NASA Explorer Schools Evaluation Brief 4: *Evidence that the Model Is Working*

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NASA-Sponsored Classroom of the Future

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About the NASA-sponsored Classroom of the Future

The NASA-sponsored Classroom of the Future program is helping to bridge the gap between America's classrooms and the expertise of NASA scientists, who have advanced the frontiers of knowledge in virtually every field of science over the last 40 years. The program is administered by the Erma Ora Byrd Center for Educational Technologies® at Wheeling Jesuit University in Wheeling, WV.

The Classroom of the Future™ serves as the National Aeronautics and Space Administration's premier research and development program for educational technologies. In this capacity the Classroom of the Future develops and conducts research on technology-based learning materials that challenge students to solve problems by using datasets and other information resources provided by the four core scientific missions underlying the work of NASA: Exploration Systems, Space Operations, Science, and Aeronautics.

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Executive Summary

A comprehensive evaluation of the National Aeronautics and Space Administration Explorer Schools (NES) program was designed and conducted over the past 2.5 years. This report describes the program's logic model, its implementation, its effect on key stakeholders, and recommendations for next steps. Full reports for each data source are included as appendices.

Scope and Nature of the Evaluation
The research and evaluation team of the NASA-sponsored Classroom of the Future at the Center for Educational Technologies® at Wheeling Jesuit University in Wheeling, WV, is conducting the evaluation of the Explorer Schools program. The goal of the evaluation is to use multiple formative and summative educational research methods to examine the nature, extent, and effect of NASA support (stipends, professional development services, and curriculum support activities) on school decisions and resulting plans for actions.

NASA Explorer Schools Model
The teachers, students, and surrounding school communities served by the NES program represent high-minority, ethnically diverse, and high-poverty populations. These groups have identified the need for assistance in teaching science, technology, engineering, mathematics, and geography (STEM-G) subjects. School teams consisting of teachers and an administrator are selected on a competitive basis. Since its inception in 2003, the program has selected 50 schools each year, with 149 schools participating in the NES program evaluation reported here. The implementation of the NES model is consistent with research evidence indicating that teacher professional development can result in improved teaching practices and student learning (Borko, 2004; Garet, Porter, Desimone, Birman, & Yoon, 2001).

As a systemic reform initiative, the NES program works with a cadre of school teams over a three-year period. The teachers and school administrators participating in this program also play a key role in demonstrating how NES serves the schools. In order to impact students, the NES model first focuses on the leadership team to increase their awareness of NASA resources and improve their knowledge of STEM-G concepts and topics. Inquiry is modeled and taught as an effective pedagogical strategy for teaching STEM-G content. Then the leadership teams are supported in planning how to promote school wide engagement of faculty, families/caregivers and the community. Ultimately, success of the program is measured in terms of student interest, attitude, and achievement in STEM-G academic areas and careers.

Research Questions and Summaries of Findings

1. How Is the NES Model Being Implemented?

This section examines how the program as described in the logic model is being implemented by examining the role of NES headquarters, field center staff, and NES school teams over the past 18 months of the program.

NES Headquarters. The NES headquarters provides the following administrative services:

a. Disseminating funds and program planning and leadership to support the organization and implementation of the program.
b. Orchestrating communications and coordination of support for the NASA staff and schools.
c. Garnering and organizing support from within NASA for the centers and schools.
d. Initiating professional development services and support for crosscutting activities for the schools, such as for professional development workshops (Winter's Story, SEM-B, regional and national conferences).

e. Offering curriculum review and development specific to inquiry and the needs of NES schools.
f. Conducting outreach, application, dissemination, and publicity services to promote NES opportunities at minority institutions, professional teacher organizations, and STEM-G professional societies and groups.
g. Contracting for program and outcomes evaluation.

NES field center staff. NES coordinators are the main contact at the field center for the school for questions, services, and support. NES coordinators come from STEM backgrounds in K-12 education, so they are able to help the school teams implement the program, advising them on strategies and ideas for accomplishing their goals. NES coordinators work with the school team leads to share successes and challenges and to develop ways to integrate best practices into the support the field center offers the schools. The NES coordinators also work closely with aerospace education specialists and other field center staff to help schools select NASA resources that address STEM-G needs and goals. Aerospace education specialists provide onsite support for schools. In fall 2005 Digital Learning Network coordinators were added to five field center teams to support the NES schools' use of the network.

NASA Explorer Schools. The schools selected for the NES program are high-minority, high poverty, ethnically diverse, and previously low-achieving schools that are in great need of help to address national goals for improving student STEM-G achievement. Once a school is accepted into the program, it completes a needs assessment profile of school academic priorities. The assessment is used as a reference for the development of strategic and implementation plans that identify how NASA resources and services will be used to meet STEM-G academic goals. The five-person NES team from each school develops these plans with support from field center staff. The staff encourages and supports the team in taking a leadership role in involving the school, community, and local partners in the reform effort.

2. How does NES encourage more involvement with NASA programs, products, and services?

Orientation workshops emphasize understanding NASA resources, creating strategic and implementation plans, using NASA resources to meet specific student needs, developing pedagogical skills, learning about the Digital Learning Network, and building teams. Critical factors are modeling and teaching inquiry, focusing on career development, providing ideas for family involvement, developing detailed plans, and developing teamwork within the school teams. Areas to improve are the use of student work, career information and strategies, family involvement information, and strategies.

Content workshops emphasize STEM-G content knowledge, specific pedagogical strategies, use of NASA resources, technology use, and the observation of expert teaching. Critical factors are modeling and teaching inquiry, focusing on specific pedagogical knowledge, and planning for use in the school.

NES coordinators provide support for NES teams during the school year via telephone, e-mail, and videoconferencing. Aerospace education specialists provide onsite support for the schools. Schools praised individual specialists who visit frequently, do master presentations, motivate NES teams with new ideas, respond to the schools' needs and requests, and provide NASA materials. The majority of field center staff (85 percent) believes they are effective in carrying out the NES program, and 82 percent say they are satisfied with the program.

Here are five factors that NASA field center staff identifies as important for successful implementation of the program:

- *Teamwork of the field center staff*
- *Responsiveness to the school's needs and goals*
- *Ongoing communication with the schools, especially reaching out to identify needs*
- *Multiple forms of communication such as e-mail, calls, visits*

- *More frequent visits to the school to create greater effect*

NASA staff that currently supports NES should focus their efforts on the factors identified in these analyses by:

- Continuing the communication methods they currently use.
- Scheduling more regular video and teleconferences with school teams to respond to their needs for information and program resources.
- Providing examples of school implementations through stories and vignettes.
- Pairing schools for mentoring and program development.
- Asking for quarterly reports on progress implementing the school strategic plans.
- Scheduling regular video and teleconferences for administrators across districts.

3. How does NASA involvement increase teacher professional growth?

From the sources of data available, it is clear that the teachers feel they are benefiting from the professional development opportunities provided as part of their NASA Explorer Schools participation. They report feeling inspired and confident and have an understanding of the NASA resources available to them. The combination of exciting, relevant content and the resources and support to use it receives high ratings from the teachers, and that content is put to use in their classrooms. The teachers are motivated to learn new content and to integrate it into their teaching. They report they are gaining knowledge and skill in STEM-G. They give very high ratings to the professional development they receive from NASA and attribute the changes in their teaching practice to the NASA connection. They show shifts toward constructivist teaching and learning after the first year of participation. Continuing this trend might require attention to the specific barriers the teachers face in their schools such as lack of time and administrative support. The teachers value the kind of involvement that characterizes active engagement and seem to be developing their constructivist teaching strategies.

Based on a triangulation of the data sources, these five characteristics emerged as critical factors that lead to increased teacher competence:

- A strong, stable NES team with a clear strategic plan that links NASA products to the school's academic need(s).
- An organized team lead that has the time to communicate and organize the connection to NASA.
- An actively supportive administrator, who provides team planning time, explicitly supports the program with the faculty and district administration, and provides extra funds.
- A whole school focus by the team with the key administrator's support of systemic changes, from curriculum to after-school opportunities and participation by teachers in professional development. When there is a whole school focus, the school naturally involves families and the community, inviting them to events, getting publicity for the school's work, and helping everyone to enjoy learning about science, technology, engineering, mathematics, and geography topics through the NASA lens.
- Close contact with field center staff to find out what products are available. Effective schools meet regularly to discuss how to take advantage of these resources, read their e-mail consistently, and use the NES web site to find additional information about NASA resources and services.

Technical challenges in setting up videoconferencing and the late arrival of funds are considered the biggest barriers to use of the Digital Learning Network, which is the core technology supported by NASA funds and which gives schools access to NASA resources.

NES professional development efforts should continue to focus on modeling active engagement and teaching constructivist strategies for specific content knowledge that will support the needs identified by each school. Helping the leadership teams to support the rest of their faculties is crucial to whole school reform and change in student knowledge, attitudes, and skill.

4. What is the effect of the program on school administrators?

Administrators from all three cohorts express satisfaction and a growing understanding of their role in the Explorer Schools model. They value constructivist teaching and learning (3.85-3.93 on 1-5 scale). They are satisfied with the program goals, emphasizing professional development, student learning STEM-G, student interest in STEM-G careers, and family involvement (77-90 percent). They believe schools will show increases in all these areas after three years in the program (80-95 percent). After having experienced the program for more than two years, the administrators from 2003 are less concerned about the time it takes teachers to implement and coordinate the program than those of 2004. They also have a clearer idea of how to support the program internally and with external resources.

The NES program should continue to work closely with administrators, particularly in the first year, to help them define their critical role in involving the faculty and community. Further support could be provided through separate professional development in the orientation workshop, mentoring from administrators from schools completing their three years as an Explorer School, a monthly videoconference for administrators and yearly professional development.

5. What is the effect of the program on family/caregiver involvement?

School teams report that they are better able to involve families and the community in STEM-G activities because of their designation as a NASA Explorer School. The aerospace education specialists affiliated with each center are instrumental in organizing and running family events, especially for first-year NES programs. The community is invited to these events, which build their relationship with the school and can lead to support for other activities. The publicity from these events also improves the image of the school in the community and for the families of the children who attend the school. As NES hoped, in the most active schools, these activities and the concomitant change in image then leads to greater confidence in the students' ability to succeed in STEM-G in school and later in careers.

As with the changes in the classroom, aerospace education specialist assistance is often critical to success with family and community involvement, by helping them plan a schedule of regular events, providing dynamic content, and building on their early successes. Getting families interested in coming out for star gazing and science shows can lead to them talking to their children about what they are learning and encouraging them to go into STEM-G careers. The recommendation emerged that family activities, content, methods to involve families, and ongoing assessment of family involvement should receive more emphasis in professional development, particularly the summer workshops.

6. What is the effect of the program on students' interest, career aspirations, and knowledge of science, technology, engineering, mathematics, and geography?

From the data gathered so far, the participants report that the program is affecting students positively and sustaining their interest in STEM-G. From the self-report data, we do not know whether their perceptions match actual gains in knowledge or if they actually do better in their classes. Going forward, case studies of a random selection of schools, student content tests in academic priority areas, and the collection of baseline data will provide additional evidence of effects the Explorer Schools program has on the schools.

Effect on student STEM-G knowledge. From the evaluation data collected to date from the participants, we can say that students, teachers and field center staff believe students have learned more STEM-G content, particularly science, mathematics, and technology. The data are unclear about the depth or quality of that understanding. Certainly, in the questions about what science and math are and how they are used, students show only a general understanding of the nature of science/mathematics and scientific work. Perhaps more attention to the nature of science, the ways of knowing in math and science and the specific uses of STEM-G would result in a better understanding of, and perhaps significant changes in, students' understanding of the intellectual and practical role of science and math, their ratings of their own knowledge, how much they actually know, and how much they engage in the subjects that address STEM-G topics in school.

Effect on career interest. The data collected from students, teachers, and field center staff indicates that the students are interested in careers in STEM-G, especially science, engineering, and technology. Students report being very interested in some of the jobs they have learned more about through the program, They indicate that events like the symposium get them more interested in STEM-G careers and topics, so they will do activities such as, watching science TV and talking with classmates about science topics. Team leads report that students are pursuing STEM-G topics after school on the Internet. Field center staff report that teachers are integrating more activities into their courses to interest students and that schools are sponsoring evening events for families that get everyone involved in supporting the students' interest and career aspirations. Students report doing science and mathematics thinking, such as; "using computers with science data," and "studying how energy is made in ecosystems."

When asked about career interests, students are most interested in being astronauts, food scientists, mechanical engineers, oceanographers, and robotics engineers. They have more enthusiasm than understanding of these careers, but it is clear that some of them have gone into depth about the career, such as with the food scientist when one student wrote, "In this job people try to figure out what type of food they should take up in space and try to find new foods that could last in space. They have to do this because if they don't have the right food, it will make it heavy." It is recommended that school teams and field center staff give more attention to student need for a better understanding of the thinking and activities of people involved in careers in STEM-G.

Effect on student application of STEM-G knowledge. The team leads and field center staff each report much more student interest in STEM-G topics as a result of the NASA Explorer Schools program. Students also report being inspired, and making connections between their NASA experiences, such as a visit to a NASA field center or lesson with an aerospace education specialist, to their school subjects and interests. Science and technology are the most often cited as the preferred areas. When asked about thinking, doing, reading and discussing STEM-G topics outside of schools, the majority of students say they will as result of involvement. In general, students reported that math and science are harder for them than other subjects. At the same time, they reported that science is fun, and they expect to do above average in math and science this year, perhaps due to the extra support and excitement from the NASA Explorer Schools program.

WHAT IS THE EFFECT OF THE NASA EXPLORER SCHOOL PROGRAM?

What Is the Effect of the Explorer Schools Program on Teachers?

Background. The Explorer Schools program provides comprehensive, ongoing professional development in STEM-G content in the NASA context, careers, and inquiry. This design for professional development is based on the hypothesis that a leadership team can develop and implement plans for using NASA resources that will affect students' STEM-G knowledge, career aspirations, and interests.

As described in detail in the model section, professional development begins in the orientation process when field center staff visit the schools to meet with the leadership team of five and discuss their academic priorities and what it means to be an Explorer School. The first summer's professional development for the leadership team focuses on orientation to NASA resources, teamwork, and inquiry. This is followed by on-site professional development planned with the Aerospace education specialists during the year and opportunities for any of the teachers at the school to attend conferences and special workshops. In May, one teacher and two students are invited to attend the Student Symposium, where the teachers have professional development. The second summer, teachers sign up for content workshops at any of the ten centers based on their interests and school needs, followed by more on-site workshops, conferences and other activities during the year. In May of the second year of participation, half of the schools are invited to attend the symposium, and all the schools are invited to a sustainability conference in the summer to share success stories and find out about opportunities beyond the third year of participation. Throughout the program, teachers received monthly newsletters that provide information they can use with students and families. The leadership team is encouraged to offer on-site professional development for the staff and families.

Methods. To examine the effect of the Explorer Schools program on teachers, three quantitative measures of the effect of the Explorer Schools program are reported here: Feedback surveys from the 22 summer workshops (orientation, content and sustainability); the annual student symposium teacher survey; the annual *Teaching, Learning and Computing* survey; and the focus group interviews with the 2003 cohort in the winter of 2005.

As mentioned in the methodology section of this report, the Teaching, Learning, and Computer survey is a self-report questionnaire adapted from Becker (2000)[1] that yields data on five constructs aligned with constructivist principles for teaching and learning: technical skill; constructivist teaching strategies; attitude toward technology; constructivist teaching philosophy; constructivist uses of technology. Data from the following surveys were collected from an online form or in printed form, analyzed, and are integrated here to address the hypotheses that involvement with NASA resources and services increases teacher competencies in teaching STEM-G topics.

The scale used to gauge constructivist perspectives and beliefs ranged from 1 (very traditional) to 5 (very constructivist). To determine whether significant changes occurred in perspectives related to evaluation constructs, five independent samples t-tests were conducted on the means of each evaluation construct utilizing questionnaires from the Fall (pre) and Spring (post). T-tests for independent groups were run to gauge growth of 2003 cohort over two years, and 2004 for one year. T-tests for matched pairs were run on subset of participants for whom data was available from the 2003 cohort for the fall ’03, spring ’04 and spring ’05 administrations and from the 2004 cohort where data was available for the spring ’04 and spring ’05 administrations. Analysis of covariance among constructs was conducted on the matched pair data.

Table 19. Teaching, Learning, and Computer (TLC) Teacher Survey

Cohort year	When TLC taken	Number of teachers (250 possible in each group)
2003	Fall 2003	121
	Spring 2004	193
	Spring 2005	146
2004	Spring 2004	189
	Spring 2005	149
2005	Spring 2005	104

Focus Groups

The 45-minute focus groups were conducted by telephone with the leadership teams. The purpose of the focus groups was to learn how school teams experienced the program, examine

[1] Becker, H. J. (2000). *Findings from the teaching, learning, and computing survey: Is Larry Cuban right?* Paper presented at the School Technology Leadership Conference of the Council of Chief State School Officers, Washington, D.C.

the implementation of their strategic plans, gauge the nature and extent of the support they received from NASA field centers, and note their evaluative perspectives. The final protocol included questions that probed how the school teams work as a unit, implement their school's strategic plan, what they perceive to be the impact of the program on themselves and their students, what are their evaluation plans, and what are their understandings of the NES goals.

The preparation process of the focus groups, prior to conducting them, ensured a naturalistic interaction between researchers and school teams (Rubin & Rubin, 1995[2]; Seidman, 1998[3]). In 10 out of the 49 focus groups, only one team member was available to participate in the focus group because of scheduling issues or because other team members did not have time to participate. Most of these ten individual interviews were conducted with Team Leads. CCT researchers analyzed the data for emerging themes organized around four research questions: 1) How are school teams experiencing the program? 2) How are they implementing their strategic plans? 3) How do they assess the support they receive from NASA field centers? 4) What are their evaluative perspectives?

Findings for Effects on Teachers

The three self-report instruments provide different lenses through which to view the program. The Summer Workshops are the most intensive concentrated professional development, while the Student Symposium is a five-day event in which the teachers have professional development but are also focused on students and their presentations. The Teaching, Learning and Computing Survey is given once a year and asks the teachers on the leadership team to reflect on their constructivist philosophy and use of technology. The findings from each survey are reported by professional development goal:

- Positive attitude toward STEM-G and the use of NASA resources for teaching and learning
- Increased knowledge of STEM-G topics and careers
- Integration into curriculum and school activities
- Use of constructivist/inquiry strategies

Overall Findings

Across all three measures, teachers report that the program has a positive effect on their knowledge, teaching practice and STEM career focus. They report they are inspired to bring NASA resources to their students and fellow teachers. They find the professional development opportunities to be relevant to their teaching and would recommend the professional development to other teachers. Their biggest complaint is that there is so much to learn and sort through in the NASA resources. See the Appendix for full reports for each measure.

Positive attitude toward STEM-G and the use of NASA resources for teaching and learning

A goal of the Explorer Schools program is to have the leadership team and the other staffs in the schools have positive attitudes toward STEM-G topics, careers and skills and the NASA resources that can support teaching and learning them.

Inspired and Confident. After the summer workshops, the participants all rated indicators of a positive attitude over 4.0 on a scale of 1-5. Being inspired and anticipating that students would be inspired were rated very highly, as was the overall quality of the workshops.

[2] Rubin, H. J. & Rubin, I. S. (1995). *Qualitative interviewing: The art of hearing data.* London: Sage Publications.
[3] Seidman, I. (1998). *Interviewing as qualitative research: A guide for researchers in education and the social sciences.* New York: Teachers College Press.

Table 20. Summer Workshop Quality

Summer Workshops	*Orientation*	*Content*	*Sustainability*
Means 1-5 scale, 5=high	*N=141*	*N=133*	*N=168*
Inspiring students	4.94	4.88	4.76
Overall quality of workshop	4.92	4.83	4.71
Teacher Confidence	4.49	4.47	4.41
Teacher Understanding of NASA	4.84	4.73	4.56
Inspiring to teachers	4.90	4.83	4.72
Interest in STEM-G	4.34	4.21	4.32

Better Understanding of NASA. Similar questions were asked to teachers after each of the two student symposiums. From feeling confident to having a better understanding of NASA, the ratings were all above 4.0. Again, the highest rated areas were regarding whether the program was inspiring to them and for their students.

Table 21. Student Symposium Ratings

Symposium	*2004*	*2005*
Means 1-5 scale, 5=high	*N=90*	*N=99*
Average overall rating of this event	4.3	4.5
Average overall rating of the content presented during this event	4.4	4.4
My personal learning objectives were met	4.1	4.0
This program was inspiring	4.7	4.7
Inspire my students	4.8	4.8
The event will impact the inspiration of my students	4.8	4.8
I have a better understanding of NASA's mission	4.6	4.5
I have a better understanding of NASA's support for education	4.6	4.5
After participating in the program, I feel confident in my ability to apply knowledge and skills learned	4.1	4.2

Attitude Toward Technology. Attitude towards technology was specifically measured on the Teaching, Learning and Computing Survey. Both the 2003 and 2004 cohort leadership teams showed statistically significant positive changes in attitude towards technology after one year in the program. That growth did not continue in the second year of participation for either cohort. It is important to note that the first cohort (2003) took the TLC in the fall of their first year, while the 2004 cohort took it in the spring, after completing their first year. These analyses are of all the surveys returned for each group each year. The next analyses are of matched pairs.

Table 22. Attitude Toward Technology

Teaching, Learning & Computing Survey	*03 in fall 03*	*03 in spring 04*	*03 in spring 05*	*04 in spring 04*	*04 in spring 05*
N=	121	193	146	189	149
Attitude Towards Technology	3.71	3.80*	3.80	3.76	3.85*

* $p < .01$ Significant differences from year one

Data from a subset of teachers who were part of the program from one year to the next were examined for changes. These analyses are of each individual's growth in attitude towards educational technology from one year to the next. Again, teachers showed statistically significant growth after one year in the program, but no additional increase after the second year. During the first year they are strongly encouraged to use the Explorer Schools website, and the polycom units for videoconferencing and DLN events. It would be expected that their attitude would continue to improve with more experience. This construct is based on a question about their degree of comfort with technology, the importance of using computers in teaching, how much they value technologies such as the phone, computers, Internet, scanners, video cameras, electronic reference guides, presentation software and authoring programs and what they see as the advantages for using technology for learning such as students working harder on their assignments, helping each other and creating better-looking products vs. the disadvantages of unreliable hardware and software, having to integrate technology into the curriculum and having to learn how to use them.

Table 23. Changes In Attitude Toward Technology

Teaching, Learning & Computing Survey – Matched Pairs	*03 in fall 03*	*03 in spr 04*	*03 in spr 05*	*04 in spr 04*	*04 in spr 05*
N=	60	60	60	124	124
Attitude Towards Technology	2.17	4.30*	4.27	3.75	3.82*

* p< .01 Significant differences after one year in the program

> *As huge and big as NASA is, they are every day, ordinary people, willing to teach children. If it's an astronaut or … [AES] or somebody in Washington DC, they are all willing to help. They never put you off. Everyone is congenial, open, they have the time to speak.*

Increased motivation. In the 2003 cohort Focus Groups, teachers report that they have been positively affected personally and professionally. The program has increased their access to educational resources and professional development opportunities at the national and local level; raised their level of motivation about teaching; and helped them improved their teaching practices. According to a 22-year veteran educator, participating in the program was the best experience for her because of "all the opportunities, and a giant pat on the back." This experience increased the teachers' love for science, especially among those who are not teaching math, science, or technology. All the NASA training has been "mind-boggling exciting stuff. It stretches your mind."

Increased involvement of other teachers. Other teachers are excited and curious about the program. They are excited about the availability of NASA's educational resources (e.g., schools' NES libraries) and professional development opportunities. One Team Lead said, "I've been able to get other teachers excited. One is just as excited as I am and now does a lot more hands on activities." The computer lab teacher on the team who does robotics noted that "more teachers are starting to ask questions" about the program. A teacher from another team reported that other teachers at her school are excited about it and want to know how they can incorporate NASA materials.

Teachers noted that more resources are now available in the library for science teachers and to share at the elementary level. They are routinely seeking out and asking about NASA resources, and are requesting additional NASA professional development. According to the NES teams, teachers who attended NASA trainings (e.g., NES school teams, summer trainings, History of Winter, JPL, Goddard), received excellent professional development in math, science, and technology. One Team Lead said that the 22 teachers on staff went through three or four NASA workshops at the school last year and "everything I heard was positive." A science teacher, who took the History of Winter course, mentioned the many useful resources for the environmental science program that came out of the course. In one school, the AES did a lot of outreach ("was a sales person" for the program) to other teachers, setting up times for what to meet with them, visiting with them in their classrooms, and requesting time to meet with the math and science departments. In some cases, teams provided professional development to their school colleagues, such as a workshop on Mars conducted by one NES teams that gave them an opportunity to share their science, math and technology knowledge gained in the program.

They have gained knowledge about NASA's contribution to every day life and are better equipped to lead hands on activities in their classrooms. They feel more confidence in teaching science, math, and technology in their classrooms. One teacher said that before the program she was not "a science type of person" but now is excited about science. A math teacher said that he learned more about science and felt more competent in science. After teaching English for 12 years, one team member was told by her former principal, "You're going to teach life science." After struggling for two years, she then became part of the NES team and took part in the Ames training after which "my whole attitude toward science changed." Now she has a passion for what she's teaching in science, and for inspiring kids. She called it, "a complete 360."

Increased access to educational resources and professional development opportunities. The teachers appreciate the educational and financial support provided through the NES grant, which included access to NASA web sites, astronauts and other NASA experts, field sites, workshops and national conferences. They have greater access to high quality teaching resources and opportunities. "Having the robotics equipment is blowing my mind," said one teacher. Another teacher said that she had no textbook, "NASA was my whole curriculum;" in addition, she reports she is more involved with her students (i.e., she does the middle grades science club and has done more field trips). In a few cases where there was a librarian on the team, they felt that the program allowed them to share NASA resources with teachers, students, and parents. They agreed with the teachers that participants were enthusiastic about the types of knowledge and learning afforded by the NASA resources.

Increased motivation to teach, especially among those who have been teaching for many years. The NES program activities have re-energized the teachers in their work. Some of the phrases and sentences used to express this feeling of rejuvenation included: "It's dragged me out of my rut," "[I'm] excited about teaching again," "After teaching for 30-odd years, it's reviving, stimulating and basically it's fun to do with kids," and "It's kept me interested and motivated in the job." One reason they are more motivated about teaching is because of the degree of involvement of their students in the program. They feel that they are better teachers because of the motivation to learn exhibited by their students. "It's made me more excited about getting the children more involved in math, science and technology. It showed me how much they need it, because it is their world." "I'm proud to say I'm a NASA educator," declared another teacher. Furthermore, they enjoy collaborating with their colleagues in a team format, within which they feel more supported in their teaching. As a result, they have a lot more motivation to perform better in the classroom.

Summary of effect on attitudes. Being a NASA Explorer School is inspiring for teachers. This "inspiration factor" for teachers is powerful in creating positive attitudes about STEM-G and their own ability to learn and teach it. It comes through in the surveys as well as the Focus groups, the stories people tell, and in their enthusiasm for the program when you talk with them. Through the professional development, the teachers gain a better understanding of NASA and its education resources. The results of the surveys were only from the leadership team, but in the Focus Groups, the teams talked about the involvement of other staff members and the positive effect on their attitudes, knowledge and teaching. Where they had access to the NASA resources and professional development experiences, they too were motivated and positive. All these data show that the leadership teams are confident and positive about technology, understand the mission of NASA in education, and are inspired by their participation.

Increased knowledge of STEM-G topics, skills and careers

The Explorer Schools model is based on the idea that teachers will become more knowledgeable about STEM-G topics, skills and careers through access to NASA resources, facilities and people. This, in turn, will result in more instruction in these areas, and integration of the NASA topics into the curriculum as a way to give a real world context for learning. Teachers give high ratings to the effectiveness of professional development opportunities provided by NASA in increasing their knowledge and skills.

Teachers give high ratings to summer workshops for building their skills and knowledge, increasing their own technology use and potentially, that of their students.

Table 24. Increased Skill Knowledge

Summer Workshops	Orientation	Content	Sustainability
Means 1-5 scale, 5=high	N=141	N=133	N=168
Teacher Skills and Knowledge	4.74	4.69	4.54
Instructional technology for teachers	4.57	4.43	4.23
Instructional technology for students	4.75	4.68	4.43

The ratings for the teachers attending the Student Symposium on effects were also very high. Teachers rated the event highly in terms of its potential impact on their technology use, their skills and knowledge, connections to the standards, and improving their knowledge and skills for using instructional technology for students. The lowest area was aligning instructional approaches to reflect national standards and state frameworks. Although rated above average, this area is critical for teachers to feel they can use NASA activities to teach core concepts, not just as enrichment activities.

Table 25. Teacher Rating Student Symposium Impact on Technology Use

Symposium (Means 1-5 scale, 5=high)	2004	2005
This event will impact instructional technology for teachers	4.5	4.4
I acquired the skills and knowledge offered to participants	4.4	4.4
Aligning instructional approaches to reflect national standards/state framework	3.6	3.8
Knowledge and skills gained about instructional technology for students	4.5	4.5

Increased technical skill. Significant growth was found in the 2003 cohort from the beginning of their first year to the end of their second year, and in the 2004 cohort from the end of their first year to the end of their second year on the TLC survey. In the survey, teachers are asked how often their students use technologies such as simulations, electronic encyclopedias, word processing, presentation software, spreadsheets, databases, digital cameras and handhelds during the year; from no lessons, 1-2 lessons, 3-9 lessons, and 10+ lessons. They are also asked how often they use technology to do grades, make handouts, correspond with parents, write lesson plans, get information from the Internet, use digital cameras or scanners, exchange files with other teachers and post student work or other information on the web. It would be expected that teachers would use technology for at least 10 lessons during the year as a part of their use of NASA resources, so anything below 5.0 shows room for growth.

Table 26. Teachers' Perspectives on Their Technical Skill: All completed

Teaching, Learning & Computing Survey - Groups	03 in fall 03	03 in spring 04	03 in spring 05	04 in spring 04	04 in spring 05
N=	121	193	146	189	149
Technical Skill	3.30	3.35	3.45*	3.28	3.52*

* p<.05 Significant differences from year one

The matched pairs analysis for technical skill also showed significant increases, especially among the 2003 cohort of teachers.

Table 27. Teachers' Perspectives on Their Technical Skill: Matched Pairs

Teaching, Learning & Computing Survey – Matched Pairs	**03 in fall 03**	**03 in spring 04**	**03 in spring 05**	**04 in spring 04**	**04 in spring 05**
N=	60	60	60	124	124
Technical Skill	2.92	3.06*	3.13	3.26	3.51†

*** p<.01 Significant differences for 2003 cohort from 03 to 05 and 04 to 05, i.e. significant growth each year

† Significant differences for 2004 cohort from 04 to 05 (after 1 year in the program)

Learning about NASA careers and topics. In the focus groups with the 2003 cohort, the teams stated that the professional development provided through the Explorer Schools program was beneficial and helpful. They learned about the many career opportunities at NASA, which opened their eyes to new science and technology developments such as robotics. “NASA has given us opportunities we never would have had otherwise. They have become aware of NASA’s involvement in areas such as health issues, the environment, biology, and technology, and have been able to expand their curricular materials.

> *We met with all these scientists who are working with problems you didn’t even know NASA dealt with, like aerosols.*

Improved teaching practices. Through the NES program teachers said they have gained more mastery of the teaching of science content, especially difficult science concepts, such as DNA, forces and motions, and aerospace.

Increased access to advanced technologies. The program has been the catalyst to improve the technology infrastructure in some of the schools. The schools also received videoconferencing equipment and telescopes from NASA, and purchased computer technologies (e.g., Laptops, projection systems) and science instruments (e.g., probes). This has a huge impact because many students at participating NES schools access technology primarily at school.

Summary of effects on teacher STEM-G knowledge, skill and career.
Teachers report that the NASA Explorer Schools program has been very instrumental in increasing their knowledge of the STEM-G. Surveys about their technical skills show statistically significant improvement during the first year of the program. Teachers have high ratings of the effect on their knowledge after the professional development in the Summer Workshops and the Symposium. In the focus groups they praise the support for technology acquisition, and learning STEM-G content through NASA. They talked about the range of interesting topics that NASA is involved in, and how interesting they found that to be. Based on these data, the professional development opportunities are engaging and affecting the teachers' STEM-G knowledge, skills and career information.

Integration into curriculum and school activities
As we have seen, in order for NASA resources to be used in the teaching and learning of STEM-G, teachers must be motivated and know the content, but they must also see how it fits into their curriculum, can be used to help students meet the standards, and involve families.

Several indicators of integration were assessed in the surveys; planning for use, relevance, application, integration, sharing with other teachers, family involvement, and application of STEM-G. In the Summer Workshops, the teachers gave high ratings to these areas, all above 4 on a 5-point scale.

Table 28. Summer Workshop Feedback: Ratings Summary

Summer Workshops	**Orientation**	**Content**	**Sustainability**
Means 1-5 scale, 5=high	N=141	N=133	N=168

Planning for use	4.88	4.79	4.70
Sharing what you learned	4.38	4.04	4.31
Relevance to Teachers	4.82	4.73	4.54
Integration of STEM-G	4.74	4.61	4.45
Application of STEM-G	4.83	4.77	4.59
Importance in contemporary life	4.34	4.43	4.61
Family Involvement	4.62	4.20	4.57
Effect on technology use	4.63	4.51	4.29

Teachers attending the Symposium also gave high ratings to these areas.

Table 29. Student Symposium Feedback: Ratings Summary

Symposium (Means 1-5 scale, 5=high)	2004	2005
The information provided during the event is relevant to my role	4.4	4.4
The concepts and skills taught in the program can be used in my work	4.3	4.4
Using NASA resources to enhance my instruction	4.5	4.4
NASA related materials provided can be integrated into my curriculum	4.5	4.5
The concepts and skills taught in the program can be used in my work	4.3	4.4
Integrating STEM-G into my instruction more	4.2	4.1
Incorporating more instructional technology in my instruction	4.2	4.1
I expect to apply what I learned in this program	4.7	4.6
Integrating STEM-G into my instruction more than I did in the past	4.2	4.1
The event will impact my application of STEM-G	4.7	4.5
The event will impact instructional technology for students	4.5	4.5
The event will impact instructional technology for teachers	4.5	4.4
Anticipated sharing what you learned with other professionals	4.2	4.1
Increased family involvement	4.5	4.4

Revisions to curriculum. In the 2003 cohort Focus Groups, teachers reported making revisions to their existing curriculum based on their teaching and students' needs because of access to new curriculum ideas, and a lot of freedom to create new activities. As a result, some of the teachers have entirely revamped their science curriculum. "When I got involved, I became enthusiastic. I sought out new things." It is a personal excitement because of the relationships they have forged with NASA scientists, astronauts, and other educators. "I've done space education for 30 years. The last couple of years, with infusion, have given me a professional growth that we couldn't have had otherwise." In addition, they reported having increased their use of technology by integrating it into their curriculum activities. Some of them are using handhelds in their classrooms, videoconferencing system for distance education, and other technologies made available through the NES grant. These experiences have helped expand their curriculum offerings. Examples of school curriculum changes and enhancements are documented in the NASA education weekly activity reports submitted by NES staff.

> A math teacher said that the training "gets your brain working in different ways," and that after he got back from NASA training he "changed the whole geometry unit."

Improved teaching practice. Teachers reported that they felt that the NES program helped them better integrate science, math and technology into their teaching.

Increased development of new educational programs. In a few of the NES schools, the program aligns nicely with and amplifies already existing programs. The knowledge gained by teachers is a springboard for other things like the JASON Project and technology integration efforts. The NASA resources have allowed them to implement and transition to magnet programs, and are a real catalyst for some schools' science programs. In one of the NES school districts, for example, the superintendent wants to start a robotics competition in the district. In the Focus Groups with the 2003 teams, some schools report that they now offer additional science programs and have a career and inquiry focused curriculum. Others were able to create new courses, add new programs, and clubs. “We have established an in-school component which allows us to offer an additional science program per week to Valnius Yiddish Institute extracurricular program cadets. We have also developed three after school programs that we offer to students. Because we have established a local steering committee we have made a connection with a local community college that allows us to offer a career connection to students. “We've added more science clubs, and much, much more.” “We added a two-year NASA Aerospace Studies course.”

Summary of effects on curriculum integration.
Teachers report that the resources they have access to are relevant, able to be integrated into their curriculum and exciting. They give high ratings to the professional development experiences as helping them to re-think their curriculum. As the 30-year veteran teacher said, the infusion approach has a much greater effect on the integration of NASA resources into the curriculum.

Use of constructivist/inquiry strategies
The NASa Explorer Schools program emphasizes the use of constructivist strategies for teaching STEM-G topics because this approach addresses misconceptions and provides active methods for students to articulate and evolve their understanding of the essential concepts. Inquiry activities engage students' minds and help them to develop deep understandings of core ideas. The NASA Explorer Schools program aims to model inquiry as well as teach it directly to develop teachers' understanding of how to use it. The Teaching, Learning and Computing Survey has three sections on constructivism: philosophy, teaching and use of technology.

Table 30. Teaching, Learning, and Computing: Constructivism Scores

Teaching, Learning & Computing Groups	03 in fall 03	03 in spring 04	03 in spring 05	04 in spring 04	04 in spring 05
N=	121	193	146	189	149
Constructivist Teaching Philosophy	3.66	3.65	3.42	3.62	3.40
Constructivist Teaching Strategies	3.14	3.21	3.21	3.01	3.24*
Constructivist Use of Technology	2.48	2.95*	2.81	2.88	3.02

Table 31. Teaching, Learning, and Computing: Constructivism (Matched Pairs)

Teaching, Learning & Computing Matched pairs	03 in fall 03	03 in spring 04	03 in spring 05	04 in spring 04	04 in spring 05
N=	60	60	60	124	124
Constructivist Teaching Philosophy	3.75	3.84	3.85	3.60	3.40
Constructivist Teaching Strategies	2.30	2.49*	2.50	3.01	3.27[†]
Constructivist Use of Technology	2.35	2.81*	2.75	3.88	3.86

*p<0.01 Statistically significant difference

In both the analysis of groups and of matched pairs, teachers’ Constructivist Teaching Philosophy ratings were above average (3.4-3.85). This indicates they place a high value on constructivist teaching. There was a significant positive change in Constructivist Teaching Strategies for both cohorts in the matched pair data, indicating that the program is helping them to use more strategies to support their philosophy. There was also a statistically significant increase in their Constructivist Use of Technology in both the group and matched pair data. Although lower than would be expected given the emphasis on technology and the teachers' reported enthusiasm, increases in this area are dependent on reliable technology that was cited by some of the teachers as a barrier to their use of technology for inquiry. It is interesting to note that the ratings do not increase after the second year in any of these three areas. It will require further investigation to determine if this is a result of something about the program in the second year, or something in the school, such as the lack of technical support some teams gave as a barrier to implementation.

Covariance analysis of the group data resulted in two pairs with moderate coefficients; Constructivist Teaching Philosophy with Constructivist Teaching Strategies and Constructivist Use of Technology with Technical Skill. Analysis of the matched pair data revealed moderate coefficients of covariance for Constructivist Teaching Philosophy with Constructivist Teaching Strategies. It was anticipated that as teachers gained an increased understanding of constructivism, they would begin to use constructivist teaching strategies more often and with greater effectiveness. Additionally, it was anticipated that as teacher's proficiency with technology increased, their ability to use technology within constructivist teaching practice would also increase. These data suggest that these two effects are emerging as positive outcomes of the NES program.

Table 32(A). Teaching, Learning, and Computing: Covariance Analysis
(Group Data)
(ATT= attitude towards technology; CUT=constructivist use of technology; CTS=constructivist teaching skill; CTP=constructivist teaching philosophy; TS=technical skill)

	CTP/ ATT	CTP/ CUT	CTP/ CTS	CTS/ ATT	CTS/ CUT	TS/ ATT	TS/ CUT
2003 in Fall 2003	0.03	0.10	0.17	0.07	0.27	0.15	0.39
2003 in Spring 2004	0.05	0.06	0.15	0.06	0.18	0.16	0.28
2003 in Spring 2005	0.02	-0.03	0.10	0.05	-0.04	0.10	0.02
2004 in Fall 2004	0.02	0.12	0.10	0.02	0.21	0.08	0.27
2004 in Spring 2005	0.01	0.05	0.06	0.04	0.18	0.09	0.19

Table 32(B). Teaching, Learning, and Computing: Covariance Analysis
(Matched Pairs)
(ATT= attitude towards technology; CUT=constructivist use of technology; CTS=constructivist teaching skill; CTP=constructivist teaching philosophy; TS=technical skill)

	CTP/ ATT	CTP/ CUT	CTP/ CTS	CTS/ ATT	CTS/ CUT	TS/ ATT	TS/ CUT
2003 in Fall 2003	-0.14	-0.21	0.19	-0.06	-0.06	-0.28	-0.30
2003 in Spring 2004	0.03	0.01	0.07	0.17	0.07	0.22	0.02
2003 in Spring 2005	0.12	-0.04	0.13	0.14	-0.03	0.17	0.01
2004 in Fall 2004	0.01	-0.09	0.11	0.01	-0.08	0.07	-0.11
2004 in Spring 2005	0.02	-0.04	0.07	0.06	0.02	0.09	-0.01

A graphical representation of the change over time for the group data is presented in the figure below:

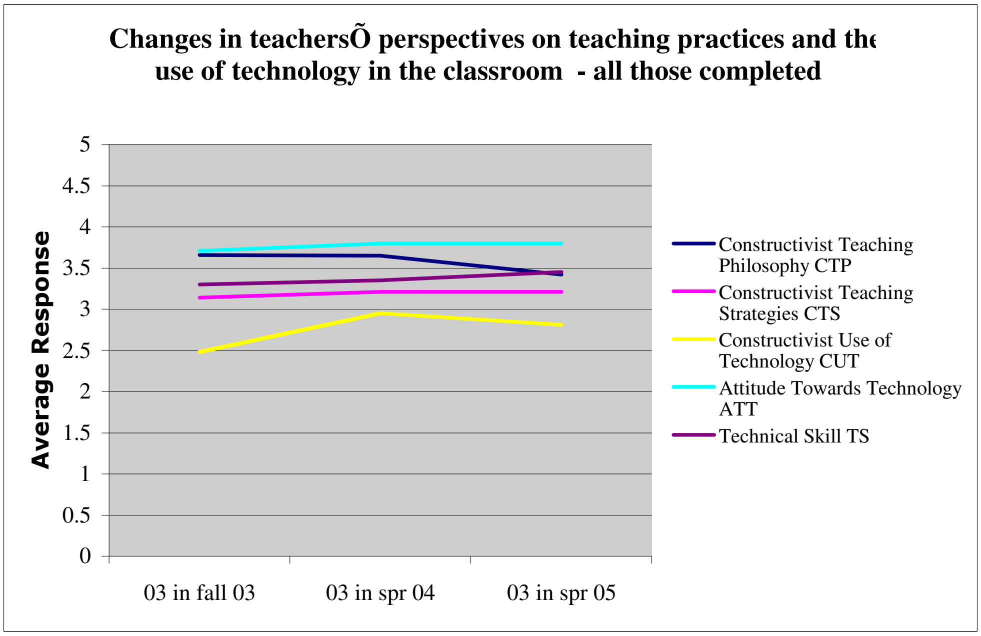

Figure 4. Changes in teachers' perspectives on teaching practices and use of technology

The positive trends can be seen in the graphical representation of the change over time for the matched pairs in the figure below:

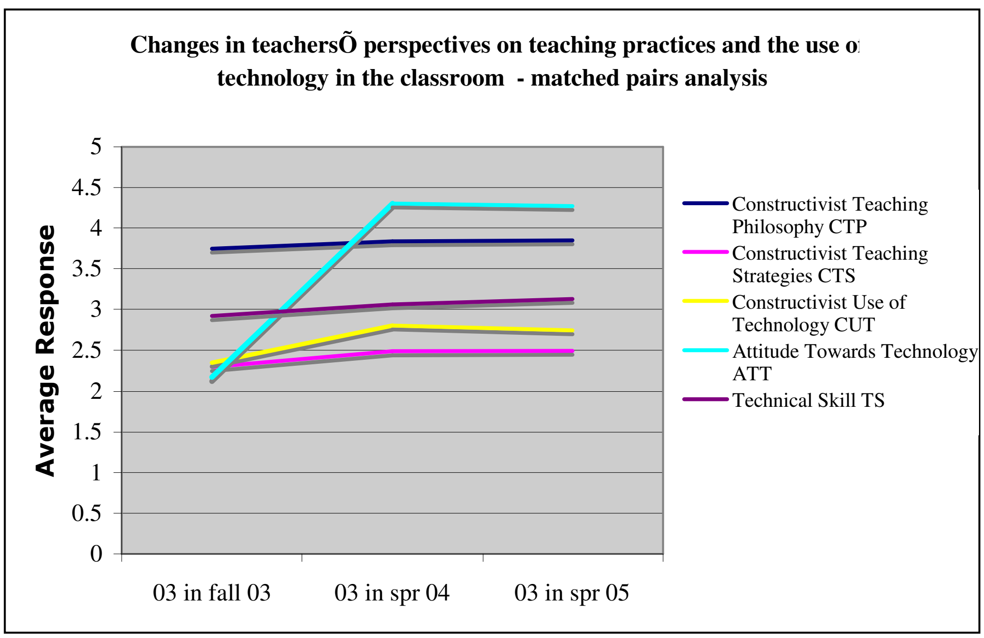

Figure 5. Matched pairs analysis - changes in teachers' perspectives on teaching practices and use of technology

In the Summer Workshops and the Symposium, teachers gave high ratings to the effect on their instructional approaches.

Table 33. Effect On Teachers' Instructional Approaches

Summer Workshops	*Orientation*	*Content*	*Sustainability*

(Means 1-5 scale, 5=high)			
	N=141	N=133	N=168
Effect on instructional approaches	4.32	4.18	4.09
Symposium (Means 1-5 scale, 5=high)		***2004***	***2005***
Incorporating inquiry activities in my instruction		4.1	4.0

> *This changed the way I teach my students. Now I use inquiry-based learning almost exclusively. I [also] changed the way I assess my students.*

In the 2003 Focus Groups, teachers reported having changed their teaching practices of science and math as a result of the program. They report that the program has provided new opportunities and understanding of how students learn through the inquiry process. Teachers report spending more time on hands-on science activities, using more inquiry-based teaching, and having learned how to set up and conduct science research projects. A teacher said that his participation in the NES program has changed him "from a paper-and-pencil teacher" to using more hands-on activities, which he believes helps make learning about science more fun. One teacher said, "Hands-on activities helped me think about what's more relevant and that more learning was going on [than] if I had just lectured." Another teacher reported that he is doing more hands-on activities and being more open to learning from the students.

Summary of effects on teacher use of inquiry.
Based on the data collected so far, the program is affecting teachers' thinking and practice in inquiry. Since they report a relatively high constructivist philosophy, the increases that have been observed are in their teaching strategies. They report being able to change how they teach to be more hands-on as they integrate science content.

Conclusions about the effect of the program on teachers
From the sources of data available, it is clear that the teachers feel they are benefiting from the professional development opportunities provided as part of their NASA Explorer School participation. They report feeling inspired and confident, and have an understanding of the NASA resources available to them. The combination of exciting, relevant content, and the resources and support to use it receive high ratings from the teachers, and get put to use in their classrooms. They are motivated to learn new content and to integrate it into their teaching. They report they are gaining knowledge and skill in STEM-G. They give very high ratings to the professional development they receive from NASA, and attribute the changes in their teaching practice to the NASA connection. They show shifts toward constructivist teaching and learning after the first year of participation. To continue to get increases in this are may require attention to the specific barriers they face in their schools. The teachers value the kind of involvement that characterizes active engagement, and seem to be developing their constructivist teaching strategies.

The data collected thus far suggests that the professional development continue to focus on modeling active engagement and teaching constructivist strategies for specific content knowledge. These content and pedagogical strategies should be carefully selected to support the needs identified by each school. Helping the leadership teams to support the rest of their faculties is crucial to whole school reform, and change in student knowledge, attitudes and skill.

What is the Effect of the Explorer Schools Program on Administrators?

Administrators have played an increasingly important role in the NASA Explorer Schools model. Each leadership team is required to have an administrator, and special professional development was offered for administrators during the 2004-05 school year. As discussed in the model section on important factors for school success, and active administrator is critical to involving the whole school in NASA activities. As part of the presentation of their strategic plan, an administrator admitted that he did not want to come to the Summer Orientation Workshop but realized that he "never would have understood what this was all about" if he hadn't come.[4]

Methods
To look more closely at the effect of the NASA Explorer Schools on administrators, a survey was created in the spring of 2005 to ask administrators in all three cohorts (2003, 2004, 2005) about how much they value constructivist teaching, their attitudes toward technology, their concerns and expectations, the support they provide to their NES leadership team and external supports to the program. Descriptive statistics were done on the data from the survey. In addition, there is some data from the focus group interviews with the 2003 cohort conducted a year and a half into the program.

As mentioned in the methodology section, the Administrator survey was created in April 2005 in an attempt to gauge the changes in beliefs of and attitudes of the administrators as well as their involvement in the NES program implementation. Only those administrators who were also members of the school teams were requested to take this survey. These are the number of administrators who took the survey: 33 from the 2005 cohort, 41 from 2004, and 44 from 2003. The Pre-survey was administered to the 2005 administrator cohort since this version intended to capture administrators' beliefs, attitudes, concerns and issues, and their projections about the impact of the program when they began the program. The post-survey was administered to the 2004 and 2003 administrator cohort to gauge their perspectives on the same issues after having experienced the NES program over a year.

Findings
Administrators value constructivist teaching. Administrators were surveyed about their philosophy of education for the first time in the spring/summer of 2005. The results indicate an above average degree of constructivist philosophy in the group. Since constructivist educational philosophy is related to constructivist use of technology, these high means should indicate that administrators are likely to support constructivist uses of technology by teachers and students.

Table 34. Constructivist Teaching Philosophy of Administrators, May 2005

Cohort	N	*Mean (1-5*)*	*Standard deviation*
Yr 2003	44	3.89	0.41
Yr 2004	42	3.93	0.35
Yr 2005	34	3.85	0.43

*1-5 scale, 5=highly constructivist

Results from the Administrator survey are reported below in terms of administrator:
(1) attitudes toward computers and technology
(2) concerns and issues
(3) support they provide to schools teams
(4) support they receive from external sources to help teams implement the program.

[4] Observation at Goddard, summer 2005

All 2003, 2004, and 2005 Administrator survey results reported below represent the baseline data since all administrators had taken the survey first time in April 2005. When post data become available, comparison between pre/post surveys will be reported.

Administrators from 2005 Cohort

2005 Cohort Attitudes toward Computers

A total of 33 administrators responded to the Administrators survey. The means of their attitude scores ranged 52 to 79 with a population mean of 63. Overall, of the 33 administrators, 15 (45%) of them had below the average and 18 (55%) of them had average to beyond average positive attitudes toward integrating computers and technology into curriculum.

Table 35. 2005 Administrators' Attitudes

Attitudes Toward Computers			
Number	Means	Standard Deviation	Range
33	63	5.63	52-79

2005 Cohort Concerns and Issues

The concerns and issues section of the administrator survey was designed to measure administrator concerns regarding the time requirements for both teachers and administrators to implement the NES program. Administrator survey responses reflected compliance with the NES program focus on students, teachers, and families in the promotion of STEM-G careers and topics for study. Administrators were asked to describe their current perspectives and project what impact they thought the program would have at the end of year three-year cycle. Table 36 shows that the majority of 2005 cohort administrators (61 to 67%) expressed concern about the time that would be required of them and their teachers to implement the NES program.

Table 36. Administrator Concerns

Concerns about Time	Yes	No	Not sure
Concerned about the time that will take teachers to implement the program	22 (67%)	10 (30%)	1 (3%)
Fear that the Explorer schools program may be overwhelming	13 (39%)	17 (52%)	3 (9%)
Concerned about the time that will take me to coordinate the program	20 (61%)	10 (30%)	3 (9%)

Administrators were asked how satisfied they were with the Explorer program emphasis on teacher professional growth, student STEM learning, student STEM career interest, and family involvement when they began the program. Their responses are displayed in the table below.

Table 37. Administrator Satisfaction

Satisfaction	Yes	No	Not sure
Satisfied with the emphasis of this program on teacher professional growth	28 (85%)	3 (9%)	2 (6%)
Satisfied with the emphasis of this program on student STEM learning	28 (85%)	0	5 (15%)
Satisfied with the emphasis of this program on student STEM career interest	28 (85%)	0	5 (15%)
Satisfied with the emphasis of this program on family involvement	30 (91%)	0	3 (9%)

Administrators were then asked to project the impact of the NES program on its constituents (students, teachers, and families) at the end of the third year. As the summary of responses in Table 38 shows, administrators expressed confidence in and positive views of the NES program.

Table 38. Administrator Future Projections

Future Projections	Yes	No	Not sure
Believe the program will increase teacher professional growth by the end of year 3	30 (91%)	1 (3%)	2 (6%)
Believe the program will increase student interest in STEM careers by the end of year 3	29 (88%)	1 (3%)	3 (9%)
Believe this program will increase student interest in STEM disciplines by the end of year 3	30 (91%)	0	3 (9%)
Want to know if we will be a better school after the three year [Not sure who the WE refers to]	28 (85%)	1 (3%)	3 (9%)

2005 Cohort Administrator Support

This section of the survey was designed to capture the support administrators intended to provide to their NES teacher teams. As Table 39 shows, a majority of administrators reported that they were not sure about their roles in helping the school teams implement the NES program. Except when asked whether they would be "prepared to implement lasting changes to district policies based on the team's strategic plan," a majority of administrators responded with uncertainty when how effectively they will be able to provide support to the school teams. Having the year-later survey data from the spring/summer of 2006, will allow us to compare the support administrators said they would provide with the support they report they did provide over the past year.

Table 39. Administrator Support

Administrators Support	Yes	No	Don't Know
Planning to actively participate in the implementation of strategic plan	9 (28%)	0	24 (73%)
Planning to represent the team's interest and concerns to higher levels of administration	9 (27%)	0	24 (73%)
Prepared to implement lasting changes to school policies based on the team's strategic plan	13 (39%)	0	20 (61%)
Prepared to implement lasting changes to district policies based on the team's strategic plan	16 (48%)	0	17 (52%)
Encourage responsible risk taking on the part of teachers and other administrators related to implementing the strategic plan	12 (36%)	1 (3%)	20 (61%)
Encourage teachers to use NASA educational products in the classroom	11 (33%)	0	22 (67%)
Support teacher attendance to professional development conferences and workshops	12 (36%)	0	21 (64%)
Support family events organized at the school	8 (24%)	0	25 (75%)
Planning to provide teachers release time to help the NASA Explorer Schools team members to implement the plan	11 (33%)	0	22 (67%)

2005 Cohort External Support

This section of the survey was designed to find out what kind of support administrators intended to seek from outside resources in implementing the NES program. As seen in Table 40 below, about half of the administrators responded with uncertainty to five statements regarding their intentions whether to seek external funding and support. Since the 2005 administrators took this survey before they started the program, one explanation of this uncertainty among administrators may be due to the fact that they may not have known enough about the program to make a decision on what kinds of external support they would need in order to help teams implement the program.

Table 40. Administrators' Projections of External Support

External Support	Yes	No	Don't Know
Plans to encourage the district leaders to maintain interest in the NASA Explorer Schools program	14 (42%)	0	19 (58%)
Plans to seek additional funding from the district to supplement those provided by the partnership with NASA	16 (48%)	2 (6%)	15 (46%)
Plans to seek personnel support from some of the businesses in the community	16 (48%)	0	17 (52%)
Plans to seek funding from some of the businesses in the community	10 (30%)	2 (6%)	21 (64%)
Plans to seek personnel support from some of the universities in the community	12 (37%)	2 (6%)	19 (58%)
Plans to seek funding from some of the universities in the community	12 (36%)	4 (12%)	17 (52%)

Administrators from 2003 and 2004 Cohorts

2003 and 2004 cohort Attitudes toward Computers

Table 41. 2003 and 2004 Administrator Attitudes

2003 and 2004 Administrators' Attitudes				
Cohort	Number	Means	Std. Dev	Range
2003	44	62	5.96	52-80
2004	41	63	5.66	47-73

A total of 44 administrators from 2003 and 41 from 2004 responded to the Administrators survey. The means of their attitude scores for the 2003 cohort ranged 52 to 80 with a population mean of 62, and 2004 cohort ranged 47 to 73 with a population mean of 63. Overall, of the 44 administrators from 2003, 19 (43%) of them had below the average and 25 (57%) of them had average to beyond average positive attitudes toward integrating computers and technology into curriculum. Of the 41 administrators from 2004, 22 (54%) of them had below the average and 19 (46%) of them had at and above average positive attitudes toward integrating computers into the curriculum.

2003 and 2004 Concerns and Issues

Table 42. Administrator Concerns About Time

Concerns about Time	2003	2004
Concerned about the time that takes teachers to implement the program	14 (32%)	27 (66%)
Feel overwhelmed by the Explorer schools program	13 (30%)	21 (51%)
Concerned about the time that will take me to coordinate the program	21 (47%)	27 66%

The administrators from the 2003 and 2004 cohorts took the survey in the spring or summer 2005. Since baseline data were not collected from neither of the cohorts, administrators' concerns and issues are displayed in the Table below as percentages representing their views after having experienced the program for some time.

Table 43 shows that the 2003 Administrator cohort concern about the time that took them to implement the program is lower than that of 2004. Time is one of the internal concerns in the teacher change literature and would be expected to be lower for the 2003 cohort than the 2004 cohort. The Concerns-Based Adoption Model (CBAM) (Hall and Hord, 2001) delineates seven stages of change individuals move through as they implement a change. These states are further grouped as internal and external changes. According to this model, teachers' internal concerns (their awareness, informational, personal, and management concerns) are expected to decrease and external concerns (consequence, collaboration, and refocusing) increase over time as teachers implement a change effort. This means after having experienced the program for over two years, the administrators from 2003 are less concerned about the time that takes teachers to implement and coordinate the program than those of 2004. As expected, having experienced the program a year longer than 2004 administrators, 2003 participants gained more confidence and became less concerned about time (an internal concern). Higher concerns about time of the 2004 cohort indicate that they are still in the early stages of the change effort.

The Table shown here indicates administrators' satisfaction with the emphasis of the NES program on student STEM learning and career interest, family involvement, and professional growth. Of the 44 administrators from 2003, 40 (91%) of them were satisfied with the emphasis of the program on teacher professional growth and student STEM learning, 38 (88%) satisfied with the emphasis on student STEM career interest, and 34 (77%) satisfied with the emphasis on family involvement. Of the 41 administrators from 2004 cohort, 37 (90%) reported satisfaction with the program emphasis on teacher professional growth, 36 (88%) expressed satisfaction with the student STEM learning, student career interest, and family involvement.

Table 43. Administrator Satisfaction

Satisfaction	2003	2004
Satisfied with the emphasis of this program on teacher professional growth	40 (91%)	37 (90%)
Satisfied with the emphasis of this program on student STEM learning	40 (91%)	36 (87%)
Satisfied with the emphasis of this program on student STEM career interest	38 (88%)	36 (88%)
Satisfied with the emphasis of this program on family involvement	34 (77%)	36 (88%)

In the 2003 Focus Groups, the administrators on the teams said that they are grateful to NASA for trying their best to respond to their schools' science, math, and technology needs. "They have made everything available to us." The administrators (Principals, Assistant Principals) in the teams indicated that they appreciate the support and resources provided to their students, teachers, and community by the NES program. The program has:

- Increased their understanding of NASA's work, and made them appreciate the learning and teaching involved in NASA's science, math and technology education programs. One administrator noted that he has become more aware of technology and what his teachers are capable of doing with the appropriate resources and support. Another administrator said that he learned a lot about what's available in math, science, and technology for his students and teachers.
- Influenced positively their teachers, especially those on the NES teams, and their students. They recognized that their teachers received quality professional development activities that they would not have otherwise had access to in the last two years, due to budget constraints.

In the Administrator Survey, administrators were asked to project the impact of the NES program on its constituents (students, teachers, and families) at the end of the third year. As displayed in the table below between 86 to 95% of all administrators from 2003 and 2004 projected that the NES program will increase professional growth, student interests in STEM careers and disciplines by the end of year three. A high percentage of administrators' optimistic projections can be interpreted as a reflection of their current positive opinion on the NES program's effect on students and teachers.

