to tell."

The fact that 13 respondents answered "don't know" or "too soon to tell" is indicative of the extended *process* involved in partnership-building.

The following interview quotations represent "too soon to tell" responses.

> It's just starting to develop. I'm not in a position to make that decision yet. If we can get some research done, make presentations, and have publications, I would consider that a good measure of success. Hopefully that will happen in a year and a half.

> It is still really too early to tell. It's been successful in the sense of it [workshop] gave me a chance to talk with other people . . . I am trying to work with people and see if there are different things I can link together.

> We've been successful as an initial step in developing a proposal entitled Curriculum Enhancement Through Research and Education in Earth System Science (CETRESS). However, we strongly need NASA support to further this partnership.

QUESTION 9

What has contributed to the success of your partnership?

Twenty (20) workshop participants identified numerous factors that they believe contributed to the success of their partnerships. Research has found that effective

partnerships are usually associated with some or all of these factors, including mutual interests and goals, complementary expertise, and a history of working together:

- The initial meeting in Chicago and peoples' initial willingness and openness
- Mutual interests/benefits, common goals, common research interests

> In this case we all have mutual benefits. We had the same goal and so then you can figure out how to pool [your] resources as effectively as possible so you can reach that goal. We clicked because we lined up with critical success factors and goals each of us was looking for.

- Complementary strengths

> [What contributed to our success is] the mutual recognition of our complementary strengths. We have actually teamed to submit proposals. We agree to team for opportunities that our respective capabilities can support.

- Knew each other beforehand
- Combining resources (from small institutions)
- Being very proactive at the conference
- NASA scientists were very open
- NASA brought quality people together
- Conference packets described participants' roles, research interests, and areas of expertise, among other information

QUESTION 10

What challenges have you faced?

Twelve (12) respondents described 9 different challenges they faced in establishing partnerships. The major challenge, cited by 10 of them, was lack of resources, including funds, technical expertise, and time.

> Some challenges are common in trying to get a new program started. Once you are in the position to get a new program, you want to put your team together. Without the resources you can only have initial discussions. That's a major challenge.
>
> All involved are very busy and there has been little time to expand our preliminary ideas.
>
> Time constraints are a serious problem for many minority scientists since many work at teaching institutions. Most of these schools still require some research, so finding the time to form new partnerships is a real challenge.

Other challenges mentioned include:

- Different cultures and experiences
- Process of developing a partnership

- Balancing partnership with other responsibilities
- Forming a good team
- Lack of follow-up

Several participants described challenges specific to working with minority-serving institutions, including support for travel, the effort and uncertainty that accompanies outreach to these institutions, and a need for a centralized clearinghouse dedicated to bringing partners together.

> Many of the minority institutions require funding, and even when we are able to travel out of our existing grants, they may not have equivalent sources to be able to travel, so we [NASA] have to cover those costs.

> My sense from this is if each institution has to go out and forge relationships with the minority community, it's a huge amount of effort with a very uncertain path. While NASA has tried to coordinate or centralize its efforts to increase diversity, for many of us (partners outside the NASA system), it hasn't been very effective. At the same time, I've become convinced that a centralized clearinghouse that brings partners together is critically important.

One (1) respondent mentioned 2 challenges often faced by small and minority-serving institutions: the need to combine resources and the need for support for follow-up meetings.

> The conference helps with success because it opens up opportunities, particularly for a lot of small institutions. [But] when they meet and link up and try to do follow-up, it is a major thing. The 3 I met are all small: 2 HBC/U and 1 Hispanic institution. That is why we are trying to combine our resources. Afterwards there will be follow through on our part which will be the hard part until we can get some seed money.

Some challenges that were cited are based on cultural differences.

> We don't talk the same language. I'm a white woman at a white institution. And there are cultural barriers that both sides communicate. We have to work very carefully, but that's a challenge. There's not necessarily a large of set of shared experiences.

> They have really approached it from the European science point of view . . . not taking into account how you have to approach Native populations and run it [colloquia/courses] from their perspective. They were not able to get [Native American] students into the program . . . It occurred to me that the way they approached the whole program was completely wrong. I know of other programs that tried to get funding from the indigenous point of view and did not get funding. They were told they were too-hands on or too fuzzy or too group friendly. NASA felt that they would not be effective. So even those judging the grant monies come at this from white man science. Their hearts are in the right place but they are looking at the problem from the wrong point of view.

QUESTION 11

How could NASA further support your efforts?