Table 44. Administrator Future Projections

Future Projections	2003	2004
Believe the program will increase professional growth by the end of year 3	38 (86%)	38 (93%)
Believe the program will increase student interest in STEM careers by the end of year 3	39 (89%)	39 (95%)
Believe this program will increase student interest in STEM disciplines by the end of year 3	39 (89%)	39 (95%)
Want to know if we will be a better school after the three year	35 (80%)	36 (88%)

Increased community involvement. In the 2003 Focus Groups, the teams reported that the program had increased their involvement with the community and parents, and helped boost the image of their schools in their communities. The visits by astronauts (e.g., Barbara Morgan, an Educator Astronaut, and Jim Voss, a former NASA astronaut) to NES schools were highlights in the program implementation that drew a lot of attention in local media outlets. These visits left huge impressions on other teachers, students, and parents, and changed the whole outlook of the NES program in most of the participating schools. According to one administrator, “the program is a real bonus for our school. It has boosted our image in the community. The school is more recognized in the district, and we have obtained more support from parents.” In some cases, they said that being part of the NES program has even brought them recognition at the state level.

<u>2003 and 2004 Cohort Administrative Support</u>
This section of the survey was intended to capture support administrators provided to the NASA Explorer Schools team. In the responses of the novice 2005 cohort, a majority of administrators had reported that they were not sure how they were going to help the school teams implement the NES program. In contrast, the administrators from the 2003 and 2004 cohorts overwhelmingly indicated that they actively supported the school teams to help implement the program. The table below provides the number and percentage of 2003 and 2004 administrators who provided various types of support to help teams implement the NES program.

Table 45. 2003 and 2004 Cohort - Administrator Support

Administrator Support	2003	2004
Actively participated in the implementation of strategic plan	41 (93%)	40 (98%)
Represented the team’s interest and concerns to higher levels of administration	43 (98%)	40 (98%)
Helped implement lasting changes to school policies based on the team’s strategic plan	39 (87%)	35 (85%)
Helped implement lasting changes to district policies based on the team’s strategic plan	29 (66%)	21 (51%)
Fostered and supported responsible risk taking on the part of teachers and other administrators related to implementing the strategic plan	39 (87%)	36 (88%)
Encouraged teachers to use NASA educational products in the classroom	43 (98%)	40 (98%)
Supported teacher attendance to professional development conferences and workshops	42 (96%)	40 (98%)
Being involved in family events organized at the school	40 (91%)	39 (95%)
Provided teachers release time to help the NASA Explorer Schools team members to implement the plan	38 (86%)	38 (93%)

2003 and 2004 External Support
This section of the survey gauged if administrators from 2003 and 2004 sought to receive external support to help team members implement the NASA Explorer Schools program. Both the 2003 and 2004 administrators reported that they sought 11 different types of external support (includes funding and personnel support from the district, school board, universities, and businesses) in varying degrees. Having experienced the NES program a year longer, the 2003 administrators reported seeking slightly more support in 8 of the 11 sources listed in the table below.

Table 46. Administrator Views Regarding Non-NES Support for NES

External Support	2003	2004
District leaders have maintained interest in the NASA Explorer Schools program	39 (89%)	32 (78%)
Superintended has maintained interest in the NASA Explorer Schools program at our school	33 (75%)	29 (70%)
School board leaders have maintained interest in the NASA Explorer Schools at our school	34 (77%)	20 (50%)
District has allocated additional funds to supplement those provided by the partnership with NASA	22 (50%)	11 (28%)
District is planning to allocate additional funds to supplement those provided by the partnership with NASA	19 (43%)	10 (26%)
District has plans to allocate funds after the end of 3 year partnership with NASA	14 (31%)	10 (26%)
District has encouraged collaboration between my school and the other schools in the district to model the gains from the program	25 (57%)	25 (64%)
We have received personnel support from some of the business in the community	28 (64%)	27 (71%)
We have received funding from some of the business in the community	16 (36%)	24 (63%)
We have received personnel support from some of the universities in the community	25 (57%)	23 (61%)
We have received funding from some of the universities in the community	16 (36%)	12 (32%)

Increased access to networks and funding for science programs and activities. The 2003 Focus Groups reported that the NES program and NASA affiliation are beginning to help some of the schools to open doors that weren't open before, such as accessing grant funds from philanthropic organizations and foundations and building new partnerships with local businesses and universities. In several schools, being affiliated with NASA has opened doors in terms of partnerships, networking, funding, and mentoring. One example is a school team that said that the Women In Technology Group had done some workshops as well as provided some grant money; their school also had a National Science Foundation I-TEST pre-proposal that was one of 14 (out of 340) accepted for a final submission, made connections with the local university's engineering department for a collaboration involving the KC-135, and have developed corporate partnership with a major corporation for project-based learning. The team commented, "The professional development through NES has given the school a solid foundation" for all these initiatives. At another school, the NES team received a check for $2,500 from a local power company to spend on technology, something the school team ascribes to a NASA staff member's visit and their resulting heightened profile. At another school, the connection of the NES team with the department of education at the local university allowed pre-service teachers to get involved with the schools in the district.

Conclusions about the effect on administrators
Administrators from all three cohorts express satisfaction and a growing understanding of their role in the Explorer Schools Model. They value constructivist teaching and learning (3.85-3.93 on

1-5 scale). They are satisfied with the program goals, emphasizing professional development, student learning STEM-G, student interest in STEM-G careers, and family involvement (77-90%). They believe the program will show increases in all these areas after three years in the program (80-95%).

After having experienced the program for over two years, the administrators from 2003 are less concerned about the time it takes teachers to implement and coordinate the program than those of 2004. As expected, having experienced the program a year longer than 2004 administrators, 2003 participants gained more confidence and became less concerned about time (an internal concern). Higher concerns about time of the 2004 cohort indicate that they are still in the early stages of the change effort. This underscores the importance of having an evaluation plan that includes a long-term timeline that aligns with the lifespan of the program. Administrator support improves each of the three years of the program, and much less administrator support was reported in the first year of the program.

How administrators see their role seems to change after participation in the program. Just after being accepted into the program, only 24-39% of the 2005 administrators reported they would actively participate in the implementation of the strategic plan, represent the team's interests and concerns to higher levels of administration, implement lasting changes to school policies based on the team's strategic plan, foster responsible risk-taking to support the strategic plan, encourage teachers to use NASA products, support teacher attendance at conferences and workshops, be involved in family events, or provide release time for the leadership team to implement the plan. Administrators in the program for one and two years (2004, 2003) report they were actively involved in all these areas (86-98%). About half (48-66%) of the administrators expect to influence district policies in each cohort year, suggesting this does not change with experience in the program. While not an explicit goal of the program to change district policy, there have been some examples where this has occurred.

Administrators report that district leaders have maintained interest in the program (89% of 2003 group; 78% of 2004 group), as well as superintendents (75%, 70%) and school board leaders (75%, 50%). They report having personnel support from the community (64% of 2003; 71% of 2004; 58% of 2005 expect it) and local universities (57%, 61%). More than half of the districts have encouraged collaboration between their NASA Explorer School and other schools in the district (57%, 64%). To a lesser extent, schools have received funding from the community (36%, 63%) and local universities (36%, 32%). Some districts in each cohort have supplemented (50%, 28%) or have plans to supplement the NASA funding (43% of 2003; 26% of 2004). The only marked differences between the 2003 and 2004 cohort around external support is in this area of additional funding, with 17-22% of the 2004 administrators reporting the district was providing additional funding. About a third of the districts have plans to allocate funding after the end of the three-year partnership with NASA (31%, 26%).

It is recommended that the program continue to work closely with administrators, particularly in the first year, to help them define their critical role in involving the faculty and community. Further support could be provided through separate professional development in the Orientation Workshop, mentoring from administrators from schools completing their three years as an Explorer School, a monthly videoconference for administrators and yearly professional development.

What Is the Effect of the NES Program on Family/Caregiver Involvement?

The NES model seeks to have leadership teams actively involve families in using NASA resources. Family involvement has a large impact on student interest and career choices. On each leadership team, one person is designated as the family involvement coordinator. Professional development for the core team includes ideas and resources for involving families. AESs help organize family nights such as Star nights, Rocket competitions and career nights. This section discusses the effects of these activities and the program on families from the Team Lead Surveys and Focus Groups. A family survey was developed and administered during the fall of 2005, the results from which will provide further data for examining the effect of the program on family involvement, support and interest in their children's STEM-G knowledge and interest.

Improved image in the community. In the Team Lead surveys with the 2003 cohort, the teachers commented that involvement with the Explorer Schools program resulted in improved family and community involvement that benefited the entire school community in terms of gaining “recognition” and “a whole new feeling about the school” in the community. The community recognition helped the school teams to improve their image in the community. They were able to recruit more families to become involved in school activities and seek and receive additional grant money because “parents can see new futures for their children and they have a more positive view about what their children can accomplish and the contributions their children can make.” Another benefit that came as a by-product of a staff's enthusiasm was the excitement of the students and parents about the NASA program materials.

> *…parents can see new futures for their children*

Increased family involvement. A major impact of the program for many NES communities reported in the Focus Groups with the 2003 schools has been an increased awareness of NASA and its educational programs and increased parental involvement. Parents have become more aware of NASA, and appreciate their children’s school being associated with NASA. The NES program is well perceived in the communities it serves, and has generated a new sense of community pride. Some parents are starting to request that their children be part of the NES classes. One of the teachers said, “We have parents coming from other schools in the area bringing their children because everyone seems to be so interested in what we’re capable of doing. From what I can tell, I see a lot more parents wanting to send children to this area. People [are] moving into the Phoenix City area because we are a ‘NASA Explorer School.’”

> *One of the greatest benefits that have resulted from our school participating in the Explorer School program is allowing us to share this program with our parents…*

In most NES communities, involvement with the NES program has centered on special school events (e.g., the family/parents nights, NASA days, science fairs) organized by the NES teams with support from other teachers, parents, and local businesses. Attendance at these events is often very high. In one school, over 1,000 people attended one of the family nights. These events have allowed parents to participate in school activities and children learning about science, math and technology.

According to the teams in the Focus Groups with the 2003 cohort, NES teams have put on special NASA-related events, such as family nights and NASA Day, related to science, math, and technology activities for the community. Other family events included weekend activities and breakfasts. They report holding one to four of these events per year, at least one of which typically involved a visiting astronaut, the AES, or other NASA staff. Community members were often invited to these events. Popular activities during these events included stargazing, robotics, technology, and space exploration -- Mars in particular.

The events usually included a variety of hands-on activities. Those held at the beginning of the year exposed parents to NASA-related information and resources, while those held later in the year showcased student work. Interview participants considered these "successful" and they often mentioned an increase in attendance at these nights over previous family events. Some sites have involved parents in other ways; for instance, parents volunteer to help with NASA-related after-school activities. In order to get information to parents, some sites have an NES newsletter and some work with the school's parent organization.

The aerospace education specialists appear to have been instrumental in establishing these family nights. They contributed in a myriad of ways, from helping to generate ideas to bringing equipment and artifacts, from conducting activities and giving talks to helping arrange the attendance of NASA scientists, administrators, and astronauts. Some sites have experienced difficulties organizing family nights or otherwise getting parents involved. It seems that aerospace educator contributions are critical in this area, since some team members did not know where to start in organizing such a school-wide event.

Several of the 2004 team leads commented on the family nights held by teachers. The NES program enabled teachers to implement family science nights on a regular basis that showcased student work and attracted families to participate in their children's learning. The quote below is a good reflection of the extent to which schools benefited from increasing family involvement. "One of the greatest benefits that have resulted from our school participating in the Explorer School program is allowing us to share this program with our parents… Parents had a chance to come in and see what their child was studying and also they build rockets as a family and had a chance to launch them in our school's P.E. field. After that event, we had many parents thanking us for having this program because it has given them an opportunity to work with their child and do something as a family. This is something we have never seen before."

Increased involvement of the community in the school. In the 2003 Focus Groups, several schools proudly explained that the publicity and recognition from the community improved family and community involvement. "We are proud to be part of the NASA family." "There is a whole new feeling about the school in our local community resulting from the prestige of NASA. "You're a classy outfit!" "The publicity that our school has received just by being a NASA Explorer School has helped our image in the community. The community outside the school supports us because they know we are an Explorer School. They see the coverage in the newspaper of the different activities we do." "We have gotten some very positive publicity locally that has helped our school's image in the community." "Community and family ties have improved. We have successful family science and math nights; the community has reached out more to us in becoming active partners in education." "We had recognition and prestige from the community."

> *More community members are willing to help… Parents are more involved. They see that the kids are really developing a love for science, math and technology.*

More community involvement sometimes also came along with increasing family participation in school activities. Some teams pointed to the evidence how the NES program helped them receive additional grants and volunteer work from the community. Others stated how the NASA family nights helped them become known in the community. "Before this opportunity to become a NASA Explorer school, we were an unknown entity in our school system. Now partnered with NASA, we have been receiving public recognition for our after-school programs, in school NASA connect programs, and NASA AES visits." "Community awareness improved school status and pride." "Being affiliated with and selected by NASA has brought some publicity to the school and community members are now backing the program with support and volunteers."

> *Everyone is excited to be affiliated with NASA.*

The 2004 Team Leads reported that involvement in the NES program led to *partnership and collaboration opportunities*. “We have networked with other NES in our area. It makes us feel like we are a part of the NASA family.” “We have gained new community partners to support our education program.” “Our district takes this school and staff seriously. At one point this was the “scary school” in the district. Now we are considered innovative risk takers. We have incredible partnership with local universities that have enriched lives of our students greatly in just a few months.” Others acknowledged how the partnership and collaboration with other NES schools, local business, and universities benefited the whole school community. “We have received many opportunities to grow as a school and community.” “The ideas and programs being brought into the school as well as professional development has been an asset to our school thus far.” “Being in the program rallies support and creates unity on campus.” “The NES program has opened up space-related topics to the whole campus.”

The 2004 Team Leads described their program implementation experience using words such as excitement, pride, and recognition. The NES program increased *excitement among teachers, students, and families as well as publicity* they received by having a partnership with NASA. “We have gotten national recognition by being a NES school.” “Pride [in] being the only NASA Explorer School in the state and having the experience of an astronaut visiting the school.” “The positive PR we have gotten… The entire community has been behind the program.” “We have access and current information on many exciting learning opportunities for our staff.” “Students have been very excited about being a partner with NASA.” “a renewed excitement in our students about our school in general.” “Excitement from the children and parents about this program is phenomenal.”

Conclusions about the effect of the NES program on families

School teams report that they are better able to involve families and the community in STEM-G activities because of their designation as an Explorer School. The AESs are often instrumental in organizing and running family events, especially in the beginning. The community is invited to these events that builds their relationship with the school and can lead to support for other activities. The publicity from these events also improves the image of the school in the community and for the families of the children who attend the school. As hoped, these activities and the change in image then leads to greater confidence in the students in their abilities to succeed in STEM-G in school and later in careers.

As with the changes in the classroom, support from the aerospace education specialists may be critical to success with family and community involvement, both in planning a schedule of regular events, in providing dynamic content and in helping the schools to build on their early successes. Getting families interested in coming out for Star Gazing, and science shows can lead to them talking to their children about what they are learning, and encouraging them to go into STEM-G careers.

It is recommended that attention to planning for family activities, content, methods to involve families and ongoing assessment of family involvement receive more emphasis in professional development, particularly the summer workshops.

Based on discussions with the program staff, three family/caregiver surveys were developed in September 2005. A short survey was developed for family night events to gauge the level of interest, satisfaction and effect of the event. The survey was field-tested and made available to the NES Coordinators to disseminate to schools. A family/caregiver survey was developed for use during the 2005-06 school year by a random sample of schools. The pre survey collected baseline data and will serve as a needs assessment on the level of involvement, the interests of parents, the needs they perceive their children have, how they support their children’s STEM-G interests, and what support they would like from the school. The post survey will provide a look at changes, and inform the planning of the program for continuing support of the schools in involving families.

What is the Effect of the Explorer Schools Program on Students?

This section summarizes the findings to describe the effect of the NASA Explorer Schools program on students in regard to their knowledge of STEM-G, their interest in STEM-G topics and careers, and their application of STEM-G.

Data Sources. At this time two main data sources were collected to examine NASA involvement increases student interest, attitude, and achievement in STEM-G content areas: the student symposium student survey and the student interest survey. Interpretation of these two sources is informed by the NES 2003 cohort interviews, student presentations, and responses to teacher questions at the 2005 student symposium, and feedback reports from special events at schools in which NES center staff were also engaged.

Students and teachers from the 2003 and 2004 cohorts were invited to attend a 3-4 day symposium event at Johnson Space Center in Houston. The goals for students were to:

1. Provide a pleasurable, comfortable, and worthwhile experience
2. Affect their interest in STEM-G careers
3. Influence them to be interested in doing more STEM-G activities in and out of school
4. Inspire them to pursue STEM-G learning and careers
5. Give them an opportunity to present their NASA activities to an audience of their peers and NASA staff (see report on student presentation responses)
6. Provide networking opportunities with students from other schools

The survey was administered before the last event of the Symposium asking students to rate the quality of their experience, describe their current levels of interest/skill/confidence and gauge the effects of the program on the interests and behaviors in the future. In the spring of 2004, the 2003 cohort's teams (50 teachers, 100 students) attended with the team leaders from the new 2004 cohort. In 2005, half of the 2003 and all of the 2004 teams (75 teachers, 150 students) and 2005 team leaders (50 teachers, no students) were invited to attend. Survey data were analyzed by attendance year. For Likert scale items, means were computed. For choices, percentages of the respondents were computed. For open-ended responses, a content analysis yielded frequency of key ideas. Items are grouped by goal for reporting.

Student Symposium Presentation Interviews
Students presented to their peers on projects they had done during the past year as a result of Explorer School involvement at the 2005 Symposium. A panel of NASA staff listened to their presentations, asked questions and gave them written feedback. The results from a content analysis of the students' responses were analyzed.

Student Interest Survey
Teachers involved in the Explorer Schools program administered the student interest survey in the spring of 2003 and 2004 to their students resulting in three groups of data: (1) 2003 cohort taken in spring of 2004 after one year in the program; (2) 2003 cohort students taken in spring of 2005 after two years in the program; and (3) 2004 cohort students taken in the spring of 2005 after one year in the program.

The survey draws from Holland's (1997[5]) theory of career development and from Krumboltz'(1996[6]) social learning theory. Widely used for career investigations, Holland's theory suggests that people who choose careers that match their own personalities are most likely to be

[5] Holland, J.M. (1997). Making vocational choices: A theory of vocational personalities and work environments. Lutz, FL: Psychological Assessment Resources.
[6] Krumboltz, J. D. (1996). A learning theory of career counseling. In M. L. Savickas & W. B. Walsh (Eds.), Handbook of career counseling theory and practice. Davies-Black Publishing Company.

both satisfied and successful. Krumboltz suggests that career decision making and development is promoted through social learning, environmental conditions and events, and learning experiences both in and out of school.

The Student Interest survey monitors interest in different school subjects and topics, abilities, and general occupational knowledge and interest as a means to documenting and understanding changes in student interest in STEM topics and careers in STEM in the NASA Explorer Schools program.

The Survey of Student Interest has three categories of items:

- Perceived competence (ability and performance in math or science classes and in a career requiring scientific or scientific ability)
- Knowledge (STEM-G, school subjects, what math is, what science is, how they might use math in the future, how they might use science in the future)
- Interest in STEM-G topics and careers (how much they like STEM-G school subjects, how much they like doing various math and science activities, the extent to which they are interested in STEM careers, and describing

For Likert scale items, means were computed. For choices, percentages of the respondents were computed. For open-ended responses, a content analysis yielded frequency of key ideas. 944 student responses were collected for the 2003 in 2004 cohort, 561 were collected for the 2003 in 2005 cohort, and 541 were collected for the 2004 in 2005 cohort for a total of 2046 students responding to the survey. Each student gave a total of seven answers for questions 4, 6, and 10 for a total of 14,322 student responses. Analysis of student responses was divided into two groups, grades 4-6 and 7-12. Items are grouped by category for reporting. 2046 surveys were analyzed for the 2003 and 2004 cohort years.

Findings

The findings for each group, students, teachers, administrators and families, are summarized and reported across data sources. The NES model predicts that students will be more interested in STEM-G topics and careers, increase their knowledge and be able to apply it. Three data sources from students are used to examine the effects of the NES program on students: surveys from the annual Student Symposium (May 2004, May 2005); student responses to questions from a NASA panel during their presentations at the Student Symposium (2005) and; Student Interest Surveys completed by a sample of students from all three cohorts (fall '03, spring '04, spring '05). Two data sources from adults are used: Team Lead Surveys, Field Center Surveys.

Across the data sources, students report being inspired by being in a NASA Explorer School. They report knowing more about science, technology, engineering, and mathematics. They seem to have much less understanding of geography, and actual careers in STEM-G and NASA. They report being more interested in STEM-G topics and show interest in pursuing more experiences and knowledge in these areas. They think math and science are important areas of knowledge and ways of knowing. They showed significant growth in how successful they think they will be in a career requiring scientific ability, but not in other areas of science thinking. They indicate an average interest in STEM-G careers (range of 2.50-3.50 on a scale of 1-5), and have a general idea about what people do in NASA careers they are interested in such as astronaut, food scientist, oceanographer and robotics engineer. The team leads and field center staff report the inspirational effect of the program on students, their increased access to resources, and their interest in STEM-G.

In this section, these effects of the NES program on students are discussed in detail in terms of the goals of the program: STEM-G knowledge, interest in STEM-G topics and careers, and applications of STEM-G.

Effect on Student STEM-G knowledge

Team Leads report that the professional development and NASA programs/events have had an effect on the students' knowledge. In the 2004 Team Lead Survey, some teachers emphasized the infusion of technology as an important benefit for students to be connected. The program provided schools with funds to purchase technology, such as videoconferencing equipment and with opportunities to be connected to other schools and science experts. "We have obtained videoconferencing equipment and our students have been able to participate in distance learning with NASA centers." "Students have participated in a contest with Lockheed and won first place in a video contest… We are in the process of buying technology that we would not have had." "We purchased and began to use technology such as hand-held and videoconferencing equipment in out classrooms."

The NASA grant provided us with the opportunity to purchase technology that will really enhance student learning at our school.

In interviews with students presenting at the May 2005 Symposium, 76% reported that their knowledge had increased in STEM-G, specifically they talked about math (graphs, data, angles), astronomy/space, engineering, robotics, forces and motion, Newton's laws, airports and flight, Earth, ocean, atmosphere, weather, volcanoes, earthquakes, as well as about teamwork, how to present and how to teach others.

We continue to observe content comprehension demonstrated by our students, on a regular basis, as a result of this infusion of support.

In the Student Interest Survey, students were asked about how much they know about various school subjects and topics, what science is, how they expect to use it in their future, what math is, and how they would use it in their future. Analysis of the student interest survey data from the 2003 group rating of their knowledge from the end of their first year to the end of their second year showed a sustained above average confidence in how much they know about five school subjects/topics. On a scale of 1-5, students reported knowing the most about technology, and the least about geography.

Table 47. Student Knowledge About STEM-G Subjects

Scale of 1-5, 5=high	03 group 1st yr N=944	03 group 2nd yr N=561	04 group 1st yr N=541	03 group change fall to spring[7]
a. English	3.72	3.72	3.60	.984
b. Math	3.83	3.69	3.56	.025
c. Science	3.84	3.88	3.67	.500
d. Geography	3.08	2.99	2.94	.211
e. Technology	4.05	4.05	3.82	.895

*t-test for independent groups

When asked about different areas of STEM-G thinking, students reported above average confidence across the board that helps from year one to year two. The growth in confidence in "Using computers with science data" was statistically significant from year 1 to year 2 for the 2003 cohort.

[7] The * symbol indicates that the change from the first to second year is statistically significant to at least the p<.005 level.

Table 48. Student Self Report About How Good They Are in the Following Topics

Scale of 1-5, 5=high	03 1st yr	03 2nd yr	04 1st yr	03[8] change
a. Designing and planning an investigation or project.	3.43	3.49	3.42	.280
b. Developing a hypothesis.	3.37	3.46	3.32	.173
c. Testing a hypothesis.	3.54	3.64	3.49	.161
d. Making observations.	3.56	3.57	3.48	.761
e. Taking measurements.	3.47	3.49	3.34	.754
f. Using computers with science data.	3.74	3.93	3.56	.004*
g. Finding patterns and relationships in data.	3.32	3.28	3.11	.536
h. Using math to explore solutions to problems.	3.37	3.33	3.15	.572
i. Presenting results of an investigation or project to the class.	3.32	3.38	3.19	.380

*t-test for independent groups

To the best of your ability, describe what science is.

In the open-ended question sections, students were asked to tell what they think science is. For students in the 2003 cohort in grades 4-6, the top three responses remained the same for both their first and second years with only the ranking changing. "Fun" remained in the top three responses in all three cohorts.

> *To the best of my ability, science is an activity that challenges my mind but is fun at the same time.*

Table 49. Student Self-Report About Description of What Science Means

	Grades 4-6	Grades 7-12
2003 in 2004 (N=954)	9.7% - Fun 9.1 – The study of Earth 8.1 – Chemicals/chemistry	17.5% - Study of living things 8.4 – Technology/computers
2003 in 2005 (N=568)	11 – The study of Earth 9 – Fun 8.7 – Chemistry/chemicals	10.5 – Study of life 8.5 – Experiments
2004 in 2005 (N=551)	9.7 – Experiments 8.3 – Study of space 7.6 - Fun	17.6 – Study of the Earth 12.2 – Everything

For grades 7-12, 2003 cohort students responded most often by defining science as the "Study of life/living things." In the 2004 group, the most frequent response was "Experiments" for the 4-6 grade group and the "Study of the Earth" for the 7-12 grade group. The students' understanding of science was extremely varied as the small percentage for even the most frequent responses indicates. "The study of" was a frequent response. The summary does not capture some of the most creative responses from the students. As can be seen from the students' response they could benefit from more discussion and consistency about the nature and processes of science.

One student feels science is indescribable:

> *If some one think they can describe science itself they are either ignorant or a scientific geenious [genius].*

[8] The * symbol indicates that the change from the first to second year is statistically significant to at least the $p<0.01$ level.

Others focused on the mysterious nature of science:

I believe science is like magic only not as powerful as magic.
I think it is a mystery.
Science is a topic that is out of the box and will stay out of the box, no matter what. And for great out of the box topic you need an out of the box person.

Some students see science as a pretty closed system, with big words and using "scientific" things.

Science is mostly a language with big words
Science is the study of scientific things
Science is when you use something that someone made scientific.

Others made connections:

Science is a combination of math and social studies.
It is kind like math a whole lot of numbers and letters.

A lot of students focused on the "doing" in science:

Science is when you get to use materials like medal [metal], liquid, plastics, or balloons.
Science is when people study what will happen if chemicals touch each other.
When I think of science I think of people experimenting with different objects like liquids, kind of like reading a novel, only you have to go out and do what you read about.
Science is when you do something to a bug.

Some students see it as specific investigations:

Science is about ecosystems planets and all the earthy stuff.
Science is like all facts and stuff except it pretty much is reality

Others see science as solving real problems;

I think science is a study of everything you never learned about or never saw or thought about in your childhood.
Science is studying about things people cannot study about.
Science is a study that finds new problems with the things in the world.

Some focused on their own experience of science as a school subject:

Science is a kind subject.
Science is a hard subject for me. It's like trying to do a man's job.
Science is pretty fun but my table is not nice
Science is a subject in school that students in all grades get.
Science is just a pain in the arm for me.
Science is stupid....only lord knows how stupid it is

Ultimately, the most common response of the 4-6th grade students was that science is fun:

To me science is fun because it has technology and it has flowers.

Describe how you might use science in your future.

When responding to how they might use science in the future, all the groups had “job” in the top three. As would be expected, the 7-12 students listed “job” more frequently than their 4-6 classmates in all the cohorts. “Scientists” was the second most common response in five of the six groups. Similar to their responses to the question about what science is, students have a wide range of ideas, and some rather general ideas about how they might use science in their future careers.

> *Science would help me in the future, because you may not notice, but you probably make hypotheses all the time.*

Table 50. Student Self-Report About How They Might Use Science in the Future

	Grades 4-6	Grades 7-12
2003 in 2004 (n=954)	11% - As a doctor/medical 10.4 – Scientists 8.7 – In my job	18.7 – In my job/career 15.3 – Scientists 11.6 – Doctor
2003 in 2005 (n=568)	11.9 - My job 8.9 – Be a scientist 7.6 – Working for NASA	13.3 – My job/career 5.9 – Doctor
2004 in 2005 (n=551)	12.9 – In my job 9.5 – Be a scientist	13.8 – In my job/career 11.2 – Be a scientist 10 – NASA scientist

To the best of your ability, describe what math is.
Most students described math as either, "Numbers" or basic operations; "Addition, Subtraction, Multiplication, and Division." One group, the 2003 students in the grades 7-12, described math as "using numbers to solve problems."

Math is my favorite subject because it challenges me to think harder and stretch my mind with all the numbers.

Table 51. Student Self-Report About Description of What Math Means

	Grades 4-6	Grades 7-12
2003 in 2004 (n=954)	33.6% - Addition, subtraction, multiplication, and division 19.3 - Number	26.3% – Numbers 15.4 – Using numbers to solve problems 14.3 – Addition, subtraction, multiplication, division
2003 in 2005 (n=568)	21.7 – Numbers 21 – Addition, subtraction, multiplication, division	23.4 – Addition, subtraction, multiplication, division 16.1 – Numbers
2004 in 2005 (n=551)	31.2 – Addition, subtraction, multiplication, division 23.2 - Numbers	27.1 – Numbers 14.4 – Addition, subtraction, multiplication, division

Describe how you might you use math in your future.
When describing how they might use math in their future, grade 4-6 students all responded most frequently with "job/career." "Shopping" was more important to the 7-12th graders. In the 2004 group, "job/career" remained the most frequent in both the 4-6 and 7-12 groups, and "shopping" was in the top three for 4-6th graders.

You might use math if you ever get a job…
Math is going to be important to you no matter what… Everything you do has math.

Table 52. Student Self-Report About How They Might Use Math in the Future

	Grades 4-6	Grades 7-12
2003 in 2004 (n=954)	17.2% - In my/a job 15.5 - Money	15.2% - Shopping 14.3 – In my/a job 11.8 – Money
2003 in 2005 (n=568)	12 – Job/career 7 – Teacher/teaching	8.8 – Everyday 7.5 – Shopping 6.9 – Job/career
2004 in 2005 (n=551)	14.4 – Job/career 9.4 – Shopping 9.4 – Teacher/teaching	16.5 – Job/career 9.5 – taxes/bills 8 – Shopping

Effect on student interest in STEM-G topics and careers

When the 2003 group Team Leads talked about the benefits of the program, they said it increased student interest in STEM content and careers. "[We] increased students' interest and attitudes toward STEM." "Student interest has improved in the way of science, careers, technology and still working on the math." Some of the Team Leads talked about the evidence of change they see; "Teachers can see a difference in the students' attitudes. More kids are interested in science. They follow it in the news and on the Internet."

> *We are pleased at the way that our students have responded to the program. Our school is not famous for interested students… When students learn that they are doing NASA activities or using NASA provided equipment it makes them feel important. They really need that attitude.*

Eighty-eight percent of 2004 Team Leads reported the NES program benefited students. The program increased student interest in STEM disciplines as a result of exciting NASA science resources and curriculum, astronaut visits, communication with NASA scientists through DLN, and special student and family events.

> *The biggest benefit thus far has been the program's enlightenment of our students as to the possible careers at a NASA facility and the various types of positions [that] are an integral part of the NASA family.*

Others emphasized that they were able to increase student interest in *STEM-G careers*. Students have become more interested in the content; "Our students have become more interested in science, math, and technology." They are seeing themselves as possibly having jobs at NASA; "I think our students are realizing that they someday could work for NASA and be scientists. Having NASA visit our school has inspired our students." The opportunities have involved teachers, students and families such as; "Participation in Reduced Gravity Opportunity has inspired many students, caused teachers look outside their textbooks for teaching materials, caused many parents to volunteer their time to come into the school." "Students are interested in the science aspect of school and inquiring about jobs with NASA. Students have a sense of worth to be a NES school."

In the interviews of students during their presentations at the 2005 Student Symposium, 49% of the comments about changes to their feelings/attitudes toward STEM-G were about increased interest, especially in science. A couple of students mentioned interdisciplinary activities. Another said she had changed fields of study as a result of involvement with NASA. Eleven percent of the responses were about feeling more motivated. 50% said they were more interested in STEM-G careers, especially in science and engineering. Other career areas included robotics, space/astronomy, meteorology, computer analyst, paranormal investigator, lawyer and doctor. Thirty-three percent of the responses were about more interest in NASA careers, such as space science/astronaut, engineering, astrobiology, astronomer, computer scientist, accountant, mission controller and designer. 18% of the responses indicated more understanding of the variety of career options available to them such as marine biologist vs. oceanographer, computer programmer, air force pilot, mechanical engineer, robotics, science teacher and geology.

When asked what their current career aspirations were, "If you could choose a job right now, that job would involve…" students reported Science and Engineering as their top choices.

Table 53. Student Career Aspirations in STEM-G Topics

	May 2004 N=85	**May 2005** N=127
Science	59%	73%
Technology	49%	66%
Engineering	72%	77%
Math	23%	22%
Geography	10%	12%

In both May 2004 and May 2005, most students reported expecting to choose a job that involved science (59%, 73%) and engineering (72%, 77%). To a lesser extent, (49%, 66%) students expected to choose jobs involving technology. About a quarter of students (23%, 22%) expected to be using math, while still fewer (10%, 12%) expected to be using geography.

There were noticeable differences between the years in the percentage of students expecting to use science (59%, 73%) and technology (49%, 66%). It is difficult to know how to interpret the higher percentage in the second year. Since the 2005 symposium included 2003 students after two years in the program, it would be expected that they would have a greater understanding and interest of STEM-G involved careers. The lower percentages of student choosing careers involving math may be lower due to more emphasis on science in NASA programs. The lower percentages in geography may reflect the lack of emphasis on this area in the symposia agenda, in the program in general, and that it is not usually a separate school subject.

Students were asked about the effect of the program on their career interests. After the Symposia, in May 2004 and May 2005, 86% and 87% of students respectively reported they planned to learn more about STEM-G careers after attending.

Table 54. Student Future Plans

	May 2004	**May 2005**
After this event, I plan to learn more about STEM-G careers	86%	87%
After this event, I plan to talk to classmates about STEM-G	59%	67%

In both years, more than three quarters of students reported planning to learn more about STEM-G careers after the event. More than half of the students in both years report planning to talk to classmates. It would be expected that a higher percentage would respond positively to this in the second symposium given that half of the students had been participating in the program for two years at that point.

One a scale of 1-5, students in both years gave high ratings to the symposium in helping them to learn more about NASA careers (4.60, 4.56) and having influenced their career interests (4.29, 4.16). They also expected to apply what they learned (4.32, 4.25) and found the event inspiring (4.41, 4.38).

Table 55. Student Knowledge About NASA Careers

Average rating, 1-5, 5=high	**May 2004**	**May 2005**
This event helped me to learn more about careers related to NASA	4.60	4.56
Participation in this event influenced my career interests	4.29	4.16
I expect to apply what I learned during this event.	4.31	4.25
This event was inspiring.	4.41	4.38

High ratings on students' plans to apply what they learned during this event as well as their responses as to how inspiring the Symposium are indicators that the Student Symposium reached its goals in having a long term effect on increasing student application and interest in STEM disciplines and careers.

The responses to the Student Interest Survey questions about interest in STEM-G showed an above average interest in all school subjects, especially technology. Although the changes were not significant from the first to the second year for the first group (2003 cohort), except in technology, the high level of interest may reflect the first year of immersion in the program. To collect baseline data, the 2005 cohort students took the survey in the fall of their first year.

Table 56. Student Self-Report Their Interest in STEM-G Topics

Scale of 1-5 5=high	03 group 1st yr N=944	03 group 2nd yr N=561	04 group 1st yr N=541	03 group change fall-spring significance[9]
a. English	3.38	3.46	3.10	.171
b. Math	3.43	3.31	3.16	.100
c. Science	3.75	3.85	3.57	.115
d. Geography	2.92	3.01	2.83	.216
e. Technology	4.15	4.35	3.94	.000*

*t-test for significant change

When asked how much they liked doing various kinds of math and science thinking, students again reported above average ratings that remain high or in a couple of cases show significant increases (d, e).

Table 57. Student Self-Report How Much They Like Math and Science Thinking

	03 1st yr	03 2nd yr	04 1st yr	03 significance
a. Conducting observations and measurements as part of an investigation or project.	3.07	3.15	2.94	.193
b. Learning about the motion of a vehicle and how force can be saved with simple machines.	3.25	3.28	3.13	.715
c. Finding patterns and relationships in data.	3.11	3.10	2.93	.773
d. Studying how energy is made in ecosystems and used through food networks.	3.18	3.37	2.95	.006*
e. Using computers with science data.	3.76	4.02	3.48	.000*
f. Plotting locations of volcanoes and earthquakes to find patterns.	3.29	3.39	3.04	.143
g. Using math in science.	3.24	3.23	2.89	.910
h. Learning about how the earth, sun, and moon work together and how gravity holds all the parts of the solar system together.	3.66	3.70	3.50	.549

[9] The * symbol indicates that the change from the first to second year is statistically significant to at least the $p<0.01$ level.

Table 58. Student Self-Report Their Top Career Choices

Means on scale of 1-5	N=956	N=584	N=526
	03 in 04	*03 in 05*	*04 in 05*
Aerospace engineer	2.76	2.80	2.60
Astronaut	**3.08**	**3.13**	**2.91**
Astronomer	2.80	2.72	2.71
Biologist	2.80	2.92	2.63
Chemical engineer	2.97	3.00	2.75
Electrical engineer	2.94	2.95	2.76
Food scientist	2.94	2.89	2.76
Geologist	2.73	2.65	2.51
Mechanical engineer	**3.08**	**3.11**	**2.85**
Meteorologist	2.64	2.74	2.55
Oceanographer	3.11	3.05	2.84
Physicist	2.78	2.77	2.85
Planetary scientist	2.82	2.83	2.57
Propulsion engineer	2.60	2.68	2.50
Robotics engineer	**3.38**	**3.50**	**3.10**

When asked about jobs, top choices were astronaut, mechanical engineer and robotics engineer. Students were asked to choose a job from a list of NASA careers that they would most like to do. 1522 student responses were recorded. For both the 2003 group in 2004 and in 2005, robotics engineer was chosen most often, followed by astronaut. The third most popular choice for both groups was oceanographer. The fourth most popular was food scientists. The least chosen career was propulsion engineer. Responses are across grades 4-12. The emphasis on astronaut and robotics engineer as jobs reflects the program. It is a big event for an astronaut to visit the school in person or virtually, and they talk in detail about what they do so students have a sense of what the job is. Many NES schools are doing some kind of robotics club or activity in which students build robots, so they get firsthand experience in engineering a robot.

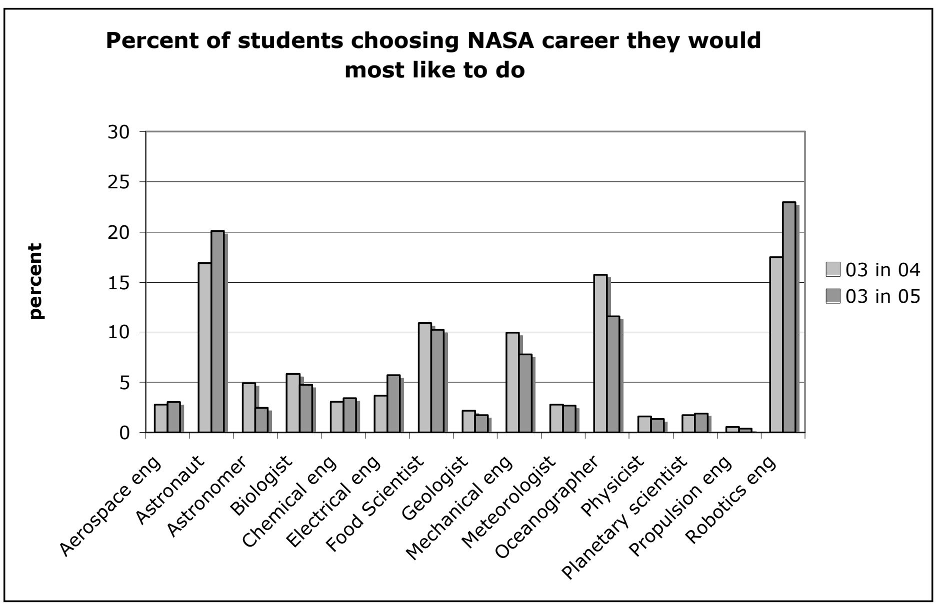

Figure 6. Student Self-Report Their Top Choice of NASA Career

When students are asked to describe what a person in the job does and why it is important to NASA, their responses indicate a limited and very general understanding of the jobs. More specific information about career options and a wider range of careers has been the emphasis of several initiatives this past year, including a new DLN event in which NASA professionals adopt a class that studies their job, interviews them in a videoconference and then creates an interactive display for a career night for the community. Other mentoring and shadowing events to increase student interest and information about careers were planned in the school team strategic and implementation plans. The sample of responses below shows both the potential for sparking career aspirations and the need for more specific information and experiences.

Table 59. Student Self-Report: *What does this person do?* *(in the job you aspire to)*

Astronaut	*Discoverer of life on other planets* *Goes into space to work on the shuttle and other rockets* *Gets to stand on the moon* *Goes to other planets in search of aliens* *Takes care of satellites* *A person who loves space and wants to know what is out there*
Food Scientist	*Study food to learn how to make new foods* *Tests food to see that there is nothing wrong with it* *Invents food for astronauts* *In this job people try to figure out what type of food they should take up in space and take out the water out the food and should try to find new foods that could last in space. They have to do this because if they don't have the right food it will make it heavy.* *Likes to look at and eat food*
Oceanographer	*A person working on this job studies the ocean and someone working on this job can help NASA observes the fish, tide and ocean life* *Look for weird species on the ocean floor* *Explore new environments, learning the difference between the land and the sea*
Robotics Engineer	*Builds robots* *Designs and builds robots* *Design robots that make things easier for humans* *These people have to be very creative*

Table 60. Student Self-Report: *How does someone working in this job help NASA?*

Astronaut	*Work at the space station and launch satellites* *They help NASA by expanding their knowledge and sending information about what is happening. They can help people learn more about what it is like in space. If something goes wrong(which is very bad..) they would be able to fix that problem so the next people would not have that problem. They help NASA know more about space and about problems that may occur. They can also help people learn more about if there is a chance that we can live in space* *By telling NASA what they discovered on the different planets*
Food Scientist	*By testing the food to see if it would be safe to take in space* *By telling NASA what types of foods that the astronauts can eat in space* *They help them decide what to send in space and what not to send in space*
Oceanographer	*I think an oceanographer helps NASA by telling them what the winds and different studies they found different.* *Oceanographers would help NASA understand why there might be water on Mars or why there isn't water on a certain planet.* *I think it help hem because when the SRB's (solid rocket boosters) fall in the water if the water is already mapped they know exactly where to go*
Robotics Engineer	*Someone doing this job can help the other people made the rovers so that they can have the required things that a rover would need on a mission to Mars or any other planet.* *They could give NASA new ways to improve their work on a new space ship or shuttle, or they could help NASA with putting some technology together to make or create different things* *This person might repair the shuttle or make a robot to do something in space instead of a man*

Effect on student application of STEM-G concepts
How are students applying what they learn about STEM-G? The 2003 Team Leads reported that teachers see a difference in what students are interested in and how they spend their time; "More kids are interested in science. They follow it in the news and on the Internet."

The Field Center staffs pointed to the successful family, community, and science nights they helped schools organize as evidence of the effect on students. The students often present or assist with the activities on those nights, and their families' attendance supports their interest.

In the Student Symposium Survey, students in both years reported that they believe the event will help them in their studies at school and to make connections (4.33 in 2004 and 4.23 in 2005). They reported that they expect to apply what they learned and were inspired by attending (4.36 in 2004 and 4.32 in 2005).

Table 61. Student Ratings of Symposium

	May 2004	May 2005
This event will help me in my studies at school.	4.28	4.21
This event connects to what I am learning in school.	4.38	4.24

Ninety percent reported they have been influenced to take additional courses, especially in science and technology.

Table 62. Symposium Influence on Students Taking Additional STEM-G Courses
If so, which areas? % students

	May 2004	May 2005
Science	70%	61%
Math	48%	46%
Technology	82%	56%
Geography	19%	17%

The majority of the students report being influenced by the symposia in the areas of science (70%, 61%) and technology (82%, 56%). Almost half reported being influenced in math (48%, 46%). This is consistent with the percentage of students responding that they would choose careers involving math (49%, 66%), science (59%, 73%) and technology (72%, 77%). Only about 20% report being influenced in their interest in geography (19%, 17%). Again this is consistent with fewer students expecting to enter careers using geography (23%, 22%). The emphasis by the students on science, technology and math may reflect the degree of emphasis in the NASA Explorer Schools.

This pattern of science and technology being the preferred areas of interest continued when students attending the symposia were asked how much they liked each subject. Most students reported really liking science (4.48, 4.35) and technology (4.59, 4.37). They rated math (4.09, 4.25) and history (4.01, 3.91) somewhat lower, but still above average. English (3.71, 3.73) and Geography (3.73, 3.75) were less well liked but still above the neutral rating (3.0). Given the positive ratings of History and English, these students seem to be positively predisposed to school in general as well as to STEM-G topics and activities.

Table 63. Students Rate How Much They Like STEM-G Topics

Average rating, 1-5, 5=high	**May 2004**	**May 2005**
Science	4.48	4.35
Math	4.09	4.25
Technology	4.59	4.37
Geography	3.73	3.75
History	4.01	3.91
English	3.71	3.73

Another source of data on how students are applying what they are learning is in their interest in taking more STEM-G courses and doing more STEM-G activities in and out of school. After the Student Symposia, the majority of students in both years reported they were interested in taking more courses in science and technology. The majority of students reported that the Student Symposium event influenced their interest in mainly science (70%, 61%) and technology (82%, 56%). About half of the students who participated in the event reported influence on math (48%, 46%). Again, influence on student interest in geography was the lowest of the subjects (19%, 17%).

Table 64. Student Self-Report on Plans to Pursue STEM-G Activities After Event
The majority of the students report that they plan to talk with their classmates about STEM-G after the event, and pursue STEM-G activities.

	May 2004	**May 2005**
After this event, I plan to talk to my classmates about STEM-G.	59%	67%
I plan to watch science TV for fun.	57%	46%
I plan to visit places featuring science.	83%	74%
I plan to visit STEM-G websites.	67%	64%
I plan to read books about STEM-G.	58%	69%
I plan to attend STEM-G events when not in school.	66%	61%
I plan to talk to family members about STEM-G.	74%	78%
I plan to talk to friends about STEM-G.	60%	60%
I plan to find out more about the science covered during this event.	87%	88%

Higher percentages on visiting places featuring science (83%, 74%), interest in finding out more about science covered in the event (87%, 88%), and plans to talk with family members about STEM-G (74%, 78) are indicators of the positive effect of the Student Symposium and the overall program.

When students were asked about how they were thinking about science and math on the Student Interest Survey, they responded with above average ratings. An analysis of the data showed only one area of significant increase from year 1 to year 2 for the 2003 cohort: b) How successful do you think you would be in a career that required scientific ability? In other words, after two years in the program, students reported they would be more successful in a science career.

Table 65. Thinking About Science

3. Thinking about science (scale of 1-5)	03 1st yr	03 2nd yr	04 1st yr	03 sig yr1-yr2
a. How well do you think you will do in science this year?	3.85	3.85	3.68	.986
b. How successful do you think you would be in a career that required scientific ability?	3.27	3.39	3.19	.049*
c. When taking a science test you have studied for, how well do you do?	4.01	3.97	3.86	.442
d. How well have you been doing in science this year?	3.89	3.84	3.62	.336
e. In general, how hard is science for you?	2.52	2.59	2.66	.268
f. Compared to other school subjects you have taken or are taking, how hard is science for you?	2.66	2.66	2.71	.935

Three areas showed significantly change in thinking about math: a) How well do you think you will do in math this year? d) How well have you been doing in math this year? f) Compared to other school subjects you have taken or are taking, how hard is math for you? After two years in the program, students reported that math was more difficult for them, that they did not, and had not been doing well in math.

Table 66. Thinking About Math

5. Thinking about math (scale of 1-5)	03 1st yr	03 2nd yr	04 1st yr	03 signi-ficance
a. How well do you think you will do in math this year?	3.73	3.58	3.51	.014
b. How successful do you think you would be in a career that required math ability?	3.66	3.54	3.42	.039
c. When taking a math test you have studied for, how well do you do?	3.88	3.74	3.66	.023
d. How well have you been doing in math this year?	3.69	3.52	3.45	.008*
e. In general, how hard is math for you?	2.69	2.79	2.82	.131
f. Compared to other school subjects you have taken or are taking, how hard is math for you?	2.80	2.99	2.94	.005*

Conclusions about the effects of the Explorer Schools program on students

Effect on Student STEM-G knowledge. Students report liking and knowing an above average amount, about science, technology and math as school subjects, as well as English (>3.6 on 1-5 scale). They rate geography lower but still above average. These responses are after one or two years in the program for two different cohorts. Only in technology was there a statistically significant increase in some of the questions. While the model is designed to increase students' knowledge in STEM-G, the self-report surveys were given after one or two years in the program, or in the case of the symposium survey, after the event, so conclusions are limited. The 2005 cohort took the Student Interest Survey in the first semester of involvement to establish baseline data. A matched pairs analysis would also provide more valid data about student perceptions of their own knowledge gains. From the current interviews with students at the Symposium, and the surveys of the Field Center staff and Team Leads, we know that the perception is that students are gaining knowledge in important STEM-G areas. Although not analyzed here, the student presentations of their own research were observed and in many cases indicated a substantial understanding of key STEM-G concepts that applied to their specific projects. But ultimately the effect on the program needs to be gauged based on knowledge assessments that establish the level of prior knowledge. To this end, tests for assessing student knowledge in the priority academic areas established by the schools have been developed and were administered to students in a random sample of schools. A parallel test will be administered at the end of the school year to assess changes.

From the evaluation data collected to date, we can say that students, teachers and Field Center staff feel students have learned more STEM-G content, particularly science, math and technology. The data are unclear about the depth or quality of that understanding. Certainly, in the questions about what science and math are, and how they are used, students show only a general understanding of the nature of science/math and scientific work. Perhaps more attention to the nature of science, the ways of knowing in math and science, and the specific uses of STEM-G would result in a better understanding of, and perhaps significant changes in, students' understanding of the intellectual and practical role of science and math, their ratings of their own knowledge, how much they actually do know and how much they engage in the subjects that address STEM-G topics in school.

Effect on student interest in STEM-G topics and careers. The NES program aims to help more minority and low SES students to enter the STEM-G career pipeline. These groups are currently underrepresented in both the courses that are required for credentialing and in the careers. The Explorer Schools program uses modeling by high profile NASA employees such as astronauts, as well as NASA employees from many different fields, and the Aerospace Education Specialists who visit the schools to work directly with the teachers and students. The jobs and career paths of NASA employees are highlighted in the monthly newsletter. Some NASA resources are focused on specific careers, and many NASA activities are created within the context of how the information or skill is currently being used.

The data collected from students, teachers and Field Center staff indicates that the students are interested in careers in STEM-G, especially science, engineering and technology. They report being very interested in some of the jobs they have learned more about through the program such as astronaut, robotics engineer and food scientist. They indicate that events like the Symposium get them more interested in STEM-G careers and topics, so they will do activities, such as, watching science TV, and talking with classmates about science topics. Team Leads report that students are pursuing STEM-G topics after school on the Internet. Field Center staff report that teachers are integrating more activities into their courses to interest students, and that schools are sponsoring evening events for families that get everyone involved in supporting the student's interest and career aspirations. Students report doing science and math thinking, such as; "using computers with science data," and "studying how energy is made in ecosystems." When asked about career interests, students are most interested in being astronauts, food scientists, mechanical engineers, oceanographers and robotics engineers. They have a more enthusiasm than understanding of these careers, but it is clear that some of them have gone into depth about the career, such as with the food scientist when one student wrote, "In this job people try to figure out what type of food they should take up in space and take out the water out the food and should try to find new foods that could last in space. They have to do this because if they don't have the right food it will make it heavy."

Effect on student application of STEM-G knowledge. The Explorer Schools model expects the modeling and instruction in STEM-G within a NASA context to be highly motivating so students see these areas as interesting and worth pursuing. How much they are applying what they are learning about STEM-G in and out of school are important indicators of continuing interest. The Team Leads and Field Center staff report much more student interest in STEM-G topics as a result of the Explore Schools program. Students also report being inspired and making connections between their NASA experiences such as a visit to Field Center, or lesson with and AES to their school subjects and interests. Science and technology are the most often cited as the preferred areas. When asked about thinking, doing, reading and discussing STEM-G topics outside of schools, the majority of students say they will as result of involvement.

In general students reported that math and science as subjects in school are harder for them than other subjects. At the same time they reported that science is "fun" and they expect to do above average in math and science this year.

Overall, from the data gathered so far, the program is affecting students positively and sustaining their interest in STEM-G. From the self-report data, we do not know whether their perceptions match actual gains in knowledge, or if they actually do better in their classes. Case studies of a random selection of schools, content tests in academic priority areas, and collecting baseline data will provide additional evidence of effects the NES program on the schools.

CONCLUSIONS AND RECOMMENDATIONS

This report began by looking back at the lessons from the previous evaluation efforts. Here we have revisited those findings in light of two and half years of implementation, and an additional 100 schools, bringing the total number of schools participating to 149. In the last eight months we have looked more closely at the model and how it is being implemented from the perspectives of the teachers, administrators, Field center staff and NES headquarters leadership. These findings establish the NASA Explorer Schools program as an effective school reform model. The design of support and engagement works. Teachers use NASA resources to increase their own knowledge of STEM-G topics and careers, and of constructivist strategies. The design engages administrators and families in supporting student STEM-G knowledge development and career interest. Students report they are learning more about STEM-G, and are excited about it.

What are the elements of this successful model?
High levels of communication and coordination focused on the schools' needs
Organizationally, the combination of a strong Headquarters team coupled with diligent Field Center support, both virtual (NES coordinators) and face-to-face (AES) creates a web of resources that schools can bring to bear on meeting the academic priorities of their students. The coordination and communication among these groups is critical to success. The schools have knowledgeable, interested support for using NASA resources that will make a difference.

A sense of purpose and importance
The motivation teachers, students, administrators and families all feel by being part of a significant endeavor of our time - to explore, explain and discover more about life here and beyond Earth - creates a level of commitment that helps the schools get over the hurdles of poverty, access and reform. The goals of NASA are inspiring, the content is intriguing, and the tools are cutting edge. NASA is a model for daring to ask questions that have not yet been answered, and setting goals before the means and the route are clear. Students, teachers and administrators all report that they are proud to be a NASA Explorer school, and they work hard to live up to that partnership. They feel empowered to think big and pursue their dreams.

Self-correcting teams
The Explorer Schools organization is self-correcting, constantly evolving to better engage the schools. The schools too are in a learning mode. They meet regularly to plan, review their progress and then plan some more. The schools that get the most out of the program participate the most.

Increased access to and engagement with STEM-G content and services
The NES program involvement with NASA programs, products and services has demonstrated the following outcomes:

- The NES teachers report having access to STEM-G instructional material that is otherwise not available to them. As two teachers reported in the 2005 interview with 2003 cohort of

NES teams said, "Having the robotics equipment is blowing my mind, said one teacher. Another said that she had no textbook, "NASA was my whole curriculum…"

- The NASA materials and services provided to the NES teachers link STEM-G content with effective pedagogical practices (especially inquiry and constructivism) so that teachers learn content and improved teaching practices as they implement the new STEM-G resources. For example, teachers in the 2003 cohort described changes they made to their curriculum based on what they learned through NES such as adding electives (aerospace, aeronautics, space exploration), restructuring their science curriculum around extended learning events (Signals of Spring, Mission Geography), and adding new topics in STEM-G curriculum and after school programs (rocketry, robotics, and astronomy) that previously were not addressed. However, a need for even more focus on ways to link pedagogical training to STEM-G learning emerges from analysis of workshop agendas. The workshops are providing professional development in instruction that teachers need in order to teach difficult concepts. The content workshop analysis indicates that taking time to demonstrate specific pedagogical strategies within the context of the thematic professional development workshop setting is particularly effective in helping teachers learn new content and new teaching methods.

What can be improved?

Sustain the Efforts to Support a Shared Understanding of Teaching and Learning

One of the lessons from NES Brief 3 was to engage NES team in a shared understanding of goals for the program and a shared vision for school improvement in the areas related to STEM-G made possible by NASA involvement. As the program graduates its first cohort and finds evidence of positive impact on schools, teachers, communities, and students, it is important to revisit the vision of success. As Baker (2005) suggests, in order to measure student learning, we must first determine what our shared understanding of learning is. In the case of the NES program, STEM-G knowledge, performance indicators, and standards are defined by the National Science Standards and state and district standards. This report shows interventions to improve professional development workshops helped to focus intervention on to these standards for learning. As we move the program to the next phase with greater focus on collecting evidence of outcomes, we need to develop a shared understanding of a model-based assessment that suits the NES program. Baker (2005) presents two graphic organizers (Figures 7 & 8) for discussing model-based assessment to support sustained learning that may well suit the NES program. This is an important topic because having this shared understanding among staff and teachers will bring coherence to the process of selecting STEM-G activities, teaching strategies, assessment tools, and evaluation measures. This is a topic that needs to be discussed with NES staff as part of the upcoming evaluation summit.

Focus on evidence of outcomes

While there is clear evidence that the model is being effectively implemented, clear evidence of outcomes is needed. Are there more STEM-G opportunities like classes, labs, assemblies, field trips, clubs, mentoring and science nights? Do the students and families participate in these opportunities more than before? Do they know more content in science, technology, engineering, mathematics and geography? Do they know what science is and what careers use it and how? Do their career aspirations change as a result of this program? Do they want to take more science, math and technology courses? Do they take them? Is attendance better in the school? Are families more involved? How much more? In what ways?

Examine outcomes in terms of the level of implementation

Data about the degree and quality of implementation along with outcomes data is needed to validate that the schools with strong teams and clear plans, that involve the whole school and the community, and use NASA resources and technology will have the greatest effect on student knowledge, interest and career aspirations. This year, we are considering asking schools to log what they actually do in their plans as part of their progress reports. Another source of data that has not yet been analyzed is the Weekly Activity Reports of the Aerospace Education Specialists and the NES Coordinators. These could potentially provide data on the activities schools are incorporating into their model of what it means to be an Explorer School.

Model the critical factors in each phase
The evaluation data identifies critical factors that can be modeled in four phases of participation in the program:

1. Orientation (application, acceptance, Symposium professional development for Team leads, pre-visit, Orientation summer workshop)
2. Startup (1st year, use of NASA resources, videoconferencing, teamwork, family/community involvement)
3. Focus/Extension/Expansion (2nd year, content workshops, focus on emerging needs, expanding successful activities, local partnerships, involving all the faculty)
4. Sustainability (3rd year, institutionalizing best practices, building on partnerships, connecting with other schools, planning for future funding)

The NASA resources and services featured at NES orientation and summer could be more closely tied to STEM-G careers and research that take place at that coordinating center and in same cases has provided a fertile foundation linking goals for student interest, knowledge, and achievement in STEM-G with community-based career opportunities.

Use embedded measures
We need a few powerful measures of the implementation factors and the outcome variables that are integrated into how NASA and the schools do their work together. In each phase, participants have identified critical factors that support success. Now that these have been identified, they can be systematically used in implementation, and measures of the degree of implementation can be used for formative evaluation. Feedback loops can be established that rely on regularly scheduled data collection. Outcome measures can be embedded in each phase to collect baseline data and then track progress over time. All measures can be aligned so conclusions are based on multiple sources of complementary data. Data needs to be collected in NEEIS so schools and Field Centers can generate their own reports. The online strategic and implementation plans need to include assessment strategies. As the plans are implemented, the schools, and NASA personnel can add to an online progress log for each objective. Schools and NASA staff can review this at any time to track progress, and plan and coordinate their work.

What is the contribution of this program to the field?
Educational reform has been approached from many different angles over the years. Success is characterized by a sound approach that the school and community believe in, that focuses on students' needs and interests. This model takes the best of what is known about reform and grounds it in one of the most comprehensive and successful endeavors of our time – the exploration of space. It reaches out to the students who do not see themselves as part of that endeavor, or benefiting from it in any way, and who are often disenfranchised from their own school experience. This program gives them access to people, ideas and experiences that makes learning "the basics" important on a whole new level. The program is a real partnership that challenges the schools and the Field Center staffs to find ways to get the whole school involved and ramp up the effectiveness of science, technology, engineering, mathematics and technology teaching and learning.

Now that preliminary evidence has been collected to support the NES model, this program and its evidence of success supported by the mixed method evaluation has an opportunity to contribute to the professional development field. By following the recommendations listed above, the NES program is positioned to be able to collect much needed data to support the somewhat revised hypotheses presented in the model that:

(1) The NES program encourages effective use of NASA programs, products, and services.
(2) The NES program increases teacher competence in STEM-G instruction.
(3) The NES program increases family involvement.
(4) The NES program increases student interest, attitude, and achievement in STEM-G.