Twenty-eight (28) survey respondents identified several ways in which NASA could support them. Approximately $^{1}/_{2}$ said more funding was needed, and ^{½} suggested "more programs" (like the Chicago workshop). This second group clearly appreciated the workshop, and expressed a need for more, similar events. Other ways in which they would like NASA to support their efforts include:

- More publicity
- A centralized clearinghouse/PIs or network of scientists interested in partnerships
- More ways to collaborate

Interview data from participants elaborate on, and extend these themes:

- Include non-NASA scientists in similar workshops.
- Continue offering and publicizing programs similar to the Chicago workshop.

  > One thing they could do is to continue the kinds of conferences I attended. That was the first and I thought it was an outstanding effort and should be continued.

- Provide support for activities beyond the Chicago workshop by helping participants connect with one another, and by providing more information about how to 'break into' the funding cycle (each of these was mentioned by 1 individual).

  > It was very difficult [at the conference] to locate the person to get in touch with if you wanted to get involved. There were too many groups, and not a procedure for connecting.

  > It would help if NASA didn't restrict this conference to NASA scientists. Like me, I imagine there were other people at the conference who found partnerships, but not necessarily with the criteria of being NASA scientists.

  > They claimed to have support material and show you how to do things but there was no primer about "This is what you have to do to break into the funding." The talks were cool but there was no link to things you could take home and start with step one and two.

- Provide more information about missions, grants, and PIs interested in partnering.

  > [NASA could help by] continuing to put out little blurbs and tips about how to get on missions, openings for research grants, PIs to contact, and something [emails] sent to us. We do not always stop to go to NASA websites. Something like a news flash.

- Work with individuals/partners who want help developing proposals (mentioned by 1 individual).

> When you have a group of persons coming together to write a proposal, NASA can work with such an organization about what it is they are looking for with these kinds of proposals. They could bring together persons interested for a workshop outlining what are the current steps they go through in reviewing proposals, key elements, have there been changes, and that would be a benefit.

- Take into account the differences between Tier 1 Research Universities and others, including minority institutions and community colleges, when funding proposals (mentioned by 1 individual).

> You [NASA] say you want us to do this but the criteria are the same you use for Harvard and MIT and we are not that. They have libraries and journals and everything. Not that we should have lower criteria but you must take context into consideration. We have different teaching loads. People looked at me as if I were insane when I talked about my teaching load. How can you write articles? I teach everything from college algebra to graduate mathematics—the whole gamut. No one understands that at minority-serving institutions it is very difficult to compete on the same playing field. Develop a centralized network/clearinghouse of NASA scientists interested in partnering [with us].

- Provide smaller institutions with the funds they need to support their programs, such as money for equipment and to seed initiatives (mentioned by 9 respondents).

> If you really want science in the pipeline, you want small schools to have research projects so students can learn and have experience.

- Consider minority representation within NASA itself.

> Most of [the workshop] was well done. The only negative thing I heard was that several people who had been there several times felt that between meetings they were not seeing the impact of minorities in places . . . [It's a] good mantra from NASA, but they are not giving true thought to systemic change and to putting minorities into positions of impact. On top of that we do not see NASA making the internal difficult decisions that must occur to drive the change they talk about happening . . . when you look into NASA and decision-making, it is the same core group and it is not diverse.

QUESTIONS 12 AND 13

Did the Chicago workshop provide you with new ideas about, or approaches to, collaboration around mission research? If yes, what were these?

Only 15 individuals answered this survey question, of whom approximately $^1/_2$ learned something new about collaborations and the other $^1/_2$ did not. Respondents mentioned learning about opportunities for meeting collaborators and/or networking, learning of potential areas for research, and "being exposed to NASA's new policies."

During interviews, 6 participants reported that they had gained information and ideas from the workshop that related to research collaboration. They profited from learning information about NASA's "new policies with respect to minority opportunities, education and outreach programs," having opportunities to meet others interested in collaborating, learning about new potential areas for research, "how the game is played," and how to partner with NASA itself.

> I saw that one can either work with a well-established long-term mission in some limited capacity, or one can work with shorter-term and less-expensive missions (rocket, balloon, small satellite, etc.) that provide more comprehensive experiences for the scientists and students.
>
> I went there to [contact] NASA to understand how we could partner together. So a lot of things we learned about were very appropriate. I met a lot of people on staff at NASA or the recipients or participants in outreach programs. . .I gained a lot of insight about what to do to be more successful than we are. Now it is up to us to follow back with those individuals to make proposals and to work with people in universities.
>
> We learned more about NASA's new policies with respect to minority opportunities, education and outreach programs. I saw potential opportunities in the planning stages.