STEM-G Standards	Performance targets	Measures
		Preinstruction
		Assessment during instruction
		Criterion performance

Figure 7. Structural elements of educational assessment systems.

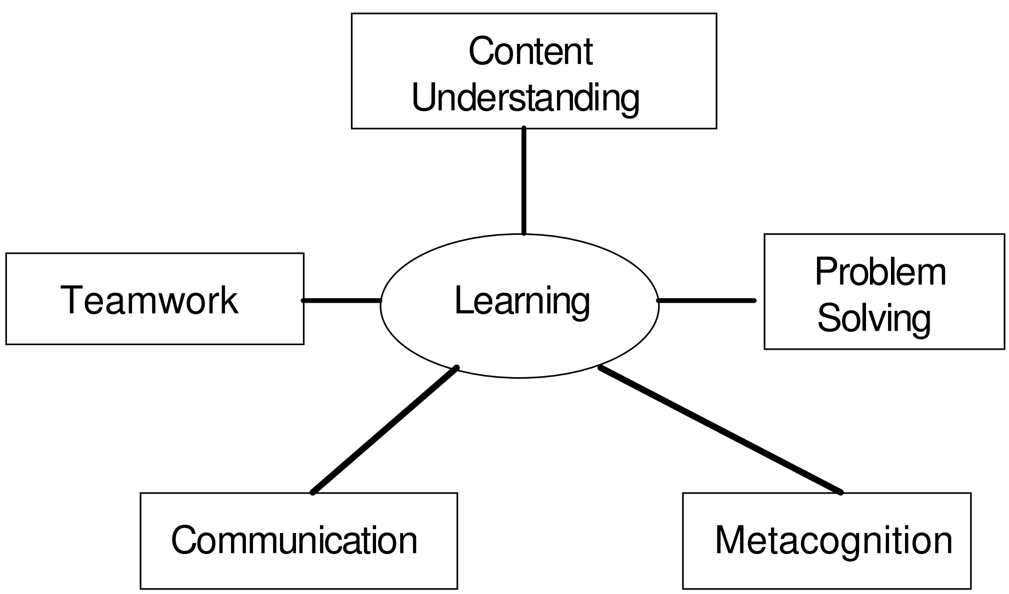

Figure 8. Cognitive families of model-based assessment.

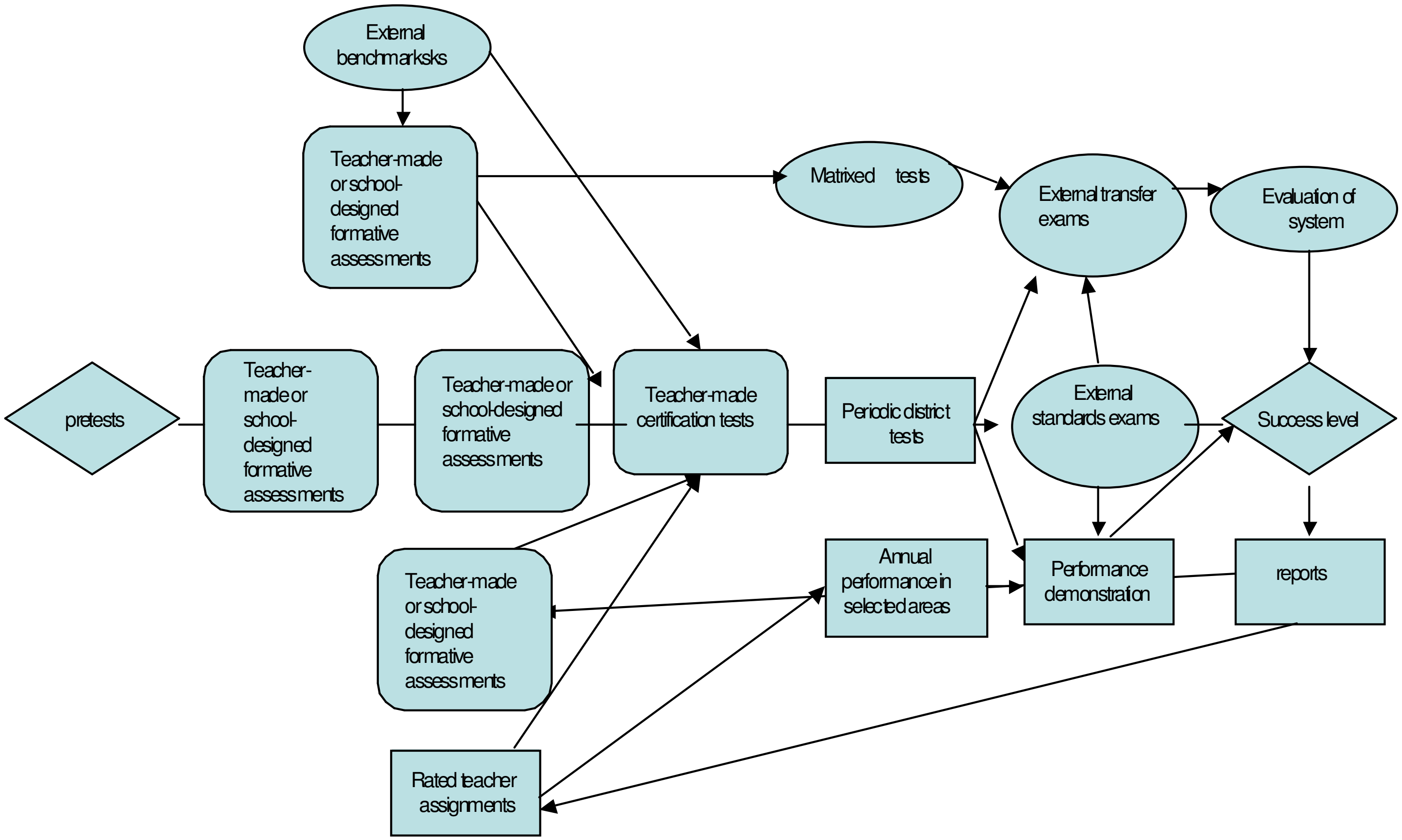

Figure 9. An assessment model for sustained learning.

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List of Appendices

Full reports on the following data sources are included in the Appendices.

To address how the NES model is being implemented:

APPENDIX 1: NES Needs Assessment
APPENDIX 2: NES Coordinators Interview Protocol
APPENDIX 3: Field Center Survey Report
APPENDIX 4: Team Leads Survey Report
APPENDIX 5: Sustainability Workshop Feedback by Center
APPENDIX 6: Strategic Plan Analysis Report

To address what is the effect of the NES program:

APPENDIX 7: Student Symposium Student Survey Report
APPENDIX 8: Student Symposium Teacher Survey Report
APPENDIX 9; Student Symposium Student Research Report
APPENDIX 10: Student Interest Survey Report
APPENDIX 11: Teaching, Learning and Computing Survey Report
APPENDIX 12: Feedback for 2005 Workshops
APPENDIX 13: Administrator Survey Report
APPENDIX 14: Focus Group Interviews Report
APPENDIX 15; Student Content Knowledge Surveys Key
APPENDIX 16: Family Involvement Survey
APPENDIX 17: Student Interest Survey (online version)
APPENDIX 18: Student Interest Survey (Scantron version)
APPENDIX 19: Teacher Needs Survey
APPENDIX 20: Administrator Survey (pre-test)
APPENDIX 21: Administrator Survey (post-test)
APPENDIX 22: Family Needs Survey
APPENDIX 23: Earth Science Survey of Student Content Knowledge (A) & (B)
APPENDIX 24: Life Science Survey of Student Content Knowledge (A) & (B)
APPENDIX 25: Physical Science Survey of Student Content Knowledge (A) & (B)

BACKGROUND AND PURPOSE

The NASA Explorer Schools (NES) program was launched in 2003 with a cohort of 50 schools. Two years later, 149 schools are participating in this program with professional development support and curriculum services provided by NES headquarters and ten NASA-affiliated field centers. The NES program is designed to provide a three-year partnership with schools that serve primarily low socio-economic, ethnically diverse, and/or low performing rural, urban, and suburban populations. The NES program is designed to improve student learning and interest in science, technology, mathematics, and geography (STEM+G) and is primarily targeted for middle schools. The NES program provides its cadre of school teams an organized and sustained professional development support model that includes financial support, access to NASA educational resources, professional development services, and technical expertise throughout the school year and summer.

The NES program guides its cadre of fifty schools per year to develop strategic and implementation plans that organize their STEM+G school improvement plans. Schools are advised to take advantage of both local community as well as NASA resources to address the following six NES objectives:

1. Student ability to apply science, mathematics, technology concepts.
2. Student knowledge about careers in science, mathematics, and technology.
3. Student interest in participation in science, mathematics, and technology.
4. Active participation and professional growth of educators in science, mathematics, and technology.
5. Family involvement in student learning.
6. Academic assistance for and technology use by educators in schools with high populations of underserved students.

As a systemic reform initiative, the NES program works with its cadre of school teams to guide their efforts to encourage students to be interested in STEM content, to pursue STEM-related careers, to involve their family caregivers in supporting their STEM interests, and to increase student knowledge of STEM content. The teachers and school administrators participating in this program also play a key role in demonstrating how schools are served by the NES program. In order to impact students, the NES program must first increase teacher awareness of NASA resources, knowledge of STEM concepts and topics, knowledge of inquiry pedagogical teacher techniques, and involvement with student families and caregivers.

The implementation of the NES model is consistent with research evidence indicating that teacher professional development can result in improved teaching practices and student learning (Borko, 2004; Garet, Porter, Desimone, Birman, & Yoon, 2001). Borko (2004) identifies three areas where the impact of effective professional development has been documented: teacher knowledge and teaching practice, teacher collaboration, and instructional design. The section describing the NES model will show how the Explorer Schools program addresses Borko's (2004) recommendations for effective professional development that helps science and mathematics teachers enhance their content knowledge and change their instructional practices. By engaging teachers in problem-solving and hands-on activities, the NES program provides ways to address teachers' inadequate preparation in science, fear of teaching science, and lack of confidence in using hand-on participation activities in their STEM-G courses (Pearson & Fechter1994).

This NES model and collaborative evaluation approach was recommended by a student learning advisory group that met in the fall of 2004. This advisory group was established to consider design options. The recommendations of this group were to engage teachers in a collaborative evaluation process that used action research, portfolios, and rubrics for examining student work in order to document student content knowledge development, changes in interest in STEM-G, and STEM-G careers. This method was recommend to replace this original design that compared NASA Explorer Schools with other schools matched demographically and in regard to prior achievement in standardized tests.

The collaborative design approach is consistent with recommendations by Ramaley (2005) in her discussion of education reform designed to "prepare our young people to enter a workforce that is being radically shaped by the social and economic impacts of new technologies" (p. 56). As Ramaley suggests, a key component of preparing youth for today's careers is science education (Ramaley, 2005). We also refer to the guidelines suggested by Linn (2005) regarding the importance of having student achievement at the heart of the design for the creation and implementation of an accountability system geared towards improved teaching and learning. A key reminder from Linn is that specificity of content standards is critical in order for standards and learning goals to provide a clear outline for the development of appropriate assessments. These guidelines from current educational research leaders have impacted the NES evaluation design model.

Orchestrating professional development within the context of group and collaborative teamwork further facilitates teacher collaboration and learning according to Borko (2004). The NES model directly addresses this strategy from the start of the program when schools submit their application and, if selected, start their professional development goal setting and school improvement plans as a team of four teachers plus one administrative representative. The NES model is further endorsed by research by Putnam & Borko (2000) which shows that professional development activities should require teachers to design instructional plans that show connections to their teaching goals and student needs.

The research and evaluation team of the Classroom of the Future Program at the Center for Educational Technologies™ on the campus of Wheeling (WV) Jesuit University is conducting the evaluation of the NES program. The goal of the evaluation is to use multiple formative and summative educational research methods to examine how the NASA Explorer School program is being implemented and what effect this program is having on teachers, school communities, and students.

Organization of Brief 4

Following an introductory section that has described the background and purpose of the Explorer School Evaluation, is a description of the NASA Explorer School Model and the role that each of the program participants play in implementing and fulfilling this model. The methodology section describes how the NES logic model is implemented within the mixed method approach. The findings are organized within the context of the major hypotheses of the NES model:

1. How is the NASA Explorer Schools program being implemented?
   a. How does the NES program encourage more involvement with NASA programs, products, and services?
   b. How does the NES program involvement increase teacher professional growth?
   c. How are Explorer School teams implementing the NES program?
2. What is the effect of the NASA Explorer Schools program?
   a. What is the effect of the NES program on teachers?
   b. What is the effect of the NES program on school administrators?
   c. What is the effect of the NES program on family/caregiver involvement?
   d. What is the effect of the NES program on student interest, attitude, and achievement in STEM-G?

Finally, we summarize the findings, make recommendations, and present the next steps for the program and its evaluation. Complete reports for each data source referred to in this report are included as appendices to Brief 4.

THE NASA EXPLORER SCHOOLS MODEL

The NASA Explorer School model posits that professional development in the form of summer workshops, on-site support, virtual support, workshop attendance, and special activities such as History of Winter (now Winter Story), will result in an increase in teachers' knowledge of NASA resources and how to use them with inquiry methods to teach STEM-G content more effectively to students, and to engage their families/caregivers. In turn, these changed knowledge and behaviors by the teachers, will affect students' interest and knowledge in STEM-G, interest in STEM-G careers, and their family/caregiver involvement.

The logic model from the evaluation plan outlines the key areas of impact and how they will be evaluated. The data sources are shown at the bottom of the diagram.

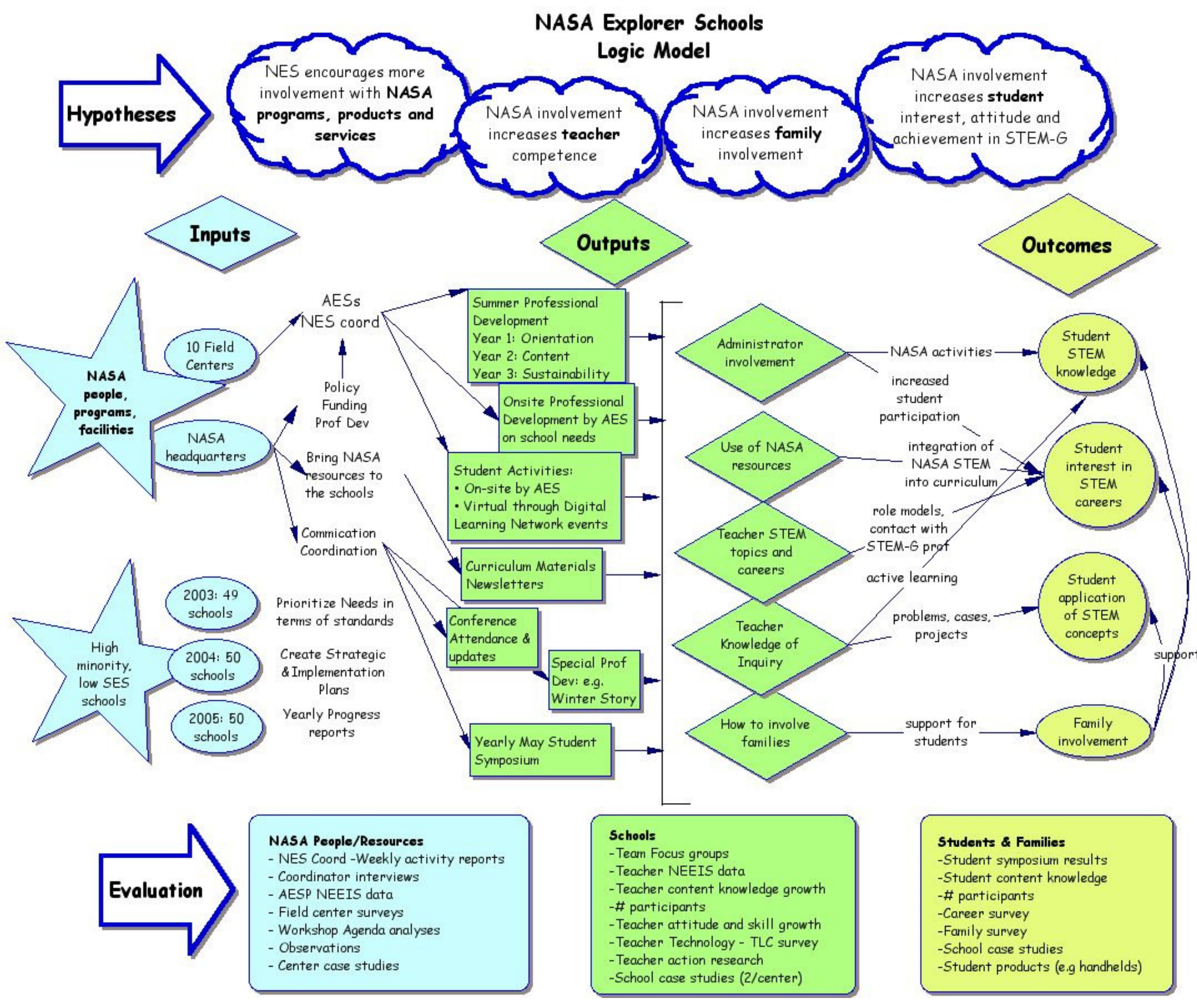


Figure 1. A graphic depiction of the NES logic model

How Is the NES Model Being Implemented?

This section examines the way the model is being implemented by NES headquarters, field center and schools. The program has evolved in the two years of implementation toward more effective practices for meeting the goals of increasing teacher confidence and competence to affect student knowledge, interest and career aspirations.

What role do NES administrators, staff, and school teams play in implementing the program?

NES headquarters team. Based on interviews, formal and informal communication with the NES headquarters staff, and document sources, the role of NES management in the NES model can be categorized as providing the following administrative services:

a. Disseminating funds and program planning and leadership to support the organization and implementation of the program
b. Orchestrating communications and coordination of support for the NASA staff and schools
c. Garnering and organizing support from within NASA for the centers and schools
d. Initiating professional development services and support for cross-cutting activities for the schools, such as for professional development workshops (Winter Story, SEM-B, regional and national conferences)
e. Offering curriculum review and development specific to inquiry and the needs of NES schools
f. Conducting outreach, application, dissemination and publicity services to promote NES opportunities at minority institutions, professional teacher organizations and among STEM-G professional societies and groups
g. Contracting for program and outcomes evaluation

NES field center staff. In the first year of the program (2003-04) the field center staff worked with the schools, from planning the summer workshops to providing on-site support during the school year. At the end of that first year (summer 2004), with 50 new schools coming on board, the field centers and NES headquarters decided to hire a coordinator specifically for the program. As has been described elsewhere in this report, their role was defined as the main point of contact for the school at the field center for questions, services and support. The aerospace education specialists (AES) continue to provide the onsite support. The NES coordinators come from STEM backgrounds in K-12 education so they are able to help the school teams implement the program, advising them on strategies and ideas for accomplishing their goals. In the fall of 2005, Digital Learning Network coordinators were added to the field center teams (5) to support the NES schools use of this resource.

A significant benefit to the program of the creation of the NES coordinator position is that they work as a team with NES headquarters coordinator to constantly share successes and challenges and to develop ways to integrate best practices into the support the field center offers the schools. They also work with the AES and other NASA field center staff to harvest resources for the schools. .

NES schools. The NES program is designed to provide support for whole school reform through a small monetary grant ($17,500 over a three-year period). Support from NASA also includes extensive professional development and teaching resources in STEM-G content, technologies, and pedagogical techniques. Once a school is accepted into the program, they complete a needs assessment profile of school academic priorities. The individual school needs assessment is used as a reference for the development of strategic and implementation plans that identify how NASA resources and services will be used to meet STEM-G academic goals. The five-person NES team from each school develops these plans with support from the field center staff. The NES team is encouraged and supported by NASA field center staff to take a leadership role in involving the school, community, and local partners in the a reform effort designed to increase student interest, attitude, and achievement in STEM-G academic areas and career paths. As mentioned earlier, the schools selected for the NES program are high minority, ethnically diverse, and previously low achieving schools. Table 1 gives a summary profile of 2003, 2004, and 2005 NES school populations.

Table 1. 2003, 2004, and 2005 School Profiles

	2003	2004	2005
School Locations			
Rural	35%	34%	24%
Suburban	21%	14%	20%
Urban	37%	52%	56%
School Characteristics			
Title I	74%	76%	88%
Low SES student population	63%	61%	62%
Overall student population	41,441	41,573	40,553
Race and Ethnicity			
Minority student population	65%	59%	75%
African American	39%	34%	25%
Hispanic/Latino	18%	17%	46%
Asian American	6%	5%	4%
Native American or Alaskan Native	4%	5%	1%
Caucasian White	35%	41%	25%

As seen in Table 1, 74% of schools from 2003 cohort, 76% of schools from 2004 cohort, and 88% of schools from the 2005 cohort reported to be Title I schools. Of the overall student population, between 61 to 63% of all schools across 2003, 2004, and 2005 reported to have been qualified for free or reduced lunch, an indicator of socio economic status. All three cohorts, 2003, 2004, and 2005, reported a high minority presence (65% for 2003, 59% for 2004, and 75% for 2005).

The percentage of minority students was calculated by adding up the total number of African American, Hispanic, Asian, and Native American students and dividing this number with the overall student population for each cohort. Consequently, 65% of all students from the 2003 cohort, 59% from 2004, and 75% from 2005 were minority students. Further, specific minority groups were calculated for cohort and reported in Table 1. The figures are reported for 2003, 2004, and 2005 consecutively: African American 39%, 34%, and 25%, Hispanic 18%, 17%, and 46%, Asian 6%, 5%, and 4%, and Native American 4%, 5%, and 1%, white 35%, 41%, and 25%.

Data Sources

This section describes the data sources. Please refer to the full reports in the Appendix for more information on each measure. As described in the background section, a variety of measures have been used to understand how and to what extent the causal relationships proposed in the model are occurring. Because of the shift to a more collaborative evaluation model, ongoing interactions provide a mixed method approach that combines quantitative and qualitative elements to document how the program is being implemented and the effect that the program is having on teachers and students. The rationale for combining these two approaches is that the NES program is not being introduced into a sterile laboratory setting, but rather into a complex social environment with features that affect the success and outcomes of the NES interventions[10]. The variety of data sources includes surveys, content assessments, interviews, observations, document analyses, and interactions with NES staff and participants.

To understand how the NES model has evolved to support the schools and field centers, we interviewed the NES headquarters team, surveyed the field center staff including aerospace education specialists who provide on-site support for the schools during the year, interviewed the NES coordinators who are the primary contact with the schools and NES headquarters, surveyed the team leads of schools in the 2003 and 2004 cohorts and interviewed (focus groups) the 2003 school teams. We also collected some data on the professional development special events such

[10] Based on guidelines from the National Science Foundation publication, *Handbook on Mixed Methods Evaluation* that can be found on the web at <http://www.ehr.nsf.gov/HER/REC/pub/NSF-97-153>

as History of Winter and observed the summer workshops. To understand how the field centers are implementing the program, we used many of the same data sources, but focused on the relationship with the schools.

To understand how the schools are implementing the NES program, we used the interviews with the NES coordinators, the surveys of the field center staff, the focus groups with school teams and the surveys of team leads. We also analyzed their strategic and implementation plans.

Table 2 provides a summary of how each data source is used to address one or more of the evaluation research questions. As the table summary shows, some data sources are extremely important because they provide data that answers several investigation questions. The validity of the results is strengthened when multiple data sources and data collection methods can be used to study the same phenomenon. Being able to triangulate findings is the main advantage for using this mixed method approach.

Data from students, teachers, administrators, NES team leads, and NASA field center staff are used to discuss the effect of the program on students. The following table shows the data sources and what they measure.

Table 2. Data Examining NES Effect on Students, Teachers, and Administrators

Effect on	Data sources	Data
Students	Student Interest Survey Student Symposium Student Survey Presentations Student Content Knowledge Surveys* Field Center Staff Survey Team Lead Surveys 2003, 04	Perceived competence, interest, knowledge, career choices Interest, knowledge, career choices Pre/post knowledge gains in earth, life and physical science Implementation activities and strategies Observations of effect on students Teacher reports about students
Teachers	Teaching, Learning and Computing Survey Student Symposium Teacher Survey Summer Workshop Feedback Form Field Center Staff Survey Team Lead 2003, 04 Teacher Survey*	Constructivist philosophy, teaching and use of technology, technical skill, attitude toward tech Knowledge, attitude, relevance, inspiration Involvement, interest, family involvement Self-report data on benefits Implementation activities and strategies Implementation activities and strategies Implementation activities and strategies
Administrators	Administrator survey	Constructivist philosophy, attitude toward technology
Families/ Caregivers	Family Involvement Survey*	School involvement, activities with own child, needs
School teams	Strategic Plan Analysis Focus groups	What teams plan to do What teams report they do

*Survey administered in the Fall 2005. Data not available yet, but instruments are described.

METHODOLOGY

The CET evaluation team has identified the most pragmatic, productive, and effective approach to design its methods for assessing the impact of the NES program on teachers, students, families, and schools. As the educational research literature affirms, comparative experiments are not sufficient methods for gathering the best evidence of "what works" when studying the impact of an educational intervention—especially one on the national scale of the NES program. The initial design suggested a scientifically based research comparison of Explorer School student performance with non-Explorer schools on state test data, and other instruments. This approach has been refined due to several factors: in most states, science testing is just beginning; with other measures, there was little incentive for non-Explorer schools to give additional surveys; state data is not readily available in many cases and obtaining that data from schools in 50 states was not feasible. Instead, the CET evaluation is using the Extended Term Mixed-Method (Chatterji, 2004) approach that blends analytic quantitative and systemic qualitative methodologies so that the evaluation can capture the contexts of events and actions within their social contexts.

The Extended Term Mixed-Method approach articulated by Chatterji (2004) includes the following five components that are well suited to the complexity and scope of the NES evaluation research:

1. The evaluation design includes a long-term timeline that aligns with a significant lifespan of a program being implemented at particular sites for systematic study.
2. The evaluation methods are guided by a program's theoretical framework as well as empirically based understanding of environmental systemic and site-specific factors that potentially influence program outcomes.
3. The evaluation incorporates formative and summative evaluation phases in the overall plan with at least one feedback loop for educating stakeholders and program personnel in regard to improvements in program implementation and delivery.
4. The evaluation design incorporates sharply focused causal questions for appropriately timed field experiments and incorporates well-defined treatment and interaction variables in the design.
5. The evaluation designs effectively combines qualitative and quantitative research evidence to obtain understandings of how, why, and when a program works, and to inform causal interpretations.

The evaluation plan developed by Davis, Palak, Kirby, Smith, and Huang Martin (2005) represents an evaluation approach that is consistent with the guidelines presented above for the Extended Term Mixed-Method. The NES evaluation is a long-term research endeavor that is designed to match a significant portion of the NES program timeline. As the NES evaluation model (depicted in Figure 1) shows, this study is guided by a theoretical framework that involves a partnership with NASA to offer professional development services and authentic STEM-G resources to improve teacher competence, increase family involvement, and increase student interest and knowledge in STEM-G disciplines. The NES program specifically selects ethnically diverse, low socio-economic and underachieving (primarily middle) schools based on data regarding the needs and environmental conditions of these schools.

As the NES evaluation model and data presented in this report will show, the CET evaluation strategically uses both formative and summative research tools. Briefs 1-3 highlight feedback that has been provided for improving the implementation and delivery of the program. This report will use the recommendations from these previous reports to show how the sharing of these "lessons" has impacted design decisions in years two and three of the NES program. In addition, data from all tools is reported throughout the life of the project for formative assessment and refinement of the design. The evaluation design continues to look at the model for implementing the program to develop an understanding of how and why the program works and to guide causal interpretations. For example, this year, case study schools have been randomly selected to collect survey data from students, families and teachers and content tests have been developed to measure change from beginning to end of a school year in the areas of greatest need (as identified by the schools). These additional approaches will complement the continued use of the Teaching, Learning and Computing Survey, the focus groups, Team Lead Survey and Student Interest Survey.

The approach to the evaluation design has evolved from lessons learned in the first two years of the program, recommendations of the student learning advisory group, and further discussions among the field center staff, NES headquarters staff and evaluation team. Interviews with NES headquarters and regional staff demonstrated the need for three areas of focus: 1) A more formative evaluation that involved field center staff to support refinement and replication of best practices in the NES implementation; 2) A strong focus on measuring the impact of the NES program on teachers, families/caregivers, and students; 3) A description of the range, adaptation, and innovation of the schools in implementing the model from a set of randomly selected case study schools.

This report will also examine how lessons from previous evaluation reports (Hernandez, McGee, Reese, Kirby, & Huang Martin, 2004) have been integrated into the NES implementation and evaluation models and how they have impacted the NES implementation. The following section provides a brief summary of the lessons articulated in Evaluation Briefs 1, 2 and 3.

Lessons from Briefs 1-3:
Brief 1 (2004[11]) established that the NES program had identified and engaged underserved schools, teachers, and students with a comprehensive portfolio of curriculum and professional development supports. Brief 2 reported on the summer professional development. Brief 3 (2005[12]) reviewed the implementation and results from the first year of implementation and offered lessons that could be useful to improve the coherence and design decisions in terms of team organization, participation, and professional development supports. The lessons from these 3 briefs are presented in terms of the two evaluation questions: How is the model being implemented? and What is the effect?

How is the NES model being implemented?
Brief 1 (2004[13]) established that the NES program had identified and engaged underserved schools, teachers, and students with a comprehensive portfolio of curriculum and professional development supports.

Brief 3 (2005[14]) reviewed the implementation and results from the first year of implementation and offered lessons that could be useful to improve the coherence and design decisions in terms of team organization, participation, and professional development supports.

[11] McGee, S., Hernandez, V., & Kirby, J. (2003). Evaluating the quality and impact of the NASA Explorer Schools program. *NASA Explorer Schools, Evaluation Brief 1 (NES/EB1/7-2003).* Wheeling, WV: Classroom of the Future.

[12] Hernandez, V. M., McGee, S., Reese, D., Kirby, J., & Martin, J. (2004). A program in the making: Findings from Year 1. *NASA Explorer Schools, Evaluation Brief 3 (NES/EB3/7-2004).* Wheeling, WV: Classroom of the Future.

[13] McGee, S., Hernandez, V., & Kirby, J. (2003). Evaluating the quality and impact of the NASA Explorer Schools program. *NASA Explorer Schools, Evaluation Brief 1 (NES/EB1/7-2003).* Wheeling, WV: Classroom of the Future.

[14] Hernandez, V. M., McGee, S., Reese, D., Kirby, J., & Martin, J. (2004). A program in the making: Findings from Year 1. *NASA Explorer Schools, Evaluation Brief 3 (NES/EB3/7-2004).* Wheeling, WV: Classroom of the Future.

Lessons from the first year about how schools are implementing the program.

- Teaming is critical. School teams with shared goals and understandings are more likely to report successful experiences and results.
- School teams with purposeful selection strategies, clear roles and responsibilities, and structures for reflection and input provided evidence of genuine engagement. Teams need to understand factors that facilitate or hinder engagement and to agree on specific roles in the spirit of true collaboration.
- School teams need to focus on increasing career interest in science, mathematics, and technology. This was not clearly articulated across participating school teams.
- Specific curricular connections are needed.
- Teams need to stick to their plans and use resources that clearly meet specific curricular needs.
- Strong administrative leadership and related supports are needed to create favorable conditions for program participation and to promote greater coherent engagement.
- School teams understand that promoting a network of parental and community support is essential for creating conditions to motivate and sustain student interest in science, mathematics, and technology in the context of the NES program.

How are centers implementing the program?

- Proactive, planned, and coherent external professional development supports are needed to help school teams sort out what they need and maximize their participation in the program.

What is the effect of the NES program on schools, teachers, students, and families/caregivers in STEM-G knowledge and career interest?

Brief 2 (2004[15]) evaluated the summer 2003 workshops and found participants were very positive about the professional development experience they had. Brief 2 recommended the NES professional development focus on:

- School content priorities
- A balance of content, active learning and reflection in professional development
- Approved curriculum resources
- Family involvement and career education strategies
- Aligning follow-up support with the strategic and implementation plans
- Using evaluation data to make program decisions

Brief 3 reported on the results May 2004 Student Symposium

- After one year in the program, students attending the symposium to report their own research reported a strong interest in Science, Math and Technology
- Students reported they would likely choose a job that involved science, math and technology (49% -72% of students).
- Student say they are likely to pursue STEM-G topics, talk to others, visit websites, visit places featuring science (55%-88% of students)
- Students say they will take additional courses in science, math and technology (48%- 82% of students)
- Students reported that the Symposium was a valuable experience, inspiring and will help them in school
- Teachers attending the symposium reported that it was relevant, gave them confidence and helped them acquire new skills.
- Teachers reported that they gained a new appreciation of NASA**'s** mission and resources
- Teachers reported that NASA resources could definitely be integrated into their curricula

[15] Hernandez, V. M., McGee, S., Kirby, J., Reese, D., & Martin, J. (2004). A program in the making: Evidence from summer 2003 workshops. *NASA Explorer Schools, Evaluation Brief 2 (NES/EB2/2-2004)*. Wheeling, WV: Classroom of the Future.

Data Collection and Analysis

A variety of data sources were used to collect information about the implementation model and its effects. This section describes the different data sources and how the results were analyzed.

NES Headquarters staff members were interviewed about how they implement the model and provide support to the centers and schools. Four Headquarters team members were interviewed and the results summarized by theme with examples to explicate the tenets of the model.

The *NES coordinators interview* and protocol was developed in February and March 2005 to capture rich data about the program model. Interviews were conducted over the telephone with 10 NES coordinators. Two interviews took place face-to-face during the student symposium. Interviews were tape recorded in most instances. In cases where the interviews were not recorded using an audiotape, extensive notes were taken to record the conversation. The transcribed data from the interviews were loaded to NVivo software to analyze the content. Using a set of codes that emerged from the interviews, data were analyzed by field center.

Teacher Focus Group Interviews were conducted with the 2003 cohort teams to describe: (1) how school teams were experiencing the program; (2) how they were implementing their strategic plans; and (3) how they were assessing the support they received from the NASA field centers. A total of 49 focus group interviews were conducted with the 2003 cohort via telephone between December 2004 and February 2005. Interviews were audio taped, transcribed, and summarized in a report by school for formative evaluation purposes, and overall for summative purposes here.

Student presentations and interviews were incorporated into the 2005 student symposium. Students presented to their peers on projects they had done during the past year as a result of Explorer School involvement at the symposium. A panel of NASA staff listened to their presentations, asked questions and gave them written feedback. Analysis of a transcription of the student presentation and the interviews that followed were coded and analyzed and are incorporated in the analysis of the effects of NES on students.

An *observation-coding scheme* for the 2005 *summer workshops* was created based on the work of Garet, Porter, Desimore, Birman, and Yoon (2001) on designing effective professional development. A coding scheme was created based on three categories (content, coherence, and active learning) with twenty codes that fall under these three categories. Using this coding scheme, four evaluation team members coded the summer Orientation workshop sessions as they occurred in the field centers for the 2005 cohort. Each session was coded using a numerical value 0 to 2 referring to “no emphasis,” “minor emphasis,” and “major emphasis.” The NES coordinators, and in some cases, the Program Manager reviewed the agenda coding for accuracy via teleconference. A frequency analysis was conducted to describe the extent of best practices in the summer Orientation workshop design and delivery by center for formative evaluation purposes and overall for summative purposes in this report. The summer Content workshops (for 2004 cohort schools) were coded from the agendas only, and then verified with the NES coordinators. Frequency analyses were completed by center and overall.

A *document analysis of school strategic plans* was conducted to investigate the types of interventions that the 2003, 2004, and 2005 schools put into their individual school plans. The NES program requires that each school prepare and implement their team action plan, to address their unique school needs. “Action plan” refers to a collection of four documents: a three year school strategic plan, a three year school implementation plan, a technology plan, and an executive summary. Strategic and implementation plans outline the kinds of NASA content materials, programs, resources, and people schools need in order to meet five NASA Explorer Schools performance objectives. The document analysis led to mapping the categories of interventions that were sensitive to individual school needs. The methodology for conducting a document analysis was built on the principles of Guba and Lincoln (1981). The 2003 and 2004 plans were coded using the initial set of codes that emerged from this process. A revised coding scheme was used to analyze the analysis of the 2005 plans. Two evaluators reviewed and coded each plan, then met to discuss differences. Strengths and weaknesses of the plans were also noted in the 2005 analyses for formative evaluation purposes, i.e. feedback to centers and schools.

The *Team Lead Survey* was administered to the entire population of team leads (N = 99) from the 2003 and 2004 cohorts. The survey is composed of 20 open-ended and 27 close-ended questions. Data were collected via an online tool (Perception) in January and February 2005. Collected data were aggregated by 2003 and 2004 cohort. A frequency analysis was conducted to analyze team lead responses to the close-ended survey items. A content analysis of the responses to open-ended responses was conducted using NVivo, qualitative data analysis software to identify themes that emerged within and across responses to specific questions.

The *Field Center Survey* is designed to collect data on the perceptions of the aerospace education specialists and NES coordinators (n = 40) on the critical factors in implementation and the evidence they have of its effects. Composed of 19 sections and over 100 open-ended and close-ended items, the field center survey data was collected online between March and April 2005. To analyze the survey results, a frequency analysis was conducted on the close-ended questions. The open-ended responses organized by cohort year, topic, and theme using the NVivo software.

The *Teacher Feedback Survey* was taken online in the NEEIS system at the end of the summer workshops. Teachers were asked about the quality of the workshops, its effect on their attitude, knowledge and practice in STEM-G, and their assessment of how this will affect students and families. Means were computed for each question and construct for each type of workshop and presented to the Field Center teams as formative evaluation data for discussion and future planning. For this report, means across Field Centers and by workshop type are presented as summative data on the effect of the workshops. The numbers of surveys analyzed were 141 in Orientation Workshops, 133 in Content Workshops, and 168 in the Sustainability Workshop.

The *Teaching, Learning, and Computer Teacher's Survey* is a self-report questionnaire adapted from Becker (2000) that yields data on five constructs aligned with constructivist principles for teaching and learning: Technical Skill; Constructivist Teaching Strategies; Attitude Toward Technology; Constructivist Teaching Philosophy; Constructivist Uses of Technology. Teachers on the leadership teams were asked to complete the TLC.

The *Administrator Survey* was created in April 2005 in an attempt to gauge the changes in beliefs and attitudes of the administrators as well as their involvement in the NES program implementation. Only those administrators who were also members of the school teams were asked to take this survey.

The *Student Symposium Student Survey* was administered to students attending the May 2003 and May 2004 Symposia. The survey was administered before the last event of the Symposium asking students to rate the quality of their experience, describe their current levels of interest/skill/confidence and gauge the effects of the program on the interests and behaviors in the future. In the spring of 2004, the 2003 cohort's teams (50 teachers, 100 students) attended with the team leaders from the new 2004 cohort. In 2005, half of the 2003 and all of the 2004 teams (75 teachers, 150 students) and 2005 team leaders (50 teachers, no students) were invited to attend. Survey data were analyzed by attendance year. For Likert scale items, means were computed. For choices, percentages of the respondents were computed. For open-ended responses, a content analysis yielded frequency of key ideas. Items are grouped by goal for reporting.

The *Student Symposium Teacher Survey* was used in both May 2003 and May 2004. In May 2004, the 2003 cohort's teams (50 teachers, 100 students) attended with the team leaders from the new 2004 cohort. In May 2005 half of the 2003 and all of the 2004 teams (75 teachers, 150 students) and the new 2005 team leaders (50 teachers, no students) were invited to attend. 90 teachers completed surveys in May 2004; 99 teachers completed surveys in May 2005. The survey administered on the last day asked participants to rate the quality of their experience, describe their current levels of interest/skill/confidence, and gauge its effects on the interests and behaviors in the future. Survey data was analyzed by year of the event. Year of participation for each teacher was not available. For Likert scale items, means were computed. For forced choices, percentages of the respondents were computed. For open-ended responses a content analysis yielded frequency of key ideas. Items were grouped by goal for reporting.

The *Student Interest Survey* was given in classes of the teachers involved in the NASA Explorer Schools program in the spring of 2003 and 2004 resulting in three groups of data: (1) 2003 cohort taken in spring of 2004 after one year in the program; (2) 2003 cohort students taken in spring of 2005 after two years in the program; and (3) 2004 cohort students taken in the spring of 2005 after one year in the program.

Complete reports for each data source are included in the Appendix of this report. Table 3 shows the analysis conducted on the data from each measure.

Table 3. Summary of Data Source and Associated Analyses

Data Source	Analysis
Student Interest Survey	Means by construct T-tests for change from year to year of groups Content analysis of open-ended responses
Student Symposium Student Survey	Means by question Content analysis of open-ended responses
Student Symposium Presentation Interviews	Content analysis of open-ended responses
Student Content Knowledge Surveys*	To be analyzed – pre/post comparisons within the year
Teaching, Learning and Computing Survey	Means by construct T-tests for change from year to year of groups T-tests for matched pairs Analysis of Co-variance between constructs
Student Symposium Teacher Survey	Means by question Content analysis of open-ended responses
Summer Workshop Feedback Form	Means by construct by type of workshop
Teacher Needs Survey*	To be analyzed after first administration in Fall 2005– pre/post comparisons within the year
Administrator survey	Baseline summary of responses Next summer pre/post matched pairs year-to-year
Family Involvement Survey*	To be collected and analyzed – pre/post comparisons within the year
Strategic Plan Analysis	Content analysis by cohort year
Focus group interviews with 2003 cohort NES teams	Conducted Jan-Mar, 2005; summary of key ideas
Field Center Survey	Frequency analysis quantitative questions, content analysis for open-ended questions
Team Lead Survey	Frequency analysis quantitative questions, content analysis for open-ended questions

*Indicates that data was collected in 2005/2006 and was not available for analysis in this report.

HOW IS THE NES PROGRAM BEING IMPLEMENTED?

How Does NES Encourage More Involvement with NASA Programs, Products, and Services?

As the logic model shows, activities of NES headquarters in the implementation of the NES model are systematic, pervasive, and crosscutting to ensure a constant focus on the goals of the program. The role of the NES headquarters team is to set program policy, disseminate funding, harvest NASA resources for the program, and coordinate communications across the NASA field centers and participating schools.

Along with this program-wide visioning, policy-making and coordination, there is an emphasis on individuality; individual coordinators and center staff creating solutions that work for their region, and their schools; individual schools, teams and teachers inventing strategies for inspiring, engaging and educating their students. This is reflected in the choice of topics for professional development conferences for the NES coordinators and aerospace education specialists. Topics emerge from needs, concerns and aspirations of those groups for services to their schools. The professional development conferences are designed to differentiate learning opportunities and allow sub-groups work together, discuss issues, and solve problems related to implementation of the NES program.

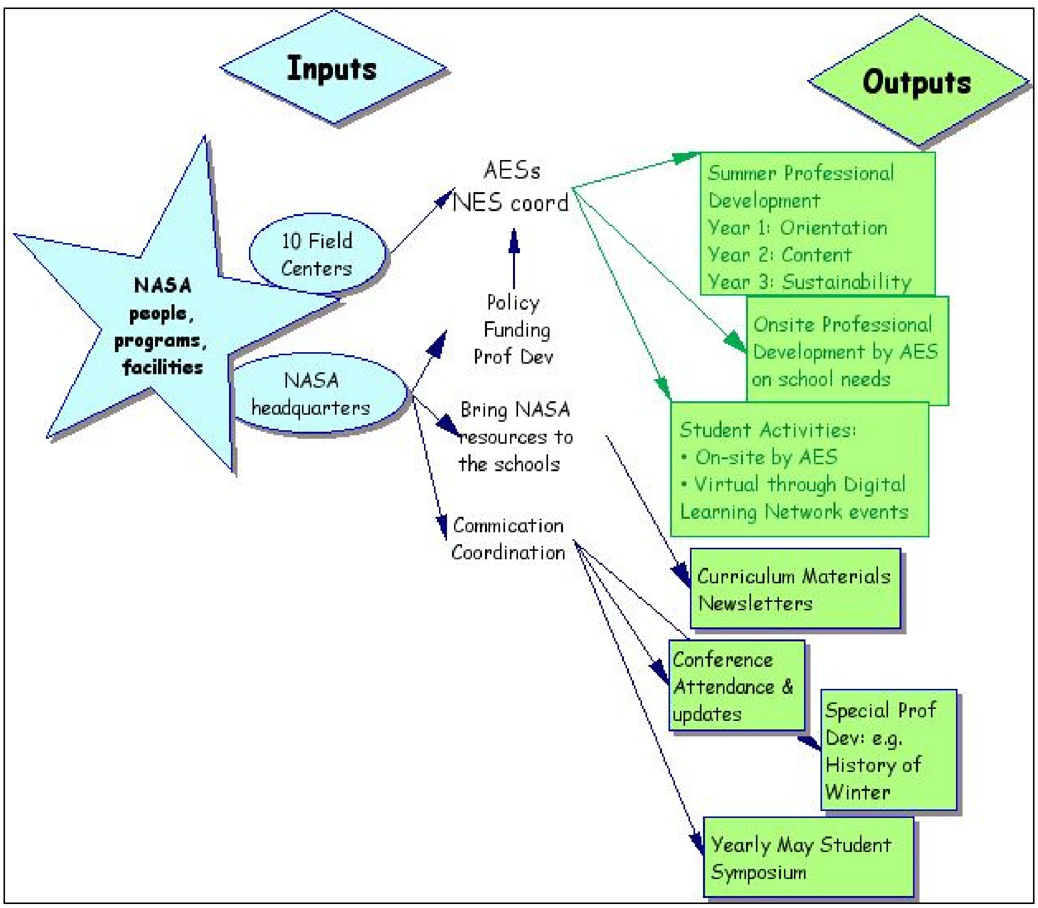


Figure 2. Concentrated view of NES headquarters role in NES logic model

The NES headquarters team provides support directly to schools through communication (weekly e-blasts, monthly newsletters) and special events, including professional development (such as Winter's History, Student Experiments to the International Space Station) and the annual May Student Symposium. NES headquarters provides coordination, communication and professional development for center-based staff in the form of regular teleconferences, professional development conferences and meetings. In the following sections, details and examples are provided to describe how headquarters is implementing the model.

- **How does NES** headquarters **provide funding and policy for the organization?**

Policy for the program, based on its goals, is constantly reinforced through ongoing communication with the centers and schools, the structure of meetings and events, and the pervasive contact of the headquarters staff with all the different groups involved in the program (from center staff to schools to partners). Decisions about what to do, when, and how to do it are explicitly consistent with the goals and vision of the program. NES headquarters staff is in constant touch with the center staff through attending all major events, workshops and events. In the broad strokes and in the details, the program is guided by a clear message from NES headquarters that the program is run by teachers, for teachers, serving students from high minority, high poverty schools.

The program funds the school stipends, the program offerings and staff:

- 9 NES field center coordinators
- 4 NES coordinators (Technology, Communication, Professional Development, Native American Liaison)
- 10 DLN field center coordinators (ARC, DFRC, JPL, KSC, and MSFC)
- 32 aerospace education specialists (5 plus 2 half-time = 6, ARC, 1 DFRC, 3 GRC, 6 GSFC, 1 JPL, 4 JSC, 2 KSC, 3 LRC, 3 MSFC, 1 SSC, 2 URCEP)
- 4 Washington DC Office staff
- Coordination, supervision and professional development support from OSU
- 4 staff at National Science Teachers Association

Professional development conferences are offered at least twice a year for four days for NES staff. These conferences focus on program goals such as inquiry, misconceptions and content, such as robotics. Professional development conferences during the 2005-2006 year are in September 2005 and March 2006. The aerospace education specialists and the NES coordinators and the program managers attend these conferences.

- **How does NES headquarters provide communication and coordination of support for the NASA staff and schools?**

NASA Explorer Schools are now in all 50 states served by the 10 regional NASA field centers. While NES headquarters provides the policy, funding and coordination for the program, the majority of services are delivered by the field centers directly to schools. The recently added, headquarters-based Native American multi-cultural liaisons provide input into the school selection and implementation processes. NES coordinators are the main point of contact from the orientation visit to the first summer's orientation workshop to monthly teleconferences to logistics for signing up for events and getting funds released. Aerospace education specialists provide on-site support with professional development, activities for students, support for family nights and assistance in locating resources. Educational resource centers at each field center catalog and house materials that are available to schools.

As one of the NES coordinators explained, "program needs are identified by headquarters, day-to-day needs are addressed at the center level. NES headquarters identifies overall program needs the individual school needs are identified by the NES team, and AES school visits are scheduled through the NASA field center education manager. In this model, each field center has its own way of coordinating AES liaisons to Explorer Schools.

Communication and coordination. Regular teleconferences (bi-monthly) are held with the NES coordinators to provide a forum for discussion, problem solving to meet the goals in implementation, and share successful strategies. Weekly communications to the schools called E-Blasts give timely information about opportunities and resources. Monthly newsletters highlight school activities, make career connections, and provide activity, content and family involvement ideas. In their surveys, field center staff frequently referred to NES leadership when talking about the NES program standards, getting their agendas approved, receiving the grant money for schools, making summer workshop logistical arrangements (hotel, food, transportation), and disseminating NES opportunities and activities to schools. Team Leads from the 2004 cohort reported that they received the following types of support from NES headquarters: announcement of NES events through e-blasts, receipt of NES materials, grant money, and information about purchasing and setting up distance learning network (DLN) equipment.

All contact with the NES is referred to the headquarters coordinator who disseminates information to the NES center-based coordinators who contact the schools. This policy was established because schools were getting calls from a lot of different organizations and entities. Headquarters works with partners and liaisons such as the national Space Grant group and the Jason Project to support NES school activities. National organizations, opportunities or initiatives are coordinated by NES headquarters who then involve the NES coordinators in contacting the schools, as well as using the weekly e-blast to provide details.

An extensive website is maintained by headquarters for use by the schools and staff with a calendar, program and content resources, and applications/reporting forms for schools. The site is used to advertise program events, support the schools, and provide a common, consistent resource for the program. User support is provided to help schools gain access to the website from restricted school computers. Support is also provided for content developers (see list in #5) to create content that will fit the NASA portal specifications.

Table 4: Headquarters Services to Centers and Schools

	Services	*Challenges*
Centers	Establish NES standards	Communication Timeliness Inconsistencies
	Workshop agenda approval	
	Workshop logistics	
Schools	E-blast	
	NES materials	
	NES grant	
	DLN support	

Field center staff reported a number of areas where they relied on NES headquarters support for the facilitation of services they provide to schools. NES coordinators reported that they were satisfied with the services and support they received from the NES headquarters in this regard. Field center coordinators explained that some of their activities require NES headquarters approval and support. The field center staff expressed appreciation and satisfaction with NES headquarters support and facilitation in these areas. Acknowledging the logistical challenges involved in communication and passing information, materials, and money between headquarters and NES coordinators, as well as between the field centers and the schools, Field center staff expressed their desire for a faster turn-around in responding to their questions, receiving NES opportunity announcements, paperwork requirements, grant money, NES promotional materials, and providing services and supports to schools.

In the teacher focus group interview with the 2003 cohort (conducted Jan-Mar of 2005), school teams expressed similar concerns related to services provided from NES headquarters. They reported that the NES money, paperwork requirements, and NES opportunities arrived late. This was a problem with the release of funds from NASA that was beyond the control of NES headquarters. In their interviews, NES coordinators also noted the timeliness of communication was a critical factor in providing support to schools. They especially wanted to receive feedback quickly on their summer workshop agendas and arrangements.

Professional Development for Center-Based Staff. The NES field center AES, the program managers and the NES coordinators met in November 2004, in March 2005, and September 2005 for professional development conferences. These conferences focus on topics identified by center-based staff and NES headquarters as timely and needed for their work in the NES program (See Appendices for sample agendas).

- Science Updates - Videoconferences, such as one with Bill McArthur from Star City Russia on the ISS Expedition and a Mars Exploration Update keep the NES staff informed about the latest NASA activities.

- Inquiry Activities - Activities that model inquiry and meet the needs of NES schools are reviewed, such as "Reading, Writing and Rings," a program that helps students develop their literacy skills while studying the planet Saturn and the Cassini-Huygens mission. Other programs reviewed include: an Inflatable Planetarium; Catching Whispers from Space; Project Life Cycle Tour; Small Bodies Missions Update and Educational Activities.

- Pedagogy - Pedagogical training includes: Levels and Methods of Inquiry; Portfolio Training; Misconceptions in Science.

- Implementation - Implementation support is addressed through seminars on topics such as: Partnering with the Informal Education Community to support NES;

- Technology - Technology training is also provided: Ion Engine Simulation Software; Robotics Training; Digital Learning Network Briefing.

- NES headquarters opportunities and Partnerships for Schools - Update on the NES Lunar Challenge, the first in a series of competitions open to Explorer Schools that also includes a DLN event focusing on the use of science in fiction featuring Chris Van Allsburg, author of Zathura. Math Counts was introduced as a partner for schools, as was Jason Project and SciGuides. Native American activities are reviewed and training provided. Family involvement activities are reviewed, and materials provided. Sustainability efforts are reviewed. Evaluation findings and upcoming activities are presented.

- NES coordinators and the five newly hired Digital Learning Network (DLN) coordinators met for professional development in November 2005. They received training and materials in effective videoconferencing, reviewed the events that are available, participated in several videoconferences, discussed how to do inquiry and conduct evaluation as part of a videoconference event, and shared resources. The NES coordinators received intensive training in communication techniques, styles and effective writing, including individual feedback.

Sustainability Workshop Involvement

- To support the Explorer Schools after their initial three-year involvement with the program, NES headquarters has organized the sustainability workshops and support for schools in their third year of participation and beyond. After three years, a school moves into a sustainability program of support managed by the National Alliance of State Science and Mathematics Coalitions (NASSMC). The Partnerships for Sustainability program is based on a system where proposals are solicited from state-based coalitions of business, education and state government who have entered into a partnership with established NASA Explorer School (or Schools) in the state. The partnership must make a commitment to the implementation of an action plan to strengthen and sustain the individual NASA Explorer Schools and to improve STEM-G education statewide. (For specific information about the program, eligibility, funding, deadlines and available technical assistance, see http://www.nassmc.org/pfsproject.html). Eighteen states have received grants over the past two years.

- **How does NES headquarters harvest and organize support from within NASA for the centers and schools?**

Resources such as astronaut visits are arranged through NES headquarters. The Washington, D.C. staff has created partnerships within NASA affiliations such as with the NASA Astrobiology Institute to create exciting content for the special workshops that are offered. NES headquarters staff serves on committees such as the Weekly Activity Report Committee and the Approved Products List Committee to find ways to work with the Mission Directorates to support NES schools, and advocate for resources. They provide coordination for resources, such as video downlinks for the International Space Station.

- **How does NES provide services and support for crosscutting activities for the schools, such as for professional development workshops** (i.e., Winter's Story, SEM-B, regional and national conferences)?

Teachers can apply to attend professional conferences. Headquarters manages this scholarship program. Conferences available for NES teachers to attend in 2005-2006 (nine total):

- National Science Teachers Association (NSTA) Area Convention, Hartford, CT, October 20-22, 2005
- National Middle School Association (NMSA), Philadelphia, PA, November 3-5, 2005
- National Science Teachers Association (NSTA) Area Convention, Chicago, IL, November 10-12, 2005
- National Science Teachers Association (NSTA) Area Convention, Nashville, TN, December 1-3, 2005
- International Technology Education Association (ITEA) Annual, Baltimore, MD, March 23-25, 2006
- National Association of Elementary School Principals (NAES), San Antonio, TX, April 1-4, 2006
- National Science Teachers Association (NSTA) National, Anaheim, CA, April 6-9, 2006
- National Council of Teachers of Mathematics (NCTM) Annual, St. Louis, MO, April 26-29, 2006
- National Educational Computing Conference (NECC), San Diego, CA, July 4-7, 2006

To capitalize on relationships with existing associations that support teacher professional development, NES update meetings and leadership symposia are integrated with already established professional conferences. For example, an all day administrator symposium was held for NES school administrators at the National Middle School Association annual conference in Philadelphia November 3-5, 2005.

Additional special professional development activities are available for teachers to sign up for throughout the year:

- Student Experiments to the International Space Station (SEM Satchel) allows students to create passive experiments (no power is required) to be sent up to the International Space Station.
- Student Experiment Module – Balloon (SEM-B) is an educational flight program that allows students to create their own experiments and fly them on board a high altitude NASA balloon.
- Free Space Rocket Flight Week – Students create passive experiments to fly in unused space onboard NASA Sounding Rockets.
- Winter's Story - The over-arching question, "In what ways are climate and the requirements for life connected?" provides the basis for the Winter's Story experience at Yellowstone National Park. This unique venue will be used to help teachers understand the role of the cryosphere on the Earth system and provides a context for delivery of compelling content to their students. (25 teachers, Feb 4-9, 2006)

- Sub-SEM Rocket Flight Week – Flight of student built experiments on a dedicated Orion sub-orbital sounding rocket from Wallops Flight Facility.

- **How does NES headquarters provide curriculum review and development specific to inquiry and the needs of NES schools?**

Given the focus on inquiry as a way to address students' lack of content knowledge in complex topical areas, and the need for high engagement, a committee to examine pre-existing NASA resources to identify those that meet these criteria was established and is ongoing. The result is an "Approved Products List" that schools and centers are strongly encouraged to use.

Additional curriculum materials and professional development opportunities are being developed through a series of grants awarded in 2005.. In 2004, five E-missions developed by the Center for Educational Technologies (CET), and handheld technology programs from GoKnow were funded. In 2005, the following additional programs were funded:

- **NASA Explorer Schools Pre-Algebra (NESPA):** NES have identified high-need pre-algebraic concepts for students to learn if they are to succeed in algebra and higher math. By exposing students to concrete graphical representations and meaningful scientific applications, students can develop a conceptual understanding and build a foundation for the mathematical symbolism. "What's the Difference" is a Learning Technologies educational technology tool developed at NASA Ames that allows a variety of graphical content to be compared in a side-by-side interactive format for teaching concepts. **The Collaborative for Higher Education**
- **Math to the Moon: "Math to the Moon…And Beyond"** will create original inquiry-based math modules related to the science, engineering and technology of space flight. The new curriculum will target grades 4-9 and be available to all NASA Explorer Schools through the project web site, CD ROM and printed notebook kits. **Cislunar Aerospace, Inc.**
- **VISIONES: Visual Instruction Support for Inquiry-based Odysseys in the NES**. The project will provide e-learning and face-to-face professional development opportunities for NES teachers to learn how to use two visualization technologies—digital image processing and analysis (IPA) and geographic information systems (GIS)—as tools for classroom exploration of NASA and other data products. **Center for Image Processing in Education**
- **Sustained Professional Development for NES:** The GEMS program will provide professional development as an integral part of NES summer workshops and then sustain support during the following school year and beyond through the national GEMS professional development network. **Lawrence Hall of Science, University of California, Berkeley**
- **LIVE, Short Courses for NASA Explorer Schools:** NES will be offered a selection of eight online, synchronous (live, interactive) training opportunities throughout the school year to enable NES to integrate NASA Earth and space content into their grades four-nine curriculum. Webcast topics include Signals of Spring, and Weather Data Learning Center Short Course opportunities that will be introduced online and in-person at NSTA national and/or regional conferences. **U.S. Satellite Laboratory**
- **Retool and Enhance:** The object of this proposal is to retool existing NASA-content exemplary products and enhance those under development to better model inquiry learning, in a technology-based approach with a specific emphasis on mathematics. Phase I will involve the retooling of existing popular materials. Phase II will involve the enhancement of materials in the development stage. **West Liberty State College**
- **Institute Symposia: Maximizing NES Professional Development Opportunities**: NSTA proposes a blended approach to professional development that combines both face-to-face training and different kinds of online learning opportunities. NSTA will facilitate the design, delivery, and evaluation of a series of Symposia that combine face-to-face training with follow-up consisting of asynchronous and synchronous web-based experiences. **National Science Teachers Association**

NES Sustainability Conference The United States Space and Rocket Center is working with NES staff to provide professional development that requires active, collective participation by teachers in activities that prepare NES teams to sustain their efforts after the three-year regular program is complete. Teachers in the final year of their NASA NES partnership will be invited to attend a four-day conference held at the U.S. Space and Rocket Center Space Camp in Alabama.