QUESTION 14

How has this partnership changed the work that you do?

Only nineteen (19) individuals answered this survey question. The Chicago workshop affected how 11 of them work or plan to work in the future, including better ways to work with underrepresented populations and minority institutions. Given the focus of the conference, this is particularly noteworthy.

- Four (4) reported an increased interest in, or learning more effective strategies for, working with minorities.

  > It has renewed my interest in recruiting minorities into undergraduate science majors and reinvigorated a neglected research project.
  >
  > We can plan our budget/activities in a better way to be more inclusive in working with more underrepresented populations.
  >
  > We have become more aware of cultural differences and are learning so much by working with the Native community. We take more time to reflect and plan.
  >
  > We can plan our budget/activities in a better way to be more inclusive in working with more underrepresented populations.

- Three (3) broadened or expanded their research as a result. One (1) commented that he is "beginning to think like a mission lead."

> It serves as an extension of our capabilities. We can go after more challenging business opportunities as part of a team.
>
> I am beginning to think like a mission lead who is trying to solicit, identify, and address the various interests, concerns, and needs of his potential partners.

- Others mentioned an awareness of new opportunities, and feeling "on the cutting edge" of technology.
- Seven (7) respondents did not note any changes in their thinking.

QUESTION 15

If you made contacts, but were not successful in establishing a partnership, please describe what happened.

Note that 15 respondents skipped from question 5 to question 15. However, others who *had* established partnerships also responded to this question for a total of 39 respondents.

Overall, respondents cited challenges reported earlier in this report—time required; lack of follow-up with, or *being contacted by,* those whom they had met in Chicago; and not meeting anyone with similar research interests. Time issues included too many other obligations; heavy schedules of scientists who work at smaller, minority-teaching institutions; and the fact that it can take months or years to work out collaborations.

These challenges are described below, accompanied by interview quotations.

- Future follow-up: Some mentioned that they had contact information if they wanted or needed to follow up in the future.

> I have their cards and will probably follow up if the opportunity arises. For example, if there is a proposal opportunity that would require a resource or partnership that I gained at the conference. Basically, I now have a larger set of information to pull from and a more complete idea of the OSS activities. I will pull from this information if I have to solve problems, do projects, or write proposals.
>
> I haven't had the need to contact anyone, but usually these types of things work out over months or years. For example, at the next conference I go to, I may meet someone I met at the Chicago workshop and catch up with them, and get to know them better. If they then applied to be part of a future mission I was working on, or for a job at my institution, for example, I would know them and their skills, and would be able to better support their application. This is how things generally work in my field regardless of whether someone is a minority or not, and for this reason it was good to meet people from minority backgrounds that I wouldn't have got to meet otherwise.

- Follow-up issues included one participant not having been contacted yet and not having had time to pursue the program he found.

> I didn't hear from anyone I met, got sidetracked, and pretty much forgot about the meeting.

- One participant explained that his specific needs didn't allow him to set up partnerships, but he expected he would in a few years. A second participant who was "not yet" successful in establishing a partnership pointed out that (currently) there was no need for his special piece of equipment.

> I talked with a few people with somewhat similar interests but nothing came of this. Basically, I attended this meeting with the hope of offering a research opportunity to those who do not have ready access to [special piece of equipment]. There is apparently no need for [them].

It is important to underscore that partnerships take time to develop and function. The data for this report was collected at the initial Chicago conference, and within 3–6 months following that meeting. In the world of partnership building, this is a relatively short time. For this reason, the findings should be read as about *one point in time* in the development or attempted development of the partnerships. In fact, it is too early to know whether they will become successful. Other partnerships funded by NASA, such as the MUCERPI partnerships also described in this report, have been developing over years.

APPENDICES

Appendix A: Participant Survey

Appendix B: Follow-Up Participant Email Survey

Appendix C: Follow-Up Participant Interview Protocol

APPENDIX A
PARTICIPANT SURVEY

LESLEY UNIVERSITY
CENTERS AND INSTITUTES

PROGRAM EVALUATION AND RESEARCH GROUP

Participants Survey: Chicago 2004 Workshop, June 27-29, 2004

This survey is part of the evaluation of the Chicago 2004 Workshop that is being conducted by the Program Evaluation and Research Group (PERG) at Lesley University. The information you provide will help the developers understand how effective the workshop was in meeting its goals.

*Please note that the information in this questionnaire is **confidential** & **voluntary.***

PERG is the only agency privy to the survey information.