Virtual Design Center Opportunities for NES Teachers: The NASA-sponsored Classroom of the Future offered a web-based workshop for the eight NASA Explorer School product developers listed above featuring product development guidelines presented in the Virtual Design Center (VDC). The VDC provides resources for designing learning activities for scientific inquiry based on contemporary educational research and guided by the experts of various disciplines. **Center for Educational Technologies, Wheeling Jesuit University**

Provide promotion, outreach, application and dissemination about the NES program. NES headquarters has set two key criteria for recruiting schools—(1) having representation of all 50 states and (2) working with high poverty, high need schools. With these goals in mind the following workshop/conferences/events have served as important recruitment forums:

- Crow Fair (Pow-wow), Crow Agency, MT, August 18-21, 2005
- Schemitzun Pow-wow, North Stonington, CT, August 25-28, 2005
- National Indian Education Association (NIEA) Annual, Denver, CO, October 6-9, 2005
- National Science Teachers Association (NSTA) Area Convention, Hartford, CT, October 20-22, 2005
- Meherrin Pow-wow, Winton, NC, October 21-23, 2005
- National Middle School Association (NMSA), Philadelphia, PA, November 3-5, 2005
- National Science Teachers Association (NSTA) Area Convention, Chicago, IL, November 10-12, 2005
- National Alliance of Black School Educators (NABSE) Annual, Detroit, MI
- November 17-19, 2005
- National Science Teachers Association (NSTA) Area Convention, Nashville, TN, December 1-3, 2005
- National Association of Bilingual Education (NABE), Phoenix, AZ, January 19-21, 2006
- International Technology Education Association (ITEA) Annual, Baltimore, MD, March 23-25, 2006
- National Association of Elementary School Principals (NAESP), San Antonio, TX, April 1-4, 2006
- National Science Teachers Association (NSTA) National, Anaheim, CA, April 6-9, 2006
- National School Board Association (NSBA), Chicago, IL, April 8-11, 2006
- National Council of Teachers of Mathematics (NCTM) Annual, St. Louis, MO, April 26-29, 2006
- National Educational Computing Conference (NECC), San Diego, CA, July 4-7, 2006

To support recruitment efforts, videos and reports are produced by the NES administrative team for internal NASA audiences and external public affairs. In the future NES will be looking to work more closely with NASA Space Grant Consortiums and other NASA-affiliated groups such as educator resource centers, the Bureau of Indian Affairs, the National Institute of Indian Education, and the Space Foundation Challenger Centers. NES headquarters works at the organizational leadership level, centers work at the individual contact level.

How does NES headquarters provide program and outcomes evaluation?
Headquarters staff commission, oversee and collaborate with the evaluation team to set goals, define strategies and ensure timely use of the information for refining the program. Headquarters staff has established routine (weekly) communication with evaluators, are collaborating to have an evaluation summit with NES coordinators, and are working collaboratively with the evaluation team to find an appropriate place to house evaluation information and resources. The evaluation

team provides formative data, involves NES staff in using the data for program decisions, and provides summative reports on the model and impact of NES.

How Does the NES Involvement Increase Teacher Professional Growth?

The question regarding how the field centers support the schools was asked in both the field center survey and NES coordinator interview. The field center survey was taken by a total of 40 field center staff including coordinators, aerospace education specialists, and education program managers. The NES coordinator interview was conducted with the ten coordinators over the telephone or in person. Observations and agenda analyses provided additional information on how the summer workshop model is developed and implemented. This section describes how the field centers are working with the schools, from the initial contact and orientation, to the summer workshops to the ongoing support throughout the year.

Orientation Activities
While NES headquarters advertises the program, collects applications, manages the selection process, and announces the successful applicants, the field center staff are involved in letting schools in their region know about the program and in the selection process. When a school is accepted into the Explorer School Program, the NES coordinator, aerospace education specialists, headquarters minority (or Native American) liaison, and center program manager are involved in a pre-visit to the school. In May of any given year, the team leads attend the May Student Symposium, where they see the work of students and teachers from previous years, learn about team-building and NASA resources, and meet NASA staff from NES leadership and around the country. Then, the school leadership team of four-five people attend a summer Orientation Workshop designed to help them develop plans for how to use NASA resources, people and facilities to meet the needs of their students.

Pre-Visit Orientation Meetings with Schools
In the spring of 2005, the NES coordinators developed a background notebook for new school teams. A sub committee looked at the needs of the schools, for information. Documents were collected or created to help the schools meet understand the program and meet requirements. The notebook was reviewed by all the coordinators and NES leadership, and presented to the entire field center group at the March 2005 PDC. After the 2005 teams were announced at the May 2005 Symposium in Houston, the NES coordinators met with each team at their school to welcome them to the program, and to provide them with the background information to get started in their planning. The coordinators reported that this was very helpful, since teams were able to get answers to their questions, identify their needs, and prepare for the summer Orientation workshop. These pre-visits resulted in many teams being more prepared than previous years' teams to benefit from the workshop and develop workable action plans.

Summer Workshops

In addition to surveying the field center staff and interviewing the NES coordinators, the summer orientation workshops were observed and analyzed based on a framework established by Garet et al (2001).[16] They examined elements and measures of effective professional development, then grouped them along three dimensions and developed a survey of teachers involved in an Eisenhower professional development program. We have used these dimensions as the basis for an agenda analysis of professional development workshops for NASA Explorer Schools. An outside evaluator coded the agenda during the workshop. The NASA Explorer Schools coordinator who organized the workshop also coded the agenda, or reviewed the coding of the evaluator for validity.

The summer content workshops were also coded from the agendas alone (without live observation), then reviewed by the NES coordinator. The Garet model is explained in detail in the full report in the Appendix. The agenda coding scheme developed from the model is given below. Each event in the workshops was coded for each category as; not present (0), minor emphasis (1), or major emphasis (2). In the next section, the workshops are described using the survey data, interview data and agenda coding data.

Orientation Workshops

The NES coordinators work with the field center staff to plan the Summer Orientation Workshops. The design process takes place throughout the spring and is based on an assessment of the previous year's agenda, the needs of the schools, and the expectations and changes recommended by the NES leadership. The planning process is collaborative within the field center since the local resources are used. The aerospace education specialists provide workshops and act as facilitators so they get to know the teams they will be working with throughout the year.

This year, the NES coordinators worked with headquarters to establish a common framework for the orientation workshops. It was decided to label each agenda activity or event with an overview, standards addressed by each agenda activity/event, anticipated learning outcomes, and assessment or reflection.

In their interviews, the NES coordinators reported that they must have NES headquarters leadership approval to finalize the orientation and content and workshop agendas and logistics. The difficulties the center staff reported when designing the workshops were: (1) changes from NES headquarters; (2) late receipt of school needs assessment information due to delays in selection of schools; (3) cost of running the workshop; and (4) arranging computer equipment, resources, and guest speakers.

[16] Garet, M. S., Porter, A.C., Desimone, L., Birman, B.F. and Yoon, K.S. (2001). What Makes Professional Development Effective? Results From a National Sample of Teachers. *American Educational Research Journal*. Winter, Vol. 38, No. 4. pp. 915-945.

Table 5. Observation Categories

Content

Content Knowledge	Knowledge about STEM-G
Career Knowledge	Knowledge about STEM-G careers
Family Involvement	How to involve families with school, with each other and with their children around STEM-G
Technology Use	How to use technology to develop STEM-G knowledge, use and involvement
NASA resources- NES approved list	Resources from the approved NASA Explorer Schools list
NASA materials not on NES approved list	Other NASA materials – not on NES list
NASA Resources & People	Scientists, aerospace education specialists, Technology experts, other resources
NASA Facilities	Labs, videoconference facilities, other
Non-NASA materials and/or people	Curriculum, materials or resources from sources other than NASA
General Pedagogy	General pedagogy or teaching practices, such as inquiry, classroom management, lesson planning, or grouping methods
Specific Pedagogy	How children learn (common student preconceptions, misconceptions and solution strategies in specific subject domains)

Coherence

School goals	Activity is connected with school goals, integrated into the teacher's curriculum, or goals identified by the teacher
Activities before & after	An activity is connected to the other activities before and after it
Standards	Activities are connected to standards
Discussion with Others	Teachers talk with each other (from own and other schools) about what is being learned and how it can be used.

Active Learning

Observe expert teaching	Activities or strategies are modeled for or with participants
Plan for use	Participants have a chance to plan for the use of what they are learning
Review student work	Participants see examples of student work and have a chance to have discuss them
Presenting, leading, writing	Participants present, lead small groups or write about what they have learned

We take the 6 program goals of NASA Explorer Schools, and we put times for each one of those goals. It may not be an entire day, but it's a significant chunk. So for careers for example, the career standards are going to take all of Thursday afternoon and we'll do careers and we'll do a mentoring experience with a NASA scientist where they can go out into their research lab and talk to them about their career path and so forth.

In the summer orientation workshops, coordinators reported that they focus on providing overall information and resources on NASA's education mission and resources, examples of NASA curriculum, NASA Explorer Schools, writing action plans and preparing to purchase videoconferencing equipment and setting up DLN events. To incorporate inquiry into the workshop, the center staff draws on the expertise of aerospace education specialists and other NASA staff and scientists who lead some workshop sessions as guest speakers. Overall, the NES coordinators reported they plan variety in the activities while keeping a balance of content (i.e., inquiry focus, NASA content), events (i.e., site visits, guest speakers), and other activities covering NES objectives (student career, technology, family focus).

In the interviews, the NES coordinators were asked if they made any big changes in their agendas from the summer of 2004 to the summer of 2005. The most frequently cited changes in the 2005 summer workshops based on feedback from the summer 2004 workshops were: (1) team building focus, (2) inquiry-focused lessons, (3) activities related to organizing DLN events, and (4) activities related to family involvement. They planned more time for the Digital Learning Network to increase its use since some of the previous year's teams did not get up and running with the equipment in their first year. One coordinator put all the equipment out for a team and said, “Make it work.” This kind of approach accomplished a second goal of the 2005 Orientation workshop – team building. Evaluation data from the first year indicated that the school teams who had a shared vision and worked together well were more effective so more emphasis was placed on team-building and keeping the teams together during activities. Other feedback from the summer workshop evaluations indicated the teams needed more time for developing their plans so most days were scheduled for 8 am to 5 pm with light activities in the evenings. As part of the revised agenda focus on assessment and planning, more time for reflection and evaluation for each session and day were built in to help teachers figure out how they could incorporate the resources into their existing curriculum and school action plans.

The agenda coding data reflected the shifts noted in the surveys and interviews, and some additional areas as well. The following tables present the average emphasis across all ten Orientation workshops.

Table 6. Summary of Content Emphasis for the 2005 Orientation Workshop

Content	Emphasis		
	None	Minor	Major
Content Knowledge	26%	25%	42%
Career Knowledge	42%	22%	26%
Family Involvement	60%	18%	11%
Technology Use	37%	27%	26%
NASA resources- approved list	57%	11%	30%
NASA not approved list	58%	13%	19%
NASA Resources/People	24%	26%	40%
NASA Facilities	50%	15%	26%
non-NASA	60%	15%	15%
General Pedagogy	49%	17%	24%
Specific Pedagogy	60%	18%	19%

The content of the orientation workshops is intended to introduce the teams to NASA resources through activities, visits to facilities at the Center and the Educational Resource Center (ERC).

Of the four goal areas - STEM-G content, career knowledge, family involvement and technology use – the most emphasis was on content knowledge (42%), and the least on family involvement (11%). While activities and events are generally content rich, developing the content knowledge of teachers is not the focus of the Orientation workshop. It is to be expected given the overview nature of the Orientation Workshop.

Of the five NASA resource categories, the most emphasis was on approved NASA resources and people. Non-NASA materials were an emphasis only 19% of the time, and mostly when they were local resources, such as a museum or specialized and not available through NASA such as some robotics materials.

In the two areas of pedagogy – general pedagogy was an emphasis 24% of the time, and specific pedagogy 19% of the time. Given the emphasis of the program on active learning, it would be expected that this would be higher. It was observed that inquiry activities were used but not discussed, so they were not coded as an emphasis in this category. It may be that given the broad goals of the orientation workshop, emphasizing pedagogy 25% of the time is appropriate.

The factor most often used to create coherence for the participants within the workshop was tying each activity to the ones before and after it. Many of the Orientation workshops were designed with daily themes such as “family involvement” “flight” or the “moon.” Each activity was a piece of the conceptual puzzle for the participants. A thematic approach is one way to create coherence among activities by providing a context for each activity. Connecting activities to the standards (26%), and asking the teams to think about how each activity would support their school goals (37%) were also used with some regularity in most workshops. The NES coordinator group created a template for the agendas that included the standards the activities addressed. All the workshops had time for reflection so participants could create their own coherent picture of what they learned in an activity or in a day. Most workshops were also structured to provide time for the participants to discuss the activity with each other. This is an important adult learning strategy for making connections within an activity or event and with their own situation, knowledge or background.

Table 7. Summary of Emphases for the 2005 Orientation Workshop: Coherence

Coherence	Emphasis		
	None	Minor	Major
School goals	30%	23%	37%
Activities before & after	15%	22%	52%
Standards	46%	19%	26%
Discussion with others	27%	27%	37%

Table 8. Summary of Emphases for the 2005 Orientation Workshop: Active Learning

Active Learning	Emphasis		
	None	Minor	Major
Observe expert teaching	51%	16%	24%
Plan for use	27%	30%	33%
Review student work	79%	8%	9%
Present, lead, write	32%	24%	34%

The third area of best practice in professional development is active learning. Presenting, leading and writing were a major emphasis in 34% of the activities. This often took the form of journal writing, sharing ideas for how to use what they were learning, or presenting to the group. Planning for use was a major emphasis in 33% of the activities. Time was often set aside for participants to reflect on what they had learned and develop their strategic plans. The least utilized strategy for active learning in this category was student work. When this strategy was used, it was very effective. Examples included video of students at work, or examples of student work in response to an activity.

Data were available on the 2004 Orientation Workshop Agenda Analysis. While the categories were refined to better reflect the model and the goals of the NES program, some key areas were analyzed in both 2004 and 2005. It is interesting to note that the emphasis on content knowledge, action planning and instructional strategies all increased, while the use of other resources declined.

Table 9. 2004 Orientation Workshop Results

		% of time
Content	Content Knowledge	32%
	Career Knowledge	2%
	Family Involvement	2%
Coherence	NASA products	14%
	NASA Resources/People	14%
	NASA Facilities	27%
	non-NASA	45%
Active Learning	General Pedagogy	12%
	Curriculum Integration	12%
	Plan for use	22%

Effective strategies used within the workshops were collected from all the observers and appear are listed in Table 10. These have been shared with the NES coordinators as part of the formative evaluation. The coordinators have requested a rubric for the best practices that incorporates these strategies for their planning of next year's workshops.

Table 10. Best Practices/Strategies

Characteristics	Best Practices/Strategies
Organization	Evening Activities: Star parties, hike, social events – dinner Participant committees: drivers, clean up – orbital debris, quality assurance, in-flight entertainment, communication, thank you notes for speakers, security Hospitality: centerpieces, you are winner, you have an amazing brain Schedule: present for a team back on time, choice of sessions rather than whole group, raffle for those on time, amount of time on task
Curriculum Integration	15 minute am and pm RAC – reflect, apply, create Integration wheel
Creating plans	90 minute at end of every day Integration wheel Reflections throughout the day: specific log, sit and write, ongoing reflection seemed to make it easier to write plans, share reflections about use with whole group Grouping teachers and administrators from different cohort groups For example, Principal Joe Blevins is an excellent administrator to mentor other cohort teams
Coherence	Wrap-ups after every session – how would you use this? Themes each day Activities built all day long Coordinator led the reflection
Teamwork Across Groups	Planning events Sharing resources Model by leaders
Technology Use	Practice videoconferencing: administrator as speaker, 03-04 teacher – guest speaker, DLN, e-missions Robots Lego League Canine rover Websites: Explorer schools website, NASA.gov, others

Characteristics	Best Practices/Strategies
Evaluation	Present on first day to set expectations Focus each day on different goal Work of teams on plans Daily evaluation Respond to next day: quality assurance group summarized Pre post
Content	Space: aviation history, aeronautics, rocketry Earth: seasons Guest speaker: astronaut, scientist, specialist giving workshops
Career	Introduce each guest speaker in-depth Panel of three Student presentations Tours – staff talk about how they got into it Always point out other jobs
Family Involvement	Model a star party Lego robots – model it Sarah Sanders – SEMA overview Principal speech (from Alabama)
Inquiry	Present content, activity, plan Jean presentation – New Orleans Pretest, hands-on, content Some presenters modeled
NASA Personnel Presenting	Specialist Scientists Astronauts
Standards	List in writing, mention verbally, and emphasize in discussions
Movie	Apollo 13

Content Workshops

In the second year of the program, NES team members or other teachers from their schools can attend a content workshop outside of their region. They choose the content workshops based on their interests, teaching assignments and students' needs. The content workshops held in 2005 were:

Table 11. 2005 Content Workshops

Center	Workshop	Dates 2005	Attendance
Ames	Astrobiology	June 19 – 23	27
Dryden	Transportation System: From Earth, to the Moon, and onto Mars	June 20 – 24	25
Glenn	The Mathemagical ISS	June 27 – July 1	25
Goddard	Satellites: look up, look down, look all around	July 17 – 22	25
Jet Propulsion	Robotics Exploration and Education	Aug 1 – 5	26
Johnson	Flight Projects Opportunities	June 7 – 9	25
Kennedy	Student Observation Network/ Signals of Spring	June 27 – July 1	25
Langley	Technology Immersion	June 12 – 17	27
Langley	Technology Immersion	June 19 – 24	25
Marshall	The Journey Continues: Rockets and the Space Environment	June 19 – 24	25
Stennis	GLOBE	June 26 – 29	15

Led by field center coordinators, field center staff reported that they work together as a team in designing the workshop. Together they decide on the agenda of the workshop (themes, technology, outcomes etc.), develop a draft, and finalize the workshop agenda based on the team's feedback. The workshop preparation continues with gathering information from school teams to accommodate their needs, ordering supplies and resources, arranging logistics (food, transportation, hotel, badging and special accommodations), and arranging guest speakers, tours, and videoconferencing events.

Those field center staff who participated in designing or observing the delivery of workshops in previous years reported to have used this experience to make alterations and adjustments to the curriculum of the next year. They used the feedback and NEEIS evaluations of last year's workshop to gather information of what worked, what did not work, and what teachers wished to see improved.

In the content workshops, there is, understandably, more of an emphasis on content knowledge; 55% vs. 42% in the orientation workshops. There is much more emphasis on technology; 40% vs. 26%, but there is much less emphasis on family involvement, 1% vs. 11% and career knowledge; 13% vs. 26% in the orientation workshops. It is important to note that career knowledge was a minor emphasis in 46% of the activities in the content workshops, while family involvement was not mentioned in 80% of the activities. In the content workshops with scientists as speakers and tours of facilities with NASA personnel, there is a good opportunity to introduce the people with special attention to their career preparation and paths. Asking them to talk about how to involve families and how they involve their own children and family is a way to bring in family involvement.

Table 12. Content Emphasis in the 2005 Content Workshops

Content	**Emphasis**		
	None	Minor	Major
Content Knowledge	12%	23%	55%
Career Knowledge	32%	46%	13%
Family Involvement	80%	8%	1%
Technology Use	30%	20%	40%
NASA resources- approved list	52%	8%	30%
NASA not approved list	70%	9%	11%
NASA Resources/People	35%	22%	33%
NASA Facilities	31%	33%	26%
non-NASA	64%	11%	15%
General Pedagogy	47%	24%	22%
Specific Pedagogy	36%	16%	39%

Table 13. Coherence Emphasis in 2005 Content Workshops

Coherence	**Emphasis**		
	None	Minor	Major
School Goals	47%	27%	17%
Activities before and after	23%	21%	55%
Standards	29%	36%	24%
Discussion with others	26%	32%	32%

The use of NASA resources, people and facilities, especially the approved products list are at levels similar to the orientation workshops. In both workshops, there is an emphasis on the each center's content and strengths. This fulfills several needs of the program and the participants. The participants want to see the facility, get to know the people and interact with the resources that will be available to them. In one workshop, participants spent an afternoon with a NASA scientist, engineer or other professional to understand what they do and how they do it. The use of NASA resources also broadens teachers' knowledge of what is available and inspires teachers to use NASA content as a context for learning. In the pedagogy area of the best practices content, the percentage of activities that focused on specific pedagogical strategies for teaching content was 39% vs. 19% for the orientation workshops. This is an indication that the content workshops are providing the professional development in instruction that teachers need to teach difficult concepts. Specific pedagogical strategies are particularly effective because they show teachers the most effective way to teach a particular concept. This should be the focus of the content workshops to prepare teachers to teach students difficult concepts through inquiry.

Table 14. Active Learning Emphasis in 2005 Content Workshops

Active Learning	Emphasis		
	None	Minor	Major
Observe expert teaching	42%	15%	43%
Plan for use	34%	33%	33%
Review student work	95%	1%	4%
Present, lead, write	49%	17%	34%

Coherence

The content workshops had less emphasis on school goals. This is an area that could be improved given the opportunity to enhance instruction in specific areas. It would be expected that the connection to standards would also have greater emphasis in the content workshops to help teachers prepare to use what they learn.

Active Learning

The high percentage of activities with a major emphasis on observing expert teaching is consistent with the emphasis on specific pedagogy. The NES coordinators select speakers for the content workshops who are both knowledgeable and good teachers. As in the orientation workshop, there is little student work available for participants to review and discuss. Perhaps this best practice can be better implemented through focusing on collecting student work during the year, using the videos and presentations from the student symposium, and asking speakers to bring student work as part of their presentations.

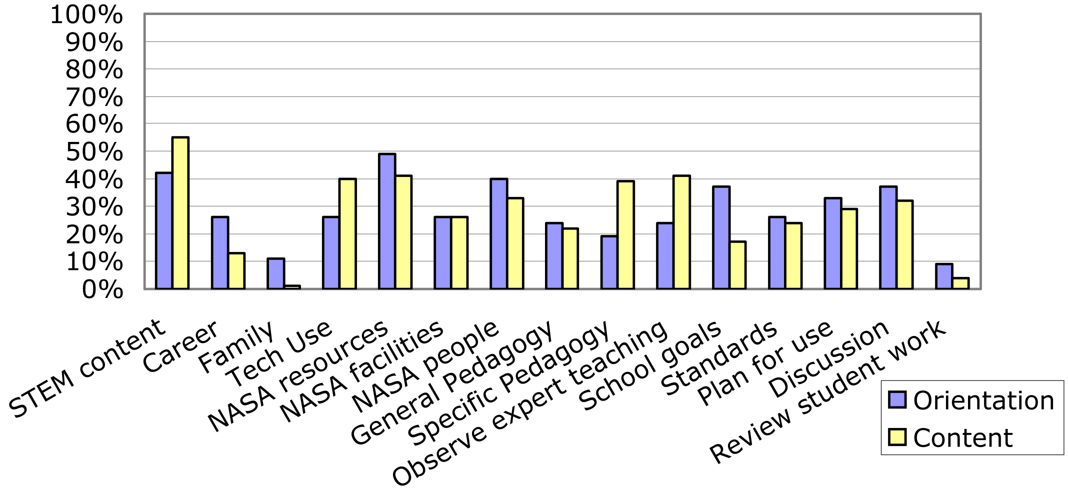


Figure 3: Comparison of orientation and content workshop emphases

Conclusions about the summer workshops

The agenda analysis and subsequent discussions with the NES coordinators and NES leadership staff indicate that the workshops are intentionally designed and delivered as planned. The Orientation workshop focuses on team-building and planning more. Content workshops focus more on STEM-G content and specific pedagogical strategies. The workshop designs have improved from 2003 to 2005 in their focus and integration of the multiple goals of STEM-G content, pedagogy and introducing NASA resources. They will undergo further refinements based on these data and the feedback from participants (see the next section on the effects on teachers). To support the continual refinement, these analyses suggest the following areas for improvement:

Provide **content** to build participants' knowledge of NASA resources, STEM-G, careers in STEM-G, family involvement, technology and inquiry strategies

- Continue to use NASA content and resources, particularly those materials on the approved products list to model inquiry and real-world exploration content "as only NASA can."
- Ask guest speakers and facilities personnel to talk about their careers; their inquiry strategies and experiences, their career preparation and their interests.
- Talk about family involvement strategies and connections for as many activities as possible. Prepare speakers to talk about their experiences and ideas for reaching out to families, or giving students extension activities to do at home with their families.
- Label the general and specific pedagogical strategies that are used throughout the workshop to build participants' knowledge and repertoire of inquiry strategies, particularly as they relate to NASA content and the concepts students find difficult. Take a few minutes to give teachers a lens to view the model lessons through and debrief on the critical elements of the lesson.
- Use themes or other strategies to build the agenda and provide a context for participants' to build their knowledge of NASA content, resources, and inquiry strategies.

To build **coherence**, make connections among activities and provide time for participants to make connections that they build into their local school plans

- Emphasize the connections of the activities/events with the school goals and national STEM-G standards.

- Provide time for discussion during every activity and event so participants can build their own coherent understanding of how to integrate what they are learning and doing into their school-based work.
- Give participants ideas, and time to discuss and reflect on how each activity, tour, or event can be part of their strategic and implementation plans.

Model **active learning** to keep participants engaged and build their understanding of constructivist teaching strategies

- Continue to provide expert teaching and label more often the components of that expertise, either in the written agenda and/or in discussion. Consider asking, "What are you doing that you like to see your students doing? What are we doing to facilitate that?"
- Continue to provide time, direction, tools (curriculum integration wheel, journal, etc…) and support in planning for use of the workshop learning. Ask the participants to specifically note what they will be using in their plans.
- Use student work to show participants what students can and will do with NASA resources. Encourage them to evaluate the student work and discuss how they will know what the effect on students is in their own schools.
- Continue to provide time for participants to reflect, write, discuss, present and actively process what they are learning so they are prepared to use it and share it when they return to their school settings.

Ongoing support throughout the school year

The NES model relies on a web of services provided by the field center, coordinated among up to seven people, and dealing with 6-15 schools. How does the NASA staff closest to schools view their effectiveness? To what do they attribute their effectiveness? How do they think the model could be improved? How do the schools view the field center support? This section addresses these questions.

Table 15. Field Center Satisfaction and Effectiveness

	Poor	Average	Good	Excellent
Satisfaction	5%	10%	39%	46%
Effectiveness	3%	10%	46%	41%

The staff in the NASA regional offices provided assistance and services to NES teams and schools, in the form of sharing special opportunities; providing professional development to other teachers at the school (e.g., modeling activities in classroom, conducting workshops); attending parent nights and other special assemblies; providing input on how to organize special events; assisting in carrying out the paperwork; recommending strategies for carrying out the strategic plans; and helping communicate to stakeholders within the educational community and beyond. Both in the NES coordinator Interview and in the field center survey, staff was asked how the centers provide services to schools and their satisfaction or dissatisfaction with the services the centers provide to schools. As seen in Table 15, a majority of center staff (85% - ratings of good to excellent) responded they were satisfied with the NES program, and 87% (ratings of good to excellent) reported that their centers were effective in carrying out the NES program activities. Those center staff who rated both their level of satisfaction in being in the NES program and the level of center service effectiveness good or excellent attributed it to effective teamwork at the center level of the program.

Teamwork

The field center staff (coordinator, program manager, and aerospace educators) worked well with each other complementing their strengths and weaknesses. These coordinators made no references to be under staffed. Instead they gave examples of situations where certain people stepped up to cover the work that remained due to lack of staff or staff turnover. They frequently praised other center staff who worked in different capacities alongside the NES coordinator, emphasizing how the center staff worked together as a team.

Responsive to school needs and goals
These coordinators referred to the successful family, community, and science nights they helped schools organize, and how aerospace educator on-site support helped these schools to gain recognition and other opportunities in the community.

In the 2003 Focus Groups, some of the teams went into detail about how the field center supported them. "Whatever we asked for, that wasn't costly, they were able to provide us. Copies of curriculum for staff members…pictures and posters for Japanese counterparts, assistance in putting together the Young Astronaut program. [Our aerospace educator] rearranged some personal events so he could be with us. He didn't have to do that. They are willing to be flexible with us."

When I think of my center support I think of my entire center. Our whole center steps in to help us with the NES program. Our Center Director participated in the Kickoff visits last fall.

A number of schools experienced turnover in their aerospace educator, some in the middle of the school year. This sometimes caused disruption but in a number of cases, relationships with the new aerospace educators were better than with the old one. Some comments in this vein include:

"From my [team leader] perspective, last year was rough because I think our former educational specialist belonged to the old school … He didn't buy into the new NES initiative … last year they did the minimum that they could. [T]his year … the motivation is there, the desire is there, the energy level is there and they're willing to work with us to help us achieve our objective and not shoving down, you know, a rigid old [NASA Regional Office] system."

An important element in a successful relationship between the aerospace educators and the school seems to be the willingness of the aerospace specialists to "reach out" rather than wait to be contacted. One site put it this way:

"One of the challenges we've found is [our previous] liaison, he was constantly here and he was spurring us on to do things… it was really helpful because he came up with the ideas and helped us carry them out…[the new aerospace specialist] got us the [20 refurbished] computers and he's willing to do whatever we want [but] it's up to us to get together and give him some ideas of what we want him to do or what we want to have him come into the school and help us with."

Some aerospace educators are more responsive than others. Overall, many schools noted a decrease in the availability of their aerospace educators between the first and second years.

One aspect of interaction with the NASA Regional Offices that participants found challenging was the paperwork. Many teams felt that the Regional Offices were not sensitive to the school calendar or school culture, in terms of deadlines. Also, many sites had to submit and re-submit paperwork due to "glitches" in the computer system or changes in personnel, something they found very frustrating.

Some schools would like more assistance in finding relevant materials (e.g., something for a specific topic and grade, or inquiry-based activities around a certain topic). One team suggested that more NASA-related artifacts be given to the school to keep there and use. They would also like NASA to facilitate more contact with other NES teams, sharing across NES schools, either within a region or across the country.

Those center staff who rated both their level of satisfaction in being in the NES program and the level of center service effectiveness from poor to average cited these limitations;

Table 16. Type and Frequency of Center Support

	Never	Once	2 or 3	4 or 5	6 or 7	8 or more
Email	5%	0%	10%	5%	3%	77%
Phone	5%	3%	10%	13%	10%	59%
Visit	8%	5%	8%	8%	26%	46%
Written	21%	3%	23%	28%	8%	18%

1) not enough school visits due to Center responsibilities, time, money and distance issues; 2). The need for more administrative/clerical support; 3) Lack of funding to get NASA engineers to visit schools.

Types and Frequency of Support Provided by Field Center Staff. As shown in Table 16, NES coordinators reported they provide support services to schools via school visits, written correspondence, email, and telephone. In the interviews, coordinators indicated they provide support via teleconferencing and videoconferencing. The most frequent medium for contact is email, followed by phone and then visits. Since coordinators do not visit the schools unless they travel with an aerospace educator, these numbers would be expected to be skewed toward email.

Among the many kinds of services and support they offer, coordinators made specific reference to the types of following: provide feedback on team plans, help schools integrate NASA materials, locate and bring in guest speakers, provide general technology assistance, help schools trouble shoot with their implementation, and help them with purchasing and setting up DLN events.

Ongoing communication. In the Focus Groups with the 2003 cohort talked about the communication with their field center as ongoing, "We're in constant communication with [the NASA regional office staff]. They're always very willing to help and that makes it easy. Whenever we have a question about anything, they'd be able to answer it or direct us to the person who can't answer it… If we didn't have the support staff there, I think I would be at a loss in terms of what to do or having our visions as a NASA Explorer School revealed and actually being professional with the things that we like to do."

Multiple forms of communication are most effective. Coordinators consistently reported that aerospace educators are the field center staff who has the most face-to-face contact with schools. Wishing to have more face-to-face contact with schools, coordinators mainly, but not entirely provide support to the schools by telephone, videoconferencing, and email. Some coordinators expressed that their sending email to schools may sometimes not be effective in cases where they are not in direct face-to-face contact with schools. Regardless, coordinators communicate with schools by email, phone, and videoconferencing, and reported to have tried to visit schools at least once a year.

Regular contact via telephone reinforces email messages. One coordinator remarked that frequent teleconferencing proved to be an effective way to keep in touch with schools and provide information regarding NES opportunities. Having cited teachers' difficulties in checking email messages to keep abreast of NES opportunities, this NES coordinator schedules teleconferencing as a primary way of communicating and meeting the needs of schools.

The shift from personal emails to mass emails was viewed as positive by some, who welcomed the decrease in the number of email messages, and negatively by others, who missed the personal nature of the communication. The latter group felt that their NASA liaison was able to point out relevant opportunities and that the mass emails took longer to go through to see if there was anything relevant. The lack of a personal connection made it, in the words of one team, "harder to get pumped up" about the opportunities. Participants found the large amount of information conveyed by NASA via email was both good and bad. On the one hand, team members said that some of the information was valuable, while on the other hand it could be overwhelming.

> *"[H]e is an excellent master teacher and [the children] are totally enthused.… The fact that he has been more than willing to train teachers is great." --Report from educator about AES*

More frequent visits to the school create greater effect. Physical distance of schools in relation to the NASA field center is one of the indicators of the frequency of school visits. As expressed by three coordinators, the farther the schools are, the less frequently field center staff was able to bring services to them in person. Although support to these schools continued via telephone, email, and DLN, Center staff were less likely to impact the program implementation with infrequent site visits. Many team members were effusive in their praise of their aerospace educator as seen in the quotations here.

> *He is of such value that I just can't see us not having him. He makes the ultimate connection. He connects us to community, to family night. He is also the master when it comes to presentation in front of a big crowd." Report from an educator about AES*

In the focus group interviews, the school teams talked about the effect that an active Aerospace Education Specialist could have. Some aerospace educators acted as "sales" people for the program, going into classrooms and modeling activities for teachers, while others either allowed professional development sessions to be opened up to teachers in the whole county or came to the school and took a more traditional approach, giving a workshop for teachers after school. The number of aerospace educators visits to school sites ranged from one to four or more during the school year. Successful aerospace educators and program managers were able to make participants feel supported and helped them continue to be motivated about the NES Program. The majority of the teams felt the NASA staff was responsive and attentive to their needs.

Conclusion to how the field centers are implementing the model

Orientation is achieved through new team leads attending the student symposium held in May, a visit to the schools before the summer workshop, schools identifying their academic priorities, providing a reference notebook, and sending the team to six days of professional development at their NASA field center in the first summer. These activities let the NES coordinator get to know the teams, give them an overview of the opportunities, and requirements, and help them to begin team-building and staff involvement.

A team of the NES coordinator and other field center staff plans workshops. They have a common format, but focus on center specific resources and content topics.

- Orientation Workshops emphasize understanding NASA resources, creating strategic and implementation plans using NASA resources to meet specific student needs, developing pedagogical skills, learning about DLN, and team building.

- Content Workshops emphasize STEM-G content knowledge, specific pedagogical strategies, use of NASA resources, technology use and observing expert teaching.

The NES coordinators via telephone, email and videoconferencing provide support during the school year. Aerospace education specialists provide on-site support for the schools. Schools praised aerospace educators who visited a lot, did master presentations, spurred them on with new ideas, were responsive to their needs and requests, and provided NASA materials. The NES coordinators provide on-going support for the school teams via email, videoconferencing, and telephone. The aerospace educators who go to the schools are viewed as critical to success by the schools. The schools appreciate it when they reach out, are involved in family nights, and make suggestions. Providing relevant materials and artifacts the school can use are also effective parts of the model.

How are Explorer School Teams Implementing the NES Program?

The NES program is designed to provide support for whole school reform through a small monetary grant ($17,500 over three years), and extensive content, technical and pedagogical support by NASA personnel. An initial needs assessment by the school of its academic priorities leads to the development of strategic and implementation plans that are supposed to determine what NASA resources are used. As has already been discussed in detail, the five-person NES team from each school develops these plans with support from the field center staff. This team then takes the lead in involving the school, community and local partners in the reform effort. Information from NES leadership and the field center staff about NASA sponsored events flows primarily to the team lead, but increasingly to the whole team via email and telephone contact.

This section examines how schools are implementing the model from the perspectives of the school teams, the team leads, the field center staff as a group, as well as the NES coordinators specifically. The content of the schools' action plans was analyzed to see what they were planning to implement after their first summer orientation period. In addition to the focus group interviews conducted with the 2003 cohort schools, the NES leadership polled participating schools for success stories. These qualitative data sources provide useful anecdotal data about how schools are implementing the program. This section describes the range of ways the schools are implementing the model. The next section will discuss the impact of implementation on the schools, teachers, families, and students.

How do schools organize for success? How do they manage and leverage the NASA Explorer School opportunity? How do they participate in ways that reform how they do business so their students achieve in STEM-G and want to pursue careers in these areas? These and other questions guide the discussion in this section from multiple data sources: the 2005 field center surveys, 2005 NES coordinator interviews, 2003 school team focus groups conducted in 2005, and the 2003/2004 team lead surveys.

The NES model depends on the schools reaching out to the NASA field center staff with specific requests, and responding to opportunities from NES leadership. At the same time, it requires field center staff to find ways to help the schools with their goals. The program provides rich NASA content, but requires the schools to use it to focus on the academic priorities outlined in the national standards. The program provides the connection to NASA, but the schools have to find ways to use that connection to involve everyone in the school in community in supporting student achievement.

Team leads were given a list of nine factors and asked to rate how critical these factors were in implementing the NES model. These nine factors were (1) school action plans, (2) team members, (3) NASA funding, (4) NASA sponsored training, (5) NASA reputation, (6) school principal, (7) NASA field center support, (8) other school staff besides team members, and (9) district staff.

Several factors emerged that characterize successful schools' activities:

1. ***Strong NES Leadership Team:*** The team lead, the coherence of the team, its leadership in the school, an active administrator team member and the school action plans were identified as critical factors in successful implementation.

2. ***Involvement of the whole school:*** A whole school focus with systemic changes and support from the school and district administration, curriculum changes, after school opportunities and participation by teachers in professional development were cited as critical from the Center and school perspectives.

3. ***Involvement of the community:*** Schools and NASA Centers noted the importance for NES schools of involving the community, specifically families, local businesses and organizations and publicizing their NASA connection and activities in the local press.

4. ***Use of NASA resources:*** Effective use of NASA resources including scheduling NASA staff to provide on-site support on a regular basis, using specific resources to support their goals, attending conferences, and figuring out how to complete the required paperwork.

5. ***Use of technology:*** Schools and Centers reported that technology was important for teachers and students. Technical support was considered critical to success. The use of videoconferencing and the Digital Learning Network were important tools for involving teachers and students with NASA content and people.

Strong NES leadership team.
The NES team is at the core of the model. The five-member team has a team lead, an administrator, a family coordinator, and two other teachers. The family coordinator may have that official role in the school or district, or may simply be the person designated to keep attention focused on that very important area. The emphasis on roles was less in the first year, but it became clear very quickly that the roles were very useful as a way to support team development. The team receives the most training, and receives the ongoing communication from both the field centers and NES leadership.
Critical factors in successful implementation identified from multiple data sources are: the team lead, the coherence of the team, its leadership in the school and the school action plans were identified as. Each of these is discussed in detail in this section.

"The plan keeps us on track to meet the goals that we have established for our school. We chose the goals based on our school's needs and the plan acts as a blueprint to achieve those goals."

"We have a plan that focuses on student achievement and enriching the curriculum. We are very focused on our outcomes."

"We have been very focused on our improvement goals at every step of this procedure."

"I feel this way because, without a vision, we would have no idea where we were going and no way to know when we had arrived at our goal. It is definitely important to have a plan."

"It guides our vision and puts it in order for us to achieve."

"Developing the plans forced our team to narrow our focus to concentrate on utilizing the NASA resources that best fit our needs."

A clear plan. 100% of the team leads (49 in 2003, 41 in 2004) reported that their team strategic plans were not only important for implementing the NES program, but also for achieving their own school improvement goals in science, technology, geography and math. They used words like, "vision, direction, focus, guideline, a roadmap to follow and reflect upon" to describe the role of the plans. See the sidebar for the voices of the team leads talking about their plans.

The NASA field center staff echoed this emphasis on the action plans. One NES coordinator put it this way, "The more involved schools typically spend time on developing and revising their plans." Another coordinator reported, "They came to the summer workshop last year with their strategic plan almost completely done already. They already had a vision of what they wanted … while they were here looking at some of the different resources and some of the activities, they generated some more ideas in their heads so that they could just throw into [their] strategic plan as well, but that's again a school that I talked to the team lead, I guess once or twice every two weeks." This is another emerging pattern, schools that have clear plans that they have put a lot of hard work into, contact their field center staff more often to help them implement that plan.

"They came to the summer workshop last year with their strategic plan almost completely done already." NASA staff

When teams submitted their plans late, it was a problem for the teams and the field center staff. Sometimes the delay was a technical issue, but often the team had not come together to finalize the plan. Other difficulties had to do with funding field trips and other activities that would have supported the plan. The hold up in funding caused some teams to feel they had to delay implementation.

A strong team. NASA field center staff reported that strong *school teams* contribute to the success of the program. They defined the attributes of strong school teams as:

- Have the desire to work as a team to improve curriculum in their schools
- Share a common vision for the success of the program
- Seek other opportunities to meet their school goals including partnership, funding, community outreach, family involvement
- Want professional development to improve their knowledge to make them better teachers for their students

Both the field center staff and the team leads expressed frustration when a team didn't come together. Sometimes there were changes in team members so the original members were no longer involved, or some members were not interested in getting more involved in the program. Twenty-four percent of the 2003 team leads were dissatisfied with their teams for these reasons. “There is so much work because of the team members who left. It was just heaped on the shoulders of those remaining.” “Our only problem is the change in team membership. Nothing can overcome that.” “Staff is being changed and teaching schedules being changed.” “Not all team members have met the new ideas with open arms. They strongly agreed to fully participate in the beginning, but "No Child Left Behind" has strongly impacted instruction delivery to become more "Old School'."

Time to meet and work together as a group as well as time to implement NES activities was an important factor. Comments included: “Team is happy with the program, but is not as involved as I would like to see them be," “Members are very satisfied with the program."

A strong team lead. The field center staff felt that the team lead’s role in bringing success to the program was another critical factor. “A strong team lead that has administrative skills and has a good working relationship with her team” is critical to the program success.

"A strong team lead that has administrative skills and has a good working relationship with her team is critical to the program success." NASA Staff

Another field center staff acknowledged that the team leads are very busy and suggested that the program needs did not always take this into account, “Honor that the team lead is a fulltime teacher… it creates too much burden on the team lead when there are short deadlines.”

Administrative support. The administrator on the team is critical to supporting the team's efforts as well as taking the lead in involving the whole school (see next section). They performed important functions such as providing team planning time, involving the whole staff, facilitating purchasing, planning whole school activities, expressing enthusiasm, and finding additional funding. Recognizing the importance of this, NES leadership started offering more direct support to administrators in 2004 in the form of special sessions for administrators at conferences and in the summer professional development. Field center staff also work closely with administrators.

"The administrator must be a visionary leader, capable of sharing this vision with his/her staff and lead them down the path that will provide for success.”
--NES teacher

Of the 2003 team leads, 33% were dissatisfied with the administrators from their schools and districts. They explained that these administrators were uninvolved or did things such as delayed technology purchasing requests, “The district has caused our problems with purchase order issues such as not being able to buy what was listed in our grant because it wasn't from a certain dealer or is a different model than the district's bid list." In other cases, the district administration was "reluctant to allow us access to transmission lines." Some school administrators did not make the program a priority so they did not want to spend money or time on the Explorer School activities. "Our principal, one of the members, does not have very much time to devote to this initiative." "My principal is least interested - did not want to spend any money and controls everything." "My principal does not want to spend money for classroom technology nor for students. It is very frustrating to get any money from him."

"When we started everything centered on the team. Since then we have strived to get the rest of the faculty involved, it is just starting to really spread to the rest of the school. The more it spreads the bigger our involvement will be."
"School team members need to be able let go of their exclusiveness and invite members to their staff to have a sense of belonging."
--NES teachers

Frequent changes in leadership were another challenge team leads experienced. "The administrative end of the program seems to change a lot." "Our school has had a change in district leadership so they are trying to figure out direction. It has been difficult to educate the district about the NES grant."

Team leads with the 2004 cohort felt satisfied with their teams, but some reported challenges. "We feel very satisfied with the program, however, we feel very frustrated because we lack the support from our administrators in providing us with the planning time during school day." "The team does not have the full support of the administration, making planning and implementation time almost nonexistent."

In summary, schools and field center staff report that the critical factors for implementation are a strong, stable team with a clear plan, an organized team lead who has the time to communicate and organize the connection to NASA, and an actively supportive administrator who provides team planning time, explicitly supports the program with the faculty and district administration, and provides extra funds.

2) Involvement of the whole school
The NES model makes clear to the school teams that they are a leadership team for involving the whole school. The amount of resources made available to a school also makes it clear that more than five people are to be involved. A whole school focus with systemic changes and support from the school and district administration, curriculum changes, after school opportunities and participation by teachers in professional development were cited as critical from the Center and school perspectives.

Buy-in. Involvement of the entire staff and school community was reported to be number one critical factor by field center staff and NES coordinators. The NES teams found ways to help everyone feel part of the program, to get involved in using NASA materials and going to professional development, and to contribute to the design and evaluation of the program. The emphasis is on "empowering the staff beyond the team" and "getting the school and community buy-in."

"We have teachers that have no tech experience and are trying, with help, to use it in their class"
"Our faculty & staff have become interested and involved in our program. They have found ways to incorporate our program into their content areas. They help with enthusiasm when we ask."
--NES teachers

When talking about whole school involvement, some of the 2003 team leads referred back to their action plans as the framework they used to focus the entire faculty on school improvement or curriculum development goals that could be met through NASA involvement. Other Team Leads emphasized the need to provide support for using technology and NASA products that support each teacher's curriculum goals.

For others, the program implementation came with a struggle to involve teachers and administrators. One 2004 team lead put it this way, “We see benefits, but it is a real struggle to get our teachers to participate and keep up the excitement.” Another team lead expressed frustration with getting teachers to take advantage of the NASA opportunities, “It is exceptionally difficult to get teachers to use NASA resources or to apply for opportunities that are available." A 2003 team lead saw the issue as related to the willingness to grow professionally, "People did not want more work nor did they want change.”

Administrative support. The field center staff focused on the role of the administration on leading the whole school involvement, in addition to their role on the NES team. In larger schools, the NES Administrator may not be the only administrator in the building. Administrative leadership is critical for students, "Administrative support for the NES program is essential in creating an environment which will allow for and foster improved student interest and achievement in STEM." Administrative support was also seen as critical for systemic changes, such as creating resource areas, setting up clubs and integrating the NASA materials, approach and theme into curriculum and instruction.

Integration. 2003 Team leads reported satisfaction with the program because the program improved *students’ STEM interest and knowledge*. The NES program allowed teachers to enhance their STEM curriculum and provided students with better learning opportunities that were not available before. While some schools reported conflicts with local, state and national standards, pacing guidelines and testing mandates, others reported finding ways to make connections and incorporate NASA materials and resources into life of the school.

In the Focus Groups, the 2003 NES teachers described strategies their schools used to increase *student engagement* in STEM learning through the integration of NASA resources. Some teachers made changes to their curriculum based on what they learned from their NES experiences. For example, they added electives in aerospace, aeronautics, or space exploration to the curriculum. Others organized science learning around monthly four-hour events called “NASA rotations." They created modules for NASA projects such as Signals of Spring or Mission Geography to go into their science curriculum. They added topics such as rocketry, robotics, and astronomy to their classes and after-school programs. They had their students engage in a range of NES activities such as, e-Missions, after school clubs and competitions, videoconferencing, attending special events – Student Symposium, Wallops International Space Station experiments Marsapalooza, KC-135, and reduced gravity flights. They added field trips and hands-on activities with a NASA focus. A few schools set up specialized rooms for NASA materials and activities. This was especially valuable at schools without science labs. Schools have also used NES funding to set up outdoor scientific exploration areas related to rocketry, the natural world, and weather.

In summary, the NES model is intended to be a whole school reform model. NES leadership and the field center staffs are consciously supporting the NES teams as leaders of that effort. The school teams have found they needed to overcome barriers of their own exclusivity and goals to include their colleagues in decision-making, implementation and evaluation. They have found they need administrators not only to support their efforts as a team, but to embrace the vision of a NASA Explorer School. They need administrators to help create the systemic changes that use NASA to achieve the school improvement goals.

> *"They get the parent organizations on board and they get the community support. These are the schools where it (the NES program) is really making a difference I believe."*
> *--NES teacher*

3) Involvement of the community

"You can't do that here; this is a NASA Explorer School!" This comment came from a parent when she was called into school because her son had been involved in a fight. When the whole school is excited about having this special relationship with NASA, the community begins to feel it too. There is a pride and sense of being part of a larger enterprise that comes through. This vision of learning about real, ongoing, complex issues related to exploration drives the creation of a variety of ways to involve the community, from families to the press.

The field center staff and the NES coordinators described family nights, student competitions, and the NES program creating other partnership opportunities. One coordinator talked about the connection between having all the teachers involved and getting a lot of community involvement. "Definitely the schools that implemented across the whole school have a lot more success. You really see that. It could just be that there are more people working on it than individual classrooms. You see a bigger success when the whole school is on board. That is definitely a strength, if you can get everyone on board. They get the parent organizations on board and they get the community support. These are the schools where it (the NES program) is really making a difference I believe."

In the Focus Groups with the 2003 schools after a year and a half of being in the program, the family component was clearly important. The Explorer Schools program gave the schools a way to organize special NASA-related events to get parents out, such as family nights and NASA Day, star gazing nights, and other events and activities related to science, math, and technology. They report holding one to four of these events per year, at least one of which typically involved a visiting astronaut, their Aerospace Education Specialist, or other NASA staff. Popular activities during these events included stargazing, robotics, technology, and space exploration -- Mars in particular. The events usually included a variety of hands-on activities. Those held at the beginning of the year let parents know about NASA resources, while those held later in the year showcased student work. Community members were often invited to these events. Some schools involved parents in other ways, such as through newsletters and having parents volunteer to help with NASA-related after-school activities.

The field center staff also notes that some schools have created other partnerships. One school, for example, "arranged for professional development not only for the school by itself, but for other schools within the community, so they're really looking at trying to have this Explorer School program affect other schools right in that same community that they're in."

In summary, involving the whole school in NASA activities appears to easily lead to involving the families and larger community in supporting students. Involvement with NASA brings excitement and inspiration that can lead to involving families that have not been involved before and in helping them to support their children's interests and aspirations in science, technology, engineering, math and geography.

4) Use of NASA resources

A big challenge for the field center staff and the schools is identifying resources from the vast collection and variety of programs, projects, competitions, speakers and events available. The strategic plans are one approach to help teams think through how to use these resources. Another is for the AES and NES coordinators to get to know the schools well enough to recommend resources to them. In addition to sorting out and organizing for the use of NASA resources, the school teams must complete requests, reports and applications to participate or sometimes receive materials. Helping the schools complete the paperwork is part of the role of the NES coordinator. They help the schools make effective use of NASA resources through scheduling NASA staff to provide on-site support on a regular basis, using specific resources to support their goals, and applying for special events. The amount of communication, the number of visits by NASA staff to the school, the distance from the field center, and participation in professional development and conferences were identified as factors in an effective school model.

Communication. Although most team leads stated their appreciation with the support from the NES representatives, 2004 Team Leads wished to have more *support*. More support was requested in resolving issues of DLN, organizing family nights, delivering NASA content to students, and improving their knowledge of STEM content to enhance their teaching skills. Most frequently needed support was technology related DLN issues for buying, setting up, and organizing DLN events. Some of the 2004 Team Leads also had concerns over the “lack of communication” between the field centers and their schools. Overall, team leads requested timelier, consistent follow-up, training and guidance, and better communication. “We are satisfied and feel that this is a good program. However, there seems to be a lack of communication and a lack of follow through on various components.” “We are very satisfied with the program. However, we have had some difficulties with our team’s communication. Since we have an elementary school and a middle school in the program, our NES team is split between the two schools. We do depend on e-mails to keep the communication open on a daily basis. I do strongly believe that if we were all at one location, communication would not be a problem.” “We are very happy to be in the program. Sometimes, we are frustrated with communication. For example, we were not able to get an answer about the dates for the summer workshop in time for one of our teachers [to attend].”

The field center staff and NES headquarters have made all the information available on the NES website so teams who have easy access to the Internet and use it often seem to be fine with knowing what to do when, and when things are happening. To respond to the concerns about communication, weekly E-Blasts (email) include information way ahead of time about events so teams can plan. The E-Blasts are sent to all the team members, not just the team leads to help with communication. Events are scheduled further in advance now because partnerships within NASA are in place.

"So much to do in so little time".
“It is difficult to keep up with the constant influx of information and activities from NASA and focus on our state standards."
"There is never enough time to meet and implement the plan.”
--NES teacher comments from workshop surveys

Use of Specific NASA Resources. ISS, reduced gravity, DLN, the establishment of student clubs, partnerships in the community, and organizing student competitions were cited in the field center survey as specific NASA resources that helped schools successfully implement the program. For example, one school created a "Women in Science Club." Another created student interest in science careers after an astronaut visited the school. This school was also able to establish partnerships with other organizations by leveraging their NASA affiliation to enhance their implementation and program sustainability.

Professional Development and Conferences. In terms of *professional development* opportunities, teachers from the focus group expressed satisfaction with being engaged in a range of professional development activities: (1) introductory, week-long NES workshop at the NASA regional offices; (2) content workshops focusing on robotics, rocketry, handheld computers, GLOBE, History of Winter, Web Wonders, MatheMagical ISS, Mission Geography, etc.; and (3) national conferences such as NSTA, NCTM, and NECC featuring special NES sessions that accompanied the conferences. As a result of these professional opportunities, teachers indicated that they enhanced their content knowledge, met scientists and colleagues nationwide, and learned about career opportunities to pass on to their students.

The wealth of information and opportunities seems to continue to be a challenge for some teams. Teams who meet weekly, NES coordinators who meet monthly (via telecon), and strong team leads seem to be able to process the information. The NES events calendar on the website also helps teams to plan. Nevertheless, 39% of the 2003 team leads reported that there were *too much to do*, *too many opportunities* to attend, and *too much paperwork* to complete. “Sometimes it gets overwhelming because there are so many opportunities or paper work to do besides our own school or state initiatives.” “We love the travel and NASA materials. Sometimes the team feels as if there is too much paperwork or obstacles, especially time. There is a lot that the team has to do on their own, on top of all that they have to do for the school anyhow.” Last minute requests were a particular problem described by several team leads, “On numerous occasions, we have received frantic, last minute calls expecting our school and district to provide news coverage and school time for events with little advance notice " and “The materials we receive, the opportunities we get and information are great. But sometimes things come too late, last minute or not enough time to do them.”

Late receipt of funds. In both 2003 and 2004, team leads reported not receiving funds in the fall to support implementation: “The receipt of the grant money does not come in a timely fashion to allow us to purchase equipment that we are counting on for program implementation.”
The field center Survey supported the problems it causes when schools do not get their NES money until February of the school year since most schools needed this money to purchase videoconferencing equipment; they were not able to begin implementing that part of the program and missed out on valuable early contact with field center staff.

In summary, the NES program provides an wide array of materials, programs, projects and events that schools have to find ways to sort out as worthy of their time, and then figure out how to organize them. Schools that do it effectively are in close contact with field center staff, either through their own initiative or that of the field center, who meet regularly to discuss what is available and how to take advantage of it, and who read their email consistently and use the website for information.

> *"The schools or districts that do not support and maintain these [virtual] connections only serve to reduce the effectiveness of their staff and the NASA professionals working with them." --from Field Center Survey*

5) Use of technology
A key part of the NES model is learning about technology as a tool for thinking, but also as a tool for communicating. All NES schools are strongly asked to purchase videoconferencing equipment with their funds to take advantage of NASA resources during their first three years, and especially beyond that time when they will have fewer on-site visits. Both schools and field centers reported that technology was seen as important for teachers and students to learn more about STEM-G topics and careers. Technical support was considered critical to success. The use of videoconferencing and the Digital Learning Network were effective tools for involving teachers and students with NASA content and people. Schools have reported challenges to successful and seamless implementation of DLN and other technologies offered through the NES program.

Effectiveness. From the NASA field center survey, center staff reported *technology and technical support* as factors bringing success to the program, highlighting technology’s role in maintaining a physical (or virtual, via videoconference) presence of NASA education and increasing distance learning opportunities that are becoming available to schools. Center staff confirmed the importance of technology and technical support for successful implementation.
Participation in the NES program has allowed school sites to enhance their existing *technology capacities* in several major ways. Sites have used the funding from the NES grant to purchase several computer, distance education, and lab equipment. In addition, teachers explained that the Explorer program enabled schools to better integrate technologies through on-site professional development and technical support.

> *"We are unable to access technology events as a result of firewall and local wiring issues."*
> *"We continue to have problems with our videoconferencing goals. It is a problem with our technology division, not NASA."*
> *"Our school has failed to install and maintain given videoconferencing and technology equipment." --NES teachers, Focus Group Report*

Digital Learning Network. DLN continues to be an important means of communication but has not been immune to issues related to school structure and function. Technology related issues included lack of existing technical infrastructure at schools, lack of center staff expertise on technology (specifically DLN), lack of teachers’ knowledge with purchasing and setting up DLN events, and lack of access to greater bandwidth were reported as problems by many center staff.

Technical Support. Focus groups sited inadequate access to computer equipment, due to school's technology infrastructure or school or district technical support, problems with the videoconferencing equipment (e.g., there are or were problems with installation [tech support, asbestos abatement, firewall issues, no space in school to put it, improper wiring]) have all presented as obstacles to seamless implementation of the NES program. All groups voiced concern over their schools ability to implement technology into their school.

In summary, the technology is viewed as important and needed for communication with NASA people and use of NASA resources. Local technical support has been a barrier to implementation. To address these issues, NES leadership staff is available to support any schools that do not get up and running. They approve the technology budget for the schools and support their startup. The new DLN coordinators in the field centers (five to date) are tasked with setting up the DLN connection in their Center and helping the schools get set up and take advantage of the videoconferencing opportunities.

Conclusions for how the schools are implementing the NES model

When asked about how the schools are implementing the NES model, the schools, their team leads, the NASA field center staff and the NES coordinators responded with several key factors. What is needed is a strong, stable team with a clear plan, an organized team lead who has the time to communicate and organize the connection to NASA, and an actively supportive administrator, who provides team planning time, explicitly supports the program with the faculty and district administration, and provides extra funds. A whole school focus by the team and the key administrator supports systemic changes from curriculum to after school opportunities and participation by teachers in professional development. When there is a whole school focus, they naturally involved families and the community, inviting them to events, getting press for what goes on, and helping everyone to enjoy learning about science, technology, engineering, math and geography topics through the NASA lens. Schools that use NASA resources effectively are in close contact with field center staff, who meet regularly to discuss what is available and how to take advantage of it, and who read their email consistently and use the website for information. Technical challenges in setting up videoconferencing and late arrival of funds were considered the biggest barriers to use of the Digital Learning Network which is the core technology supported by NASA funds and that gives schools access to NASA resources.

These factors underscore the importance of multi-level communication by NES leadership, but especially by the field center staff in supporting the school's implementation of the model. They hear about the needs first (or don't hear from the schools), and they offer the first response. They have refined their roles, and provided additional support for the schools through such things as a pre-visit and orientation notebook to provide an overview of the program and support for the teams immediately after they are accepted into the program, using the summer Orientation Workshop to identify specific NASA resources to meet the academic needs identified by the schools in the plans, and reaching out to the schools through scheduled meetings and emails. They communicate with the schools in a variety of ways to be sure they are asking for what they need and taking advantage of opportunities for professional development and student activities. NES leadership has also responded by providing additional website information and timely updates in E-blasts.

It is recommended that NASA staff at all levels explicitly focus on the factors identified in these analyses by continuing the communication methods they currently use, scheduling more regular video and teleconferences with school teams to respond to their needs for information and program resources, to provide examples of school implementations through stories and vignettes, by pairing schools for mentoring and program development, to ask for quarterly reports on progress on the school action plans and regular video and teleconferences for administrators across districts. These are some examples of strategies that can support the schools in developing the routines and structures that will make them successful.

Document Analysis on School Action Plans
School plans were analyzed to understand how the schools intended to their work after their initial orientation. Plans from all three cohorts were analyzed. The process of understanding, recording, and analyzing school action plans was iterative. Initially, a thorough context analysis was conducted on the 2003 plans to specify the following characteristics of schools: school type (elementary, middle, and high school), school location (urban, rural, transient, and isolated) school status (public, magnet, intermediate, charter, Title I), and school demographics (racial profile, socio-economic status, percentage of ESL and Special Education students). Following reading and recording the contextual school characteristics, two additional tiers of analyses were conducted to investigate and record “what” school teams reported to implement in their plans to meet their school improvement goals within the context of the NES program goals and objectives. The messages which are emerged from the plans were recorded in an Excel spread sheet. A frequency analysis was conducted on the emerged codes to describe the interventions at individual school level and at the level of occurrence of each intervention among the overall 2003 schools.