Field of research: _____

Position(s)/Role(s): _____

Home Institute(s)/Organization(s)_____

Are you a(n): ❑Undergraduate ❑Graduate ❑Post Doc ❑Professional

If you checked 'Professional', please indicate how long since you completed your degree? _____

Do you identify yourself with any group that has been traditionally underrepresented in the sciences? ❑Yes ❑No

If yes, please indicate group _____

Have you ever been involved in NASA Office of Space Science funded research?

❑Yes ❑No

If yes, please indicate grant category(s):

❑Mission or program (AO solicitation)
❑Supporting research or technology (NRA or CAN solicitation)
❑ NASA Minority University Grant (MURED or MUREP)
❑OSS Minority University Grant (MUCERPI or MUI)
❑Education and Public Outreach
❑Other_____

How did you learn about the Chicago 2004 Workshop?

- ❑The official Chicago 2004 Workshop web site
- ❑Supervisor
- ❑Colleague
- ❑Personally contacted by OSS personnel
- ❑List Serve
- ❑Professional Organization Name of organization:_____
- ❑Other_____

Was the information communicated to you about the Workshop (check as many as apply):

- ❑Accessible
- ❑Timely
- ❑Clear
- ❑Sufficient
- ❑Appropriate
- ❑Other_____

Please explain:

How well did the Workshop meet your expectations?

- ❑Exceeded expectations
- ❑Met expectations
- ❑Met some expectations
- ❑Did not meet expectations

Please explain:

I: How effective was the Workshop at providing information about the following:

Future OSS mission and research program plans and opportunities?
❑Very Effective ❑Effective ❑Somewhat Effective ❑Not Effective ❑N/A

How successful mission and research teams and proposals are put together?
❑Very Effective ❑Effective ❑Somewhat Effective ❑Not Effective ❑N/A

How plans and solicitations for future OSS missions and research programs are developed and publicized?
❑Very Effective ❑Effective ❑Somewhat Effective ❑Not Effective ❑N/A

How proposals are reviewed and selected?
❑Very Effective ❑Effective ❑Somewhat Effective ❑Not Effective ❑N/A

II: How effective was the Workshop at providing the following experiences:

Providing opportunities to share experiences and interests with others?
❑Very Effective ❑Effective ❑Somewhat Effective ❑Not Effective ❑N/A

Forming partnerships leading to broader participation in future OSS missions and research programs?
❑Very Effective ❑Effective ❑Somewhat Effective ❑Not Effective ❑N/A

Did you make any new contacts during the Workshop? ❑Yes ❑No

How useful do you think the contacts will be?
❑Very Useful ❑Useful ❑Somewhat useful ❑Not useful ❑No opinion

III: How useful did you find the following Workshop sessions:

Monday

Overview of the OSS enterprises?
❑Very Useful ❑Useful ❑Somewhat useful ❑Not useful ❑No opinion

Break-out and discussion sessions?
❑Very Useful ❑Useful ❑Somewhat useful ❑Not useful ❑No opinion

Plenary session: Science talk?
❑Very Useful ❑Useful ❑Somewhat useful ❑Not useful ❑No opinion

Poster Session: Interests and experience of scientists seeking to join teams?
❑Very Useful ❑Useful ❑Somewhat useful ❑Not useful ❑No opinion

Evening at Adler Planetarium?
❑Very Useful ❑Useful ❑Somewhat useful ❑Not useful ❑No opinion

Tuesday

Plenary session: How NASA Space Science does business?
❑Very Useful ❑Useful ❑Somewhat useful ❑Not useful ❑No opinion

Poster Session: Interests and needs of scientists seeking new partners?
❑Very Useful ❑Useful ❑Somewhat useful ❑Not useful ❑No opinion

Final Panel: Reflections on the Workshop
❑Very Useful ❑Useful ❑Somewhat useful ❑Not useful ❑No opinion

IV: We would like to contact a sample of participants to talk about the impact of the Workshop.

Would you be willing to be contacted? ❑Yes ❑No

If yes, please provide your:

Name:
Phone number:
Email:

Please indicate which time frame works best for you to be contacted?

❑3 months ❑6 months

V: Other comments:

APPENDIX B
FOLLOW-UP PARTICIPANT EMAIL SURVEY

Last June 28 you attended NASA's Office of Space Science's Chicago 2004 Workshop, and filled out a brief survey for the Program Evaluation and Research Group at Lesley University. As you may recall, we were hired by NASA's Office of Space Science to assess the OSS Education and Public Outreach program and its products. A central goal of the workshop was to provide an opportunity for networking between NASA mission scientists and PIs, and institutions/scientists seeking mission partners with similar interests and needs.