When available, several sources of documents were analyzed simultaneously in this process. These were the (1) Strategic plan (2) Implementation plan (3) Executive summary, and (4) Technology plan. In addition, (5) NASA Education Evaluation System (NEEIS) demographic data and (6) the National Center for Educational Statistics data were used to describe school demographics. Although some schools stated these demographics in their executive summary, they were neither consistent nor complete. The demographics information that is collected from the NEEIS and the National Center for Education Statistics allowed the evaluators to specify school characteristics in terms of (a) school size, (b) students on lunch assistance (an indicator of socio-economic status), (c) school location (urban versus rural), and (d) minority students. See Table 1 for an overview of school population profiles.

Table 17 provides a summary of 2003, 2004, and 2005 cohort school plan analyses. The data shows the percentages of school plans by cohort year that list these interventions in their strategic, implementation, or technology plans.

The preliminary analysis revealed that the interventions schools expressed were *multi-level* and *multi-faceted*. They were multi-level interventions, because an intervention, such as “using people,” involved several types of NASA and non-NASA people. The same multi-level intervention was also multi-faceted depending on the purposes of using people. For example, people (either NASA or non-NASA) served three main purposes: (1) increasing student ability in science, technology, engineering, and math concepts, (2) increasing student interest in STEM careers, and (3) increasing professional growth among teachers. In addition, using *people* were also a critical component for implementing a specific pedagogy such as, project and inquiry-based learning. The same was true for other interventions: student events, teacher events, change in school practices and programs, and finally connection and collaboration efforts. All these activities seem to have been related or contributing to the implementation of more than one NES objective.

These numbers and percentages are based on the analysis of 47 school teams. Since plans from three schools were missing at the time of the analysis, a complete strategic plan analysis from 50 schools teams will be conducted when these plans become available. Figures displayed in Tables 12 and 13 present the numbers and percentages of specific NES activities that school teams reported to implement in regards to teacher, teacher, and family events, using NASA and Non-NASA people, and Collaboration. Table 17 and Table 18 present the results of the frequency analysis conducted on the plans.

The process of conducting content analysis school plans was revised for the 2005 schools. Below is a summary of for the 2005 plan analysis (See Table 18). The frequency analysis summarizes information from across individual school plans based on a revised checklist (a list of interventions as outlined in the student, teacher, and family activities, communication, and collaboration efforts) that is provided in the Appendices.

Table 17. Strategic Plan Analysis for 2003, '04, and '05 Cohorts

	2003 N = 49		2004 N = 38		2005 N = 47	
Teacher Participation	n	%	n	%	n	%
PD - unspecified	36	74%	31	82%	28	60%
Conferences - Attend	18	37%	22	58%	22	47%
Conferences - Present	-	-	-	-	3	6%
Technology-related PD	14	29%	18	47%		
PD/workshop - Facilitate	14	29%	13	34%	17	36%
Instructional PD - Attend	10	21%	11	29%	32	68%
PD plan	12	25%	-	-	20	43%
Grant Writing	11	22%	10	21%		
Using NASA people						
NASA Science professionals	35	71%	25	66%	20	42%
Aerospace educator	9	19%	23	61%	22	47%
Guest Speakers	6	12%	6	16%	10	21%
NASA Center staff	2	4%	17	45%	16	34%
Using non-NASA people						
Guest Speaker	11	23%	21	55%	18	38%
Local people	5	10%	8	21%	10	21%
Science professionals	3	6%	9	24%		
Student Participation						
Presentations, Fairs	20	41%	17	45%	-	-
Fieldtrips	20	41%	20	53%	15	32%
Competitions	17	35%	18	47%	12	26%
Presentations	-	-	17	45%	13	49%
Clubs	13	27%	13	34%	21	45%
Career paths, shadows, days	24	49%	22	58%	-	-
Career days	-	-	-	-	26	55%
Career shadows/paths	-	-	-	-	25	53%
Mentoring/Apprenticeship	-	-	-	-	11	23%
Math/Science/Tech Fair	-	-	-	-	19	40%
Family Participation						
Family nights - unspecified	45	92%	36	95%	33	70%
Sky nights	36	73%	12	32%	-	-
Family nights – build/show	-	-	-	-	20	43%
Kick off	-	-	-	-	17	36%
Parental volunteering	-	-	-	-	11	23%
Parent/teacher conferences	-	-	-	-	8	17%
Collaboration						
Schools in Community	35	71%	23	61%	16	34%
University	15	31%	15	39%	22	47%
Other NES Schools	15	31%	9	24%	13	28%
Local Businesses	18	37%	17	45%	21	45%
Government agencies	-	-	-	-	9	19%
Informal educators	-	-	-	-	8	17%
Specific Pedagogy						
Inquiry	44	89%	28	74%	35	74%
Project-Based learning	32	65%	-	-	18	38%
Critical thinking	22	45%	-	-	6	13%
Problem-Based learning	-	-	6	17%	8	17%
Communication & Publicity						
Newsletters	-	-	-	-	10	21%
Bulletin board/banners/poster	25	51%	20	52%	27	57%
Involve local media	-	-	-	-	7	15%

Table 18. 2005 School Plan Analysis: Plans Identifying Specific Activities

Teacher Participation	N	%
PD - unspecified	28	60%
Instructional PD - Attend	32	68%
PD/workshop - facilitate	17	36%
Technology related PD	20	43%
Conferences – Attend	22	47%
Conferences – Present	3	6%
PD plan	20	43%
NES team meeting	15	32%
Student Participation		
Career days	26	55%
Career shadowing/paths	25	53%
Student Clubs	21	45%
Mentoring/Apprenticeship	11	23%
Fieldtrips	15	32%
Conferences/Symposium	12	26%
Competitions	12	26%
Presentations	13	49%
Math/Science/Tech Fair	19	40%
Family Participation		
Family nights – unspecified	33	70%
Family nights - build / experiment /showcase	20	43%
Kick off	17	36%
Parental volunteering	11	23%
Parent/teacher conferences	8	17%
School Participation		
Change/add curriculum	28	60%
Change/add program	17	36%
Change/add a resource room or library	10	21%
Address STEM-G State content	9	19%
Sustainability	10	21%
Integration of NASA curriculum	34	72%
School wide implementation	23	49%
Using NASA people		
Guest Speakers	10	21%
NASA science professionals	10	21%
NASA scientists	10	21%
NASA field center staff	16	34%
aerospace educator	22	47%
Using non-NASA people		
Guest speakers – unspecified	18	385
Local/community guest speakers		
Local science professionals	10	21%

Collaboration		
Collaborate with other NES schools	13	28%
Collaborate with non-NES teachers at the same school	25	53%
Collaborate with schools in the district	16	34%
Collaborate with local universities	22	47%
Collaborate with local businesses	21	45%
Collaborate with government agencies	9	19%
Collaborate with informal educators	8	17
Communication and Publicity		
Newsletters	10	21%
Bulletin board	17	36%
Banners/posters	10	21%
Create and update school web pages	10	21%
Involve local media	7	15%

Conclusions and Recommendations Regarding NES Implementation

Based on a preliminary analysis of the school action plans, the following recommendations emerge as key factors to support NES teams writing and implementing their plan. NASA staff who support the NES program should help schools keep their focus on their school academic needs, goals, and specific NASA activities and services that can fulfill those goals. Consistent and frequent communications between NES coordinators and aerospace education specialists play a key role in school success. Scheduling regular video and/or telephone conferences with NES teams offers one solution for the need to stay in touch with schools and be responsive to their needs for information and program resources. NES coordinators can also play an effective role in guiding and supporting NES team by providing examples of exemplary school implementation plans, highlights of successful events as they occur at Explorer Schools, and by offering to pair new schools with more experienced NES team who can mentor new teams through the orientation phase of the program. Including administrators within and across school districts in communications (telecons and videoconferences) may also be an effective way to sustain support and enthusiasm for the program.

Needs Assessment Data Analysis

Background

Explorer Schools were asked to identify the areas of greatest need for their students in Science, Math, Technology and Geography. The standards most often cited by schools in all three cohorts are listed in the summary. NASA Explorer Schools Program has a commitment to help students improve in these priority areas. NASA Field Centers are well equipped to support content and skill development in most of the priority areas. For example, physical science standards such as motion and forces and the transfer of energy can be addressed through NASA content and context. Math standards such as "Understand how mathematical ideas interconnect and build on one another to produce a coherent whole" can be developed through NASA content. The Technology standard for Design: "Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving" can be supported through the modeling, contact and processes of NASA as a premier research organization. One of the Geography standards cited by the schools as a priority, "The world in spatial terms: How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information" is supported in many geospatial NASA activities. The Field Centers use these data for their schools in planning summer workshops, virtual and on-site activities.

The NASA Explorer Schools reform model is based on providing support for schools using NASA resources in areas of identified need. To identify the priorities, schools were asked to rank the needs of their students in science, math, technology and geography.

Methods

This report summarizes the results of the analysis for each of the three cohorts of schools. Each cohort began with 50 schools. Each school submitted one set of rankings. Every school responded.

The data were analyzed in two ways. First, one score for each standard was created as a percentage of the number of times it was chosen (at any rank) over the total number of schools (50). Since this score does not take into account the particular ranking schools gave the standard, graphs were created to show this information. The results are shown by standard area – science, math, technology and geography.

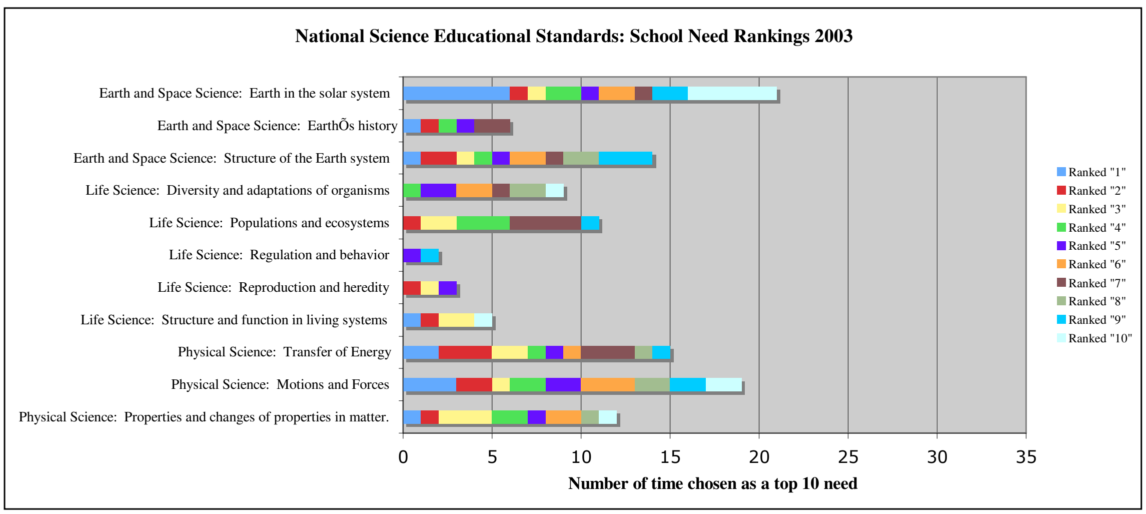
Results

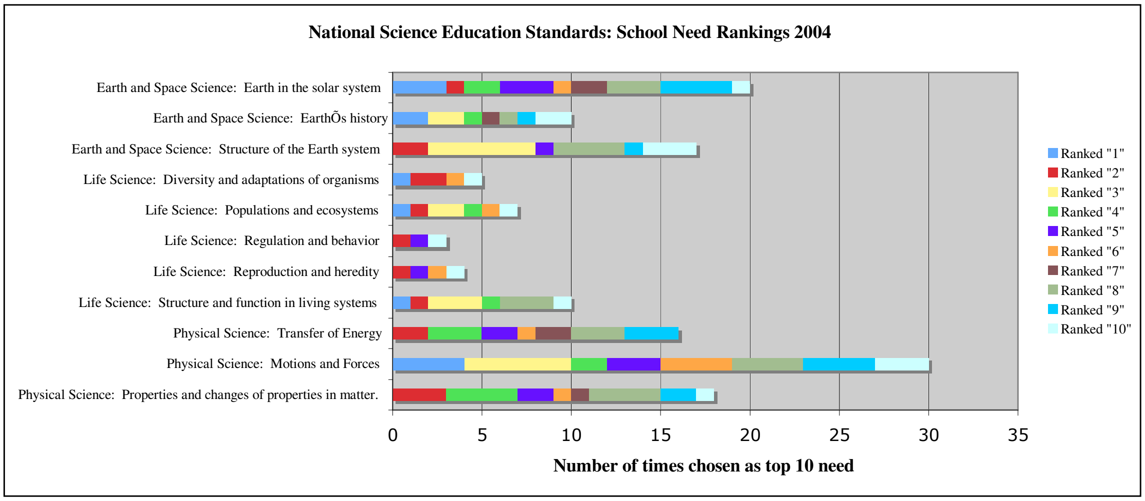
Science Standards All results are percentages %

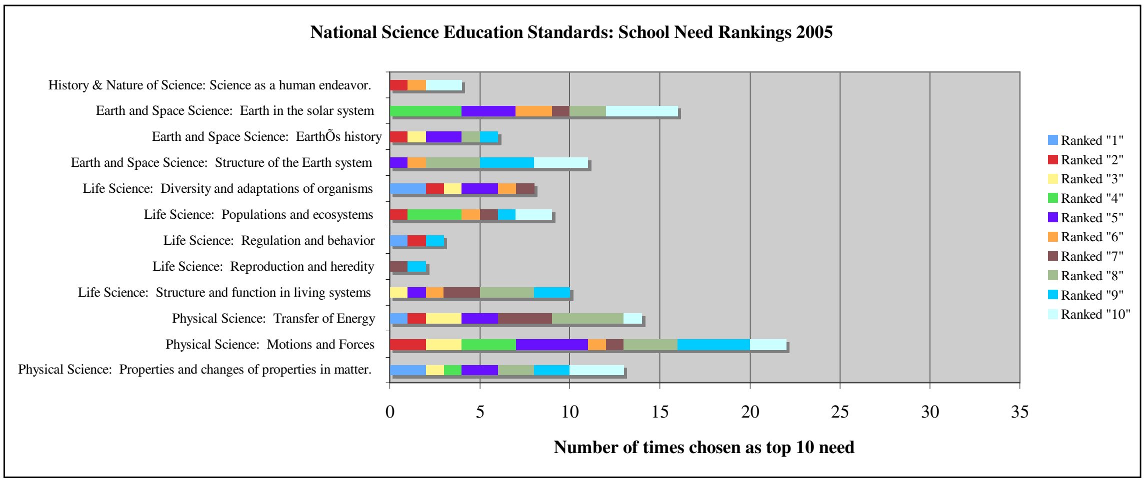
Cohort Year	2003	2004	2005
Physical Science: Properties and changes of properties in matter	24	36	26
Physical Science: Motions and Forces	38	60	44
Physical Science: Transfer of Energy	30	32	28
Life Science: Structure and function in living systems	10	20	20
Life Science: Reproduction and heredity	6	8	4
Life Science: Regulation and behavior	4	6	6
Life Science: Populations and ecosystems	22	14	18
Life Science: Diversity and adaptations of organisms	18	10	16
Earth and Space Science: Structure of the Earth system	28	34	22
Earth and Space Science: Earth's history	12	20	12
Earth and Space Science: Earth in the solar system	44	40	32

The standards most often cited as needs across all three years were:

- Physical Science: Properties and changes of properties in matter; Motion and Forces; Transfer of Energy
- Life Science: Populations and ecosystems; Diversity and adaptations of organisms
- Earth and Space Science: Earth in the solar system




National Science Education Standards: School Need Rankings 2004
Earth and Space Science: Earth in the solar system
Earth and Space Science: EarthÕs history
Earth and Space Science: Structure of the Earth system
Life Science: Diversity and adaptations of organisms
Life Science: Populations and ecosystems
Life Science: Regulation and behavior
Life Science: Reproduction and heredity
Life Science: Structure and function in living systems
Physical Science: Transfer of Energy
Physical Science: Motions and Forces
Physical Science: Properties and changes of properties in matter.
0 5 10 15 20 25 30 35
Number of times chosen as top 10 need
Ranked "1"
Ranked "2"
Ranked "3"
Ranked "4"
Ranked "5"
Ranked "6"
Ranked "7"
Ranked "8"
Ranked "9"
Ranked "10"


National Science Education Standards: School Need Rankings 2005
History & Nature of Science: Science as a human endeavor.
Earth and Space Science: Earth in the solar system
Earth and Space Science: EarthÕs history
Earth and Space Science: Structure of the Earth system
Life Science: Diversity and adaptations of organisms
Life Science: Populations and ecosystems
Life Science: Regulation and behavior
Life Science: Reproduction and heredity
Life Science: Structure and function in living systems
Physical Science: Transfer of Energy
Physical Science: Motions and Forces
Physical Science: Properties and changes of properties in matter.
0 5 10 15 20 25 30 35
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Ranked "4"
Ranked "5"
Ranked "6"
Ranked "7"
Ranked "8"
Ranked "9"
Ranked "10"

Math Standards: Basic operations, measurement, Representation, Communication

Cohort Year	2003	2004	2005
Number and Operations: Understand numbers, ways of representing numbers, relationships among numbers, and number systems	12	16	8
Number and Operations: Understand meaning of operations and how they relate to one another	2	10	12
Number and Operations: Compute fluently and make reasonable estimates	8	16	12
Measurement: Understand measurable attributes of objects and the units, systems, and processes of measurement	18	14	16
Measurement: Apply appropriate techniques, tools, and formulas to determine measurements	20	16	18
Representation: Create and use representations to organize, record, and communicate mathematical ideas	8	8	6
Representation: Select, apply, and translate among mathematical representations to solve problems	10	6	2
Representation: Use representations to model and interpret physical, social, and mathematical phenomena	4	6	4
Communication: Organization and consolidate their mathematical thinking through communication	6	6	2
Communication: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others	14	12	16
Communication: Analyze and evaluate the mathematical thinking and strategies of others	2	2	0
Communication: Use the language of mathematics to express mathematical ideas precisely	6	6	6

The standards most often cited as needs across all three years were:

- Measurement: Understand measurable attributes of objects and the units, systems, and processes of measurement; Apply appropriate techniques, tools, and formulas to determine measurements
- Communication: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others

Math Standards: Algebra, Geometry, Connections

Cohort Year	2003	2004	2005
Algebra: Understand patterns, relations, and functions	10	14	10
Algebra: Represent and analyze mathematical situations and structures using algebraic symbols	6	12	4
Algebra: Use mathematical models to represent and understand quantitative relationships	12	6	6
Algebra: Analyze change in various contexts	4	2	2
Geometry: Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships	2	12	4
Geometry: Specify locations and describe spatial relationships using coordinate geometry and other representational systems	2	10	2
Geometry: Apply transformations and use symmetry to analyze mathematical situations	0	8	0
Geometry: Use visualization, spatial reasoning, and geometric modeling to solve problems	10	14	10
Connections: Recognize and use connections among mathematical ideas	6	8	8
Connections: Understand how mathematical ideas interconnect and build on one another to produce a coherent whole	10	12	16
Connections: Recognize and apply mathematics in contexts outside of mathematics	18	28	6

The standards most often cited as needs across all three years were:

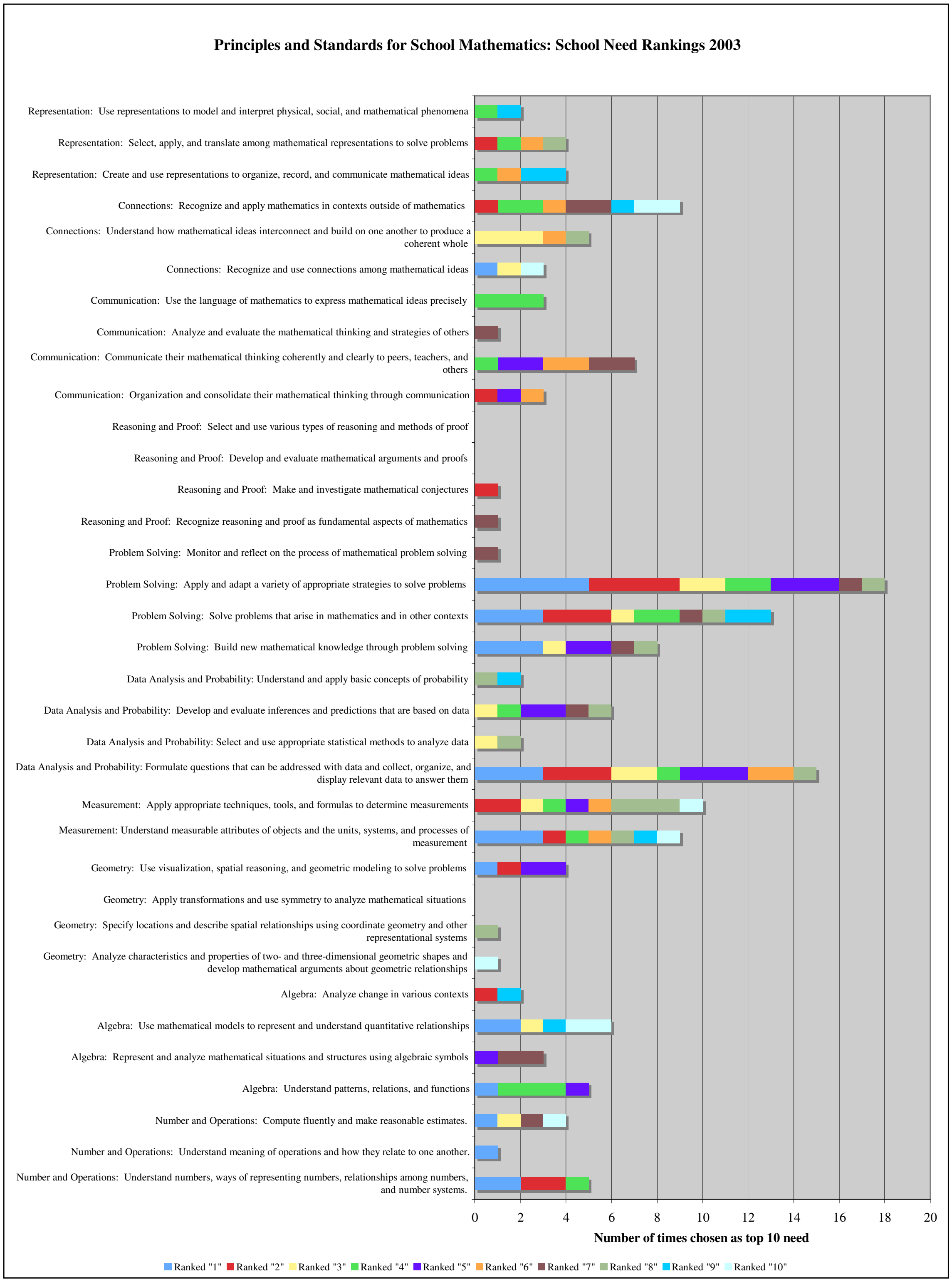
- Geometry: Use visualization, spatial reasoning, and geometric modeling to solve problems
- Connections: Understand how mathematical ideas interconnect and build on one another to produce a coherent whole; Recognize and apply mathematics in contexts outside of mathematics

Math Standards: Data analysis and Probability, Problem Solving, and Reasoning

Cohort Year	2003	2004	2005
Data Analysis and Probability: Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them	32	38	16
Data Analysis and Probability: Select and use appropriate statistical methods to analyze data	4	6	12
Data Analysis and Probability: Develop and evaluate inferences and predictions that are based on data	12	14	12
Data Analysis and Probability: Understand and apply basic concepts of probability	4	8	6
Problem Solving: Build new mathematical knowledge through problem solving	16	20	18
Problem Solving: Solve problems that arise in mathematics and in other contexts	26	24	26
Problem Solving: Apply and adapt a variety of appropriate strategies to solve problems	36	24	36
Problem Solving: Monitor and reflect on the process of mathematical problem solving	4	2	12
Reasoning and Proof: Recognize reasoning and proof as fundamental aspects of mathematics	2	4	6
Reasoning and Proof: Make and investigate mathematical conjectures	2	2	2
Reasoning and Proof: Develop and evaluate mathematical arguments and proofs	0	2	2
Reasoning and Proof: Select and use various types of reasoning and methods of proof	0	4	6

The standards most often cited as needs across all three years were:

- Data Analysis and Probability: Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them; Develop and evaluate inferences and predictions that are based on data
- Problem Solving: Build new mathematical knowledge through problem solving; Solve problems that arise in mathematics and in other contexts; Apply and adapt a variety of appropriate strategies to solve problems


Principles and Standards for School Mathematics: School Need Rankings 2003
Representation: Use representations to model and interpret physical, social, and mathematical phenomena
Representation: Select, apply, and translate among mathematical representations to solve problems
Representation: Create and use representations to organize, record, and communicate mathematical ideas
Connections: Recognize and apply mathematics in contexts outside of mathematics
Connections: Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
Connections: Recognize and use connections among mathematical ideas
Communication: Use the language of mathematics to express mathematical ideas precisely
Communication: Analyze and evaluate the mathematical thinking and strategies of others
Communication: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
Communication: Organization and consolidate their mathematical thinking through communication
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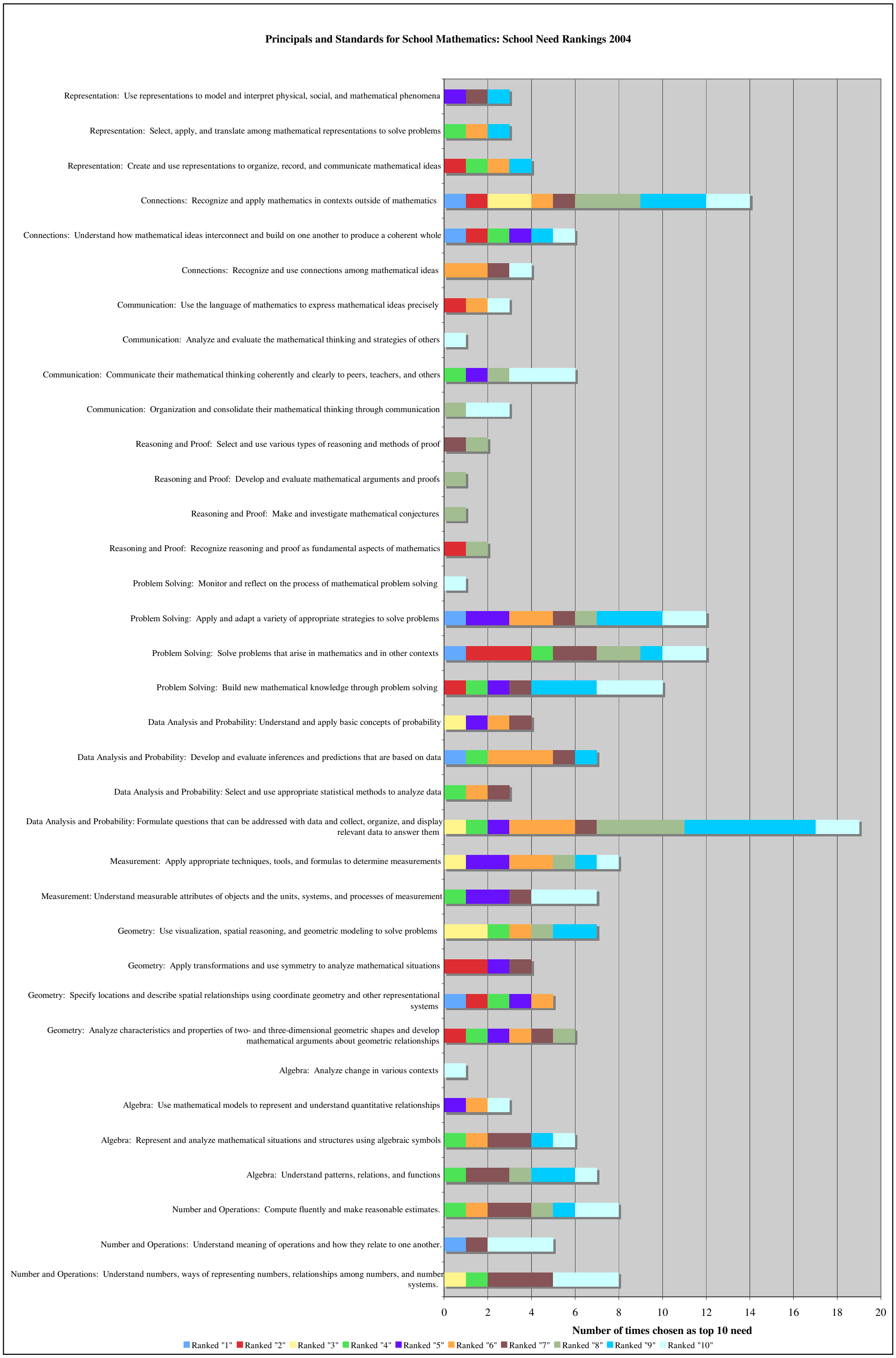
Data Analysis and Probability: Understand and apply basic concepts of probability
Data Analysis and Probability: Develop and evaluate inferences and predictions that are based on data
Data Analysis and Probability: Select and use appropriate statistical methods to analyze data
Data Analysis and Probability: Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
Measurement: Apply appropriate techniques, tools, and formulas to determine measurements
Measurement: Understand measurable attributes of objects and the units, systems, and processes of measurement
Geometry: Use visualization, spatial reasoning, and geometric modeling to solve problems
Geometry: Apply transformations and use symmetry to analyze mathematical situations
Geometry: Specify locations and describe spatial relationships using coordinate geometry and other representational systems
Geometry: Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
Algebra: Analyze change in various contexts
Algebra: Use mathematical models to represent and understand quantitative relationships
Algebra: Represent and analyze mathematical situations and structures using algebraic symbols
Algebra: Understand patterns, relations, and functions
Number and Operations: Compute fluently and make reasonable estimates.
Number and Operations: Understand meaning of operations and how they relate to one another.
Number and Operations: Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
0 2 4 6 8 10 12 14 16 18 20
Number of times chosen as top 10 need
Ranked "1" Ranked "2" Ranked "3" Ranked "4" Ranked "5" Ranked "6" Ranked "7" Ranked "8" Ranked "9" Ranked "10"



Principals and Standards for School Mathematics: School Need Rankings 2004
Representation: Use representations to model and interpret physical, social, and mathematical phenomena
Representation: Select, apply, and translate among mathematical representations to solve problems
Representation: Create and use representations to organize, record, and communicate mathematical ideas
Connections: Recognize and apply mathematics in contexts outside of mathematics
Connections: Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
Connections: Recognize and use connections among mathematical ideas
Communication: Use the language of mathematics to express mathematical ideas precisely
Communication: Analyze and evaluate the mathematical thinking and strategies of others
Communication: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
Communication: Organization and consolidate their mathematical thinking through communication
Reasoning and Proof: Select and use various types of reasoning and methods of proof
Reasoning and Proof: Develop and evaluate mathematical arguments and proofs
Reasoning and Proof: Make and investigate mathematical conjectures
Reasoning and Proof: Recognize reasoning and proof as fundamental aspects of mathematics
Problem Solving: Monitor and reflect on the process of mathematical problem solving
Problem Solving: Apply and adapt a variety of appropriate strategies to solve problems
Problem Solving: Solve problems that arise in mathematics and in other contexts
Problem Solving: Build new mathematical knowledge through problem solving
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Geometry: Apply transformations and use symmetry to analyze mathematical situations
Geometry: Specify locations and describe spatial relationships using coordinate geometry and other representational systems
Geometry: Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
Algebra: Analyze change in various contexts
Algebra: Use mathematical models to represent and understand quantitative relationships
Algebra: Represent and analyze mathematical situations and structures using algebraic symbols
Algebra: Understand patterns, relations, and functions
Number and Operations: Compute fluently and make reasonable estimates.
Number and Operations: Understand meaning of operations and how they relate to one another.
Number and Operations: Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
0
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4
6
8
10
12
14
16
18
20
Number of times chosen as top 10 need
Ranked "1"
Ranked "2"
Ranked "3"
Ranked "4"
Ranked "5"
Ranked "6"
Ranked "7"
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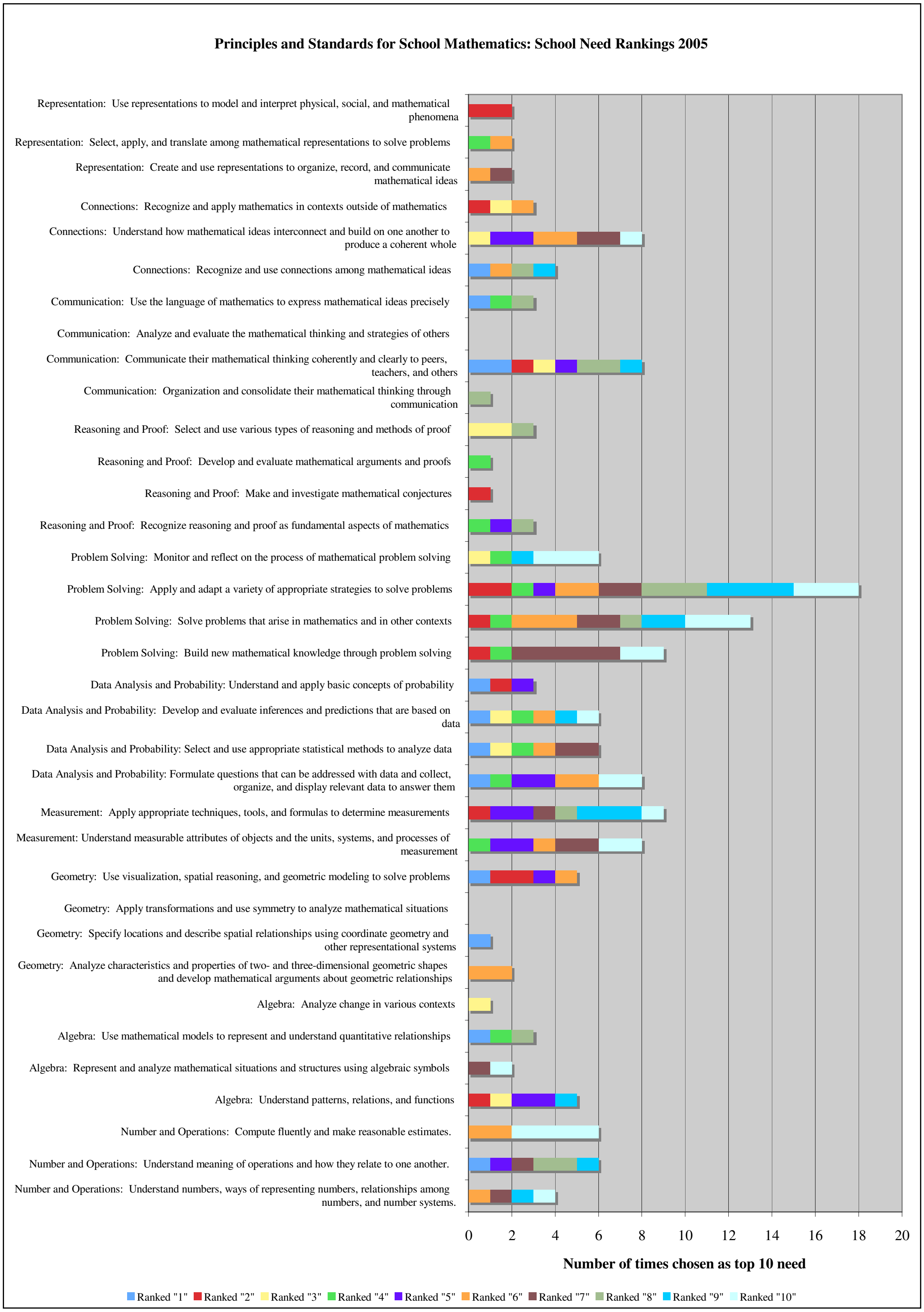
Principles and Standards for School Mathematics: School Need Rankings 2005
Representation: Use representations to model and interpret physical, social, and mathematical phenomena
Representation: Select, apply, and translate among mathematical representations to solve problems
Representation: Create and use representations to organize, record, and communicate mathematical ideas
Connections: Recognize and apply mathematics in contexts outside of mathematics
Connections: Understand how mathematical ideas interconnect and build on one another to produce a coherent whole
Connections: Recognize and use connections among mathematical ideas
Communication: Use the language of mathematics to express mathematical ideas precisely
Communication: Analyze and evaluate the mathematical thinking and strategies of others
Communication: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
Communication: Organization and consolidate their mathematical thinking through communication
Reasoning and Proof: Select and use various types of reasoning and methods of proof
Reasoning and Proof: Develop and evaluate mathematical arguments and proofs
Reasoning and Proof: Make and investigate mathematical conjectures
Reasoning and Proof: Recognize reasoning and proof as fundamental aspects of mathematics
Problem Solving: Monitor and reflect on the process of mathematical problem solving
Problem Solving: Apply and adapt a variety of appropriate strategies to solve problems
Problem Solving: Solve problems that arise in mathematics and in other contexts
Problem Solving: Build new mathematical knowledge through problem solving
Data Analysis and Probability: Understand and apply basic concepts of probability
Data Analysis and Probability: Develop and evaluate inferences and predictions that are based on data
Data Analysis and Probability: Select and use appropriate statistical methods to analyze data
Data Analysis and Probability: Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them
Measurement: Apply appropriate techniques, tools, and formulas to determine measurements
Measurement: Understand measurable attributes of objects and the units, systems, and processes of measurement
Geometry: Use visualization, spatial reasoning, and geometric modeling to solve problems
Geometry: Apply transformations and use symmetry to analyze mathematical situations
Geometry: Specify locations and describe spatial relationships using coordinate geometry and other representational systems
Geometry: Analyze characteristics and properties of two- and three-dimensional geometric shapes and develop mathematical arguments about geometric relationships
Algebra: Analyze change in various contexts
Algebra: Use mathematical models to represent and understand quantitative relationships
Algebra: Represent and analyze mathematical situations and structures using algebraic symbols
Algebra: Understand patterns, relations, and functions
Number and Operations: Compute fluently and make reasonable estimates.
Number and Operations: Understand meaning of operations and how they relate to one another.
Number and Operations: Understand numbers, ways of representing numbers, relationships among numbers, and number systems.
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Number of times chosen as top 10 need
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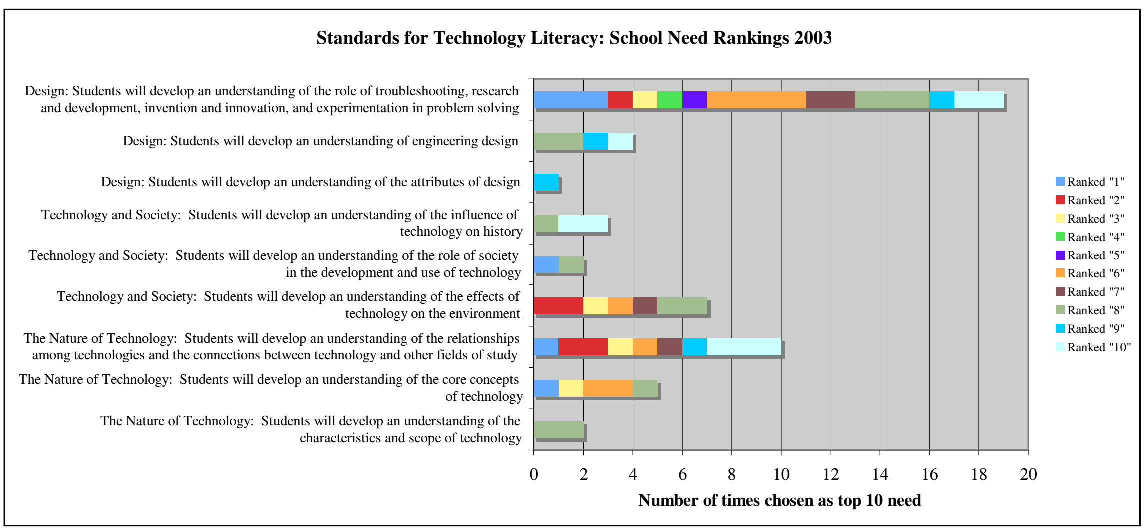
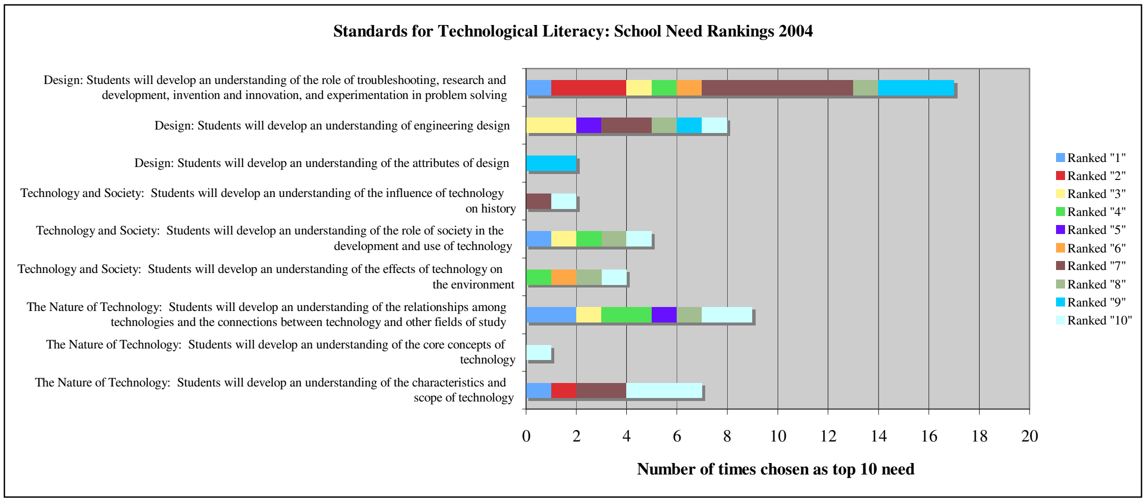
Standards for Technology Literacy

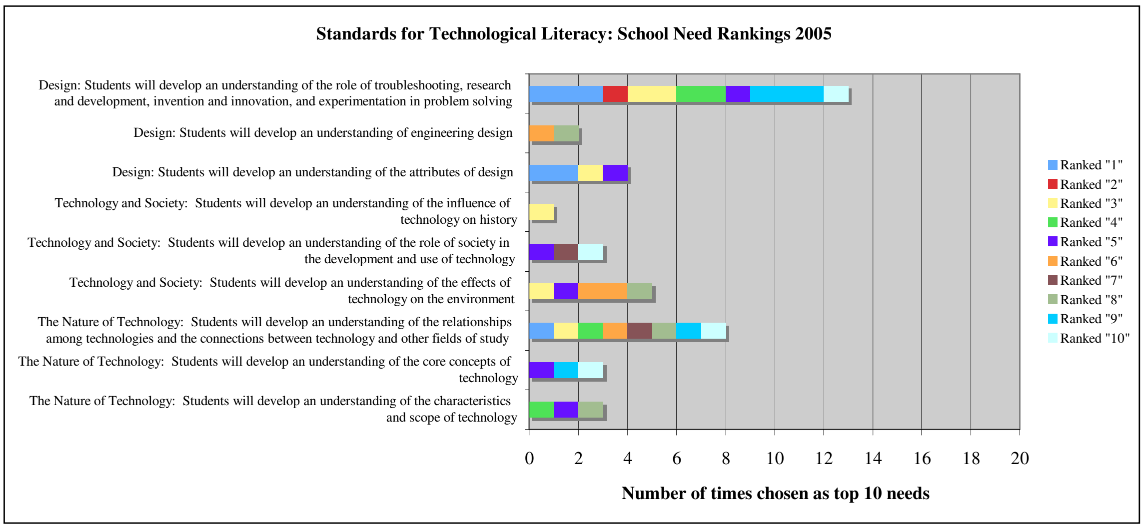
Cohort Year	2003	2004	2005
The Nature of Technology: Students will develop an understanding of the characteristics and scope of technology	4	14	6
The Nature of Technology: Students will develop an understanding of the core concepts of technology	10	2	6
The Nature of Technology: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study	20	18	16
Technology and Society: Students will develop an understanding of the effects of technology on the environment	14	8	10
Technology and Society: Students will develop an understanding of the role of society in the development and use of technology	4	10	6
Technology and Society: Students will develop an understanding of the influence of technology on history	6	4	2
Design: Students will develop an understanding of the attributes of design	2	4	8
Design: Students will develop an understanding of engineering design	8	16	4
Design: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving	38	34	26

The Standards for Technology Literacy most often cited as needs across all three years were:

- The Nature of Technology: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study Technology and Society: Students will develop an understanding of the effects of technology on the environment
- Design: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving







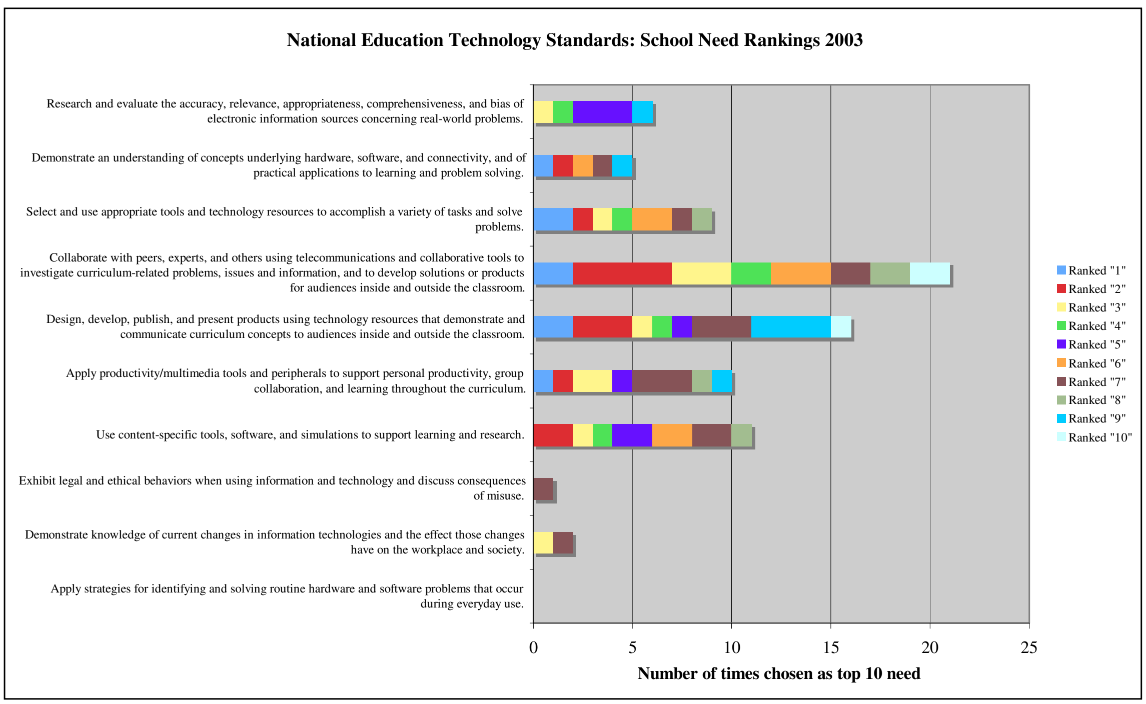
National Educational Technology Standards

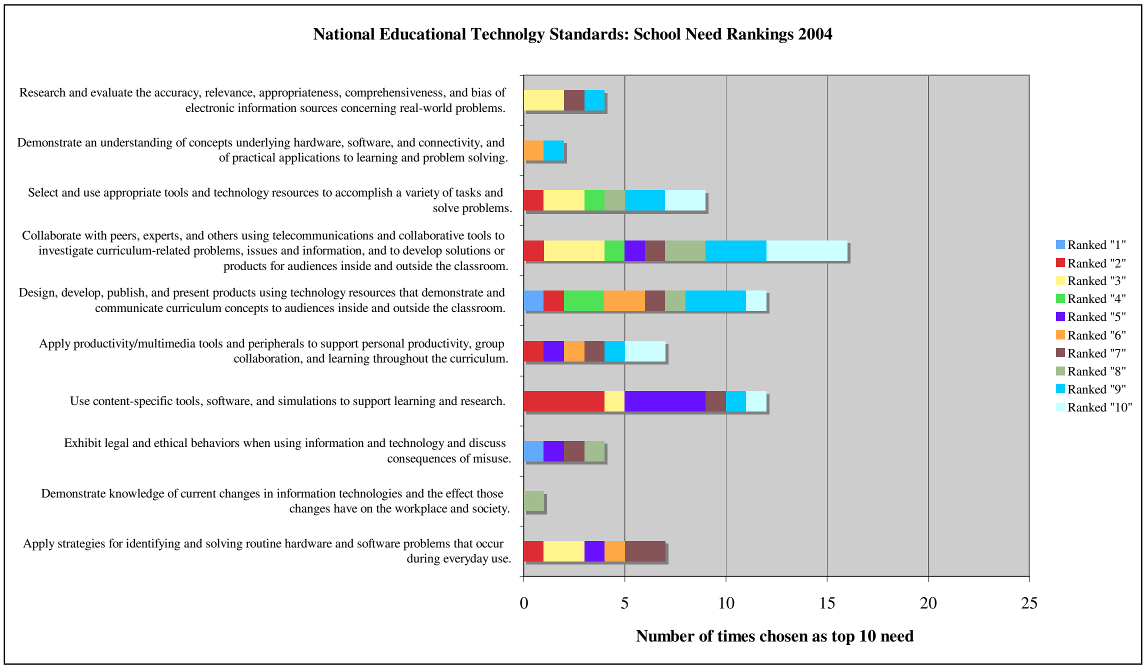
Cohort Year	2003	2004	2005
Apply strategies for identifying and solving routine hardware and software problems that occur during everyday use	0	14	6
Demonstrate knowledge of current changes in information technologies and the effect those changes have on the workplace and society	4	2	0
Exhibit legal and ethical behaviors when using information and technology and discuss consequences of misuse	2	8	0
Use content-specific tools, software, and simulations to support learning and research	22	24	30
Apply productivity/multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum	20	14	18
Design, develop, publish, and present products using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom	32	24	18
Collaborate with peers, experts, and others using	42	32	38

telecommunications and collaborative tools to investigate curriculum-related problems, issues and information, and to develop solutions or products for audiences inside and outside the classroom			
Select and use appropriate tools and technology resources to accomplish a variety of tasks and solve problems	18	18	18
Demonstrate an understanding of concepts underlying hardware, software, and connectivity, and of practical applications to learning and problem solving	10	4	0
Research and evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources concerning real-world problems	12	8	8

The National Educational Technology Standards most often cited as needs across all three years were:

- Use content-specific tools, software, and simulations to support learning and research
- Apply productivity/multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum
- Design, develop, publish, and present products using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom
- Collaborate with peers, experts, and others using telecommunications and collaborative tools to investigate curriculum-related problems, issues and information, and to develop solutions or products for audiences inside and outside the classroom
- Select and use appropriate tools and technology resources to accomplish a variety of tasks and solve problems




National Educational Technolgy Standards: School Need Rankings 2004
Research and evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources concerning real-world problems.
Demonstrate an understanding of concepts underlying hardware, software, and connectivity, and of practical applications to learning and problem solving.
Select and use appropriate tools and technology resources to accomplish a variety of tasks and solve problems.
Collaborate with peers, experts, and others using telecommunications and collaborative tools to investigate curriculum-related problems, issues and information, and to develop solutions or products for audiences inside and outside the classroom.
Design, develop, publish, and present products using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom.
Apply productivity/multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum.
Use content-specific tools, software, and simulations to support learning and research.
Exhibit legal and ethical behaviors when using information and technology and discuss consequences of misuse.
Demonstrate knowledge of current changes in information technologies and the effect those changes have on the workplace and society.
Apply strategies for identifying and solving routine hardware and software problems that occur during everyday use.
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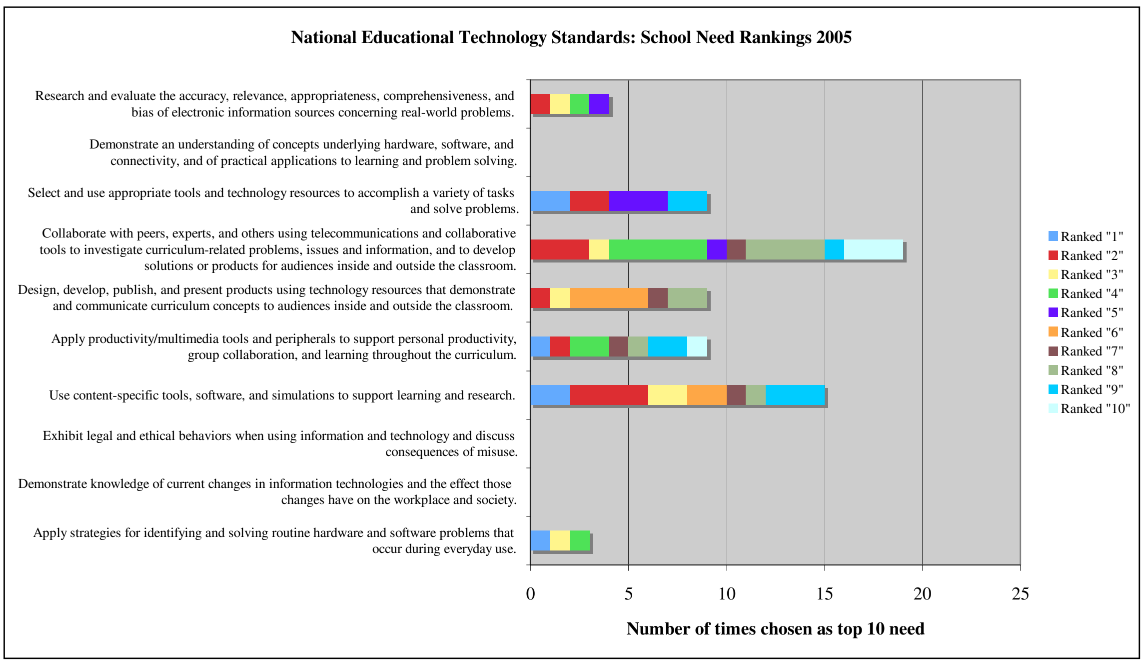
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Demonstrate an understanding of concepts underlying hardware, software, and connectivity, and of practical applications to learning and problem solving.
Select and use appropriate tools and technology resources to accomplish a variety of tasks and solve problems.
Collaborate with peers, experts, and others using telecommunications and collaborative tools to investigate curriculum-related problems, issues and information, and to develop solutions or products for audiences inside and outside the classroom.
Design, develop, publish, and present products using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom.
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Use content-specific tools, software, and simulations to support learning and research.
Exhibit legal and ethical behaviors when using information and technology and discuss consequences of misuse.
Demonstrate knowledge of current changes in information technologies and the effect those changes have on the workplace and society.
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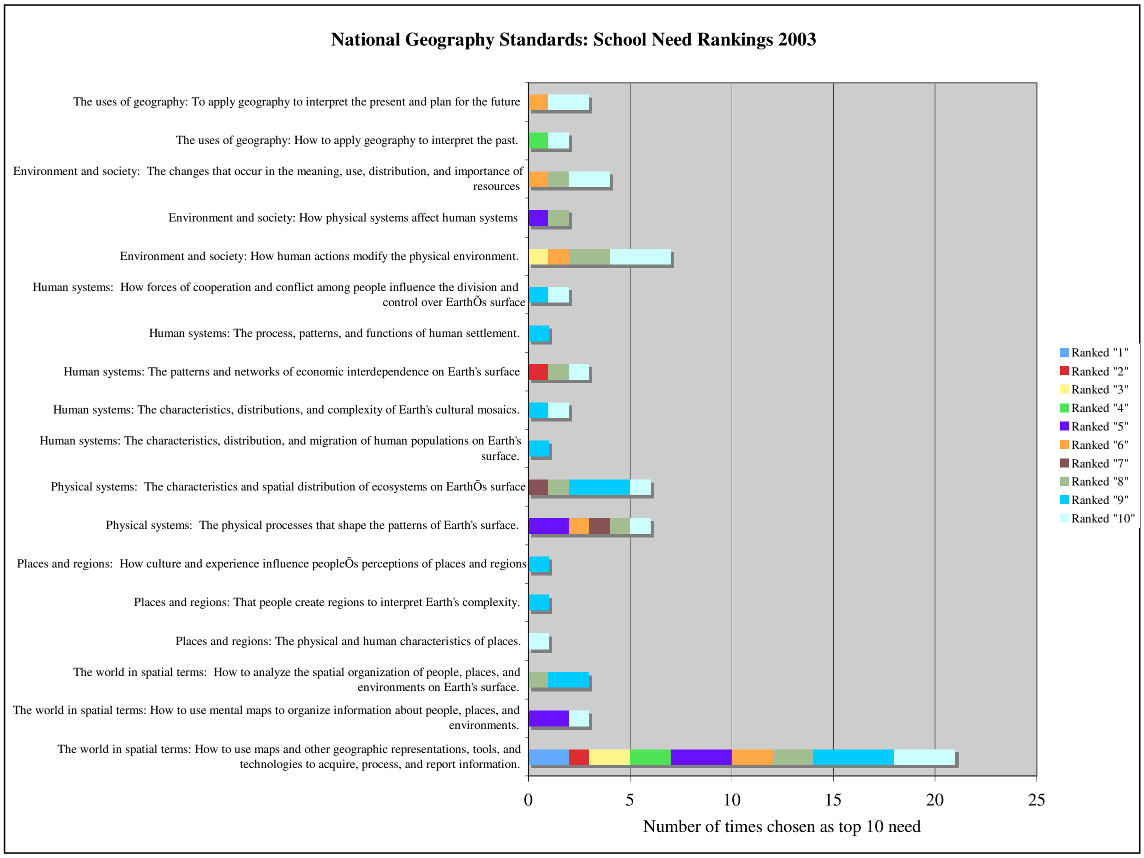
Geography: Human systems, Environment and society, the uses of geography

Cohort Year	2003	2004	2005
The world in spatial terms: How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information	42	48	48
The world in spatial terms: How to use mental maps to organize information about people, places, and environments	6	4	10
The world in spatial terms: How to analyze the spatial organization of people, places, and environments on Earth's surface	6	10	2
Places and regions: The physical and human characteristics of places	2	6	8
Places and regions: That people create regions to interpret Earth's complexity	2	8	4
Places and regions: How culture and experience influence people’s perceptions of places and regions	2	10	8
Physical systems: The physical processes that shape the patterns of Earth's surface	12	12	10
Physical systems: The characteristics and spatial distribution of ecosystems on Earth’s surface	12	10	6
Human systems: The characteristics, distribution, and migration of human populations on Earth's surface	4	2	10
Human systems: The characteristics, distributions, and complexity of Earth's cultural mosaics	4	2	4
Human systems: The patterns and networks of economic interdependence on Earth's surface	6	2	0
Human systems: The process, patterns, and functions of human settlement	2	2	2
Human systems: How forces of cooperation and conflict among people influence the division and control over Earth’s surface	4	2	6
Environment and society: How human actions modify the physical environment	14	12	16
Environment and society: How physical systems affect human systems	4	6	2
Environment and society: The changes that occur in the meaning, use, distribution, and importance of resources	8	2	8
The uses of geography: How to apply geography to interpret the past	4	6	4
The uses of geography: To apply geography to interpret the present and plan for the future	6	14	10

The Geography standards most often cited as needs across all three years were:

- The world in spatial terms: How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information
- Physical systems: The physical processes that shape the patterns of Earth's surface
- Environment and society: How human actions modify the physical environment


National Geography Standards: School Need Rankings 2003
The uses of geography: To apply geography to interpret the present and plan for the future
The uses of geography: How to apply geography to interpret the past.
Environment and society: The changes that occur in the meaning, use, distribution, and importance of resources
Environment and society: How physical systems affect human systems
Environment and society: How human actions modify the physical environment.
Human systems: How forces of cooperation and conflict among people influence the division and control over EarthÕs surface
Human systems: The process, patterns, and functions of human settlement.
Human systems: The patterns and networks of economic interdependence on Earth's surface
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Human systems: The characteristics, distribution, and migration of human populations on Earth's surface.
Physical systems: The characteristics and spatial distribution of ecosystems on EarthÕs surface
Physical systems: The physical processes that shape the patterns of Earth's surface.
Places and regions: How culture and experience influence peopleÕs perceptions of places and regions
Places and regions: That people create regions to interpret Earth's complexity.
Places and regions: The physical and human characteristics of places.
The world in spatial terms: How to analyze the spatial organization of people, places, and environments on Earth's surface.
The world in spatial terms: How to use mental maps to organize information about people, places, and environments.
The world in spatial terms: How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information.
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Number of times chosen as top 10 need
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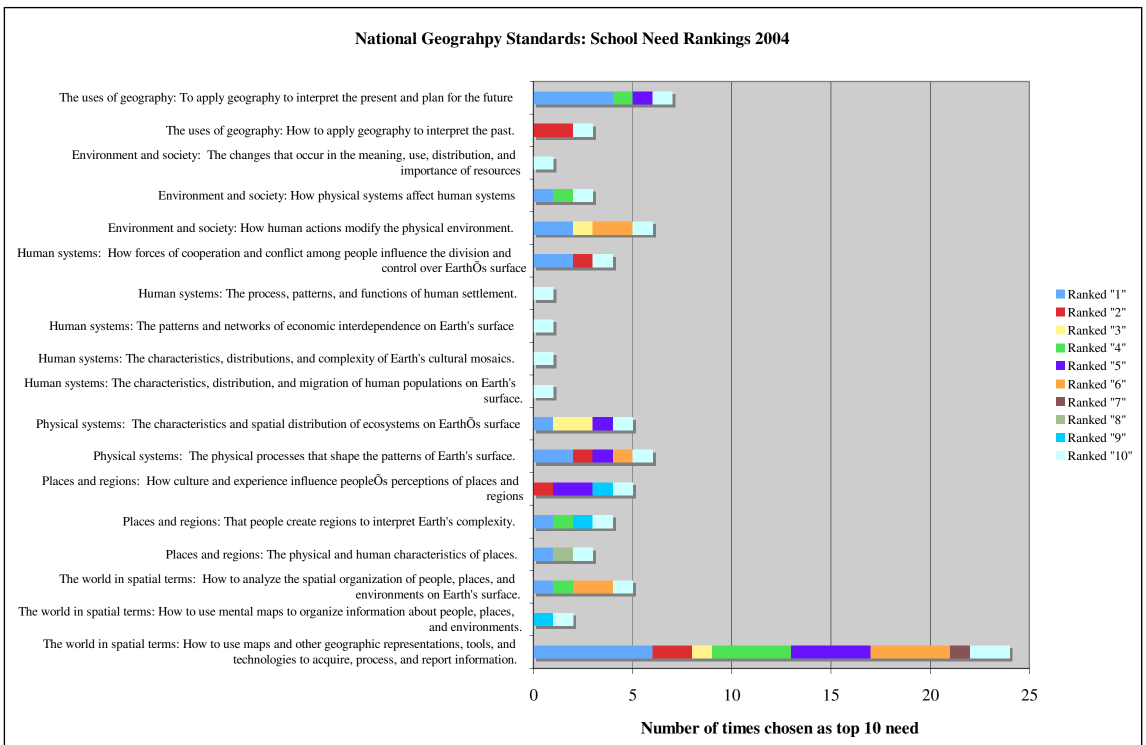
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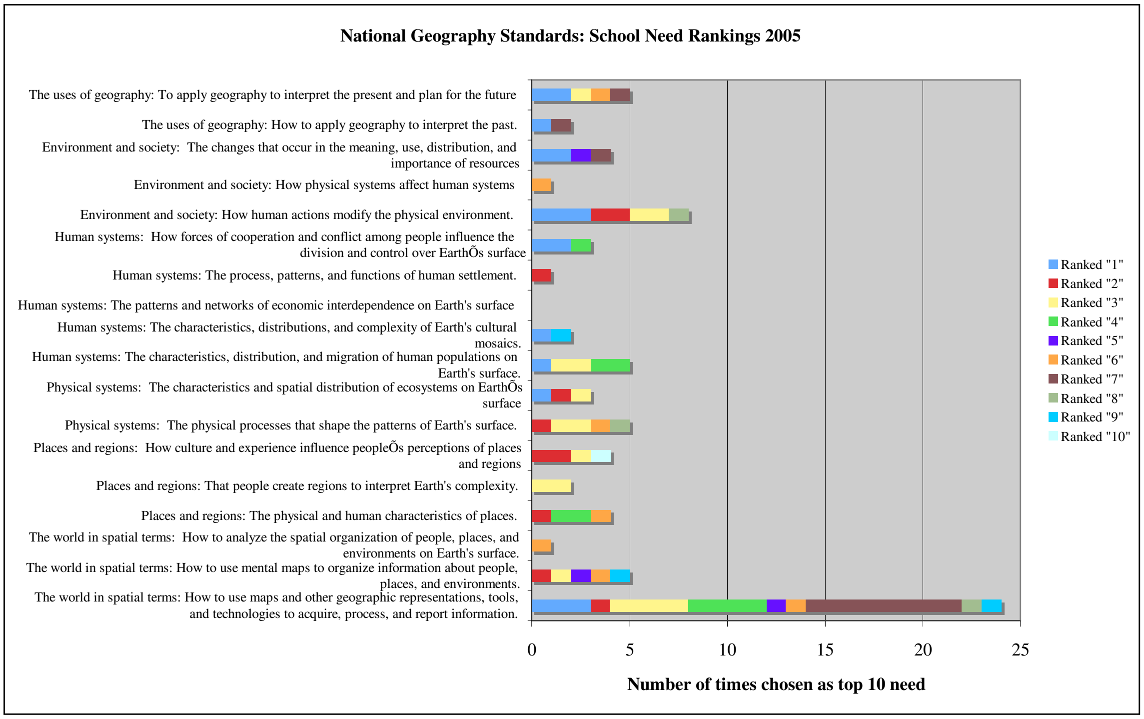
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In summary:
The Science Standards most often cited as needs across all three years were:

- Physical Science: Properties and changes of properties in matter; Motion and Forces; Transfer of Energy
- Life Science: Populations and ecosystems; Diversity and adaptations of organisms
- Earth and Space Science: Earth in the solar system

The Math Standards most often cited as needs across all three years were:

- Measurement: Understand measurable attributes of objects and the units, systems, and processes of measurement; Apply appropriate techniques, tools, and formulas to determine measurements
- Communication: Communicate their mathematical thinking coherently and clearly to peers, teachers, and others
- Geometry: Use visualization, spatial reasoning, and geometric modeling to solve problems
- Connections: Understand how mathematical ideas interconnect and build on one another to produce a coherent whole; Recognize and apply mathematics in contexts outside of mathematics
- Data Analysis and Probability: Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them; Develop and evaluate inferences and predictions that are based on data
- Problem Solving: Build new mathematical knowledge through problem solving; Solve problems that arise in mathematics and in other contexts; Apply and adapt a variety of appropriate strategies to solve problems

The Standards for Technology Literacy most often cited as needs across all three years were:

- The Nature of Technology: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study Technology and Society: Students will develop an understanding of the effects of technology on the environment
- Design: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving

The National Educational Technology Standards most often cited as needs across all three years were:

- Use content-specific tools, software, and simulations to support learning and research
- Apply productivity/multimedia tools and peripherals to support personal productivity, group collaboration, and learning throughout the curriculum
- Design, develop, publish, and present products using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom

- Design, develop, publish, and present products using technology resources that demonstrate and communicate curriculum concepts to audiences inside and outside the classroom
- Collaborate with peers, experts, and others using telecommunications and collaborative tools to investigate curriculum-related problems, issues and information, and to develop solutions or products for audiences inside and outside the classroom
- Select and use appropriate tools and technology resources to accomplish a variety of tasks and solve problems

Geography

The standards most often cited as needs across all three years were:

- The world in spatial terms: How to use maps and other geographic representations, tools, and technologies to acquire, process, and report information
- Physical systems: The physical processes that shape the patterns of Earth's surface
- Environment and society: How human actions modify the physical environment

NASA Explorer Schools Coordinators Interview Protocol

Background

NES Coordinators were interviewed in May and June, 2005 about their role, the program and its outcomes. Interviews were conducted in person or via telephone. Interviewers were trained in the following protocol.

Interviewer Guidelines

Key Idea: How is this center implementing the Explorer Schools Model? How do they make it work for them? Key questions to be answered in the case studies and overview are: What is happening? What works (types of programs, approaches, communication, support)? How do we know?

Products: Center case studies; Overview of the model as it was intended (from Peg and Leah) with the range and variation of the center's implementation.

1. **This is a semi-structured interview – the intent is more important than the specific words in each question. Your job is to understand how each center is implementing the Explorer Schools Model and be able to tell that story in a case study, so be the thinking person that you are and ask what you need to ask to figure it out. This is one source of data, but a <u>very</u> important ongoing one. I am suggesting that we plan to talk to these people once a month and keep a log of the conversations so we can do a good job on the case study over time – it will evolve as they do. We will do the first draft after the interviews and center staff surveys, then update it next spring (at least, maybe once in between).**
2. **You will schedule your own interviews. Call and introduce yourself if you have not met him or her already. Let the person know to allow 60-90 minutes, in one or two time periods. It didn't take us that long, but you are also getting to know them so it is better not to rush. Schedule a second interview if they run out of time (leave yourself 2.5 hours to review your notes and edit them after the interview).**
3. **<u>After</u> you make the appt, send them the questions (the version with no prompts). Call the day before to be sure they got the questions and to confirm the appointment. Just leave a message if the person doesn't answer, something like, "Hi, it's Hilarie, just checking that we are still on for … (11 am tomorrow)…Call me if you need to reschedule. Otherwise, I will talk to you tomorrow.**
4. **Read their survey responses ahead of time. Read about their center on the website if you don't know them, and have a list of their schools and team leaders in front of you. Jenn has the agendas from last summer's workshops so you can review them and ask more specific questions when you get to that part.**
5. **Say the question number, and use segues like, "Now, I'm going to move on to question 4… it is a little bit different…" Use the person's name in a natural way and be positive and curious. Be a great interested listener – the antithesis of those telemarketers who just seem to want to get on to the next question.**
6. **After the interview, send them a thank you. Edit your notes so they are sensible, check the taped transcript if you need to, and send them the record of their answers to the questions with a note asking something like, "Just finished writing up our interview. Please take a minute to read it over for accuracy. Does it represent your best thoughts at this time? Just edit it directly with Tools, Track changes. Thanks again for your time."**

Protocol

We need your help to learn more about the NASA Explorer Schools Program. The information you provide will be used to improve the program and deepen our understanding of how the program operates – the Explorer Schools **<u>model</u>** and its **<u>impact</u>** on teachers, students and families. This information will be part of a report prepared for NASA headquarters officials. Your responses will be combined with the responses of other individuals in ways that make it impossible to determine which individual provided the information. Your name will never appear in any report. There are no right or wrong answers to our questions and we appreciate your candid responses. To better recall this interview, we are taping it. The content of this tape will be erased after it is studied. You will receive a copy of the summary of your interview for you to verify its accurateness as well as the report. *Do you have any questions about how the data will be used?*

Design-Based Research – The Explorer Schools Model

1. We know that you are the field center coordinator at _________. In your own words, how would you describe your role in the EXPLORER SCHOOLS program? Do you have any other responsibilities? If so, what are they? *If something pulled you off, for how long? And how often does this happen.*

2. Are other center staff involved in any way with Explorer schools program?

Prompts: How many? Who are they? What are their responsibilities? What did they do in the explorer schools? *Do they have any other responsibilities? If so, what are they?* Trainers only?

3. How are NASA AESP specialists involved with Explorer schools?
   Prompts: Are you involved in their scheduling? Would you like to be more involved? How are the evaluations of their visits used? By you? By others? (e.g. or planning, for follow-up with schools). Would you be interested in using it? If you don't see them, how do you know what happened?

4. How does the center design and deliver the summer workshops? INTRO for the year 1 teams
   Prompts:
   What are the concepts? How does it use inquiry? How does it support family involvement? How do you evaluate it?
   How far in advance does planning begin?
   What are the some difficulties in planning the workshop?
   Are you using the pre-visit notebook? Do you plan to use the one that the team developed?
   Have you made any changes in the design and delivery of the summer workshop between the 1st and 2nd year?
   What about between the 2nd and this 3rd final year?

   What are these changes? What are these changes based on?(feedback from the HQ, external evaluators, or your own observations/methods of evaluations)

5. How does the center design and deliver the summer workshops? CONTENT- 2nd year teams.
   Prompts:
   What are the concepts? How does it use inquiry? How does it support family involvement? How do you evaluate it?
   How far in advance does planning begin?
   What are the some difficulties in planning the workshop?
   Have you made any changes in the design and delivery of the summer workshop from last year to this year?
   What about between the 2nd and this 3rd final year?

What are these changes?
What are these changes based on?(feedback from the HQ, external evaluators, or your own observations/methods of evaluations)

6. How does your center provide services to its Explorer schools?
   Prompts: In your online survey you indicated _________. Can you say more? (See support section - why that way? How does it work? Go through each one getting more infor… for example, what kind of support do you provide via email?
   Types of interactions (by email, phone, in person?)
   Frequency of these interactions? How do you log it? Would you consider sending them notes on a regular basis to let them know you are there?
   Purposes of interactions (e.g. provide feedback to plans, integration of NASA materials, technical assistance, instructional assistance…)

7. In your online survey you indicated your satisfaction with your center as ------, can you tell me more about your reasons please?
   Prompts:
   Since this is a reform effort, rather than the standard education outreach, how do you think the center has adjusted to working with the schools?
   What is different about how you work with EXPLORER SCHOOLS schools versus other schools in your region?

8. In your online survey you indicated your satisfaction with how the schools are implementing the EXPLORER SCHOOLS program objectives as ------, can you tell me more about your reasons please? See OVERALL PROGRAM SECTION
   Prompts:
   Give me an example of one you are very satisfied with, and one with which you are dissatisfied.
   Look at a list of schools – ask about the Explorer Schools they don't say anything about…

9. In terms of how the schools are implementing the Explorer Schools model, what are some things you have have seen work really well – that you would consider exemplary? What are some particularly problematic issues that have come up in the schools' implementation of the model?
   Prompts: What are you using as using as indicators (frequency of contact, how much they have done, how well they work together, how many students are involved)
   Have you saved any documentation, video, instruments, correspondence you have had with these schools? We may want to include some of that in that case studies?

10. So in summary, what are the major challenges and breakthroughs in implementing the EXPLORER SCHOOLS model whose focus is on reform with underserved populations of teachers and students?

Prompts: What are the major challenges in carrying out the EXPLORER SCHOOLS program activities? How does the center address these challenges or problems
If needed - In your online survey you indicated _(from page 1)__, Can you say more?
What has been most rewarding about working with the schools? So far, have you seen any major positive effect of the EXPLORER SCHOOLS program in any specific schools you serve?
What evidence could you point to? In other words, how could we document the implementation of the EXPLORER SCHOOLS model to date and how could we measure this in the future?

Scientifically-Based Quantitative & Qualitative Research: Impact on Teacher and Students

11. What do you see as the effects on teachers of the EXPLORER SCHOOLS program?
Prompts:
What are you doing, that "only NASA can?"
What are you doing that supports "reform?"

Have you or how could we measure these impacts?
Prompts: (go through each one they gave in #11; like, How can you measure changes in teachers' inquiry? For example. ask what they don't know and want to know about (pre/post)? What do you want to do in your life (pre/post)?

12. What do you see as the effects on students of the EXPLORER SCHOOLS program?
Prompt: In STEM? (go through each one if they don't mention them)

Have you or how could we measure these impacts?
Prompt: (go through each one they gave in #11)

13. Is there anything I didn't ask that you would like to share? Or that you think we need to
know? For example what are some unique elements, some powerful things that have happened.

Field Center Survey Report
Fall 2005

Background
The field center survey was designed by the Center for Educational Technologies® evaluation team in spring 2005. The survey was taken by 40 center staff, including NES coordinators, aerospace education specialists, and education program managers at the 10 field centers. The survey was administered online in May 2005.

Composed of 19 sections and more than 100 open- and close-ended items, the survey was designed to collect information from the field center staff about their perceptions of the NASA Explorer Schools program implementation. More specifically, the survey used open-ended questions to investigate field center staff involvement in the following program goals and objectives:

(1) Critical factors in implementing the program
(2) Major challenges in carrying out these critical factors
(3) Major contribution of the center to the implementation of the program
(4) School needs in accomplishing the program objectives
(5) Evidence that center staff might have collected in the following fields:
  (a) Teacher STEM content knowledge
  (b) Teachers' use of inquiry
  (c) Teachers' knowledge of careers
  (d) Teachers' knowledge and use of NASA resources, people, programs, and facilities
  (e) Family involvement in STEM
  (f) STEM content knowledge of students
  (g) Students' use of inquiry as a learning strategy
  (h) Students' knowledge of and interest in STEM careers
  (i) Students' knowledge of NASA resources, people, program, and facilities

Using a Likert scale, the field center survey was designed to collect answers to the following items with close-ended questions:

(6) Overall program support
(7) Program activities, value, and support
(8) Impact of the explorer schools program on teachers

Analysis

Following the retrieval of data collected via Perception (the online database), two separate analyses were conducted. First, qualitative data analysis was conducted on the first four open-ended questions listed above using qualitative data analysis software, NVivo. Second, a frequency analysis was conducted on the close-ended responses using SPSS quantitative data analysis software. Since most fields regarding collecting evidence from school teams (see #5 above) were left blank, this report does not include the analysis of these items listed on question 5. This report presents data from questions 1-4 and 6-8.

Critical Factors

Four major themes emerged from anhe analysis of the question on "critical factors in implementing the Explorer Schools program successfully" : (1) critical factors related to field centers, (2) critical factors related to NASA headquarters, (3) critical factors related to schools, and (4) communication as an umbrella theme that encompassed the first three factors.

Critical Factors Related to Field Centers

Center staff indicated that *services* provided by the center staff together (AES, coordinator, program manager) are critical factors for the successful implementation of the program. In general, center staff, reported they were able to handle the concerns of school teams; provide services to teachers, students, and schools; and provide and identify appropriate STEM educational resources, NASA products, and special opportunities.

Five center staff from different centers expressed the need to provide *customized support* to the school teams. They indicated that "understanding the unique environment, challenges, and goals of the school community," "meeting the needs of the school and the school's improvement plan for success for the students," "making sure that our services tie back to each school's strategic plan," "a well-defined action plan for addressing needs of schools," and "adaptability and flexibility" are ways to ensure the program is implemented successfully.

Two center staff from different centers stated the importance of *sharing a common vision* and expectations for the success of the program. One person indicated that "understanding NASA educational resources, implementation of NASA educational resources, understanding of clerical/political requirements required by NASA" contribute to the program's success. Another center staff said the use of *center resources* (engineers and facilities) was a critical factor for the program success.

Center staff also said that services they provide to schools are constrained by time and money. Their services were constrained by finding *time* to plan and obtain materials, communicate with NASA staff, such as engineers, and teachers, prepare programs, and visit schools. Center staff reported they needed *more money* to fund extra personnel and ongoing frequent travel to schools.

Center staff indicated that Aerospace Education Specialists are the gatekeepers of the program. Their school visits, services to teachers/students/families, and reporting back to the center staff as to what is happening at schools are crucial for implementing the program. One person indicated that the specialists are pulled to support other educational programs. As a result, in some centers, their time is divided between the NASA Explorer Schools program and their other responsibilities. Another center staff member suggested having one specialist per state to provide better services. One center staff member recommended shifting reliance of the Explorer Schools for support from only the specialists to other resources.

Critical Factors Related to Headquarters

The following themes were coded as critical factors related to headquarters since these themes represented headquarters' decision-making authority. First, as expressed by five center staff, *timeliness* appears to be the major factor in implementing the NASA Explorer Schools program successfully. Center staff expressed school teams' concerns on late receipt of grant money, NES opportunity announcements, paperwork, support, and communication in a timely manner.

One center staff member recommended *implementing the program incrementally* over the three years, building from one year to the next. Another center staff recommended that "*choosing the right schools*" was the major factor. Schools should be selected not based on the perceived need but "on whether NASA could provide success" to prospective schools.

Another center staff member suggested *explicit consequences* for those school teams who are not able to "maintain a productive team and participation in the NES program." Given an unsuccessful situation, it was recommended that resources should be directed to another school that would be able to benefit their schools.

One center staff member referred to the ever *increasing requirements from HQs* as making the program difficult to manage. It was recommended that "the program get grounded before taking on new ideas. It (the program) seems to be moving too fast. Enough time needs to be devoted to lessons learned to make the program a great success."

One center staff member recommended the "need to develop uniform nationwide forms for reporting work completed, work in progress, and future plans. NEEIS is a very clumsy tool, like using an adjustable spanner for recording actual NES interactions."

Critical Factors Related to Schools
The following themes were coded as critical factors related to schools since these themes represented center staff's perception of how schools were implementing the program. Four center staff members expressed the importance of *school teams* as contributing to the success of the program. They indicated school teams who are successful in implementation: (a) have the desire to work as a team to improve curriculum in their schools, (b) share a common vision for the success of the program, (c) "seek other opportunities to meet school goals including partnership, funding, project-based learning, community outreach, family involvement," and (d) "communicate well and want professional development improve their knowledge to make them better teachers for their students."

Second, the center staff pointed to the importance of school teams' *enlisting non-NES teachers* to the program. Six center staff members made this point by stating the following: school "team members need to be able let go of their exclusiveness within NES and invite additional members to their staff to have a sense of belonging," "engaging not only NES team members, but also the entire faculty, students, and family members in the NES program design, implementation, and evaluation process," "empowering the staff beyond the designated team," "extending the benefits to the entire school staff," and "getting the school and community buy-in."

Third, center staff expressed the importance of *school administration and district support* as a critical factor to contribute to the success of the program. They indicated the following: "administrator must be a visionary leader, capable of sharing this vision with his/her staff and lead them down the path that will provide for success," "school building administrator and district level administrative support for the NES program is essential in creating an environment which will allow for and foster improved student interest and achievement in STEM," "a dedication by the administrative staff to provide support to individual team," and "a principal or vice principal must be part of the team. From the outset, the stated purpose should be to enhance the school through team interaction, not for specialists to be substitute teachers."

Fourth, two center staff members expressed the importance of *enlisting other non-NES schools* as a critical factor to contribute to the success of the program. One center staff member stated "working with feeder schools as well as schools where students will attend after leaving the NES" is a critical to the success of the program.

Fifth, two center staff members expressed the importance of *technology and technical support* as factors bringing success to the program. Indicating that many of the NASA opportunities are provided via Internet one individual expressed the following: "the schools or districts that do not support and maintain these connections only serve to reduce the effectiveness of their staff and the NASA professionals working with them." One center staff member indicated technology's role in maintaining a physical (or virtual, via videoconference) presence of NASA education while another one pointed to increasing distance learning opportunities that are becoming available to schools.

Sixth, two center staff members expressed the importance *of team lead's role* in bringing success to the program. "Honor that the team lead is a fulltime teachers… it creates too much burden on the team lead when there are short deadlines." "A strong team lead that has administrative skills and has a good working relationship with her team" is critical to the program success.

Communication
Poor communication, lack of communication or miscommunication between center and schools, between HQs and center, and between the center personnel and coordinators were cited by 20 different individuals as being a critical factor. The following are the quotes that denote this critical factor:

"Communication between the school teams and NASA and communication between the field center coordinators and program personnel at the national level. At times the messages are mixed, or are come out after the information was needed."
"Open communication with the schools in an efficient manner that provides plenty of lead time for opportunities and completion of any requirements for the NES program."
"Effective two-way communication between NES personnel and the NASA Explorer Schools"
"Single source of communication with the NES: rather than getting information from NSTA, center coordinator, center AESP, etc."
"I believe that communication is essential to the Explorer School program running successfully. This communication should occur between Headquarters and the NASA Center as well as between the NASA Center and the school. It is imperative that the communication occurs in a timely fashion flowing from Headquarters to the coordinators and the coordinators will then disseminate to all stakeholders."
"Clear, timely, and accurate communication between the schools and NASA."

“Ensuring that everyone is on the same page and clearly communicating expectations to the NES Teams.”
“Communication between NES Team teachers and AESP specialists/NES Coordinator.”
“Communications between HQ and field centers” “Active communication among all parties”
“Good initial contacts with the Explorer Schools teams, continuing contacts, with the teams, the general school faculty”
“Having and communicating a clear vision of what NES should be doing and it's program objectives”
“Communication among the many players is a challenge.”

Major Challenges

Major challenges related to Schools and Field Centers
One field center coordinator expressed that schools from the first year utilize the AESPs as their *primary point of contact*. Since “each specialist had a slightly different take on things, different schools sometimes heard different things” and therefore received inconsistent messages. “While there has been dramatic improvement with the advent of the coordinator position, many of the original schools still utilize the specialist as their primary point of contact.

Eight field center staff expressed that *time* was a major challenge. From the perspective of center staff, two center staff expressed that given the number of schools, distances, and days at schools they need to cover, time is a major challenge. From the school teams' perspective, center staff expressed the following” “team leads are full-time teachers,” “time for the schools to meet NES expectations along with the other expectations in each school,” “NES is only one of many programs and expectations in a school,” “an underestimation of time required to implement the strategic plan as it relates to the school,” “time, time, time teachers are under greater challenges to find time in their schedules than ever before with the new requirements for meeting standards, and testing…” were given as examples to point to this challenge from the perspective of teachers.

The issue of AESs *covering both NES and non-NES schools* emerged as a major challenge in one center. It appeared that the AESP, center coordinator, and education program manager of this center are all juggling to keep the balance between serving NES schools and other schools in the region.

Two center staff members from different centers pointed to the challenges in *teacher training*. They expressed the difficulty in training teachers “how to use the NASA products with their entire staff” and “how to think beyond their own classroom by asking and using resources that might be in their community that might be used to improve their program.”

One center staff member pointed the program *sustainability* as being a major challenge: “Learning requires a full richness to be substantial and lasting. Sustainability in both the sense of continued funding for ever-changing technology and the professional motivations we have ignited in the teachers and staff. Without some NASA influence and opportunities, how long will the fires burn when left to the fuels of their local communities?

In parallel to *teacher/admin turnover*, one center staff expressed that there is center staff turnover with the following statement. Staff turnover is a major problem. "Many [of the] staff is not familiar on what NASA can offer to teach others how to integrate materials."

Five center staff expressed the *challenges related to schools*. Although all five issues were school related issues, each respondent had a different take on the issue. One cited school environments as not being conducive to the program by stating the following: "the school environment, No Child Left Behind, testing, money for substitutes for teachers to attend professional development or just finding substitutes." Two other center staff members complained that either schools don't know what they need or they are poor at communicating their goals: "If schools don't know what they need, they don't know what to ask for services. The balance between providing support and directing the program in the schools is hard when you know the school needs help but the school staff is not aware of their need. The critical factor to me is the school. How much are they willing to work with NASA/AESP to get the most out of the partnership?" Another person said it this was: "Schools are poor at communication and planning within their own buildings which carries over into scheduling errors for visits to schools by NASA personnel.

One field center staff expressed concern that NASA approved products list is not helping support inquiry-based activities. This list is "more of an anchor than a sail."

Major Challenges Related to HQs
Tardiness and *inconsistencies* pointed as being major challenges of the program. Several center staff expressed concern that information or opportunities released by HQs are inconsistent and late. The center staff reiterated that concern, "items coming from NSTA or HQs are not timely," "rules are being changed without adequate notification of time," "required items (from HQs) being sent in conflicting dates for turn in," "money is not released in a timely fashion," "information is not coming to the coordinators in a timely manner," "not enough notification time," "thinking ahead, deliberate planning with fewer last minute demands," and "schools don't know all their opportunities because they get notice of them too late." One center staff member described this problem as: "Lack of forethought and planning at the national level is a major challenge and stumbling block for everyone. There has been no consistent vision for this program and expectations sometimes change more than once a day. Critical program information comes to the centers late and gets to the schools even later. This program tends to be reactive rather than proactive, and, consequently, is not as effective as it should be."

Related to issues involveing HQs, two center staff members brought up the issue of changes in *funding*. Pointing to the decrease in staff and the initiation of full cost accounting, one person recommended that "ensure enough personnel are available at the center to properly assist the schools in implementing the Explorer Schools program."

Major Contributions

This question was concerned with the major contributions of a center to the implementation of the Explorer Schools program. Center staff answered this question by highlighting the major contributions they provide to schools through the overall center services, AESPs, ERC, and HQs.

Almost unanimously, center staff highlighted the services they provide to schools as major contributions to the program success. Following is a list of center services that the center staff stated contributing to the success of the program: "providing NASA resources and personnel at the request of the schools," "delivering summer workshops and school site visits," "proving assistance and guidance to the team in order for them to design, implement, and evaluate the NES program which meets their unique needs at their schools," "providing on-site educational opportunities for teachers and students including job shadowing and e-missions," "offering customized professional development, family nights assistance, assisting schools," assisting schools in developing strategic and implementation plans," "helping the schools organize events for the students and community that will enable them to execute their implementation plan," providing information, resources, teacher professional development, student workshops, student programs, consultation, and communication opportunities. In sum, as it was put by one person, the major contributions included "everything" that they did with schools for the schools to help them implement the program.

Related to the center services, DLN, AESPs, and ERC were identified as other major contributing factors to the success of the program. Eight center staff talked about the use of DLN as illustrated in the following quotes: "if there is no money to travel, AESPs will do DLN to the schools that have it," "the DLN team has worked extensively to develop and provide specialized STEM content videoconferences, which will meet the individual needs of NES." In addition, six center staff members identified the ERC as a major contributing factor to the program success: "ERC staff has been quite helpful in filling in the gaps." Eleven center staff referred that AESPs were the major contributing factor to the program success. Finally, two center staff members acknowledged that HQs support was a major contributing factor.

School Needs

Five center staff stated that schools need *clear, concise information and timely release of funding* as well as opportunities. "Schools need the bureaucracy to move faster to disburse the grant money after a successful completion of the strategic planning process," "the schools should receive their funding earlier in the school year. Expectations should be clear and concise. The schools also need consistency from the program." "Clarification of expectations and roles for NES schools in a timely manner." "We have to provide the grant money when we say we will, information about workshops when we say we will, information about travel when we say we will. We tend to expect that schools will comply with deadlines, but rarely meet the deadlines that are established at the national level." "We need to provide more organized paperwork. Special opportunities sometimes have very short timelines for proposal submission. Teachers have asked more lead time."

Five center staff members thought that schools need to *expand their partnership with NASA and others* in order to keep the program to sustain. "continuing partnership and support with NASA and beyond the 3 years," "an extended length of time to partner with NASA," "continuing partnership and support with NAS beyond 3 years, working with the feeder schools, families, community, assisting NES local partnership and resources, expanding the base of the team," "the schools need more motivation to apply for other grants and bring other opportunities into the school. This includes working with industry."

Four center staff members thought that schools need to *understand NASA resources better than they do*. "Schools need to understand to take their existing plans for improvement and weave their NES strategic plans into that plan." "Schools need a better understanding of the program and the expectations and desired outcomes." "It takes lots of energy and excitement as well as patience in understanding NASA."

Four center staff members emphasized the *importance of administrators* in the building and at the district level. "Support and training for administrators at the building and district level," "outstanding commitment from the administration" "Commitment from their school board and people in decision-making positions, the districts must make NES a priority and not just provide lip service to its importance," "we don't have enough administrator buy-in to affect change because we have not made the strategic plan a useful document."

Four center staff members stated that schools need more *family involvement*. "more family involvement training, ideas for family involvement, and resources that teams can use for the objective," "more direction especially with certain components of the Explorer Schools program to include the family component," "family component help," "we need a more organized family component section with ideas for involving families." Three center staff members pointed to the need for schools to have *a stronger team*. "The schools need good teams. I have noted that some of our teams are not as productive or work together as well as other. I guess this is inevitable, but the strength of the school team can't be stressed enough. They also need to work really hard to bring the whole school and faculty in." "The schools need some of their internal issues cleared before any explorer goals can be achieved. Curricular change does not occur when departments and administrators don't talk to each other."

Three center staff members felt that schools need *customized support*. "Each school is unique. Some need help from the basics, such as developing curriculum before you can integrate NASA resources into their curriculum," "people need to understand the different conditions in each schools and rules have to be bend," "more specific plans and instructions/requirements detailing NASA's (specialist's) interaction and activities at the school. Making clear individual objectives and describing the means to accomplish them."

Three center staff members pointed to need for *technical equipment and support*. "Schools in my region need to have more help getting their video conference equipment working so that they can access the digital resources that we, and the other centers, have to offer," "I believe as soon as the DLN is running we will be able to make solid inroads to bring about systematic change in education. Unfortunately, the first year working with the teleconferencing equipment we had to overcome technical issues such as lack of Center support, IT support on local level, and infrastructure in place for next year." "Technology training is needed for many of the teachers at the school to best utilize the technology offered as part of the NES program."

Two center staff members expressed that schools need more visits, "continue with the so-called center director visits at the beginning of the three year partnership. These visits, along with the presence of an astronaut and pre/post event education activities served to energize the schools and communities. The ability to have visits to schools by NASA personal other than AESP specialists, not just digitally but physically, during subsequent years would be a great positive." "I do not believe that NASA going out to the schools 2-3 times a year is enough for them to execute their implementation plans."

One center staff member expressed schools need "a policy and procedure kind of manual developed by NES/AESP interaction." Another one stated that schools need "more training on developing strategic/implementation plans." And finally, one center staff expressed that schools need "more money for the schools in the ways of additional grants …. We also should allow the NES grant money to be spent on subs, so that they can attend professional development opportunities."

Overall Program

	Poor	Average	Good	Excell ent	Not Applicable
What is your overall opinion of the summer 2003 introductory workshop?	5%	15%	23%	18%	67%
What is your overall opinion of the summer 2004 introductory workshop?	3%	5%	40%	28%	33%
What is your overall opinion of the summer 2004 content workshop?	3%	15%	30%	33%	25%
How would rate your overall satisfaction working with the Explorer Schools program?	5%	10%	38%	45%	3%
How would you rate overall teachers' engagement to the program activities?	3%	30%	53%	10%	5%
How effective is your center in carrying out the Explorer Schools program activities?	3%	10%	45%	40%	3%
How effective are the schools in carrying out the Explorer Schools program activities?	3%	30%	53%	10%	5%
How prepared are you to help the schools sustain this program?	3%	23%	33%	38%	5%

Program Activities and Value

	None	A little	Somewhat	A great deal
How prepared are you for the delivery of the 2005 summer workshop?	3%	0%	35%	63%
How different is the 2005 workshop program from the workshops in the earlier years?	3%	3%	55%	39%
How much did the center staff work with teachers in the development of their plans during the workshop?	0%	21%	39%	39%
How frequently have the school teams asked you for support since the summer workshop?	0%	14%	38%	49%
How satisfied are you with school team's participation in the Explorer Schools program activities?	0%	15%	49%	36%
How much of the NASA curriculum, activities, and products have been used by schools so far?	0%	10%	50%	40%
How much has the Explorer Schools program impacted family involvement?	3%	32%	39%	26%

Support

	Never	One time	2-3 times	4-5 times	6-7 times	8+ times
Since the last summer workshop, how often have you delivered support by email?	5%	0%	10%	5%	3%	77%
Since the last summer workshop, how often have you delivered support by phone?	5%	3%	10%	13%	10%	59%
Since the last summer workshop, how often have you delivered support by school visits?	8%	5%	8%	8%	26%	46%
Since the last summer workshop, how often have you delivered support by written correspondence (mailings)?	21%	3%	23%	28%	8%	18%

Impact of the EXPLORER SCHOOLS Program on Teachers

	None	A little	Somewhat	A great deal
How much effect do you think the Explorer Schools program has had on the STEM content knowledge of teachers?	3%	8%	51%	38%
How much effect do you think the Explorer Schools program has had on teachers' use of inquiry as a teaching strategy?	5%	26%	46%	23%
How much effect do you think the Explorer Schools program has had on teachers' knowledge of STEM careers?	3%	13%	49%	36%
How much effect do you think the Explorer Schools program has had on teachers' knowledge, and use of NASA resources – people, programs and facilities?	3%	0%	21%	77%
How much effect do you think the Explorer Schools program has had on family involvement in STEM?	8%	33%	41%	18%

2003 and 2004 Cohort Team Lead Survey Report

Background

The *Team Lead survey* was developed in December 2004 by the CET evaluation team. The survey was administered to the entire population of team leads (n = 99) from the 2003 and 2004 cohorts. Composed of 20 open-ended and 27 close-ended questions, data were collected via an online tool (Perception) between January and February 2005. Collected data were aggregated as 2003 and 2004 cohort. Open-ended qualitative responses were analyzed using NVivo, qualitative data analysis software. A frequency analysis was conducted to analyze team leads' responses to the close-ended survey items.

Below the report is organized in two major sections: qualitative data analysis on the open-ended questions and quantitative data analysis on the close-ended questions. For each type of analysis, the report is presented to summarize the results from the team leads of 2003 and 2004 cohort.

Qualitative Data Analysis on the Open-Ended Questions

The Team Lead survey had 20 fields of open-ended questions that were designed to invite the team leads to expand on the answers to the close-ended questions. To analyze the team lead open-ended responses, data were aggregated by field center and cohort year and then loaded to NVivo, qualitative data analysis software. The analysis was conducted to answer the following questions for each cohort:

1. How effective or ineffective was the NASA summer workshop in preparing the teams to implement the program?
2. How satisfied were the team members about being in the Explorer Schools program?
3. What benefits did school teams experience as a result of their participation in the Explorer Schools program?
4. How dissatisfied were the team members about being in the Explorer Schools program? What problems did they experience?
5. How did the teams develop the plans?
6. What kind of problems did the school teams encounter when writing and implementing the plans?
7. How important is the plan in achieving school and staff improvement goals in STEM?
8. What kind of field center assistance was provided to school teams?
9. How satisfied or dissatisfied the school teams were with the overall support received from the field center staff?
10. What types of NASA curriculum materials did the school teams use since they became part of the Explorer Schools Program?
11. What are the other critical factors to the implementation of the plan?
12. What are the lessons learned?
13. What is missing from the program?

2003 Cohort Team Lead Survey
Qualitative Data Results

1. ***How effective or ineffective was the NASA summer workshop in preparing the teams to implement the program?***

Among those who said the summer workshops were effective made their comments around the following cluster of themes: summer workshops were effective because they (1) increased teachers' excitement and involvement, (2) built the Explorer schools team, (3) increased teachers science and NASA curriculum content knowledge, and (4) set out expectations of the Explorer schools program.

Those who said the summer workshops were effective because they increased *teacher excitement and involvement with the program* expressed themselves with using words such as excitement, inspiration, and wonderful. Here are some of the quotes expressing how the workshops exhilarated teacher motivation and content knowledge:

"The team came back very excited and loaded with resources. They also brought back a vision of expanding the program to our entire school." The workshop brought "enthusiasm and inspiration. It was wonderful." "We got so much information. We left with a lot of materials and ideas. We were excited." "The NASA connection makes the teachers and students feel special. The workshop really inspired the team."

Those who expressed that the workshops were successful because they *built the NASA Explorer School team spirit* made the following comments: "The summer workshop brought our team together and placed a focus on objectives." ""We did various team building and planning activities during the week of our training." "I think the primary motivation for our continuing our change effort is the summer workshop program. Our time spent at the training sites not only provided information and materials, but also provided the inspiration for our team to implement fully the NASA Explorer Schools objectives."

Teachers also commented that the summer workshops were very effective because the workshops *increased teachers' content knowledge on science and NASA curriculum content*. "The summer workshop gave us information about NASA resources that we could use for our NASA Explorer School program." "We were worked very hard and learned a lot about different aspects of NASA and how to use available resources in our teaching." "Our summer session was a good balance of exposure to the vast resources of NASA and practical planning time." "It provided materials and resources for our science and math curriculum." "We were exposed to NASA's wide variety of resources, programs, and materials. The curriculum development aspect was very important." "The NASA summer workshop was very effective because we received training and materials on a variety of NASA related programs and activities to enhance our science, mathematics and technology instruction." "Workshop experiences helped our teachers with inquiry using NASA materials."

Most teachers commented that the summer workshops were effective because *workshops set out expectations of the NASA Explorer Schools program*. They said the summer workshops set the scene and expectations, gave them the background NASA information, allowed them make NASA contacts, and provided them with better understanding of what the program was about. Below are selected quotes:

“It presented the realm of NASA to all of us.” “The summer workshop was extremely effective. It allowed us to understand the mission of NASA and the program overall objective.” “It provided us with a solid background on the workings of NASA and the science behind the work we will be taking on. We were able to make face-to-face contact with some of the key people that will provide support for us in the coming year.” “We were given a comprehensive and thorough overview of the program. The amenities (speakers, special activities like the telescope experience and facility tours) were outstanding.” “We gained an insight into the work that NASA is doing.” “This workshop provided the foundation for a very successful program.” “Making contacts and receiving information, materials and resources helped our staff and students to "see learning in a whole new light.” ““The workshops provided a better understanding of what we were getting into. They allowed our teachers to bring back concrete ideas for implementation into our school. We learned to understand our responsibilities as an Explorer School and how to enhance lesson delivery to our students.” “The team also recognized what it takes to ensure the program is operated according to the set standards.”

A few teachers expressed that the summer workshops were effective yet “as this was the first time for the training, bugs were still being worked out.” *Straightforward paperwork and devoting more time in plan writing* were consistently some of the things teachers wished to see improvement. “More time was needed to review programs and plan implementation while on site. Also, there was a great deal of confusion about paperwork forms and expectations - mixed messages.” “The information received was valuable, however, the time spent on developing plans were not applicable to our school setting.” “The hands-on activities were great for the classroom, but we probably needed more time to work on an action plan.” “The workshop gave us some ideas of what we could do as far as curriculum, and activities, but as far as what they expected form us in regards to the "plan" was not clear. Items were missing from documents they had us fill in so we added in our own to try to make the document make sense.” “More time was needed to review programs and plan implementation while on site. Also, there was a great deal of confusion about paperwork forms and expectations - mixed messages.

2. ***How satisfied were the team members about being in the Explorer Schools program?***

Of the 44 who expressed their satisfaction with the program stated that his program increased *professional development opportunities* that were made available to them. The increasing professional development opportunities, in turn, contributed to increasing their professional growth and excitement about teaching and learning.
Regarding teachers’ overall *excitement and satisfaction with the opportunities* and materials they receive, team leads made the following comments: Overall, “the NASA

Explorer Schools project has provided a much needed boost in morale, energy, and excitement in our classes." "I know that each person on our team has felt very grateful for all of the opportunities that we have had. It has made each of us excited about teaching and given each of us that push that we needed to get our students excited about learning. We have also had the chance to get together with teachers from other areas to share our information." "The materials we receive, the opportunities we get and information are great." "It is helping them excite and teach." "My team is very enthusiastic about what we are doing and members work conscientiously to provide quality programs. They are excited about what we are doing." "We are thrilled with the curriculum and integration of math, science and technology. Increased student exposure to math, science and technology is excellent. We love the training and conferences provided by NASA.

"The opportunities for our staff and students have been wonderful. The staff has attended professional development while our students have benefited in the classroom. We have had NASA guest speakers....the list goes on...." "We have all enjoyed the amazing experiences that we have been able to include our students in. We have also all benefited greatly from the professional development opportunities we have had through NES." "This program has given our teachers and students materials that we can use in the classroom to motivate and excite our students about learning. We felt this was very important because we never really understood what was really out there for us to use and gain access to. We have been given experiences that have made us excited about teaching." "It is helping them excite and teach. The teachers see an improvement in their students."

Team leads expressed satisfaction with the program because the program improved *students' STEM interest and knowledge*. "The Explorer Schools Program has allowed them to integrate more science, math and technology programs into our school curriculum" and increased students' interest and attitudes toward STEM. "They can see a difference in the students' attitudes. More kids are interested in science. They follow it in the news and on the Internet." "Being a NASA Explorer School has allowed us to offer opportunities to students that we could not have done without the program." We continue to observe content comprehension demonstrated by our students, on a regular basis, as a result of this infusion of support." "Student interest has improved in the way of science, careers, technology and still working on the math."

"We are pleased at the way that our students have responded to the program. Our school is not famous for interested students or parents but our Science Night was wonderful. Everyone who attended (over 500 this year) gave us a positive reaction. When students learn that they are doing NASA activities or using NASA provided equipment it makes them feel important. They really need that attitude."

Embedded in their comments about *improving student interest and knowledge in STEM*, team leads made several references to *increasing students' and teachers' use of technology* that made available through NES grant money.

"We have been able to implement new technology and see our students increase interest in learning. There has been a major impact on our students, faculty, staff, and community. We have opportunities now that we would never have gotten before because we have taken the lead in technology in our district." "We have gotten more technology into our school. The students have used that technology."

Finally, team leads refer to *improved family and community involvement* when expressing their satisfaction with the program. "Community and family ties have improved. We have successful family science and math nights, the community has reached out more to us in becoming active partners in education." "Community and family ties have improved. We have successful family science and math nights, the community has reached out more to us in becoming active partners in education." "We had recognition and prestige from the community." "Parent activities - parents can see new futures for their children and they have a more positive view about what their children can accomplish and the contributions their children can make."

3. ***What benefits did school teams experience as a result of their participation in the Explorer Schools program?***

Team leads expressed satisfaction with the program since the program *benefited the entire school community* by bringing "recognition" and creating "a whole new feeling about the school" in the community resulting from the prestige of NASA. As a result of NASA presence, schools were able to improve their image and receive recognition from the community. Also, some schools now offer additional science programs, have a career and inquiry focus curriculum. Finally, team leads also acknowledge the money, resources, and technology connections the program has brought to the school.

Some team leads expressed that the entire school community benefited from the Explorer Schools program as they were able to create new courses, add new programs, and clubs. "We have established an in school component which allows us to offer an additional science program per week to KNESA cadets. We have also developed 3 after school programs which we offer to students. Because we have established a local steering committee we have made a connection with a local community college which allows us to offer a career connection to students. "We've added more science clubs, and much, much more." "We added a two-year NASA Aerospace Studies course."

Several schools proudly stated how their schools gained publicity and recognition from the community. The community recognition helped the school teams involve families with the Explorer School activities. As a result of this community recognition, school teams expressed that they improved their image in the community and they were able to recruit more families to involve in school activities and seek and receive additional grant money.

"We are proud to be part of the NASA family. "There is a whole new feeling about the school in our local community resulting from the prestige of NASA. "You're a classy outfit!" Parent can see new futures for their children and they have a more positive view about what their children can accomplish and the contributions their children can make. "The publicity that our school has received just by being a NASA Explorer School has helped our image in the community. More community members are willing to help." "Parents are more involved. They see that the kids are really developing a love for science, math and technology. The community outside the school supports us because they know we are an Explorer School. They see the coverage in the newspaper of the different activities we do." "We have gotten some very positive publicity locally that has helped our school's image in the community."

It seemed teachers appreciated summer workshops, other professional development opportunities, professional development support, funding, curriculum help, and material support. As expressed with one of the teachers below, perhaps teachers most appreciated the excitement and enthusiasm came as a result of having the NASA partnership. "The primary benefit has been the summer workshop experiences that gave out teachers the enthusiasm to use NASA materials to teach a big part of our state core content curriculum and program of studies. Another benefit that came as a by-product of our staff's enthusiasm was the excitement of our students and parents about the NASA program materials**.** We also appreciate the support being given us this year by the NASA education support people from our center." The increasing enthusiasm among teachers, excitement among students, and increasing number of families involved in the school activities have been repeatedly cited.

4. ***How dissatisfied were the team members about being in the Explorer Schools program? What problems did they experience?***

"So much to do in so little time. It is difficult to keep up with the constant influx of information and activities from NASA and focus on our state standards." As concisely expressed in the above quote by one of teachers, nineteen team leads stated that they were challenged to find enough *time* to meet their day-to-day responsibilities in addition to implementing and taking advantage of the Explorer Schools program. In their own words "there is never enough time to meet and implement the plan" or "not enough time on our (my) part to take full advantage of the resources available."

Sometimes within the lines they expressed their dissatisfaction with not having enough time, team leads expressed that there were *too much to do*, *too many opportunities* to attend, and *too much paperwork* to complete. "Sometimes it gets overwhelming because there are sooo many opportunities or paper work to do besides our own school or state initiatives." "We love the travel and NASA materials. Sometimes the team feels as if there is too much paperwork or obstacles, especially time. There is a lot that the team has to do on their own, on top of all that they have to do for the school anyhow." "There is so much work because of the team members who left. It was just heaped on the shoulders of those remaining."

Team leads expressed dissatisfaction with receiving information, paperwork, opportunities, and grant money late. They expressed their frustrations with last minute notices. "My team and I have been frustrated by the ongoing issue with program reports

and last-minute deadlines." "One of the never ending frustrations that we have dealt with is the tendency for every request to be dropped on us at the last minute. On numerous occasions, we have received frantic, last minute calls expecting our school and district to provide news coverage and school time for events with little advance notice."
"The materials we receive, the opportunities we get and information are great. But sometimes things come too late, last minute or not enough time to do them."

In regards to receiving the grant money late, team leads made the following comments: "Not getting the grant money on a timely basis is a big problem especially since we right into out implementation plans how we will use the items we buy in our curriculum. When we don't get the $, we can't do all the things we plan because we didn't get to get our materials or resources." "The receipt of the grant money does not come in a timely fashion to allow us to purchase equipment that we are counting on for program implementation."

Several team leads expressed that communication at times is dissatisfying. They stated that directions and paperwork sometimes are not clear and they were not cure about expectations. Though some team leads expressed improvement in communication from the first year to the second year, they said it could always be better. "I guess communication might be the biggest one, in regards to: Directions sometimes is not clear on what they expect from us, and feedback is not always there to tell us if we are on the right track." "Communication was almost non existent last year, but 100 times better this year. Thanks." "We didn't have very good communication with our NASA mentors the first year. However, this year we have new personnel and they are fabulous! Very responsive and available, unlike the first year."

Sixteen team leads expressed dissatisfaction with the *school and district administrators*. They explained that these administrators delayed technology purchasing requests. "The district that has caused our problems (purchase order issues such as not being able to buy what was listed in our grant because it wasn't from a certain dealer or is a different model than the district's bid list." In other cases, the district was "reluctant to allow us access to transmission lines."

Some school administrators were simply not interested in the program and consequently they did not want to spend money or time on the Explorer School activities. "Our principal who is one of the members does not have very much time to devote to this initiative." "My principal is least interested. Did not spend any money and controls everything." "My principal does not want to spend money for classroom technology nor for students. It is very frustrating to get any money from him."

Finally, frequent changes in leadership were another school and district administrator related problems team leads experienced. "The administrative end of the program seems to change a lot." "Our school has had a change in district leadership so they are trying to figure out direction. It has been difficult to educate the district about the NES grant."

As expressed by twelve team leads, there is also certain degree of dissatisfaction with the *involvement of other staff* in the program. Team leads explained that their satisfaction was either due to the fact that there were too many changes in the original team or certain team members were not interested in getting more involved in the program.

For those who said there was too many staff changes expressed their following with the following quotes: “There is so much work because of the team members who left. It was just heaped on the shoulders of those remaining.” “Our only problem is the change in team membership. Nothing can overcome that.” “Staff is being changed and teaching schedules being changed.”

“Not all staff is on board with the program.” “Not all team members have met the new ideas with open arms. They strongly agreed to fully participate in the beginning, but "No Child Left Behind" has strongly impacted instruction delivery to become more "Old School" “The staff. People did not want more work nor did they want change.”

Ten team lead members stated problems related to technology. Technology related problems were due to access to technology, technical help, and purchasing restrictions. Those team leads who expressed technology problems to due to access said: “our inability to access technology events as a result of firewall and local wiring issues.”

In other cases, their dissatisfaction was related to lack of technical support: “I have also been disappointed that out technology people have not hooked up our videoconferencing equipment. We have had it for quite a while and I have provided the Explorer program and our Tech. dept. with each other's contact information, but to no avail.” “We continue to have problems with our video-conferencing goals. It is a problem with our technology division, not NASA.” “Failure to install and maintain given video-conferencing and technology equipment at the local level.”

In other cases, technology problems were related to “purchasing restrictions”: “We have some trouble ordering computer related things, since our tech department does not order from certain companies. We have had to change our vendors to satisfy them and cannot get what we originally wanted to order. We still don't have the laptop we wanted. The prices they got were more expensive than we had quoted. We don't know what to do about that.” “The limits we have encountered have been from our school system, mostly on the purchasing end of things.”

5. ***How did the teams develop the plans and what problems they encountered when writing the plans?***

In the open-ended responses, it appeared that the 2003 team completed their plan after the summer workshops during the school year. Several stated that they spent many nights during and after the summer workshops writing and making the requested changes. “Several of the team on a number of nights worked on drafting and redrafting the requested corrections.” “Many nights they stayed up to midnight during the summer training.” “Our team met extensively during the summer once we returned from the 2003 summer workshop. We met this summer to revise our plan for the 04/05 school year." "We were already in session when we first came to our workshop session. We were in 2003, so for the revision of our plans some was done at the end of last school year, the summer and then tweaked once school started this school year 2004."

6. ***What kind of problems did the school teams encounter when writing the plans?***

Of those who stated to have encountered problems while writing the plan expressed several reasons. Some referred back to the changes in administration and staff, lack of clear directions, and lack of time to write and research equipment and technology. Some had difficulty in narrowing down their ideas and agreeing as a group what the plan needed to include.

7. ***How important is the plan in achieving school and staff improvement goals in STEM?***

As stated by an overwhelming majority (41) team leads, responses to open-ended questions indicated that team leads acknowledged the importance of the plans in achieving their overall goals. They expressed that the plan gave them a direction, focus, guideline, a roadmap to follow and reflect upon their implementation. Some stated that they refer back to the plan and use it as a framework to focus on their specified goals and objectives.

"This is the whole point. We are a math, science, technology magnet middle school. This plan helps us to achieve our overall program goals." "The plan will support our curriculum and enhance the students' learning." "This plan gave us a focus that integrated all of our other benchmarks and goals. With the monetary help that gave us equipment we implemented our plan easily." "We refer back to the implementation plan when we feel we are getting off track. "Our plan gave us a focus for our school. We used the strategies in our plans throughout our School Improvement Plan that was submitted for the state." "The plan provides a uniformed framework from which we all can work." "Stated goals are important. Even if you have to change plans once you start working, the goal that you set out is always there in sight. We knew what we wanted to achieve. If we have to change the way we get there that is ok."

Several mentioned that they were able to incorporate the plan into their school improvement plans. "We incorporated our plan into our yearly school improvement plan as part of the science component." "We have incorporated several of our main school system goals into our strategic plan. So our NES schools are leading the way for our middle schools as far as curriculum development goals." "The plan was built to meet the District Strategic Plan. They even had a copy of the District Strategic Plan that they brought to the workshop to make sure it would fit. We all have to FOCUS to see where what we are doing fits into the larger plan." "The plans assist in our school-wide plan, schedules and calendar for the school year." "The plan, to some degree, fits in with our Comprehensive School Improvement Plan" "We developed our NES Plan to go along with our Title I Plan for School Improvement. By doing this, we made our NES plan an integral part of school improvement in every area including parental involvement." "The plan keeps us on track to meet the goals that we have established for our school. We chose the goals based on our school's needs and the plan acts as a blueprint to achieve those goals."

Some team leads pointed that they were able to involve the entire faculty body to help them with their school improvement objectives. "The only way to achieve the goal of the Explorer School is to incorporate the entire staff of a NES school. We have teachers that have no tech experience and are trying, with help, to use it in their class." "When we started everything centered on the team. Since then we have strived to get the rest of the faculty involved, it is just starting to really spread to the rest of the school. The more it spreads the bigger our involvement will be." "Our faculty & staff have become interested and involved in our program. They have found ways to incorporate our program into their content areas. They help with enthusiasm when we ask. Our students have responded with enthusiasm and their scores are improving."
Those team leads who stated that they encountered problems when writing the plans expressed themselves with using words such as "confusion" and "frustration." It appeared that the 2003 team had very little help with the writing process during the summer workshops. Team leads said because they were the first cohort in the program, there lack of clarity and personnel to help them with the writing process.

"We discussed a little, but really not much at all during the workshops because in 2003, we still didn't really know what they wanted form us. In 2004 we all went to different workshops and nobody sat with us regarding our plan. We were fortunate that we had an outside consultant work with us who has since then become a part on NASA's aesp team who lives here on the same island and he was a great help form the beginning of the plan process to the revisions we made this year. "The strategic plan was an exercise in frustration. We were the first group to submit our three year plan. We were constantly told to complete it one way only to be later informed that we needed to go in another direction later. We all came to a point where we wondered whether the work required was worth what we would receive." "No one at NSTA or NASA seemed to know what they wanted." "Confusion over what the proper form was and what was required. We were given different forms at different times by different people for the same task. 2. The process for having our forms approved was a nightmare. We sent them to our AESP, who sent them to who he thought was the appropriate person, and then nothing happened. It took a number of submissions, e-mails, and phone calls before they were approved and funds released." "The expectations for the components were not clearly spelled out. We were asked to do it all over again in year two, even though we had already completed a 3 year plan. Turnover with our center contacts also caused confusion."

8. ***What kind of field center assistance was provided to school teams?***

Of the 47 team leads who answered to have received the following types of support from the field center staff: professional development, curriculum development, organizing special events such as Reduced Gravity Flight, strategic and technology plan writing, workshops for students such as Robotics, helping with family nights, videoconferencing related issues, ISS downlink, and identifying relevant NASA resources. In most instances, the team leads cited to have received multiple types of assistance provided by AEPSs and field center coordinators. The field center staff provided this assistance via school visits, telephone, teleconferences, and email.

9. ***How satisfied or dissatisfied the school teams were with the overall support received from the field center staff?***

Of those who confirmed their satisfaction with the field center support expressed their satisfaction using phrases such as: "The quality of support from our facility demonstrates great satisfaction and their sincere efforts to help us achieve our objectives." "Everything we asked they did. They have been wonderful!" "They've done everything they could to help us."

Team leads pointed how the center staff helped them with whatever concerns and issues they had. "They bent over backwards to reach out and assist." Some said the field center staff helped them with "everything and anything." "Everyone has been so quick to respond and offer assistance. When we need them, they are there."

As expressed by several teachers, team leads also pointed that they received more support the second year and therefore they are more satisfied with the center support this year. "We didn't have this (support) the first year and felt lost a big part of the year. Having those people teleconference and visit us has kept the program going this year."

Among those few who expressed dissatisfaction they pointed to the following. "We have not been visited by an astronaut to data." Receiving the grant money late was another point of dissatisfaction. As stated repeatedly team leads complained about receiving very little support during the first year while praising the support they received from the center in 2004. "Not having direct support during the first year. After the wonderful workshop experience, the only contact we had was by e-mail or phone until our primary "publicity" visit in March 2004. That has changed this year, with more direct support, video-conferences, etc."

A few team leads wished to have a "more proactive help." "There is a lack of guidance from our center. While we are perfectly free to contact them, they are not proactive in offering services or ideas beyond 4 days of professional development." Some others wanted to have constant contact and presence in the classroom. "We thought we would get more support and direct involvement from our field center contacts. We have seen little of them in our classrooms." They wished "we had more school visits from them and faster replies to our emailed requests."

While acknowledging the limited number of AESPs, team leads also wanted to see more AESP visits. "It seems that the field staff is limited in size. The AESPs are stretched and don't have as much time available as we would like to have from them. Another said "The AESP was hard to find sometimes." One said "We need more constant support."

Team leads also wanted more AESP visit to get help with family involvement and technology. “One of the Explorer School goals is to increase parent participation. This is a very difficult struggle for urban communities. We were hoping to receive support from NASA to help us with this goal.”

10. What types of NASA curriculum materials did the school teams use since they became part of the Explorer Schools Program?

All 49 teachers from the 2003 cohort stated to have used NASA curriculum materials at their schools.

GRC teachers added a two-year Aerospace Studies course and stated that they used a variety of NASA curriculum materials. Team leads from GRC stated to have used Mission math, human physiology in space, astrobiology, meteorites, rocketry, astronomy, Mars, ocean, Wright Brothers, e-Missions, Rockets, Health and Nutrition materials. The list of NASA products that GRC teachers continued with Rats, KC-135 Microgravity, History of Winter, ISS Downlink, Mars curriculum materials, Micro-gravity curriculum materials, NASA Connect, Liftoff, Glovebox, and Saturn (reading, writing & rings.

Teachers from JSC stated that they used AWS weather software and Signals of Spring. KSC teachers used GLOBE online weather program and building models.
Teachers from MSFC said they used DLN, online chats with NASA personnel, mission control, star gazing activities, and integrated a variety of science and technology in the classroom.

Teachers from ARC said they used NASA videos, NASA website links Astro-Adventure, Robotics, GLOBE, and Signals of Spring. Team lead from ARC stated that “we have shared many materials with the entire school. I disseminate to the various NASA activities to teachers. Sometimes we give workshops or inservices, and let them know we have the resources if they need it.”

Team leads from DFRC said the teachers at their schools used Mars Rover, flight, geology, environment, microgravity, math, solar system, aeronautics, astronomy, and so many other materials.

GSFC teachers cited to have used the following products: GLOBE, Sun Earth Connection, EarthKAM, AIRES, Civil Air Patrol, Lake PLacid Winter Study Materials, Marsbound, Mission Geography, Mission Geography, How High Is High, Living and Working in Space, Biological Sciences, numerous NASA websites, Satellite Imagery, Rocketry, Water Cycle, Echo the Bat, Mars Rover, Landing Wallop Island, and SEM preparation investigation.

JPL teachers used the following NASA products: NASA explores, videoconferencing lessons, Saturn materials, MARS imaging, microgravity, World Wind, Signals of Spring, aerospace and rocketry materials, and various other curriculum materials.