At that time you generously indicated your willingness to be contacted after 3 months for some follow-up information about the outcomes of your partnering efforts. Today I am taking you up on your generous offer. In the following text of this email I have pasted a survey, and ask that you respond to the questions and return it to me. If you prefer, I can send you the survey as an attachment. Your candid responses to this survey will help NASA improve its efforts in facilitating and supporting such partnerships. Your survey will remain confidential and will only be reviewed by PERG. Aggregated data that emerges from our study will be shared in report form with NASA. If you have questions, please contact Sabra Lee, PERG at 1-800-999-1959 ext. 8450 or by e-mail, slee@mail.lesley.edu. Thank you very much.

1. At the workshop did you get contact information from at least one person you had not met before?

2. Did you meet a scientists or other professional relevant to your field, who shared your interests and needs?

3. What contacts/partnerships have you pursued since attending the workshop?

4. What partnerships do you plan to pursue in the future as a result of the workshop?

5. If you are now working with a new partner as a result of attending the Chicago conference, what steps did you take to develop that partnership? [If you are not working with a partner skip to #15]

6. Does your partnership include a minority-serving institution (your own or your partner's)?

7. What activities have taken place as a result?

8. From your point of view, has your partnership been successful?

9. What has contributed to the success of your partnership?

10. What challenges have you faced?

11. How could NASA further support your efforts?

12. Did the Chicago workshop provide you with new ideas about, or approaches to, collaboration around mission research?

13. If yes, what were these?

14. How has this partnership changed the work that you do?

15. If you made contacts, but were not successful in establishing a partnership, please describe what happened.

APPENDIX C
FOLLOW-UP PARTICIPANT INTERVIEW PROTOCOL

Interview Protocol
Participants in the Chicago Conference

Name of interviewee:
Role:
Institution/NASA program or mission:
Contact information:
Date:
Interviewer:

I'm calling from the Program Evaluation and Research Group (PERG) at Lesley University in Cambridge MA, hired by NASA's Office of Space Science to follow up with participants at the Chicago Workshop last June. I'm calling you today because you indicated an interest in being contacted three months after the workshop to provide an update on what's happened in the intervening time. I'm calling other participants as well and surveying yet another sample for our study.

As you know, a central goal of the workshop was to provide an opportunity for networking between NASA mission scientists and PIs, and institutions/scientists seeking mission partners with similar interests and needs. Our conversation today is **confidential** and will only be reviewed by PERG. Aggregated data will be shared in report form with NASA.

Overall, I'm interested in finding out whether you have been able to partner with a scientist, mission, or institution since attending the Chicago Workshop. I'd like to know the outcomes of any partnering efforts, what has contributed to your success, and what challenges you have run into.

Questions for everyone: introduction

1. About how many contacts with people you had not met before did you make at the workshop?

2. Did you meet a scientist or other professional relevant to your field who shared your interests and needs?"

3. What contacts/partnerships have you pursued since attending the conference/workshop?

4. What partnerships do you plan to pursue in the future as a result of the workshop?

If interviewee has not established a partnership(s) and does not plan to pursue any at this time, go to b (bottom of survey).

A. Development and success of partnership

5. Does your partnership include a minority-serving institution (your own or your partner's)?

6. If you are now working with a new partner as a result of attending the Chicago conference, what steps did you take to develop that partnership?

    6a. If you are partnering with a mission, in what ways have you been integrated into their work?

    6b. How have the mission and mission scientists with whom your are partnering enriched your work?

    6c. If you are a scientist or PI in a mission, in what ways have you involved your partnering institution/scientist?

7. Has your partnership been successful, to date, from your point of view?

8. What has contributed to the success of your partnership?

9. What challenges have you faced?

10. How could NASA further support your efforts?

Impact of partnership

11. Did the Chicago workshop provide you with new ideas about, or approaches to, collaboration around mission research?

12. If yes, what were these?

13. How has this partnership changed the work that you do?

B. Interviewees not successful in developing any partnership

13. a Did the Chicago workshop provide you with new ideas about, or approaches to, collaboration around mission research?

14. If you made contacts, but were not successful in establishing a partnership, please describe what happened. What were the contributing factors?

15. How could NASA have further supported networking?

For NASA interviewees:

16. How successful do you think the conference has been in involving new scientists and educators in NASA programs?