Teachers from KSC said they used Glove Boxes, Mission Mathematics, Operation Montserrat, Brassica Plants/Butterflies, NASA Challenge, S'COOL, Mars Rover, Parachute activity Given, reduced Gravity Aircraft, plants in space, space flight models, GLOBE, and “almost all of the materials given to us during our 2003 visit.”

Teachers from LARC World Space curriculum units, posters, bulletin board materials , videos, CDs, websites, and Montserrat. Teachers from LARC used the robotics materials, History of Winter materials, Rocketry, and Astro-venture.

Teachers from MSFC used Mission Geography, Science Files, Wright Brothers materials, Tomato-sphere, Digital Learning Network, Signals of Spring, Venus Transit, Sun earth connection, History of Flight, and “tons of materials to many to list.”

Teachers from SSC stated they used the SCI-Files, GLOBE materials, Amusement Park Physics, Rocketry, and Mission Geography. Several of them said they selected “NASA activities to follow a monthly theme.

11. What are the other critical factors to the implementation of the plan?

Finding time to implement the NES program and take advantage of its opportunities is a critical factor as indicated by three team leads. Timely, accurate and comprehensive information and explanations about what is going on with the program is another critical factor.

Community and parental support are another critical factor indicated by three teaches. Sustainability or continuity of NES news, support, and professional development opportunities beyond the end of third year was expressed to be critical factor by four teachers.

Additional funding besides the grant money provided by the Explorer Schools program is stated to be a critical factor. These schools wished that NASA help them identify additional grant possibilities.

A sustained, committed school team is being pointed as one of the critical factors in successfully implementing the program. Administration at schools and school board has been pointed as one of the critical factors.

12. What are the lessons learned?

Team leads said *taking advantage of professional development opportunities* such conferences, workshops, and special events in addition to the resources they bring from these events to be shared with students and teachers (in the same or outside of the team) are among what they recommended for the incoming cohorts.

On the other side of the coin, team leads also recommended patience, taking time, pacing out, perseverance, and careful selection of professional development opportunities that best fit their needs. "It takes time, patience and perseverance to make changes happen in schools. Don't give up!" "Stick with it. Initially it seems overwhelming." "Do not try to do everything at once." "Start out slow and as you get a feel for what you are doing, you can add to it. It is amazing how much more you can do." "Take one step at a time implementing your plan. Don't overwhelm your staff." "Rome wasn't built in a day - it takes time to learn how and what is best for the school and kids involved." "I would say the most important things that we learned is not to try everything the first year or you will get overwhelmed. It is best to start slow and have other members of the team help with the paperwork." "Take it slow and steady don't try to do too much to fast." "Choose what fits your curriculum and limit what you do the first year and add each year."

As stated by many team leads of 2003, teachers advised that "You must have a strong team and have buy in from non-team members on your school site" to be able successfully implement the program. It is recommended that team is made up by committed and multi-talented individuals who are unified. This team presents the initial plan to the entire faculty to invite them to get involved with the program right from the beginning. To increase the buy in from non-team members, it is recommended that all staff members are allowed to attend training, workshops, and conferences. Beyond establishing a unified team and having the buy in from the non-team members, working with state math and science consortium through the NES partnership for sustainability, sharing their work with others in the district and throughout the state are recommended.

Two team leads expressed that they learned "better ways of teaching." As put by one of the team leads, the NES program has contributed their professional growth. "The ability to consistently manage, schedule, problem solve technical issues, and plan activities, as a liaison to our NASA Site, in an effort to achieve outcomes and expectation of the Strategic Plan, has been an incredible challenge that has exponentially increased my teaching and administrative perspective.

Seeking and gaining support from the NES contacts at the field center, site administrators, and non-team members at school have been pointed as one of the lessons team leads stated to have learned. "Ask questions of the NASA personnel, don't be afraid to ask for help, and apply for everything you can." "Support of my site administrator is vital to overcoming the district bureaucratic obstacles that will slow your progress and drain the grant funds."

Having a good plan that "is realistically within the reach given the NES resources" "focuses on the weaknesses in your school and enhances your strengths" based on the school improvement plan are other valuable lessons team leads expressed to have learned.

13. What is missing from the Explorer Schools Program?

A team lead stated that "It is the support and presence of NASA that has made this program such a success and separated it from other programs." As results, team leads expressed to see more support, i.e., school visits, on-site professional development, help with videoconferencing, and help with curriculum implementation provided by NASA. “More support for straight math curriculum.” “More math needs to be incorporated to show us how we can incorporate it more through the program.” “Come to the school for a week-long or weekend training.” “More professional development needs to be done to help teams be change agents in their schools. Also, NASA needs to provide more ongoing support to help schools institutionalize the strategic plan. Because of changes in AESP personnel and the number of schools that Centers are working with it is not always easy to get NASA staff to the schools.” In summary, they wanted to see “more emphasis on the school as a whole” and “more NES driven school site professional development.”

Team leads expressed to have more extended, sustained communication and collaboration among team members themselves, with other NES schools, and with NASA scientists to better educate their students on NASA-related careers. “The team needs feedback on how they are doing. We want to know more about what the other NES schools are doing. We would like to share information with the other NES schools.” “I have been to two centers and the time there was great, but all we did was talk or go over classroom stuff. We talked to people about their jobs at NASA, but we didn't get to spend any time with them on their jobs. To really understand what these people (NASA scientists) go through every day we could shadow them for a couple of days and then try to work what they do into a lesson plan. As educators, we need to understand what is required for the work force NASA needs in order to prepare our students.” “I also feel that NES teams should get together on a regular basis to discuss common goals, successes, and problems. I think this component should be built into the NES concept. Regular discussions online in a designated chat room would be helpful.”

2004 Cohort Team Lead Survey
Qualitative Data Results

1. ***How effective or ineffective was the NASA Summer workshops in preparing the teams to implement the program?***

Among those who said the summer workshops were effective and somewhat effective made their comments around the following cluster of themes: summer workshops were effective because they (1) increased teachers' excitement and content knowledge, (2) built the Explorer schools team, (3) provided opportunities, and (4) set out expectations of the Explorer schools program.

In regard to *increasing teachers' excitement and content knowledge*: "workshop excited team members to teach science content." "It was incredible to see all the education material out there that NASA has to help teachers," "very informative. They taught a lot and made everybody enthusiastic about the program." "We left the summer workshop more excited than ever to get started our school." "It opened my eyes to the possibilities available to implement into our program, the activities related to current events, and National math and science standards. We were taught as only NASA can." "We learned a lot of strategies for classroom implementation of inquiry learning." "Workshop was very informative. They taught a lot and made everybody enthusiastic about the program." "Good examples were modeled of things that our school could do." "We learned tons and gained lots of new ideas. It was great !!!"

In regard to *building the NASA Explorer school team spirit*, teachers made the following comments: "without the workshop, the team would not have been on board of the program," "we had the chance to works as a team to become excited about the program, everyone on the team left ready to work to make our Explorer School be successful."

In regard to summer workshop's effectiveness on *providing opportunities*, team members made the following comments: "There were tons of different opportunities. There was something for everyone. No one should have walked away without having new and exciting opportunities for their school." "Our team was exposed to many of the opportunities available to us as an Explorer school." "The workshop program provided an opportunity for out ream to grow professionally." "It opened new ideas and opportunities for us to bring back to our students." "The workshop was effective because they presented the available resources to us."

In regard to *setting out expectations of the Explorer Program*, teachers said "We were able to have many of our questions answered about the program by our coordinator and program director. It was a very effective because it really defined what was expected of us as an Explorer School." "I was given all the information and resources necessary to implement the NES program in my school." "We were given an overview of NASA mission and some ideas to use in the classroom … the workshop provided a useful overview of the NES program." "We were able to discuss how to incorporate NASA's goals and our goals for our schools with our three year partnership."

Among those who said the workshops were ineffective, somewhat ineffective, or neither effective nor ineffective made their comments around the following cluster of themes: (1) lacked guidance on program expectations, paperwork and strategic plan writing, (2) lacked information on how to implement the program in the schools, and (3) lacked providing certain content knowledge.

In regard to *lacking guidance on program expectations, paperwork, and strategic plan*, one team member made the following comment:

> "Our guidelines for participation in the program were not clearly defined. Guidelines for strategic plans were confusing and non-existing. As a team we spent a lot time asking questions, hoping to clarify NES goals. With no clear answers, we wrote a plan, only to have the plan come back to us, accompanied by newly implemented guidelines. Basically, we had to rewrite our plan and tech budget, during the school year. This added unnecessary time spent on paperwork (DURING the school year) which made a portion of our summer workshop ineffective."

Similarly, nine other team members made the following comments on the lack of guidance: "It lacked information, guidance, and time for writing the strategic plan and budget." "We could have used some time to get together the necessary paperwork that was due." "When we got back and into the school year, we were still not sure how and what was expected of us." "We could have used more time to get together the necessary paperwork was due." "I enjoyed the activities, but I did not feel prepared to complete all of the paperwork." "Not enough information, guidance, and time for writing strategic plan and budget." "We were not given enough information regarding the strategic plan, technology plan. In some cases, the information we received was incomplete and untrue." "Now I feel I need more time in learning about the various paperwork, goals etc." "I think we could have used more time developing our implementation and strategic plans as well as our action plan."

Four team members commented that the summer workshops *lacked information on how to implement the program in the schools*. "Some of the information was very helpful, but there was not a lot of specific information on exactly how to go back and really implement the change within school." "The summer workshop was very informative and gave us insights into many of NASA's program into our school, but it did not give specific instructions on how to implement the program into our school… no concrete steps were given." "When we got back to school to implement our program we found out that we have received and continued to receive contradictory information." "Team returned with what turned out to be erroneous idea of the expectations for our plans.

Three teachers commented that the summer workshops *lacked providing certain content knowledge*. "I really would have liked to have worked on the scope and sequence of the Astronomy unit." "I wish it was more organized as far as better targeting the materials for the school level: share elementary materials with elementary, middle school materials with middle school, high schools materials with high school teachers." "The presentations were repetitive. The persons sharing the information are not the individuals available to come to schools."

2. How satisfied were the team members about being in the Explorer Schools Program?

45 of the 50 team leaders expressed that they were very satisfied with the Explorer Schools program. Only 5 of the 50 said they were neither satisfied nor dissatisfied.

Those team members who expressed satisfaction with the program highlighted the following themes: increasing (1) opportunities for professional development, (2) opportunities for partnership and collaboration, (3) use of technology, (4) use NASA content and science content, (4) involving families and community, and overall pride, excitement, and publicity resulted from the involvement in the Explorer schools program.

Majority of teams expressed satisfaction with increasing number of *professional development opportunities* that were made available to them. They mentioned the national conferences they attended such as, NSTA, special events such as, Reduced Gravity, professional development and support they received at their schools through AESPs. "Great support from AESPs. They helped us in the classroom with staff development and host NASA nights at our two schools where the whole town was invites." "We benefited from the professional development provided by our NASA liason. He has worked closely with our Science and Math teachers and has brought several new ides to our students."

Team members (7) expressed satisfaction with the *partnership and collaboration opportunities* that became available as a result of the program. "We have networked with other NES schools in our area. It makes us feel like we are a part of the NASA family." "We have gained new community partners to support our education program." "Our district takes this school and staff seriously. At one point this was the "scary school" in the district. Now we are considered innovative risk takers. We have incredible partnership with Wichita State University and Kansas Cosmosphere that have enriched lives of our students greatly in just a few months.

Fourteen team members expressed satisfaction with the *increasing technology use*. They stated that the Explorer schools program provided them the funds to purchase technology such as videoconferencing equipment and with opportunities to be connected to other schools and science experts. "We have obtained videoconferencing equipment and our students have been able to participate in distance learning with NASA centers." "The NASA grant provided us with the opportunity to purchase technology that will really enhance student learning at our school." "Students have participated in a contest with Lockheed and won first place in a video contest… We are in the process of buying technology that we would not have had." "We purchased and began to use technology such as hand-held and videoconferencing equipment in out classrooms."

Some team members tied their satisfaction with the program to the use of *NASA content* and *science content*. “I think two of the team members are very satisfied because those two are using the information in most classes. The other two had limited opportunities to participate in the use of the material.” “Use of NASA content and curriculum enhanced learning.” “NASA resources are being used more and more in the classroom everyday. The more we know as a team, the more we spread to the rest of the faculty. We quickly found out that there is lot more to NASA than science and math. We work hard to incorporate their resources into all lessons because again it motivated children.” “Our team members are satisfied with being in the Explorer program. Many use resources that NASA has provided to us.” “Science teachers have gained more content knowledge.” “more emphasis and implementation of STEM in the classroom.” We have been able to integrate and actually begin teaching science on a regular basis.”

Increasing *parental and community* involvement have been mentioned by several team leads. Perhaps the quote below is a good reflection of the extent to which schools benefited from family involvement.

> “One of the greatest benefits that have resulted from our school participating in the Explorer School program is allowing us to share this program with our parents… We conducted our lift off where parents had a chance to come in and see what their child was studying and also they build rockets as a family and had a chance to launch them in our school’s P.E. field. After that event, we had many parents thanking us for having this program because it has given them an opportunity to work with their child and do something as a family.”

Others expressed that they have had “family science nights on a regular basis.” “Parents have attended night activities, showing the students that education is important.” “Our parents have become more involved in our school.” “Parents are impressed with the program.” “At our last family science night at the elementary school, we had approximately 250 participants. This is something we have never seen before.”

As for involving *community*, teams expressed “We have had increased community interest as indicated by additional grants and volunteer work.” “We have provided the community and specifically our students’ families an opportunity to interact with our faculty on NASA family nights. Before this opportunity in becoming a NASA Explorer school, we were unknown entity in our school system. Now partnered with NASA, we have been receiving public recognition for our after-school programs, in school NASA connect programs, and NASA AESP visits.” “Community awareness improved school status and pride.” “Being affiliated with and selected by NASA has brought some publicity to the school and community members are now backing the program with support and volunteers.”

Team leads also recognized the benefits the whole school received due to improved family and community involvement as well as funds, support, and opportunities they have had from NASA. “We have received many opportunities to grow as a school and community.” “The ideas and programs being brought into the school as well as professional development has been an asset to our school thus far.” “Being in the program rallies support and creates unity on campus. Everyone is excited to be affiliated with NASA." "The NES program has opened up space related topics to the whole campus, not just the Magnet students."

At least 12 team leads mentioned their satisfaction with the program since the Explorer Schools increased *excitement among teachers, students, and families as well as publicity* they received by having a partnership with NASA. "We have gotten national recognition by being a NES school." "Pride being the only NASA Explorer School in the state and having the experience of an astronaut visiting the school." "The positive PR we have gotten… The entire community has been behind the program." "We have access and current information on many exciting learning opportunities for our staff." "Students have been very excited about being a partner with NASA." "a renewed excitement in our students about our school in general." "Excitement from the children and parents about this program is phenomenal."

3. ***What benefits did school teams experience as a result of their participation in the Explorer Schools program?***

47 of the 50 team leads expressed that they benefited from the program a lot to some while 3 of the 50 said they benefited a little

When teams were asked about the benefits that have resulted from their participation in the Explorer Schools program, they expressed the benefits affecting their students and themselves as teachers.

A significant number of team members, 43 total, expressed that *students benefited* from the Explorer program. Among the specific benefits, team listed cited the following: increasing student interest in STEM disciplines and careers as a result of exciting NASA science resources and curriculum, astronaut visits or having communicated to them through DLN, and special student and family events,

"The biggest benefit thus far has been the programs enlightenment of our students as to the possible careers at a NASA facility and the various types of positions which are an integral part of the NASA family." "Our students have become more interested in science, math, and technology." "I think our students are realizing that they someday could work for NASA and be scientists. Having NASA visit our school has inspired our students." "Participation in Reduced Gravity Opportunity has inspired many students, caused teachers look outside their textbooks for teaching materials, caused many parents to volunteer their time to come into the school." "Students are interested in the science aspect of school and inquiring about jobs with NASA. Students have a sense of worth to be a NES school."

Inseparable from the benefits students have had from the program, *teachers benefited* from the program expressed in the following quotes: "We think "big" when we plan our science instruction because we know NASA will help us." "Every member of the team has had opportunities to experience new ideas." "Professional development has been great. Our teachers really need that." "Teachers having the professional development is so rewarding. As teachers we do not get a lot of awards or recognition. NASA respects our hard work and rewards us besides. It is great to be complimented on being a professional. We feel like we are part of a team and success is the only answer. We are motivated to work even harder." "All of our teachers more are more aware of NASA and their missions. As a result students in many classes are being exposed to NASA activities, resources, and knowledge. Many of our teachers are considering attending some of the workshops and activities offered. None would have happened if I was the only one singing the NASA song."

4. ***How dissatisfied were the team members about being in the Explorer Schools program? What problems did they experience?***

Team leads stated the following as problems or dissatisfactions they have had with program: (1) tardiness, (2) lack of team and administrator involvement, (3) lack of support, (4), communication, (5) too much paperwork and lack of time, and (6) too many opportunities.

Tardiness in receiving the funds was the most common issue expressed by 13 school teams. "Since our first check has not arrived, they are somewhat disappointed, purchases still cannot be made, and it is almost February." "We had a huge delay in getting the MOU back from district headquarters." "The demands made by NASA for timely action on our parts have contrasted with NASA's less than timely response to our requests. This does not include the AESPs who are very helpful, but requests made of those higher up the chain."

Schools stated that receiving the grant money late affected team involvement in the program, participation in the DLN events as they were unable to purchase the equipment, and implementing their plans. "It would have been easier to make some changes and convince the other faculty if the grant money was received closer to the beginning of the school year. Receiving the money in the spring money in the spring is too late to be able to participate in many of the Explorer School activities that require DLN equipment." "Where is the $$$? It is late in the year. We are unable to make purchases that would benefit this year's student body." "We had planned certain activities and events, which require us to have some of the items that we plan to purchase when we receive the money. It has put a delay in some of our implementation plan."

The second issue the team leads expressed to be dissatisfied was *support* as mentioned by 10 leads. Team leaders clearly expressed that they would like to receive more support from the field center coordinators and Education Specialists in implementing their strategic plans. Team leads requested more support in resolving issues of DLN, organizing family nights, delivering lessons to students and professional development training to teachers.

About five team leads expresses dissatisfaction with the DLN support they received from the center staff made the following comments: "We need to work with center staff to resolve issues of DLN." "Our school needs technology support. It would have been helpful to have NASA staff visit our school prior to the summer to evaluate our network system to assist in running and purchasing video equipment." "We have had difficulty setting up DLN. We are anxiously looking forward to using this technology."

Some team leads expressed their dissatisfaction with the support they received from the field center coordinator. Overall, they requested timelier, consistent follow-up, training, and guidance. Although they expressed their satisfaction with the support they received from AESPs, they wished that AESPs worked more than one teacher on a visit.

Despite their satisfaction with the Explorer Schools program, three school teams expressed that *communication* was a problem at times. "We are satisfied and feel that this is a good program. However, there seems to be a lack of communication and a lack of follow through on various components." "We are very satisfied with the program. However, we have had some difficulties with our team's communication. Since we have an elementary school and a middle school in the program, our NES team is split between the two schools. We do depend on e-mails to keep the communication open on a daily basis. I do strongly believe that if we were all at one location, communication would not be a problem." "We are very happy to be in the program. Sometimes, we are frustrated with communication. For example, we were not able to get an answer about the dates for the summer workshop in time for one of our teachers." "having NASA liaisons return our e-mails and request in a timely manner."

About seven team leads expressed their *dissatisfaction with their own fellow team members' and administrators* involvement with the program. "We see benefits, but it is a real struggle to get our teachers to participate and keeping up the excitement." "Team is happy with the program, but is not as involved as I would like to see them be." "It is exceptionally difficult to get teachers to use NASA resources or to apply for opportunities that are available." One team lead expressed "members are very satisfied with the program. However, a change in the building principal has brought some dissatisfaction among members." "We feel very satisfied with the program, however, we feel very frustrated because we lack the support from our administrators in providing us with the planning time during school day." "The team does not have the full support of the administration, making planning and implementation time almost inexistent."

Time was an issue some team members expressed to have more. "We are very excited to be a part of the program. It just seems we all are short on time to plan and prepare NASA events. It takes extra time to plan downlinks, classroom visits, clubs etc. We are finding that along with our regular classroom duties, the program can be overwhelming." In parallel to lack of time, three team leads expressed that too much *paperwork* dissatisfying. "The team was frustrated with the time it took us to get the paperwork done." "We are a bit bogged down with paperwork at the moment." "Too much paperwork and time spent on filling out the same forms several times. We did not expect this degree of inefficiency and confusion."

5. ***How did the teams develop the plans?***

In the open-ended responses team leads responded that the entire team was involved in the process of developing and writing the plans. In most cases, although one person wrote the plan, team spent hours of work together in developing the ideas and writing the draft.

6. ***What kind of problems did school teams encounter when writing and implementing the plans?***

Confusion was the word most expressed by team leads in describing the problems they encountered when writing the plans. Team leads were confused. Either they were not clear about what the plans entailed, or they were confused by the center staff due to lack of guidance and unclear messages.

First, teams expressed that they received unclear expectations and messages from the center staff. "I was a bit unclear as to what a strategic plan should look like." "We did not have an example to direct us. A copy of a 2003 school's plan or a sample developed by NASA staff would have helped tremendously. There was very little guidance until we attended the summer workshop. Even then the staff was unfamiliar because they were never exposed to sample plans." "We were confused about what was expected." "We were given several messages about the funding. During the summer we were told the money could be used to purchase whatever we needed to make our program successful. At one point we were told the funding could be used to provide students with experiences, field trip support, etc. Then the actual plan came and we were told it could only be used to purchase technology." "The only problem was the confusion and delays caused by waiting for the forms to be activated online and then having to change and send it to the center and then the wait we have experienced waiting on our MOUs. "

Second, the team itself was confused since they either had erroneous ideas about what the plan needed to have or they lacked knowledge to find enough or judge the amount of information needed to be in the plans. "Team members had a very erroneous idea of the teams as to what needed to be included in the plans." "We were confused about how much information and detail was required in the plan. Ours was returned for editing because it contained too much." "We could not make a decision amongst the group. Some members thought there was too much there. Others felt there wasn't enough. It was overwhelming and stressful for me. Some could not meet when others could." We could not find enough to fill three years."

Two team members stated that finding time to write and finalize the plans during the school year was a problem. One team lead expressed that "getting the person responsible for final editing and submission to actually do her job" was a problem.

Most frequently cited problems were related to technology. Schools either lacked expertise using or purchasing technology or received the technology money too late to be able purchase and use it the way they stated in their plans. These technology problems were related to lack of knowledge and guidance on buying DLN equipment or delays on reaching an agreement on their technology budget. In one case, technology budget had to be approved by the district. This caused some delays.

Lack of planning and implementation time was another problem team leads encountered. Four team leads pointed to the administrators for the problems they encountered. They stated that administrators were not supportive, reluctant to signg MOUs on time, or they were too many changes with new administrator. Three team leads expressed their frustration in regard to their lack of knowledge when purchasing technology. Their lack of knowledge combined with lack of technology support created problems when implementing the plan. Two other team leads stated that communication among the team members as well as communication with the field center was a problem.

7. ***How important is the plan in achieving school and staff improvement goals in STEM?***

In the open-ended questions, team leads clearly expressed overwhelmingly (n = 23) that the plan gave them a focus, vision, direction, guidance to follow in order to achieve their on-going school and staff improvement goals in STEM. The plan helped them focus on student achievement, curriculum enrichment, and professional development activities related to STEM. "We have a plan that focuses on student achievement and enriching the curriculum. We are very focused on our outcomes." "We have been very focused on our improvement goals at every step of this procedure." "I feel this way because, without a vision, we would have no idea where we were going and no way to know when we had arrived at our goal. It is definitely important to have a plan." "It guides our vision and puts it in order for us to achieve." "The Implementation and Technology Plan provide a direction for us to follow that allows us to work toward our goals in an incremental fashion." Developing the plans forced our team to narrow our focus to concentrate on utilizing the NASA resources that best fit our needs."

Some referred to the plan as a blueprint in achieving their goals. "It is important because the plan is a blue print of the program we want to set up at our school. The plan allows for us to improve on all those fields. "The plan addresses the goals of the school in the areas of science, mathematics, geography, and technology. "We have a blueprint of how to achieve the goals." "Only when goals are set can they be achieved. We are really trying to set them so we have a vision of where we want to be in the future."

They expressed that having their goals in writing helped them reflect on their activities. "The plan reflects specific PD, activities, and events that will help us achieve NASA's objects and the goals of our team project. Our plan reflects activities that will allow staff and students to relate science, math, technology, and geography to real life experiences." "It is important to have your goals in writing. It helps one achieve them. If you have a set of goals staring you in the face, you are more likely to get paranoid that you are not achieving them and change your habits so you will be more successful." "I have already had to refer back on many occasions to review, refresh, and keep things on track." "It forced us to organize and prioritize activities. It also made us have more realistic expectations of what we could actually accomplish."

In some cases, the strategic plan helped schools define their school goals and helped them re-focus or revisit the plan to meet their needs. “Our school is in a transitional phase of development of goals for our students. The implementation plan is helping us develop these goals in math and science.” “It is part of our campus strategic plan so we are continually revisiting and adapting our plan to meet the needs of our students.” “It is now a part of our school improvement and goals.” “It has helped to chart out where our school is going in the future.” “We didn't have any definitive goals for science, math, geography, and technology. It has given us direction, but there are still teachers in our school putting these subjects on the back burner. The plan has provided specific ways we can accomplish our goals.” “: It has helped to chart out where our school is going in the future.”

Some team leads stated that the plan leveraged in achieving their school improvement goals: “We wanted to become a NES school to move our school ahead in the areas of math and science specifically. That is our emphasis in our Strategic Plan and continues to be our priority.” “We created a plan to meet goals and needs that we have in our school. It gave us the means to get some much needed tools in our school.” “Developing the plan raised the expectations of how teachers deliver curriculum in the classroom.”

About 5 team leads expressed that the plan was not so important in achieving their school improvement plans. They expressed that the strategic plan was not so relevant to their school improvement plans: “We have five goals overall for our school with none of them specifically addressing math and science directly.” “We can not handle extra, so our plan needs to supplement existing curriculum for improvement.”

Teachers expressed the pressure by the current emphasis on testing. “I feel our plans are important as far as the science and technology aspects are concerned. However, as far as the math and the remainder of the staff, I feel it is not as important. The current political educational agenda of testing, testing, and testing our students, to determine achievement, is developing an atmosphere for teachers which promote teaching to the test and not teaching for inspiration, wonder, or knowledge.”

8. ***What kind of field center support was provided to school teams?***

Team leads expressed that they received assistance from the field center staff to design and conduct school events, professional development, and strategic plan writing support. Teachers expressed satisfaction with this help received via e-mail, telephone, and school visits. Among the many events team leads stated to receive help from the field center staff were kickoff events, family and community nights, blast off events, and lift off celebrations. Support was provided to help school teams set up DLN events and e-mission. Professional development mainly delivered by AESPs was most frequently cited. Teachers received professional development on using NASA resources, STEM content, videoconferencing, resource identification and finding. Finally, teachers stated to receive help with the strategic, technology, and implementation plan writing. They received feedback and guidance on their writing had their questions addressed when requested.

9. ***How satisfied or dissatisfied the school teams were with the overall support received from the field center staff?***

An overwhelming majority of teachers expressed satisfaction in the open-ended responses with the general overall support they received from the field center staff.

“Any time we have asked, they have provided us with the necessary support when able to.” “I have been able to get any help that I have needed.” “NASA staff is always prompt and very helpful.” “The NASA staff has helped us with everything we have asked of them.” “They have done almost everything that has been asked.” “They have provided everything we have asked for. Our NES coordinator in constant communication with us and is an extremely personable individual.” “Our contacts are quick to respond to any questions or concerns we have. Our NASA Field center has been extremely supportive on everything we have asked for, questions about, or helping us in all of our ideas. They have visited us and helped us on many occasions.” “Every time I called, or sent an email, the staff was polite, professional, and quick to respond.” “We have been overwhelmed by the amount of help given by our center director, AESP, and others who have contacted us to work with our students.”

Among a few dissatisfactions team leads expressed were unclear direction or lack of direction. “Some materials from headquarters and other field centers have arrived without explanations or directions, requiring me to find out what we had and why it had arrived.” There were a few team leads who also expressed their dissatisfaction with communication. “Seems there are too many cooks in the NES Program kitchen; we waste precious school time communicating the same information to many different 'officials'.” “Sometimes NASA's communication and support was not clear. It is our hope that communication and NASA support for our NES School will be better. “

10. ***What types of NASA curriculum materials did the school teams use since they became a part of the Explorer Schools program?***

Since teachers who work in the same field center tended to use the same or similar products, NASA curriculum materials used by teachers are aggregated by center. Teachers from the ARC stated that they use the following specific products: Astro Venture, DLN, Glovebox, Space Nutrition, Rocketry, Wright Brothers, ultraviolet activities, sunspot plotting, and Astronomy village, signals of spring in addition to unspecified various webbased NASA resources and activities.

Teachers from GRC expressed to use the following products: Hubble lessons, ISS lessons, Mars Rover materials, Principles of Light materials, and Mission Geo in addition to other unspecified NASA math and aerospace materials.

Teachers from GSF stated to have used the following specific materials: FMA Live, Mission Geography, EarthKam, Sun-Earth connection, Amusement Park Physics guide, Solar system lessons, moon lessons, Rocketry, History of Space Flight, Solar system, Echo the Bat, Glove Box, Reduced Gravity, E-missions, Earth Observatory Network, as well as other CDs, videos and unspecified NASA curriculum materials.

Teachers from JPL stated to have used the following: various curriculum packets in reading and writing from ERC, Saturn Rings, Mars Student Image project, Exploring Meteorite Mysteries, and other materials brought back from the summer workshop.

Teachers from JSC used the following: Meteorite Mysteries, Amusement Park Physics and Aerodynamics, DLN projects, earth and science materials, robotics, space travels, Rocket guide, Astroworld, Microgravity, Geography, Food in Space, Rockets, Payload, and Hydroponics materials.

Teachers from KSC used the following: Mission Mathematics, Mission Geography, and Earth Day.

Teachers from LARC used Spacelink, Astro Venture, Our Mission to Planet Earth, Earth Science Enterprises, KSNN, and Atmosphere Below Video series in addition to NASA website and materials brought back from the summer workshop.

Teachers from MSFC used the following: Connect, NASA Kids, NASA Live, NASA Liftoff, in Space, Microgravity unit, Videos Signals of Spring, Glovebox, a model of Saturn in addition other unspecified resources from the NASA website.

Teachers from SSC used the following: Mission Mathematics, Mission Geography posters and accompanying lesson materials

11. What are the other critical factors to the implementation of the plan?

Team leads stated that community and family involvement and support, technology support, time, communication, professional development opportunities, and NASA’s name and reputation are critical factors other than what is listed on question 27.

12. What are the lessons learned?

Team leads expressed that *building a strong and diverse* team is essential in the success of the program. They emphasized the fact that “everyone has to be "onboard" in order to implement positive change.” Team leads stressed diversity among team members to lend their influence in the implementation phase. They emphasized the importance of having an administrator and a technology savvy teacher in the team. In addition, they highlighted the importance of getting the district behind the school and as many people on the staff early in the process.

In addition to building a strong and diverse team, team leads advised *patience* with the program and team effort as well as *commitment* to the change effort. “Patience and commitment is required of all.” “Patience and determination” “Calm down. Everything is not for your school. You can't do everything, so take your time and choose what works best.” They cautioned that leading to facilitate a change effort is a challenging endeavor, which takes time, patience, and leading by example. “Do not try to do it all. Do what you can manage and hopefully others will help out.” “It won't be easy and it won't happen overnight. Being a NASA Explorer School opens many doors that were not open to us before.”

Within the same sentences that expressed a strong diverse team, patience, and commitment to the program, team leads emphasized the importance of “*a good plan*” that outlines teams vision for the next three years. As expressed by one teacher, “It is important to get a vision of where you want to go and work together as a team to get there” and by another “Follow your plan and don't try to do it all the first year.”

I know that if I have a topic that I wish information on, NASA will have information for me. If I can't find it, NES will guide me. I also firmly believe in connecting with other NES schools to build knowledge and support. It is crucial that we reach outside of our own building to those who are like minded about science and aerospace.

Support was among the other lessons team leads learned. They expressed the importance of support received not only from NASA centers and headquarters, but also support from the principal, district, partners such as businesses, colleges, and other organizations.

Technology related issues including technology knowledge, technology support, and technology infrastructure were the other important lessons team leads learned. Having the in-house knowledge or outside support to trouble shoot and purchase technology such as videoconferencing, readily available technology equipment, timely arrived funding all seemed to be important lessons they learned. One team lead specifically mentioned the importance of the technology plan. “The best thing that we did was in our technology plan. We spent money to insure that the team has technology that could be used on a daily basis in the classroom. I think that frequent use of technology has benefited both the teachers and students.”

13. What is missing from the Explorer Schools Program?

Team leads were asked if the Explorer Schools program is missing. As expressed in the sections problems and dissatisfaction with the program, teachers stated that they needed *time* to process the information and implement the program. They also reiterated the importance of receiving the *funds on time* so that they will be able to make their purchases and start implementing the program in the fall as opposed to starting in late spring.

Some expressed to have *more funding* to be able really affect students since most of the NES funding was going into purchasing technology. Others wanted to see more astronaut and NASA guest speakers in their schools. Although they acknowledged the busy schedule of these people, they expressed the positive impact of the NASA scientists on increasing student interest in STEM content and NASA careers. A few re-stated the importance of *support* from AESPs, *educational opportunities*, and *professional* *development.* In summary, more funds, school visits by NASA scientists and AESPs, educational opportunities, and professional development were stated not as a matter of what is missing but what is needed more.

A few teachers expressed that Explorer schools had a “basic ordered curriculum outline” missing in using the NASA materials in conjunction with their own science and math curriculum. In line with ordered NASA curriculum that is aligned to with their own science and math curriculum, teachers expressed to receive the information streamlined. They wanted a “user friendly core catalog,” “central link” to online educational resources, and “a simple streamlined way” to find lessons, information, and resources.

Final Comments and Remarks
Overall, school teams expressed their Explorer School experience with using the following adjectives: positive, rewarding, a dream coming true, excitement, honored and blessed, awesome, snowballing impact, and amazing journey. Despite a few struggles and problems teachers expressed, they acknowledged that leading a change process was a process that involved multiple players, required patience and commitment. And despite the fact that the 2004 teachers had been with the program only about six months at the time when they took survey, they felt truly content and excited about what the program had the potential to offer.

Quantitative Data Analysis on the Close-ended Questions

The 2003 and 2004 Cohort Team Lead Survey data were received from 99 team leads with 100% response rate. Data were aggregated and analyzed around the 12 factors listed below.

(1) 2003 cohort,
(2) 2004 cohort,

a. Decision making to join in the NES Program (Q1a, b, c, d, e, f, g, and h)
b. Effectiveness of the summer workshop (Q3)
c. Changes and effectiveness of team members (Q4, 5, and 6)
d. School benefits (Q7)
e. Strategic plan design (Q10, 13, 14, and 15)
f. Strategic plan support (Q11 and12)
g. Strategic plan implementation (Q16, 17, 18, 26a, 26b, 26c, 26d, and 26e)
h. Center support (Q19, 20, and 21)
i. Use of NASA materials (Q22)
j. Attending PD events (Q23, 25a, 25b, 25c, and 25d)
k. Lessons learned (Q28)
l. Suggestions (Q29)

Following is a summary of results presented in the tables for the 2003 and 2004 cohort team lead survey.

2003 Cohort Team Lead Survey Results from Close-ended Questions

Decision Making: To what extent did each of the following influence the decision to join the Explorer Schools program?	1a	39 (81%) said **a lot** for themselves 6 (12%) said **some** for themselves 3 (6%) said **none** for themselves
	1b	21 (44%) said **a lot** for other team member 15 (32%) said **some** for other team member 7 (15%) said **none** for other team member 5 (10%) said **a little** for other team member
	1c	19 (40%) said **none** building principal 11 (23%) said **a little** building principal 9 (19%) **some** building principal 9 (19%) said **a lot** building principal
	1d	33 (69%) said **none** for science and math teacher not on the team 6 (13%) said **some** for science and math teacher not on the team 5 (10%) said **a little** for science and math teacher not on the team 4 (8%) said **a lot** for science and math teacher not on the team
	1e	35 (73%) said **none** other teachers besides science or math not on the team 10 (19%) said **some** other teachers besides science or math not on the team 2 (4%) said **a lot** other teachers besides science or math not on the team 1 (2%) said **a little** that other teachers besides science or math not on the team
	1f	34 (71%) said **none** for district or central staff 7 (15%) said **a lot** for district or central staff 4 (8%) said **a little** for district or central staff 3 (6%) said **some** for district or central staff
	1g	41 (85%) said **none** parent of attending student 2 (4%) said **some** parent of attending student 2 (4%) said **a little** for parent of attending student 3 (6%) said **a lot** parent of attending an student
	1h	39 (85%) said **none** for community member without a child attending the school 6 (13%) said **a lot** for community member without a child attending the school 1 (2%) said **some** for community member without a child attending the school
Effectiveness of workshop	Q3	33 (67%) said the summer workshop was very effective 14 (29%) somewhat effective 2 (4%) neither effective nor ineffective
Team members changed Times met Team satisfaction	Q4 Q5 Q6	34 (69%) team members have changed; 16 (31%) team members have remained the same 36 (72%) met 6 or more times; 4 (8%) met 5 times; 4 (8%) met 2 times; 3 (6%) met 3 times; 2 (4%) said met 4 times; 1 (2%) never met 27 (54%) very satisfied; 17 (39%) satisfied; 3 (6%) neither/nor; 1 (2%) dissatisfied; 2 (4%) very dissatisfied
School benefits	Q7	36 (74%) benefited a lot; 13 (27%) benefited some
Strategic Plan design	Q10	29 (60%) team developed a draft as a group with a few editing and writing the plan 11 (23%) a few members developed the plan after input from all group members 8 (16%) one of two team members developed the a draft and a few others provided feedback

	Q13 when	14 (29%) during regularly scheduled hours of the summer training 14 (29%) after school started 12 (25%) some time after the summer training and before school started 7 (14%) after regularly scheduled hours of the summer training 1 (2%) before the summer training
	Q14 How long?	16 (33%) took 3 to 5 hours 10 (21%) took 6 to 8 hours 10 (21%) took 9 to 16 hours 9 (19%) took more than 16 hours 3 (6%) took 1 to 2 hours
	Q15 Prob?	31 (65%) no problems were encountered 17 (35%) problems were encountered
Strategic Plan support	Q11	14 (29%) received a lot of assistance from NASA field Center 14 (29%) received a little assistance from NASA field center 13 (27%) received some assistance from NASA field center 7 (15%) received no assistance from NASA field center
	Q12	24 (55%) provided feedback via email or phone during 2004 summer workshop 5 (11%) provided other kinds of assistance 4 (9%) provided feedback on rough draft during 2004 summer workshop 3 (7%) met with the center staff during workshop to discuss the plan 6 (14%) received help from the center staff combinations of above
Strategic Plan implementation	Q16	21 (43%) said the plan was <u>very important</u> to achieving their goals 20 (41%) said the plan was <u>important</u> to achieving their goals 8 (16%) said the plan was <u>somewhat important</u> to achieving their goals
	Q17	36 (75%) said they have achieved their goals listed below 12 (25%) said it is too early in the implementation phase
	Q18	31 (65%) yes, they have encountered problems while implementing the plan 17 (35%) no, they have not encountered problems while implementing the plan
	Q26a	19 (39%) said actions of district office staff were <u>very critical</u> 13 (27%) said actions of district office staff were <u>not</u> critical 12 (25%) said actions of district office staff were <u>somewhat</u> critical 5 (10%) said actions of district office staff were <u>a little</u> critical
	Q26b	31 (63%) said actions of principal were <u>very critical</u> 14 (29%) said actions of principal were <u>somewhat critical</u> 4 (8%) said actions of principal were a little or not important at all
	Q26c	48 (98%) said actions of the Explorer school team were <u>very critical</u> 1 (2%) said actions of the Explorer school team were <u>somewhat critical</u>
	Q26d	21 (43%) said actions of any other staff besides the principal and team members were <u>somewhat critical</u> 14 (29%) said actions of any other staff besides the principal and team members were <u>very critical</u> 7 (14%) said actions of any other staff besides the principal and team members were <u>a little critical</u>

		7 (14%) said actions of any other staff besides the principal and team members were not critical at all
	Q26e	29 (59%) said NASA regional center staff assistance were very critical 15 (31%) said NASA regional center staff assistance were somewhat critical 5 (10%) said NASA regional center staff assistance were a little to not critical at all
Center support	Q19	47 (94%) received assistance from the center during the school year 3 (6%) received no assistance from the center during the school year
	Q19b	21 (45%) have had school visits 12 (26%) received assistance only via telephone 4 (9%) received other kind of assistance 2 (4%) received assistance via written communication 1 (2%) received assistance via email 4 (9%) received assistance combinations of all above
	Q20	44 (88%) said they would request assistance 4 (8%) said they were not sure whether they will request assistance or not 2 (4%) said they have no plans to request assistance
	Q21	31 (62%) very satisfied with the overall support received from the NASA field centers 10 (20%) satisfied with the overall support received from the NASA field centers 5 (10%) neither satisfied nor dissatisfied with the support they received from the centers 3 (6%) dissatisfied with the support received from the centers 1(2%) very dissatisfied
Use of NASA materials	Q22	49 (100%) said they have used NASA curriculum materials at their schools
Attending PD events	Q23	17 (38%) attended only NES update session during NSTA symposium 11 (24%) attended only National Science Teachers Association (NSTA) symposium 4 (9%) attended special events 1 (2%) attended conferences/workshops sponsored with expenses by through NASA 12 (27%) attended combinations of all above
	Q25a (n=37)	26 (70%) said NSTA symposium was very useful 10 (27%) said NSTA symposium was somewhat useful 1 (3%) said NSTA symposium was not useful at all
	25b (n=39)	27 (69%) said Update session on NES schools was very useful 10 (26%) said Update session on NES schools was somewhat useful 2 (5%) said Update session on NES schools was a little to not useful at all
	25c (n=23)	18 (78%) said special events were very useful 4 (17%) said special events were somewhat useful 1 (4%) said special events were a little useful
	25d (n=40)	32 (80%) said the other conferences they attended were very useful 5 (13%) said the other conferences they attended were somewhat useful 3 (8%) said the other conferences they attended were a little useful

2004 Cohort Team Lead Survey Results from Close-ended Questions

Decision Making:	1a (n=49)	39 (78%) said **a lot** for themselves 10 (20%) said **some** for themselves
To what extent did each of the	1b (n=49)	15 (31%) said **a lot** for any other team member 13 (26%) said **some** for any other team member

following influence the decision to join the Explorer Schools program?		14 (28%) said **none** for any other team member 8 (16%) said **a little** for any other team member
	1c (n=49)	18 (36%) said **none** for building principal 13 (22%) said **a lot** building principal 11 (23%) said **some** building principal 8 (16%) said **a little** building principal
	1d (n=49)	36 (74%) said **none** for science and math teacher not on the team 7 (14%) said **some** for science and math teacher not on the team 5 (10%) said **a lot** for science and math teacher not on the team 1(2%) said **a little** for science and math teacher not on the team
	1e (n=49)	35 (70%) said **none** other teachers besides science or mat not on the team 9 (18%) said **some** for science and math teacher not on the team 3 (6%) said **a lot** for science and math teacher not on the team 3 (6%) said **a lot** that for science and math teacher not on the team
	1f (n=49)	34 (68%) said **none** for any district or central staff 7 (14%) said **some** for any district or central staff 5 (10%) said **a lot** for any district or central staff 4 (8%) said **a little** for any district or central staff
	1g (n=49)	43 (86%) said **none** for parent of attending student 6 (12%) said **a lot** to **some** for parent of attending student 1 (2%) said **a little** for parent of attending student
	1h (n=48)	42 (84%) said **none** for community member without a child attending the school 3 (6%) said **some** for community member without a child attending the school 2 (4%) said **a lot** for community member without a child attending the school 2 (4%) said **a little** for community member without a child attending the school
Effectiveness of workshop	Q3	26 (52%) very effective 19 (38%) somewhat effective 3 (6%) neither effective nor ineffective 2 (4%) somewhat ineffective
Team members changed Times met Team satisfaction	Q4 Q5 Q6	34 (68%) team members have remained the same; 16 (32%) team members have changed 35 (72%) met 6 or more times; 6 (12%) met 4 times; 5 (10%) met 5 times; 3 (6%) met 2 times or less 26 (52%) satisfied; 19 (38%) very satisfied; 5 (10%) neither satisfied nor dissatisfied
School benefits	Q7	32 (64%) benefited a lot; 15 (30%) benefited some; 3 (6%) benefited a little
Strategic Plan design	Q10	33 (66%) team developed a draft with a few editing and writing the plan 6 (12%) a few members developed the plan after input from all group members 6 (12%) one of two team members developed the a draft and a few others provided feedback 4 (8%) one or two team members wrote the plan on their own with little feedback
	Q13 when	19 (38%) after school started 11 (22%) after regularly scheduled hours of the summer training 9 (18%) during regularly scheduled hours of the summer training 5 (10%) before the summer training 3 (6%) some time after the summer training and before school started 3 (6%) other

	Q14 How long?	19 (38%) took 9 to 16 hours to develop their plans 10 (20%) took more than 16 hours to develop their plans 10 (20%) took 6 to 8 hours to develop their plans 10 (20%) took 3 to 5 hours to develop their plans 1 (2%) took 1 to 2 hours to develop their plans
	Q15 Prob?	27 (54%) problems were encountered 23 (46%) no problems were encountered
Strategic Plan support	Q11	19 (38%) **a lot** of assistance from NASA field Center 18 (36%) **some** assistance from NASA field center 11 (22%) **a little** assistance from NASA field center 2 (4%) **no** assistance from NASA field center
	Q12	15 (30%) said field center staff provided feedback on rough draft during 2004 summer workshop 15 (30%) said field center staff provided feedback via email or phone during 2004 summer workshop 7 (13%) said field center staff met with team during workshop to discuss the plan 3 (6%) came to the school after the summer workshop and met with the team 8 (17%) received help from the center staff combinations of above 1 (2%) received other kinds of assistance from the center
Strategic Plan implementation	Q16	25 (50%) said the plan was **very important** to achieving their goals 15 (30%) said the plan was **important** to achieving their goals 10 (20%) said the plan was **somewhat important** to achieving their goals
	Q17	29 (58%) said they have accomplished some of their goals from the strategic plan 21 (48%) said it is too early in the implementation phase
	Q18	27 (54%) have not encountered problems while implementing the plan 22 (46%) encountered problems while implementing the plan
	Q26a	19 (38%) said actions of district office staff were **very critical** 17 (34%) said actions of district office staff were **somewhat** critical 8 (16%) said actions of district office staff were **not** critical 6 (12%) said actions of district office staff were **a little** critical
	Q26b	37 (74%) said actions of principal were **very critical** 10 (20%) said actions of principal were **somewhat critical** 3 (6%) said actions of principal were **a little or not** important at all
	Q26c	47 (98%) said actions of the Explorer school team were **very critical** 1 (2%) said actions of the Explorer school team were **somewhat critical**
	Q26d	25 (50%) said actions of any other staff besides the principal and team members were **somewhat** critical 14 (49%) said actions of any other staff besides the principal and team members were **very critical** 8 (16%) said actions of any other staff besides the principal and team members were **a little critical** 3 (6%) said actions of any other staff besides the principal and team members were **not critical** at all
	Q26e	36 (72%) said NASA regional center staff assistance were very critical 12 (24%) said NASA regional center staff assistance were somewhat critical

		2 (4%) said NASA regional center staff assistance were not critical at all
Center support	Q19	48 (96%) received assistance from the center during the school year 2 (4%) received no assistance from the center during the school year
	Q19b	26 (55%) received school visits assistance 7 (15%) received assistance only via telephone 4 (9%) received assistance only via written communication 2 (4%) received assistance only via email 8 (17%) received assistance combinations of all above
	Q20	44 (88%) said they will request assistance 4 (8%) said they were not sure whether they will request assistance or not 2 (4%) said they have no plans to request assistance
	Q21	32 (65%) **very satisfied** with the overall support received from the NASA field centers 12 (25%) **satisfied** with the overall support received from the NASA field centers 4 (8%) **neither satisfied nor dissatisfied** with the support they received from the centers 1 (2%) **dissatisfied** with the support received from the centers
Use of NASA materials	Q22	48 (96%) said they have used NASA curriculum materials at their schools 1 (2%) said they don't know
Attending PD events	Q23	2 (13%) attended only NSTA symposium 2 (13%) attended only NES update session during NSTA symposiums 1 (6%) attended only special events 11 (69%) attended combinations of all above
	Q25a (n=13)	9 (69%) said NSTA symposium was very useful 3 (23%) said NSTA symposium was somewhat useful 1 (8%) said NSTA symposium was a little useful
	25b (n=8)	5 (63%) said Update session for Explorer schools was very useful 2 (25%) said Update session for Explorer schools was a little useful 1 (13%) said Update session for Explorer schools was somewhat useful
	25c (n=7)	5 (71%) said special events were very useful 1 (14%) said special events were somewhat useful 1 (14%) said special events were a little useful
	25d (n=16)	11 (69%) said the other conferences they attended were very useful 4 (25%) said the other conferences they attended were somewhat useful 1 (6%) said the other conferences they attended were a little useful

Attachment: **2004 and 2003 NES Team Leader Survey**

We would like your help in learning more about the NASA Explorer Schools Program. The information you provide will be utilized to improve the program and deepen our understanding of how the program operates in schools. Although the information you provide will be shared with NASA officials responsible for the program, your response will be combined with other responses in ways that make it impossible to determine which individual provided the information. Your name and contact information will be used only for follow-up questions and will never appear in any report.

Thanks for your participation.

Name: ______________________ School: ________________________

Daytime phone number: (___)__________ Email:___________________

1. To what extent did each of the following influence the decision to join the Explorer Schools program? Select one for each item.

	A lot	Some	A little	None
Yourself	☐	☐	☐	☐
Any other team member	☐	☐	☐	☐
Building principal	☐	☐	☐	☐
Science or Math teacher not on the team	☐	☐	☐	☐
Other teachers besides science or math not on the team	☐	☐	☐	☐
Any district or central office staff	☐	☐	☐	☐
Parent of an attending student	☐	☐	☐	☐
Community member without a child attending the school	☐	☐	☐	☐

2. When did you and your team attend the NASA summer week-long workshop for Explorer Schools? Select one

☐ Summer 2003
☐ Summer 2004

3. Overall how effective or ineffective was the NASA Summer workshop in preparing you to implement the Explorer Schools program in your school? Select one and answer follow-up question.

☐ Very effective
☐ Somewhat effective
☐ Neither effective nor ineffective
☐ Somewhat ineffective
☐ Very ineffective

Why did you respond as you did?

4. Has membership on your Explorer Schools Team remained the same or changed since attending the NASA summer school? Select one and answer follow-up question.
☐ Has remained the same
☐ Has changed (answer follow-up question)

This is how many of the original members remain ___________________

5. How often has your Explorer Schools team met during the last 6 month on matters related to the program?
☐ Never
☐ 1 time
☐ 2 times
☐ 3 times
☐ 4 times
☐ 5 times
☐ 6 or more times

6. How satisfied or dissatisfied would you say most team members are about being in the Explorer Schools Program? Select one and answer follow-up question.
☐ Very satisfied
☐ Satisfied
☐ Neither satisfied nor dissatisfied
☐ Dissatisfied
☐ Very Dissatisfied

Why did you respond as you did?

7. How much has your school benefited from being a part of the Explorer Schools Program? Select one and follow instructions.
☐ A lot (go to question 8)
☐ Some (go to question 8)
☐ A little (go to question 8)
☐ Not at all (go to question 9)

8. Identify and describe 1 to 3 important benefits that have resulted from your schools participation in the Explorer Schools Program.

9. In what ways have your expectations for the Explorer Schools Program not been met?

10. Which of the following statements best describes how your team developed the required Strategic, Implementation and Technology Plan? If none of the choices represent your experience, select "other" and describe your experience.
☐ The team developed a draft as a group with a few editing and writing the plan.
☐ A few team members developed the plan after input from all group members.
☐ One or two team members developed a draft and a few others provided feedback.
☐ One or two team members wrote the plan on their own with little feedback.

Other: Please Describe

11. How much assistance did your contacts at the NASA Field Center provide in developing your Strategic, Implementation and Technology Plan? Select one and follow instructions.
☐ A lot (go to question 12)
☐ Some (go to question 12)
☐ A little (go to question 12)
☐ None (go to question 13)

12. How did your contacts at the NASA Field Center assist your team in developing the Strategic, Implementation and Technology Plan? Select all that apply.
☐ Met with team during 2004 summer workshop to discuss potential plan
☐ Provided feedback on rough draft during 2004 summer workshop
☐ Provided feedback via email or phone during the development process
☐ Came to the school after the summer workshop and met with the team

Other: Please Describe

13. When was most of your Strategic, Implementation and Technology Plan developed? Select one or describe under "other".
☐Before the summer training
☐ During regularly scheduled hours of the summer training
☐ After regularly scheduled hours of the summer training
☐ Sometime after the summer training and before school started
☐ After school started

Other: Please Describe

14. Approximately how many hours did it take to develop the Strategic, Implementation and Technology Plan? Select one.
☐ Less than 1 hour
☐ From 1 to 2 hours
☐ From 3 to 5 hours
☐ From 6 to 8 hours
☐ From 9 to 16 hours
☐ More than 16 hours

15. Did your group experience any problems while the Strategic, Implementation and Technology Plan was being developed? Select one and answer follow-up question.
☐ No problems were encountered.
☐ Our group experienced the following problem(s) listed below:

16. Your Strategic, Implementation and Technology Plan should contribute to achieving your on-going school and staff improvement goals for science, mathematics, geography, and technology. Overall, how important would you say the plan is to achieving these goals? Select one and answer follow-up question.
☐ Not at all important
☐ Somewhat important
☐ Important
☐ Very important

Why do you feel this way?

17. Has anything from your Strategic, Implementation and Technology Plan been completed that contributes to achieving your on-going school and staff improvement goals for science, mathematics, geography, and technology? Select one and answer follow-up.
☐ No, it is too early in the implementation phase.
☐ Yes. Listed below are the activities and/or actions we have accomplished.

18. Has your team encountered any problems while implementing the Strategic, Implementation and Technology plan? Select one and answer follow-up.
☐ No
☐ Yes (answer follow-up question below)

The most troublesome problem is

19. During this school year, has anyone from your NASA Field Center assisted your team? Select one and answer follow-ups.
☐ I am not sure. (go to question 20)
☐ No assistance has been provided. (go to question 20)
☐ Yes (answer follow-up below and question 19a)

Assistance was provided for

19a. The assistance was provided though (check all that apply)
☐ A school visit
☐ Telephone
☐ Email
☐ Written correspondence
☐ Other

Other: Please Describe

20. Is your school planning to ask for assistance from your contacts at the NASA Field Center during the remainder of the Explorer Schools program? Select one.
☐ I am not sure
☐ No plans to request assistance
☐ Yes, assistance will be requested

21. To what extent are you satisfied or dissatisfied with the overall support your school has received from NASA staff during the past year? Select one and answer follow-up.
☐ Very satisfied
☐ Satisfied
☐ Neither satisfied nor dissatisfied
☐ Dissatisfied
☐ Very Dissatisfied

Why did you respond as you did?

22. Has any teacher at your school used NASA curriculum materials since you became part of the Explorer Schools program? Select one and answer follow-up.
☐ I really don't know
☐ No they have not
☐ Yes (answer follow-up below)

The following have been used at our school

23. Since joining Explorer Schools did team members or any school staff attend the following NASA funded supporting activities? Select all attended.
☐ National Science Teachers Association (NSTA) Symposium
☐ National Explorer Schools (NES) update session during NSTA Symposiums
☐ Special Events (e.g., History of Winter, KC-135 Reduced Gravity Aircraft, etc.?)
☐ Conferences/workshop sponsored by others with expenses paid through NASA

24. Since joining Explorer Schools did team member or any school staff attend other workshops/conferences besides those listed above to support your school's strategic plan? If yes, please provide workshop/conference title and sponsor.

25. If attended, how useful was the each of the following for implementing your school's strategic plan? Select one for each choice				
	Not at all useful	**A little useful**	**Somewhat useful**	**Very useful**
NSTA symposium (Skip question if not attended)	☐	☐	☐	☐
Update session for Explorer Schools (Skip question if not attended)	☐	☐	☐	☐
NASA Special Events (Skip question if not attended)	☐	☐	☐	☐
Conferences/workshops sponsored by others (Skip question if not attended)	☐	☐	☐	☐

26. To what extent is each listed factor critical to the implementation of your Strategic, Implementation and Technology Plan? Select one response for each.				
	Very critical	**Somewhat**	**A little**	**Not critical**
Actions of district office staff	☐	☐	☐	☐
Actions of principal	☐	☐	☐	☐
Actions of our Explorer Schools Team	☐	☐	☐	☐
Actions of any other school staff besides team members and principal	☐	☐	☐	☐
NASA Regional Center Staff assistance	☐	☐	☐	☐
NASA provided funding	☐	☐	☐	☐
Reputation of NASA itself	☐	☐	☐	☐
NASA sponsored training	☐	☐	☐	☐

27. Are there any factors not listed in the previous question that you consider critical to the implementation of your plan? If so, please identify these factors.

28. Have you learned any thing about implementing a math, science, and technology change effort from participating in the Explorer Schools that may help others just beginning the program? Select one and answer follow-up question.

☐ No, not really
☐ Yes (answer follow-up below)

Here's what I have learned that may be helpful for others:

29. Is the Explorer Schools program missing anything that affects its potential as a math, science, and technology change effort? Select one and answer follow-up

☐ Nothing that I can think of
☐ Yes (answer follow-up below)

The program is missing:

30. Is there anything not included in your previous responses that you would like to share about your Explorer Schools program experience? If so, we would appreciate your comments in the space provided.

	Ames	Dryden	Glenn	Goddard	JPL	Johonson	Kennedy Stennis	Langley	
N=	19	36	16	16	6	12	17	12	2
Overall rating of workshop	4.83	4.86	4.76	4.67	4.27	4.64	4.61	4.41	4
Effect on Teachers									
Relevance to Teachers	4.70	4.66	4.52	4.48	4.13	4.48	4.46	4.36	4
Teacher Confidence	4.56	4.39	4.44	4.32	4.17	4.33	4.50	4.31	4
Teacher Understanding of NASA	4.48	4.68	4.58	4.44	4.42	4.48	4.55	4.29	4
Inspiring to teachers	4.89	4.89	4.75	4.63	4.60	4.67	4.76	4.31	4
Teacher Skills and Knowledge	4.78	4.53	4.56	4.47	4.83	4.50	4.35	4.38	4
Use of instructional technology	3.85	4.33	4.07	4.04	4.00	4.09	4.39	4.35	4
Planning for use	4.78	4.86	4.81	4.60	4.50	4.50	4.71	4.46	4
Working with colleagues	3.71	4.53	4.69	4.45	4.50	4.08	4.44	4.08	4
Use inquiry instructional approaches	3.62	4.06	4.03	3.93	4.21	4.07	4.40	4.25	4
Effect on Teacher and STEM-G									
Integration of STEM-G	4.40	4.59	4.42	4.34	4.11	4.23	4.58	4.28	4
Application of STEM-G	4.67	4.74	4.38	4.41	4.17	4.58	4.59	4.54	4
Interest in STEM-G	4.32	4.39	4.40	4.32	4.10	4.35	4.34	4.35	4
Importance in contemporary life	4.58	4.68	4.66	4.67	4.40	4.38	4.55	4.83	4
Effect on students									

Inspiring students	4.78	4.78	4.63	4.66	5.00	4.67	4.88	4.69	4
Instructional technology for students	4.22	4.46	4.25	4.25	4.17	4.42	4.47	4.46	4
Family Involvement	4.56	4.67	4.38	4.34	4.80	4.58	4.56	4.62	4
Effect on technology use	3.97	4.37	4.13	4.11	4.06	4.20	4.41	4.38	4

NASA Explorer Schools Strategic Plan Analyses: A Process of Documenting and Categorizing "What Schools Said"

Objectives

The NASA Explorer Schools program designed and delivered by ten NASA field centers and implemented by 149 schools throughout the country is not composed of a standard set of interventions applied by all involved schools. Variations in the interventions present major challenges in delivering customized support and designing evaluation activities sensitive to a host of interventions expressed at the individual school level. Since the latitude of the program design, delivery, and implementation generate variance on the content and skills covered, mapping out what interventions emerged from the strategic plans was essential for program developers and evaluators to conduct their outreach support and effective formative evaluation activities. Thus, the primary purpose for conducting a document analysis on the 2003, 2004, and 2005 NASA Explorer Schools strategic plans was to investigate the specific goals, objectives, and activities school teams planed to employ in order to assess how schools were implementing the model. This analysis led to mapping out categories of interventions sensitive to individual school needs. Another purpose emerged at the completion of document analysis of the first year (2003 cohort) plans. A checklist of interventions was created to serve as a scaffolding tool to guide the incoming cohort members as to what strategies they could possibly employ when writing their plans.

Theoretical Framework

The NASA Explorer Evaluation model is based on a mixed-methodology with formative and summative evaluation methods to examine the nature, extent, and effect of the NASA inputs (financial, technical, and professional development support) on student learning, teacher professional growth, and family involvement (Davis, H., Palak, D., Martin, J. & Ruberg, L. 2006).

The NASA Explorer Schools Evaluation focuses on two key evaluation questions: (1) how the Explorer Schools model is being implemented and (2) what is effect of the program on students, teachers, families, and schools? Below these two key evaluation questions are stated in detail.

The two key evaluation questions are:

1. How is the Explorer Schools model being implemented?
    a. How does the NASA headquarters provide services/support to schools and centers?
    b. How do the NASA Explorer Schools field centers work with schools and NASA headquarters?
    c. How are the schools implementing the NASA Explorer Schools program?

2. What is the effect of the NASA Explorer Schools program?
    a. What is the effect of the program on students?
    b. What is the effect of the program on teachers?
    c. What is the effect of the program on families?
    d. What is the effect of the program on schools?

In order to assess the NASA Explorer Schools implementation and its effect on students, teachers, families, and schools several sources of data are collected from the program constituents (students, teachers, administrators, families, headquarters staff, and field center staff). Data sources include pre and post surveys, content test items for students, observation and coding of summer workshop agendas, school needs assessment, and school action plans. Focus groups and individual interviews are also conducted with the school teams and NASA personnel.

The current study of document analysis on the school action plans is one single end of this evaluation effort. The analysis described here is directed to collect evidence for (1) how the schools are implementing the NASA Explorer Schools program, and (2) what is the effect of the program on students, teachers, families, and schools.

Guided by these two evaluation questions, the driving force for conducting the document analysis was the following: understand, identify, and categorize the schools' customized approach to the NASA Explorer Schools program in the three years of implementation given the funding, support, and resources provided to schools by the NASA headquarters and NASA field centers. Since the NASA Explorer Schools model is neither guided by a set of interventions that are good for all participating schools nor designed or delivered by one professional development center, conducting the strategic plan analysis at an individual school level was crucial not only to assess the model, but also to measure the effect of the program on students, teachers, families, and schools.

Data Sources

The NASA Explorer Schools program requires that each school team made up of five individuals (four teachers and one administrator) who prepare and implement their school action plan which addresses each school team's unique needs. Action plan is a generic word that is used to refer to a collection of four documents: (1) a three year school strategic plan, (2) a three year school implementation plan, (3) technology plan, and (4) executive summary. In order to conduct this study of document analysis, all four data sources (if all four were available) were analyzed simultaneously for the 2003, 2004, and 2005 cohorts.

The strategic plan allows teams to identify their school's unique goals around the following five NASA Explorer Schools performance objectives: (a) increasing student interest in STEM disciplines, (b) increasing student application of STEM concepts, (c) increasing student interest in STEM related careers, (d) increasing teacher professional growth, and (e) increasing family involvement. Since the NASA Explorer Schools is a three-year partnership, school teams state their goals for each implementation year using a strategic plan template. This template simply provides scaffolding to help school teams author their plans.

The implementation plan allows teams to identify the specific activities and resources in relation to corresponding objectives they stated in their strategic plan. In other words, the implementation plan invites teams to outline the kinds of NASA content materials, programs, resources, people, and events schools will utilize in order to meet their customized needs. Using a template, school teams author their implementation plan by writing the activities, personnel, and timeline that they need to employ in order to implement the program goals they state in their strategic plan.

The technology plan helps team outline technology-related purchases they need to make in order to meet the Explorer Schools program goals they stated in the strategic plan. Each participating school is given a $10,000 grant to be used to upgrade or purchase technology schools need in order to successfully implement the program. Although schools are free to use this money to purchase any technology they need to implement the program, most schools choose to use the technology money to purchase videoconferencing equipment to have access to a variety of NASA content, people, and resources.

The executive summary allows teams to provide a narrative about the challenges, problems, and aspirations of their individual schools. In most cases, executive summary includes school demographics information, some statistics about student achievement scores, and contextual information about school’s unique challenges. Each school submits a 1-2 page long executive summary to set the scene for their school context.

Method

Several methods of document analysis were examined to find a close match that would allow the researcher to map out the variations and latitude of the NASA Explorer Schools program implementation (Denzin & Lincoln 2000; Guba & Lincoln, 1981; Miler & Huberman 1994; Patton, 2002). After a literature review on analyzing documents, this study was framed based on Guba and Lincoln’s (1981) framework.

Guba and Lincoln (1981) liken document analysis with content analysis. Accordingly, a method of content analysis has to satisfy three criteria: objectivity, systemization, and theoretical framework. The specific characteristics of the *messages* need to emerge from the material itself rather than be imposed by a prior theoretical construct. This process guarantees that the categories are grounded in the data and, consequently, in the context (Hodder, 2000; Guba and Lincoln, 1981). Document analysis requires vigilance directed toward context since context creates the framework for interpreting evidence. Without considering the context, Guba and Lincoln argue, the inquirer commits “the worst sin” by taking the evidence away from its milieu. To better understand the context for which school teams wrote their strategic plans, school executive summary reports were examined before starting the action plan analysis process.

According to Guba and Lincoln, document analysis consists of two types. One form of document analysis is concerned with the *message*. The analysis is directed toward the *message*, portion of communication is called “content analysis.” The second type of investigation is concerned with case studies of similar events, programs, settings, situations, but they do not all concern themselves with the same phenomenon. This type of document analysis is called “case-study aggregation analysis” and is used to report evaluation results from multiple sites of a locally adopted education program. Both of these types suited to the needs of the NASA Explorer School strategic plan analysis since the plans were collected from multiple cases (schools) and were concerned neither with the same message nor with the same phenomenon.

Procedure
As recommended by Guba and Lincoln, NASA Explorer Schools action plan analysis began with *context analysis* conducted on the first cohort of 2003 school executive summary reports. Context analysis set the scene or the context within which these plans were written. It allowed better interpretation and thus facilitated systematic recording of contextual school characteristics. As a result of the context analysis, following school characteristics were recorded for each school: school type (elementary, middle, and high school), school location (urban, rural, transient, isolated) school status (public, magnet, intermediate, charter, Title I), school demographics (racial profile, socio-economic status, percentage of ESL and Special Education students). Each of these school characteristics was recorded as a single unit in a spread sheet cell to be able to quantitatively describe school context information.

Action plan analysis continued with the remaining three documents (the strategic, implementation, and technology plan) while applying the two phase document analysis methodology explained in the methods section. The first phase was concerned with identifying and recording individual messages or interventions, such as use of a single product, use of a specific NASA personnel, type of teacher professional development, or type of a student learning activity etc. On a separate spreadsheet, these emerging interventions from the plans were recorded as a single entry on a separate spreadsheet cell. This primary analysis led to quantifying the types of interventions emerging at the individual school level.

The second phase was directed to categorize the interventions that emerged from the first phase under a meaningful unit or a category. This more advanced analysis was directed to examine a single message school by school while collapsing a collection of related messages under a single category. Categories of interventions, therefore, were created to be able to better describe how schools would implement their NASA Explorer Schools goals in relation to the following six major categories (teachers, students, families, technology, schools, and products). These categories formed the basis of a checklist of interventions. This checklist provides types of interventions appropriate for students, teachers, and families in addition to NASA products, NASA personnel, technology, and pedagogy necessary to implement these interventions.

The three step analysis (context, phase 1, and phase 2) described above was conducted on the first cohort of 2003 school plans. Once the interventions categorized under meaningful units emerged, the method of analysis was established. The same method was used to analyze the 2004 and 2005 plans using the checklist of interventions. This checklist allowed the program evaluators simply to check a type of intervention under a category related to one of the six categories. In cases where new interventions emerged from the 2004 and 2005 plans, the items on the checklist were expanded to include the new messages. Using the checklist, two evaluators recorded the interventions for each school. To reassure inter-rater reliability, two evaluators met to consolidate differences and oversights that might have occurred during the analysis.

Based on the lessons learned from the analysis of the 2003 plans, evaluators added one final component: recording qualitative feedback on the strengths and weaknesses of each school plan (See Appendix A). The three step analysis explained above provided descriptive quantitative data only without addressing strengths and weaknesses. Qualitative feedback on the strengths and weaknesses of school plans complemented the quantitative description. The combination of (a) quantitative feedback which answered the question of "what" and (b) qualitative feedback which answered the question of "how," is expected to benefit program evaluation and implementation efforts.

In conclusion, the process of document analysis was vigilant, iterative and required systematic interpretation of emerging messages. Determining the primary set of messages on school contextual information and interventions (NASA content, resources, people, pedagogy, technology) required revisiting the plans several times to capture, interpret, and record the interventions thoroughly and systematically. Once the initial messages were identified and placed under a specific category, the process from this point on was cumulative. Although the checklist was expanded to include emerging new codes from the 2004 and 2005 plans, the very same checklist of categories of interventions was used to analyze the 2004 and 2005 school plans. This cumulative method yielded both quantitative and qualitative description of schools' customized approach to the program implementation benefiting the program evaluators, program developers, and program implementers.

Results

Below aggregated results from the 2003, 2004, and 2005 school plans are reported. As seen in Table 1, of the 74% of schools from 2003 cohort, 88% of schools from 2005 cohort, and 90% of schools from the 2005 cohort reported to be Title I schools. Of the overall student population, between 61 to 62% of all schools across 2003, 2004, and 2005 reported to have been qualified for free or reduced lunch, an indicator of socio economic status (SES).

All three cohorts, 2003, 2004, and 2005, reported a high minority presence (65% for 2003, 59% for 2004, and 75% for 2005). The percentage of minority students was calculated by adding up the total number of African American, Hispanic, Asian, and Native American students and dividing this number with the overall student population for each cohort. Consequently, 65% of all students from 2003, 59% from 2004, and 75%

from 2005 were minority students. Further, specific minority groups were calculated for each cohort. The figures are reported for 2003, 2004, and 2005 cohorts consecutively: African American 39%, 34%, and 25%, Hispanic 18%, 17%, and 46%, Asian 6%, 5%, and 4%, and Native American 4%, 5%, and 1%, white 35%, 41%, and 24%.

Table 1: 2003, 2004, and 2005 School Profiles

	2003	2004	2005
School Locations			
Rural	35%	34%	24%
Suburban	21%	14%	20%
Urban	37%	52%	56%
School Characteristics			
Title I	74%	76%	88%
Low SES student population	63%	61%	62%
Overall student population	41.441	41.573	40.553
Race and Ethnicity			
Minority student population	65%	59%	75%
African American	39%	34%	25%
Hispanic/Latino	18%	17%	46%
Asian American	6%	5%	4%
Native American or Alaskan Native	4%	5%	1%
Caucasian White	35%	41%	25%

The analysis revealed that the interventions schools expressed were *multi-level* and *multi-faceted*. They were multi-level interventions, because an intervention, such as "using people," involved several types of NASA and non-NASA people. The same multi-level intervention was also multi-faceted depending on the purposes of using people. For example, people (either NASA or non-NASA) served three main purposes: (1) increasing student ability in science, technology, engineering, and math concepts, (2) increasing student interest in STEM careers, and (3) increasing professional growth among teachers. In addition, using *people* were also a critical component for implementing a specific pedagogy such as, project and inquiry-based learning. The same was true for other interventions: student events, teacher events, changes in school practices and programs, and finally connection and collaboration efforts. All these activities seem to have been related or contributing to the implementation of more than one NES objective.

Table 2: Summary of Strategic Plan Analysis of 2003, 2004, and 2005 Cohorts

	2003 N = 49		**2004 N = 38**		**2005 N = 47**	
Teacher Participation	n	%	n	%	n	%
PD - unspecified	36	74%	31	82%	28	60%
Conferences - Attend	18	37%	22	58%	22	47%
Conferences - Present	-	-	-	-	3	6%
Technology-related PD	14	29%	18	47%		
PD/workshop - Facilitate	14	29%	13	34%	17	36%
Instructional PD - Attend	10	21%	11	29%	32	68%
PD plan	12	25%	-	-	20	43%
Grant Writing	11	22%	10	21%		
Using NASA people						
NASA Science professionals	35	71%	25	66%	20	42%
AESP	9	19%	23	61%	22	47%
Guest Speakers	6	12%	6	16%	10	21%
NASA Center staff	2	4%	17	45%	16	34%
Using non-NASA people						
Guest Speaker	11	23%	21	55%	18	38%
Local people	5	10%	8	21%	10	21%
Science professionals	3	6%	9	24%		
Student Participation						
Presentations, Fairs	20	41%	17	45%	-	-
Fieldtrips	20	41%	20	53%	15	32%
Competitions	17	35%	18	47%	12	26%
Presentations	-	-	17	45%	13	49%
Clubs	13	27%	13	34%	21	45%
Career paths, shadows, days	24	49%	22	58%	-	-
Career days	-	-	-	-	26	55%
Career shadows/paths	-	-	-	-	25	53%
Mentoring/Apprenticeship	-	-	-	-	11	23%
Math/Science/Tech Fair	-	-	-	-	19	40%
Family Participation						
Family nights - unspecified	45	92%	36	95%	33	70%
Sky nights	36	73%	12	32%	-	-
Family nights – build/show	-	-	-	-	20	43%
Kick off	-	-	-	-	17	36%
Parental volunteering	-	-	-	-	11	23%
Parent/teacher conferences	-	-	-	-	8	17%
Collaboration						
Schools in Community	35	71%	23	61%	16	34%
University	15	31%	15	39%	22	47%
Other NES Schools	15	31%	9	24%	13	28%
Local Businesses	18	37%	17	45%	21	45%
Government agencies	-	-	-	-	9	19%
Informal educators	-	-	-	-	8	17%
Specific Pedagogy						
Inquiry	44	89%	28	74%	35	74%
Project-Based learning	32	65%	-	-	18	38%
Critical thinking	22	45%	-	-	6	13%
Problem-Based learning	-	-	6	17%	8	17%
Communication & Publicity						
Newsletters	-	-	-	-	10	21%
Bulletin board/banners/poster	25	51%	20	52%	27	57%
Involve local media	-	-	-	-	7	15%

Discussion
Below discussion of the study is directed toward the lessons learned from this process. The discussion is made as to explain the potency and limitations of the vigilant, cumulative process of action plan analysis to provide insight for those who consider employing a similar method.

Potency
According to Borko (2004) "a professional development program must be well defined and clearly specified" (p.9). A well defined system includes academic tasks, description of teaching, and learning outcomes. The NASA Explorer Schools professional development model - well defined in terms of its mission, goals, and objectives - is intended to have a great latitude in terms of its design, delivery, and implementation in order to better respond to individual school improvement needs. The NASA Explorer schools model is neither composed of a standard set of interventions applied by all involved schools nor is it designed and delivered at one professional development site. The program is being implemented by 149 schools in 50 states, the District of Columbia, and Puerto Rico. Further, the program is designed and delivered by several dozens of NASA field center staff at ten NASA field centers spread across the country in collaboration with four NASA Headquarters personnel in Washington, D.C.

Having this great latitude built into the NASA Explorer Schools program, documenting and analyzing school specific goals, objectives, and strategies all in interventions expressed at an individual school level was essential not only to deliver customized support but also to evaluate the effect of the program at a single school level. As a result, the action plan analysis began with a guiding research question of "what schools said" to understand how the schools were implementing the program from the perspectives of program evaluation and delivery. The information found out from this process helped the program evaluators answer evaluation questions in terms of the model and effect of the program. Further, document plan analysis results were potentially useful for the program design and support personnel at the ten NASA field centers since the analysis yielded information at an individual school level facilitating the plan and delivery of customized support to the schools. Finally, the information garnered from this process gained momentum as it unfolded challenges for school teams' authoring of the plans.

This final conclusion revealed the notion that the most school teams needed tools to help them author a clear, well-defined plan. As documented by several data sources employed in the NASA Explorer Schools program evaluation, those schools with real, clear plans were the ones to the road of successful program implementation. The schools with clear, well-defined plans were able to employ specific strategies, resources, and people they needed for effective program implementation. However, most school teams struggled to express their school specific strategies in the action plans as this meant aligning their goals with a seemingly endless list of NASA Explorer Schools products, curriculum, and opportunities available to the schools.

Facilitating the authoring process, therefore, also meant helping school teams identify and employ their custom specific approaches for successful program implementation. To facilitate the process, a document named "strategic plan guidelines" was created (see Appendix B). These guidelines provided a background about the significance of action planning and included question and answer type of explanations as to why and how the planning was important followed by recommendations, good and bad examples taken from anonymous plans, and a checklist of interventions that was used to record their plan analysis. It is anticipated that the Strategic Plan Guidelines will help incoming cohort of school teams author clearer plans leading to successful implementation.

Limitations

Action plan analysis has a great potential to help program evaluation and implementation efforts. Action plan analysis may be essentially important for programs with great variance and latitude in their design, delivery, and implementation as in the case of the NASA Explorer Schools program. When conducted with vigilance, while being committed to the context of a specific plan in the systematic process of identifying and interpreting the emerging messages, the method of action plan analysis employed here will help contribute to program success.

This proclamation, however, comes with a caveat. Action plan analysis is the first step of building toward measuring program evaluation efforts case by case. The information learned from this process only answers "what schools chose to implement." It does not answer "how and if schools will successfully implement what they said they would implement." In other words, information learned from the analysis can benefit the program evaluation efforts in regard to identifying the school specific strategies. This first step analysis in and of itself does not reveal results to be used to gauge what and to what extent schools actively participated in the program implementation. To measure the impact and effectiveness of schools' self-identified goals, strategies, and activities, the evaluation methods have to include other means of measures.

Conclusion

The process of document analysis requires extensive time commitment and vigilance, and demands analytic ability to identify mutually exclusive codes as well as some degree of judgment to be able to systematically record the emerging messages across cases in all documents. The method of analysis and information learned from this process served three meaningful ends for program evaluators, program developers, and school teams. As a result of strategic plan analysis, the program evaluators mapped out the categories of interventions expressed at a single school level to assess how each school will be implementing the program. Further, it has the potential to help the program developers understand specific interventions to be able to provide customized support to schools. Finally, lessons learned from this process can guide school teams toward authoring clear, well thought-out strategic plan goals, objectives, and activities focusing on teams' common vision of teaching and learning

The dissemination of this study is intended for two purposes. It provides a framework or a method of document analysis for those who are challenged by specifying and categorizing phenomena with no single unified form or context. The study further elaborates as to how this process can be used to help facilitate program delivery involving professional development personnel and program implementation involving school teams. The whole procedure helped crystallize *what commitments each school community specified* and *how each school community solidified its commitment to a vision based on their school needs* (Horsley-Loucks, Love, Stiles, Mundry, & Hewson, 2003).

Appendix A

Glenn Schools

School	Strengths	Weaknesses
Clara Barton IP SP TP	Clearly states numerous student activities, specific pedagogy and family involvement. Addresses content in STEM-G and integration within the school. Will connect with PTA to enhance parent involvement. Stated collaborations with other NES schools, local universities, and businesses.	Additional teacher PD/Wksp may enhance their knowledge and effectiveness. Need to say how the NES program will be used to address identified national and state standards in science and technology. NASA personnel and technology through the DLN are available and should be utilized. Need to be more specific as to what products will be used to meet the NES objectives.
Harlan Community IP SP	Addresses some professional development and clear student activities. Clear integration of program across disciplines and throughout school. Many specific uses of NASA people and resources, astronaut, technology, local universities, NES schools, other district schools, local businesses. Well thought-out publicity plan that involves art students to make posters, playing music of Voyager spacecraft school-wide, and displaying NES material at report card pick-ups.	More family involvement will help enhance the community presence of the program. Need to say how the NES program will be used to address identified national and state curriculum standards in science and technology.
Linton-Stockton IP05 IP06 IP07 SP	Teacher mentoring program (experienced teachers mentoring new teachers). Using technology to communicate with NASA professionals. Content area to contain STEM+G. Stresses inquiry based learning. Specific mention of NASA program (space camp) to involve students. Will collaborate with other NES schools, local universities, and informal educators. Will create an advisory board made up of teachers, students, staff, and NASA personal to direct NES program.	Additional NASA personnel are available to enhance the program. Why have no outside PD/Wksp been proposed for teachers? It is important to offer a variety of student and family activities to increase their involvement and investment. Need to say how the NES program will be used to address identified national and state curriculum standards. Additional community involvement may also enhance the programs effectiveness. A large variety of technology is available through the DLN. Communication and publicity is key to any successful school program.
Luis Munoz Marin IP SP	Clearly stated teacher activities including PD/Wksp, and PD plan. Student activities including career days, shadowing, and science fair. State requirements to be meet with STEM+G program, Program to be integrated school-wide. Address STEM+G content. Will make use of AESP, DLN, EarthKam, NASA TV, and other NASA print. Intended collaboration with other NES schools, non-NES schools, universities, and parents in the classroom.	Communication and publicity are key components to successful NES programs. Teachers may benefit from additional PD opportunities. Why have no non-NASA personnel been included in the strategic plan? State standards are addressed but no mention of national science standards.

Warrensville Heights	Specific purchase/incorporation of technology (smartboard, computers, DLN. Utilize NASA web and online, and NASA print. Inform community with newsletter, bulletin board, and "Wednesday Letter."	Collaborations with schools, universities, local businesses, and other NES schools can help enhance the value and effectiveness of the program. Why are so few PD opportunities given? Unique student opportunities would help increase student participation. NASA and non-NASA personnel are available and should be utilized. Collaborations can also enhance the program and are available within the community.

Goddard Schools

Goddard School SP	Have a good club for students ("Rocketeers") to be supported by parents ("Rocket Boosters").	Professional development is available and would enhance teacher understanding and participation, especially in inquiry. Family involvement would also enhance the program and encourage community involvement. NES materials fit well with national and state science curriculum standards. Why have no NASA and non-NASA personnel been involved in the strategic plan? Technology products and curriculum are available through the DLN and should be in the strategic plan. Communication and publicity are key components in a successful school-wide reform program. Plan is not clear as to how the NES goals will be achieved. Who are the key players? What are the specific student/teacher/parent activities? How the students will have career awareness?
Harrison Health and Space IP SP	Student activities are well described (career days, shadowing, clubs, field trips, presentations). Involving families in field trips. Use technology to integrate curriculum and add programs. Will use NASA personnel, and local science professionals. Will collaborate with other non-NES schools, local universities, and local businesses.	Additional teacher activities would help to enhance the other proposed items. Why have no technology purchases been proposed? There is very little mention of the products and curriculum that NASA offers and how it will be utilized are present. Publicity and communication are key components in a successful school-wide reform program.
Oliver Hazard IP SP	Attention has been given to student activities and shadowing. Within the school, additions to the curriculum have been made as well as new programming developed. Curriculum will address problem-based and inquiry learning. A clear directive has been put forth to update current computer facilities, purchase projectors for classrooms, use robotics, and participate in web casts. The strategic plan mentions many products to be utilized (Foss Kit, NASA	Additional teacher activities would help to enhance the other proposed items. Family involvement is crucial to continued program success and it is recommended that this area be further addressed. Why little use of available NASA and non-NASA personnel? Need to say how the NES program will be used to address identified national and state curriculum standards in science and technology.

	Radio, Robotics, Teleconferencing, NASA print materials, and GIS). Communication and publicity is also clear and strong.	

Langley Schools

Arcadia Middle IP SP	Solid plan for PD/Wksp at the school and outside of school. Stated student to student mentoring program. Integrating curriculum change school-wide. Utilizing numerous programs to bring NASA materials to students in the classroom (S Cool, aeronautics, NASA media, videoconferencing, FMA live). Program will utilize NASA science professionals, NASA guest speakers, and non-NASA guest speakers, and specific pedagogy.	The value of specific student activities should be emphasized to increase student participation and interest. Additional family involvement will help increase community awareness of the program. Need to say how the NES program will be used to address identified national and state curriculum standards in science and technology. What collaborations will be attempted to enhance and further develop the program? What communication and publicity techniques will be used to increase awareness within the community? Consider revising statements such as “encourage higher-order thinking” to specify the activity, product, event etc..
Breckinridge County IP05 IP06 IP07 SP TP05 TP06	Strategic plan suggests an excellent program overall. Adequate attention given to PD/Wksp where teachers have monthly meetings and release time built-in. Students are to be involved in career shadowing and path recognition, fieldtrips, and academic fairs. State curriculum connection recognized. Resource center to be updated with NASA materials. Program will utilize NASA personnel for variety of activities. A variety of products and NASA curriculum to be used and incorporated. Will collaborate with other schools, universities, and local businesses. Will publicize program with school website, school board presentations, and involving local media.	Need to say how the NES program will be used to address identified national and state curriculum standards in science and technology. Family and community involvement events could have been better addresses.
Forrest Heights IP SP	A well-rounded approach. Excellent teacher activities including PD/Wksp, attend conferences, present at conferences, and training. Many student apprenticeship and career path opportunities. Creation of student portfolios. Alignment with state standards, add additional curriculum and bring it into all classrooms. Utilize NASA professionals, experts, and GS. Will use DLN, NASA resources, videoconferencing, NASA e-blast. Collaborations with local universities and local businesses. Publicity through web	Why is there limited family involvement in the proposed strategic plan (family night and take home project). Special Pedagogy could use additional attention (most likely doing project-based, problem-based learning and critical thinking activities but need to state them specifically).

	page, newsletter, and local media.	

Kate Walker Barrett IP SP	Will have teachers involved in PD. Students to be introduced to career paths and STEM+G careers. Add school curriculum, and address state standards through integration and application. Use DLN and videoconferencing.	Why are no specific PD/Wksp plans described for the teachers? What other activities will the students be engaged in to enhance their NES experience? Many NASA personnel, scientists, professionals as-well-as local professionals are available and are a valuable resource. A great deal of NASA products and curriculum are available and will enhance this NES strategic plan. Why have no collaborations been addressed? Communication and publicity is an important part of a successful program and should be considered. Overall the plan is too general. How will the Barrett school expand student knowledge or and student participation in STEM?
Tucker Valley IP SP	Large emphasis on inquiry based learning. Student performance is major focus and it is stated that it will equal or exceed national averages. Program will allow students to do independent activities in science, math, and technology. A large amount of PD is listed. A “homework help” program has been created to parent involvement. DLN will be utilized.	Family involvement in kick-off events and back-to-school nights can enhance interest and participation. Why have NASA personnel been utilized so little and non-NASA personnel not at all? Collaborations with other NES and non-NES’ as-well-as local businesses and informal educators may enhance the scope of the program. Why is there little mention of communication and publicity?
Vance Elementary SP	Have a clear plan to raise the academic achievement level of all students in math and science. Focused on NCLB and accountability. Will collaborate with schools and local businesses.	Needs to make explicit use of NASA resources, personnel, products, curriculum, and support available to NES schools. Overall, the plan does not specify NASA resources, people, as well as family and teacher activities that will be used to achieve NES goals.

JPL Schools

School	Strengths of NES Plan	Weaknesses of NES Plan
Nestle	Integrating NASA [activities] into existing math, science, & reading activities will help build sustainability for the new initiatives. Getting the students involved in collecting and graphing the data they gather from NASA inquiry activities provides an effective way to reinforce the STEM+G content/processes associated with the NASA activities. These activities also help build a foundation for student research projects that follow as part of the plan. The ideas for publicity and science-centered family nights reinforce the integration of NASA activities. Good use of variety of specific pedagogy and NASA activities.	The professional development for teachers, "educate teachers in NES opportunities" does not provide enough detail regarding the content of the training or how the training will be done. The plan is not clear about what specific NASA curriculum, student career, teacher, and family activities will be used. "Engaging students in career exploration," what careers, how are the students engage and what specific activities they are going to explore?
Columbia	Engaging students in STEM+G careers through multiple means/media, field trips, and interactions with role models while also reinforcing student STEM-related inquiry activities. Offering professional development in new technology to all staff. Developing documentation to show alignment between learning activities, NASA resources, and state standards	Need to provide more details about what specific STEM+G activities will be used, what new technologies will be purchased (in addition to videoconferencing units), and topics for teacher professional development. Avoid using incomplete sentences such as "utilize NES training" Explain what part of NES training will be used for what purpose.
Los Angeles	Getting students involved in the creation of displays for student artifacts will help students feel ownership of this program. Sharing information with all school staff will help build school-wide support. Getting teachers involved in lesson-design using NASA materials will encourage teacher professional development and involvement.	Need to be more specific about what inquiry activities will be used and how they can be integrated into the existing curriculum. The plan lacks outlining specific teacher professional development activities. How do you plan to "engage students in NASA career explorations." Collaboration and publicity activities could have strengthen the plan.

School	Strengths of NES Plan	Weaknesses of NES Plan
Village	Integrating the use of computers and software to perform tests, collect data, analyze relationships, and display data in all math/science classes will help encourage students to talk about their data collection and analysis—modeling real science practices. Including technology upgrades to plan for sustainability demonstrates good planning. Involving all staff and building on individual staff development plans will help support school-wide benefits to the program and also support sustainability. Offering enrichment activities for the home will underscore the importance of family involvement. Integrating the NASA activities across all content areas.	Collaboration, publicity, and partnership with community and/other educational organizations would add strengths to the plan and ensure sustainability.
Charles Kranz	Getting all staff involved in technology training and integration into the curriculum will help support sustainability. Showcasing student inquiry research in the cafeteria will reward student achievement. Developing inter-disciplinary partnerships w/n the school will help engage more teachers and students in STEM-initiatives. The multi-level involvement of parents and community will help build support for the program. Use of the Science Pacing Chart will help document the goals, objectives, and progress of program.	Need to be more specific about which inquiry activities are being used and how they will be integrated across the curriculum. Need to identify local and national competitions that will be offered to students and show how these enrichment activities relate to the inquiry activities being added to the curriculum.

Johnson Schools

School	Strengths	Weaknesses
Ysleta Middle	• Partnership with local and feeder schools as well as local agencies are in place • Collaboration with non-NES schools and non-NES teachers at the same school, NASA personnel will strengthen your program • Student career interest is in place	• The goals pertaining to increase professional growth and involving families are not expanded well • How do you/what do you provide to increase opportunities for professional growth? • How do you create an environment that is conducive to family involvement?

		• What specific pedagogy do you use when integrating technology and NASA materials?
Raul Besterio IP, SP	• Involving the entire faculty body of all disciplines at school and integrating NASA resources into all subjects/disciplines will facilitate successful program implementation and sustainability • Collaboration with other NES schools and local universities is in place • A strong plan to increase student career interest	• Plan is weak in terms of involving families. Family component and community connections are not well explained in the plan •
Oak Hills IP, SP, TP	• Integration of specific NASA curriculum materials into the curriculum • Great focus on increasing student career interest and family involvement • Identifying specific pedagogy to increase student interest in STEM+G disciplines • Collaboration with NES schools, local businesses, and universities is in place	• Involving the entire faculty body and school community is essential to ensure successful implementation and sustainability of the program.
Little Wound School SP, IP	• Excellent use of teacher, family, student activities. • A good plan is in place to start a successful implementation	• A PD plan or more specific outline of teacher professional development activities could have enhanced the plan. • What about collaboration with local universities and businesses? •
Fox Meadow SP, IP	• Good use of student, teacher, and family activities • Great focus on collaboration with other schools, teachers at the same school, schools in the district, and local businesses	• Lack of specific pedagogy when integrating technology and NASA resources • What specific NASA products are intended to be integrated?
Todd County Middle School SP	• Integration of NASA resources and involving the entire school staff in implementation • Use of DLN to connect students to NASA scientist and content	• An implementation plan would have been helpful to flesh out the specific activities your team planned to implement in order to increase student STEM

		knowledge and career interest and family involvement. • Collaboration with local and distant people and businesses/universities as well as publicity of NES activities at school are not addressed in the plan.

Marshall Schools

Harris Health and Science Elementary School	• Involving the entire school body in the implementation of the NES program • Good use of AESPs to help run PD at school • Good use visuals to publicize NES activities • Inquiry-based learning and DLN activities are highlighted • Collaboration and communication are in place	• Career component is addressed too broadly. Other than AESPs and using unspecified NASA resources, what other career related activities can be conducted? • Family involvement could have been made more specific. What other ways can you involve families? • What specific NASA products/resources are intended to be used?
Jones Cove Elementary School IP, SP	• Good use of local and community members in addressing NES objectives • Good use of publicity and getting students involved with NES activities through visuals • Emphasis on purchasing and using DLN equipment	• Family involvement component is weak in the plan. Any follow-up, recruitment has planned to get families involved? • Any future plans for getting the entire school community involved in the NES program?
Hobgood Elementary School SP, IP	• Good use of NASA personnel and scientists to increase student ability to apply STEM concepts • Good use of visuals to increase student interest in the NES program • Using DLN to connect teachers and students to live resources and content	• Career component could have been addressed better. How would you increase student career opportunities related to STEM+G? • How would you expose students to STEM careers and what would you do to engage students in career explorations? • What about family involvement? What specific activities can be incorporated to increase family involvement?
Caddo Parish	• Great ideas and activities to get students interested in STEM+G	• What specific pedagogy do plan to use when integrating NASA

School IP, SP	concepts • Good use of community members, AEPS, and families to help with NES implementation • Excellent use of publicity to recruit community members • Emphasis on communication and collaboration between the school and families as well as between NES and non-NES teachers	resources? • What specific products and content areas will be addressed?
Sioux City Community District SP	• Great emphasis on publicity and communication of NES activities to the district and community • Involving the entire school to the NES program activities • Good use of student clubs and career related activities (career days, fairs, and interviews)	• What specific pedagogy will be used when implementing the NES program? • What about specific products and content are planned to be integrated? • An implementation plan would have helped to put the specific activities in context.
Aberdeen Middle school SP, IP	• Excellent ideas and activities in getting the students and families involved. • Good plan for technology integration • Great emphasis on teacher professional growth	• Extending the NES program to other teachers at school will ensure success of implementation and sustainability • Collaboration with other NES schools local and distant people/and resources have not been addressed.

Appendix B

Action Plan Writing Guidelines[17]

"Change is a journey not a blueprint." – Michael Fullan

1. What is an action plan?

Your action plan (strategic and implementation plan combined) outlines your team's common vision of teaching and learning based on your school improvement plan. Your action plan is charged by your *Dreams* about your school speaks to your *Vision*, which sketches a road map to your *Mission*.

2. I am not sure about "why" I need to write the plan.

The vision of teaching, learning, based on standards is the "**why**" of your plan. You may find writing your school action plan challenging. The tension between your vision and current reality will fuel your team's goal setting and planning, drive the desire to change, and give meaning to the daily tasks of implementing your mission. As you reflect on and evaluate your goals (vision) in relation to your implementation (mission), you will find yourself how closely your school community is moving closer to its vision and recommit to the future you want for your own professional growth and student learning.

3. I understand the dream, vision, and mission part, but I am not sure "how" I should write what I envision to implement.

Your action plan outlines "*how your school community solidifies its commitment to a vision based on your school needs*." At first, you may think and perhaps experience (we hope not!) the process of developing your vision as a meaningless exercise of putting words on paper that may either promptly ignored, written and embraced by only a few, or so general as to inspire no one. We acknowledge the fact that vision of science and mathematics reform is rooted in deeply held beliefs and assumptions. Developing a truly shared and compelling vision is a complex and long-term process. It is important that your vision statements in your school action plan are written based on shared knowledge based on the standards your school desires to reach.

As Michael Fullan puts it in words, "vision emerges from, more than it precedes, action." Fullan further suggests "ready, fire, aim" sequence. *Ready* implies that you start implementing the NASA Explorer Schools program with a purpose which may not necessarily reflect your perfect shared vision. *Fire* is implementing your program, which is about doing, learning, reflecting, and applying new knowledge and skills that the vision is clarified. *Aim* is crystallizing new beliefs and clarifying and strengthening the sense of shared purpose. This is why we encourage you to look back to your plan during implementation and reflect on your actions in relation to your vision.

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[17] The content of these guidelines are adapted from this book: Designing Professional Development for Teachers of Science and Mathematics: Horsley-Loucks, S., Love, N., Stiles, K.E., Mundry, S., & Hewson, P.W. (2003)

4. How do we begin to write our school action plan?
Your action plan will speak to your collective vision and set of commitments your team envisions on behalf of your school. On the next page you will find recommendations and guiding questions to help you build this collective vision.

Action Plan Writing Recommendations

1. We encourage you to submit both your Strategic and Implementation Plan.
There is a good reason for this recommendation since the strategic and implementation plan are complementary to each other. **Your Strategic Plan** outlines the specific goals your school team will employ during the next three years when implementing the 5 major objectives. Don't think of goals as *activities* such as, organizing student competitions for students and attending professional development conferences for teachers. Instead think of goals as *accomplishments* or *outcomes*: students will use inquiry in the class projects to demonstrate their application of STEM concepts and teachers will learn inquiry-based learning strategies by attending conferences.

So, the goals are your outcomes or accomplishments. They answer questions like:
   1. What would we see if we were successful?
   2. What would have changed for students, teachers, families, and for your entire school?

You should write your goals in the Strategic Plan. The goals you select to implement should be *specific*, *attainable*, and *measurable*. For example, the goal "teachers will apply inquiry-based learning strategies" is clear, but it does not tell us what specific activities you are going to employ, who are going to do them, and how you are going to measure the results. It is in the Implementation plan that you explain what specific activities you have for your attainable, measurable goals.

Implementation Plan invites you to write the specific activities and other details in relation to corresponding goals (accomplishments). The Implementation Plan answers the following questions:
   1. What specific activities you are going to employ in relation to the goal?
   2. Who will do or involve in these activities?
   3. When will they take place or how often do you plan to do them?
   4. How will you measure the results?

2. We advise you first start with goals you want to accomplish for students.
First start writing specific goals for students before selecting goals for professional growth and family involvement. Goals for teachers and families should flow directly out of goals for students. If students are going to increase their interest in STEM, their ability to apply STEM concepts, and their knowledge about STEM careers, what do teachers need to know and do to be able to realize these objectives.

3. We advise you then use the checklist to select specific activities.
The checklist will give you a list of student, teacher, and family activities you might select to employ to achieve your goals about students, teachers, and families. List your activities for each goal under "Task Description." While thinking about this specific activity, answer the other question about due date for completion, number and name of people involved, and plans for measuring the outcomes.

Some Good and Bad Examples of Strategic Plan Statements

Below some good and bad examples of strategic plan statements are presented. These statements are directly taken out from the plans of previous years. Reviewer's comments provide reasons as to why these examples are good or bad.

Good Examples:

Performance Objective: Increase student interest and participation in STEM.

- Integrate NASA resources (print, online, DLN, AESP resources) into the existing curriculum. Focus on robotics, physiology, earth science and reduced gravity.

Reviewer's comments:

- Specific focus on integration of certain NASA curriculum and resources

Performance Objective: Increase student ability to apply STEM concepts.

- Incorporate inquiry and problem based learning into the science and geography curriculum utilizing AESP, DLN, and NASA resources: 7th grade students will incorporate ISS Earthcam into Science and Geography.

Reviewer's comments:

- The goal statement makes is very clear the specific pedagogy (inquiry and PBL), content (science and geography), specific NASA product (ISS and Earthcam), and target grade level (7th grade) of students.

Performance Objective: Increase student knowledge about careers in STEM

- Introduce student to people with careers in STEMG to help create connections and knowledge in these areas. Things such as Science fair, visiting speakers, and partnerships with business within the community will be used to help create those connections.

Reviewer's comments:

- Goal in achieving the career objective is clear and specific. The statement specifically defines both the action plan (creating connections) and how these connections are to be made to increase student interest.

Performance Objective: Increase active participation and professional growth of educators in STEM.

- Introduce NES and variety of NASA resources and opportunities to the school teachers. The NES team and AESP personnel will conduct professional development for 6-8 staff

Reviewer's comments:

- Involving the other 6-8 teachers in the implementation of the NES program
- Specifying the types of professional development (what), the parties involved in the activity (who), persons who deliver the activity (whom), and the purpose (why) the activity makes the plan clear and specific.

Bad Examples:

Performance Objective: Increase family involvement in student learning

- Provide an environment that is conducive to parent involvement

Reviewer's comments:

- How do you create an environment that is conducive to parent involvement?
- What is that environment like?
- What special family activities can the school have to get the parents involved?

Performance Objective: Increase student knowledge about careers in STEM

- Explore careers in STEM
- Expose students in career opportunities as related to STEM

Reviewer's comment:

- The goal statement is not specific as to what careers will be explored, who will explore them (all students or students from grades 6-8), what specific activities will be conducted when exploring the careers.
- The goal statement does not make it specific as to what "career opportunities" students will be exposed to, by doing what, and by whom.

Guiding Questions for Strategic Plan Writing

The following questions are designed to encourage you to think about how you might go about writing your goals in your Strategic Plan. They are only some examples of goals and therefore do not present the entire list of goals you might select.

1. What is your vision for accomplishing student learning outcomes in STEM disciplines?
   a. Focus on inquiry
   b. Involve students in different learning environments
   c. Collaborate NASA personnel, local scientists, and local universities
   d. Tie NASA curriculum to national and state curriculum
   e. Implement a school wide curriculum change
   f. Use problem-based learning strategies
   g. Use critical thinking skills
   h. Integrate NASA curriculum

2. What is your vision for increasing student interest in STEM careers?
   a. Use NASA people
   b. Involve students in career exploration projects
   c. Collaborate with local universities and businesses
   d. Collaborate with other NES schools
   e. Involving students with mentors in the field
   f. Use specific NASA products

3. What is your vision for increasing teacher professional growth to address the goals you listed for students?
   a. Creating a professional development plan
   b. Collaborating with colleagues
   c. Building capacity to teach inquiry
   d. Use field center staff

4. What is your vision for increasing family involvement?
   a. Seeking partnership
   b. Increasing communication between school and home
   c. Publicity
   d. Seeking partnership and collaboration opportunities
   e. Establishing parent/school coalition, steering committee

5. Have you addressed implementing the NES program school wide?

6. Have you thought about aligning curriculum to integrate NASA products?

7. Have you thought about addressing national and state STEM standards?

Checklist of Activities for Implementation Plan Writing

1. Teacher Activities

❑ PD/Workshop - unspecified
❑ Instructional PD/Workshop - attend
❑ Technology PD/Workshop - attend
❑ PD/workshop – run/facilitate
❑ Conferences - attend
❑ Conferences - present
❑ PD plan
❑ Portfolios
❑ Mentoring
❑ Other (live demonstrations)
❑ Other (pre-assessment/evaluations)
❑ Other (a protocol for evaluating PD)

2. Student Activities

❑ Career Days
❑ Career Shadowing/Paths
❑ Clubs/Interest groups
❑ Mentoring/Apprenticeship
❑ Tutoring
❑ Portfolios
❑ Fieldtrips
❑ Conferences/Symposium
❑ Competitions
❑ Presentation
❑ Web pages
❑ Other (MST Fair)
❑ Other (LA/SS/Geo Fair)

3. Family Activities

❑ Family nights - unspecified
❑ Family night – build/experiment/showcase
❑ Sky/Star nights - unspecified
❑ Sky/Star nights – build/experiment/showcase
❑ Focus groups
❑ Field trips
❑ Parent and Teacher conferences/meetings
❑ Grant writing
❑ Other (open-house)
❑ Other (kick-off/picnic)
❑ Other (home experiments)
❑ Other (parents club)
❑ Other (homework help)
❑ Other (event planning/volunteers)
❑ Other (parent led workshops)
❑ Other (translations)

4. Schools

❑ Change/add curriculum
❑ Change/add program
❑ Change/add a room, library, resource center
❑ Address STEM+G National content
❑ Address STEM+G State content
❑ NCLB/Accountability
❑ Other Disciplines/Non-Accountability
❑ Other Disciplines/Accountability
❑ Sustainability
❑ Integration
❑ Other (assemblies)
❑ School wide

5. Using People from NASA

❑ Guest Speaker - unspecified
❑ NASA Science professionals
❑ NASA Scientists
❑ NASA Experts
❑ NASA Guest Speakers
❑ Center staff
❑ Astronauts
❑ Other

6. Using People not from NASA

❑ Guest Speakers – unspecified
❑ Local/community guest speaker
❑ Family guest speaker/presenter
❑ Local science professionals
❑ Other (mentors)
❑ Other (NOAA)

7. Content

❑ Science
❑ Technology
❑ Engineering
❑ Math
❑ Geography
❑ Reading
❑ All Disciplines
❑ Literacy

8. Special Pedagogy

❑ Critical thinking skills
❑ Extended learning
❑ Project-based learning
❑ Problem-based learning
❑ Inquiry

❑ Self-Directed learning
❑ Use/Integrate technology
❑ Other (Higher order thinking skills)
❑ Other (Leadership/team building)
❑ Other (hands-on)
❑ Other (Cooperative/Collaborative learning)
9. Purchasing and using technology
❑ Handheld
❑ Eboard / Smartboard
❑ Digital Cameras/Video cameras
❑ Printers
❑ Computer equipment
❑ TV/DVD
❑ DLN / Video conferencing equipment
❑ Projector
❑ Robotics
❑ Other (handheld computers)
❑ Other
11. Collaboration
❑ Collaborate with other NES schools
❑ Collaborate with non-NES schools at the school
❑ Collaborate with non-NES teachers at the school
❑ Collaborate with feeder schools
❑ Collaborate with schools in the district
❑ Collaborate with local universities
❑ Collaborate with local business
❑ Collaborate with informal educators
❑ Collaborate with government agencies
❑ Other (community)
❑ Other
12. Communication/Publicity
❑ Publicity
❑ Create or update school web pages
❑ Newsletters
❑ Banners/posters
❑ Other (marketing)
❑ Other (letter of introduction)
❑ Other (PTA)
❑ Other (create advisory board)
❑ Other (local media)
❑ Other (Weekly letter)
❑ Other (cable TV show)

10. Products and Curriculum
❑ Astro_Venture
❑ Collaboration Tools
❑ Competitions
❑ Challenger Space Center
❑ Earth/Science Materials
❑ Earthday
❑ EarthKam
❑ Email
❑ e-Missions
❑ Fieldtrips
❑ Foss Kits
❑ Global Position System (GPS)
❑ Globebox
❑ Honeywell
❑ International Space Station
❑ Mars Imaging
❑ NASA Activities/resources/curriculum
❑ NASA Radio
❑ NASA Tools
❑ NASA TV
❑ NASA Website
❑ Photo-Journalism
❑ Presentations
❑ Robotics
❑ Rocketry
❑ S'Cool
❑ Simulations
❑ Sky Calls
❑ Space Day
❑ Starlab
❑ Teleconferencing
❑ Telescope
❑ Videoconferencing
❑ Weather Tracking Software
❑ Space Day
❑ Starlab
❑ Teleconferencing
❑ Telescope
❑ Videoconferencing
❑ Weather Tracking Software
❑ Other
❑ Other

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Appendix: Student Symposium Student Survey Report

Effect of Annual Student Symposium on Students

Overview of Results

Overall, students' evaluation of the event was positive and even higher in May 2005 than May 2004 (on a scale of 1-5, 4.32 in May 2004 and 4.53 in May 2005). Students believe that the event will help them in their studies at school and to make connections (4.33 in May 2004 and 4.23 in May 2005). Overall, students expect to apply what they learned and were inspired by attending (4.36 in May 2004 and 4.32 in May 2005). In May 2004 and May 2005, 86% and 87% of students respectively planed to learn more about STEM-G careers after attending. Overall, students in May 2005 were more satisfied with the experience and reported that the pacing and scheduling was better than in May 2004. As further described below, the May 2005 event was successful in reaching the stated goals.

Background

Students and teachers from the 2003 and 2004 cohorts were invited to attend a 3-4 day symposium event at Johnson Space Center in Houston. Based on an application process, half the teams from the 2003 cohort were invited. All 2004 teams were invited to send representatives. Two students and one teacher representative from each attending Explorer school attended the Student Symposium to report on their activities throughout the year, to learn from each other and to participate in NASA activities. Team leads from 2005 cohort teams were invited to attend the workshops and be present for the nationwide announcement of the new teams on the last day of the Symposium. In May 2004, representatives from the 2003 teams, and the team leads for 2004 attended the symposium. The results of that symposium are presented here for comparison purposes:

The goals for students were to:

7. Provide a pleasurable, comfortable, and worthwhile experience
8. Affect their interest in STEM-G careers
9. Influence them to be interested in doing more STEM-G activities in and out of school
10. Inspire them to pursue STEM-G learning and careers
11. Give them an opportunity to present their NASA activities to an audience of their peers and NASA staff (see report on student presentations
12. Provide networking opportunities with students from other schools

Design

To evaluate the quality and effects of the Symposium, several instruments were used. Student and teacher surveys were administered before the last event. These self-report tools ask participants to rate the quality of their experience, describe their current levels of interest/skill/confidence and gauge its effects on the interests and behaviors in the future. When student teams presented, a team of NASA staff listened, asked them questions and wrote their responses. The results of the student survey analysis are presented here.

Participants

In May 2004, the 2003 cohort's teams (50 teachers, 100 students) were invited to attend with the team leaders from the new 2004 cohort. In May 2005, half of the 2003 and all of the 2004 teams (75 teachers, 150 students) and 2005 team leaders (50 teachers, no students) were invited to attend.

In the May 2004 and May 2005 Student Symposia, students reported the following demographics. 85 students and 90 teachers completed surveys in May 2004. 127 students and 99 teachers completed surveys in May 2005.

Student demographic data

Gender	May-04	May-05
Male	50%	49%
Female	50 %	47%
Ethnicity		
African American/Black	13%	20%
Hispanic/Latino	12%	8%
Asian American	8%	6%
Native American or Alaska	2%	9%
Caucasian/White	57%	41%
Other	8%	13%
No response	7%	2%

Methods
Survey data were analyzed by attendance year. For Likert scale items, means were computed. For choices, percentages of the respondents were computed. For open-ended responses, a content analysis yielded frequency of key ideas. Items were grouped by goal for reporting.

Findings
The results presented below are from the student surveys.

Students – Evaluation Questions by Symposium Goal
Items for Goal 1: Provide a pleasurable, comfortable, and worthwhile experience

- Overall, I think this event was…
- This event was a valuable experience.
- This event was well-organized
- What did you like about this NASA Explorer Schools event?
- What would you change about this NASA Explorer Schools event?

Students were asked to evaluate the event in general terms:

(1-5 scale)	May 2004	May 2005
Overall, I think this event was (1-very poor, 5-excellent)	4.44	4.63
This event was a valuable experience	4.65	4.68
This event was well organized	3.86	4.27
Overall	4.32	4.53

On a scale of 1-5, students rated the event highly overall (4.44, 4.63), as valuable (4.65, 4.68), and for being well organized (3.86, 4.27). The second year symposium was rated higher on organization. This higher rating may reflect improvements that were made based on the feedback from the first year. Activities in the second year started and ended on time with more time at the Space Center interacting with NASA educators. The comments about the facilities may have to do with the problems with not enough capacity in the elevators on the last morning as students were trying to get to breakfast and the buses with their luggage.

What did you like about this NASA Explorer School Event?

This open-ended question was intended to gauge what specific things students' liked about the Student Symposium. Student responses in the table below are reported based on the frequency of their responses. The students from the May 2004 symposium stated that they liked the following: visiting new places (29), learning about NASA (20), learning and doing new things (19), meeting new people (13), just about everything (11), and inquiry activities.

The students from the May 2005 symposium reported the following: They liked this well-organized fun event (38), meeting new people (33), learning about NASA (32), inquiry activities (28), hotel, facilities, and food (11), and finally visiting new places.

Students responses	May 2004		May 2005	
Visit new places	29	27%	9	5%
Learn about NASA	20	19%	32	17%
Learn about things, do things	19	18%	20	11%
Meet new people	13	12%	33	18%
Everything	11	10%	12	7%
Well organized busy, fun	7	7%	38	21%
Inquiry, exciting, activities	7	0%	28	15%
Hotel facilities (4), food (7)			11	5%

Below are sample responses of student comments from the May 2004 and May 2005 symposia presented in response to the question of what they liked about this event:

May 2004 Students:

That we got to discover more about things that we only understood a little about (inquiry)

I learned a lot more about NASA than I thought I would (learn more about NASA)
We got to see a lot of things from the future (exciting)
I thought it was exciting and educational. I learned a lot and I'm very glad I got to come (well organized, busy, fun)

I liked meeting people from all over the country and making friends (meeting other students)
This is a once in a lifetime experience and we are experiencing it

May 2005 Students:
That we all get to have time together to learn about other schools and their tradition, and we get to do a lot of activities together (meeting other students)
Everything was perfect (pleasing, comfortable, worthwhile)
I liked it a lot and I hope that I will be here next year (worthwhile)
I learned a lot of new things and explored many new fields (learn)
They explained everything so well and clear and they taught everybody everything about amazing things which can move on its own and isn't alive [Robots] (learned, inquiry)

What would you change about this NASA Explorer School event?
In the May 2004 symposium, students (49%) said they needed more free time, sleep, and alone time. Only 23% of the students from May 2005 symposium said they needed more free time, sleep and alone time. Instead, 33% of the May 2005 group wanted more time between activities, and a longer symposium.

As seen in table below, a majority of students (n = 30) from the May 2005 symposium reported to have satisfied with it as reflected in their responses that they would change nothing about the event. Higher student satisfaction rates of the May 2005 group may be attributed to the fact that first time involvement with a NASA-sponsored event added to the excitement and fascination of the incoming cohort students more so than the students who have been affiliated with NASA over a year.

Student responses	**May 2004**		**May 2005**	
More free time, sleep, alone time	41	49%	25	23%
'04 - Make schedules right (1), shorter bus rides (1), more days (2), later starting time (5) '05 – more interactive team building (3), planed out activities/more time between activities (23), make it longer (10)	9	11%	36	33%
Nothing	10	12%	30	28%
More time at space center	7	8%	1	1%
More activities, shorter speeches	5	6%	6	6%
Better, varied, diet sensitive food	5	6%	1	1%
Separate elementary and middle school	4	14%	1	1%
Better rooming arrangements	3	4%	9	8%

Below are sample responses of student comments from the May 2004 and May 2005 symposia presented in response to the question of what they would change about this event:

May 2004
I would change it by explaining everything a bit better (learning)

I think the schedule shouldn't be stuffed because the students are very tired at the end and if they're tired, they won't remember what they're there for (schedule)

I think you should put the 4th and 5th graders together and the 6th-9th grades together because I felt like I was doing little kid things. (learning, inquiry)

May 2005

I would change and add some more team-building activities, because I would liked to make more new friends. (meeting other students)
I would change nothing, It's all fantastic! (worthwhile)
I know it costs a lot of money, but I still wish it could be longer!! (worthwhile, inspiring)
I feel that this is such an outstanding event, more students should be able to attend. !! (worthwhile, inspiring)
This experience I will never forget. I just loved it. *!! (worthwhile, inspiring)*

While there are some conflicting comments, the students seem to be seeking a way to keep their energy up. Some suggest more interactive activities. Others want more systematic team-building and interaction with peers. In May 2004, some students commented on the frustration of being at EPCOT and the Center for such a short time, and being in Florida without having beach or pool time. In May 2005, there were many activities at the Center that were problem-solving or inquiry based, most with teamwork. In May 2005 many students continued to make comments about the need for more sleep or free time at the same time they were asking for more activities.

Goal 2: Affect student interest in STEM-G careers

It would be expected that the Explorer Schools program and the Symposium event in particular would have a positive effect on students' interest. To assess this effect, students were asked how much they like different subjects, what their current career interests were, about the effect of the symposium on their interests and what their plans were after the event.

Items for Goal 2: Affect their career interests

- Participation in this event has influenced my career interests.
- This event helped me to learn more about careers related to NASA.
- If I could choose a job right now, that job would involve science, math, technology, geography or no-STEM.
- After this event, I plan to learn more about STEM-G careers.

Students were asked to respond to the following question for the five topics shown below in the table:

If you could choose a job right now, that job would involve…

% students

	May 2004	May 2005
Science	59%	73%
Technology	49%	66%
Engineering	72%	77%
Math	23%	22%
Geography	10%	12%

In both May 2004 and May 2005, most students reported expecting to choose a job that involved science (59%, 73%) and engineering (72%, 77%). To a lesser extent (49%, 66%) students expected to choose jobs involving technology. About a quarter of students (23%, 22%) expected to be using math, while still fewer (10%, 12%) expected to be using geography.

There were noticeable differences between the years in the percentage of students expecting to use science (59%, 73%) and technology (49%, 66%). It is difficult to know how to interpret the higher percentage in the second year. Since the May 2005 symposium included 2003 students after two years in the program, it would be expected that they would have a greater understanding of STEM-G involved careers. The lower percentage of student choosing careers involving math may be lower due to the generally less obvious use of math in many science careers. The low percentage in geography may reflect the lack of emphasis on this area in the symposia agenda, and perhaps in the program in general.

	May 2004	**May 2005**
After this event, I plan to learn more about STEM-G careers	86%	87%
After this event, I plan to talk to classmates about STEM-G	59%	67%

In both years, more than three quarters of students reported planning to learn more about STEM-G careers after the event. More than half of the students in both years report planning to talk to classmates. It would be expected that a higher percentage would respond positively to this in the second symposium given that half of the students had been participating in the program for two years at that point.

	May 2004	**May 2005**
This event helped me to learn more about careers related to NASA	4.60	4.56
Participation in this event influenced my career interests	4.29	4.16

One a scale of 1-5, students in both years gave ratings to the symposium in helping them to learn more about NASA careers (4.60, 4.56) and having influenced their career interests (4.29, 4.16).

Students were asked about the effect of the symposium:

My experiences during this event have influenced my interest in taking additional courses in science, technology, math and/or geography. Yes=90% No=10%
If so, which areas?

% students

	May 2004	**May 2005**
Science	70%	61%
Math	48%	46%
Technology	82%	56%

Geography	19%	17%

The majority of the students report being influenced by the symposium in the areas of science (70%, 61%) and technology (82%, 56%). Almost half reported being influenced in math (48%, 46%). This is consistent with the percentage of students responding that they would choose careers involving math (49%, 66%), science (59%, 73%) and technology (72%, 77%). Only about 20% report being influenced in their interest in geography (19%, 17%). Again this is consistent with fewer students expecting to enter careers using geography (23%, 22%). The emphasis by the students on science, technology and math may reflect the degree of emphasis in the Explorer Schools training and activities.

Goal 3: Influence them to be interested in doing more STEM-G activities in and out of school

It would be expected that the Explorer Schools program and the Symposium event in particular would have a positive effect on students' choices of courses and activities in school, and how they spend their time outside school. To assess this effect, students were asked how much they like different subjects,

Items for Goal 3: Influence them to be interested in doing more STEM-G activities in and out of school.

In school:

- Rate how much you like these schools subjects: Science, Technology, Math, Geography, History, and English.
- After this event, I plan to talk to my classmates about STEM-G.
- My experiences during this event have influenced my interest in taking additional course in Science, Technology, Math and/or Geography.
- This event will help me in my studies at school.
- This event connects to what I am learning in school.

Rate how much you like each subject:

Most students reported really liking science (4.48, 4.35) and technology (4.59, 4.37). They rated math (4.09, 4.25) and history (4.01, 3.91) somewhat lower, but still above average. English (3.71, 3.73) and Geography (3.73, 3.75) were less well liked but still above the neutral rating (3.0). Given the positive ratings of History and English, these students seem to be positively predisposed to school in general as well as to STEM-G topics and activities.

Average rating, 1-5, 5=high

	May 2004	**May 2005**
Science	4.48	4.35
Math	4.09	4.25
Technology	4.59	4.37
Geography	3.73	3.75
History	4.01	3.91
English	3.71	3.73

The majority of students reported that the Student Symposium event influenced their interest in science (70%, 61%) and technology (82%, 56%). About half of the students who participated in the event reported influence on math interest (48%, 46%). Again, the influence on student interest in geography was the lowest of all subjects (19%, 17%).

My experiences during this event have influenced my interest in taking additional course in Science, Technology, Math and/or Geography

	May 2004	**May 2005**
Science	70%	61%
Math	48%	46%
Technology	82%	56%
Geography	19%	17%

	May 2004	**May 2005**
After this event, I plan to talk to my classmates about STEM-G	59%	67%

A high percentage of students feel the symposium influenced them to take more science and technology courses. More than half plan to talk to their classmates about STEM-G after the event.

(scale of 1-5)	**May 2004**	**May 2005**
This event will help me in my studies at school.	4.28	4.21
This event connects to what I am learning in school.	4.38	4.24
Overall	4.33	4.23

Students also felt the symposium was connected to what they were taking in school.

After this NASA event is over, I plan:

	May 2004	**May 2005**
I plan to watch TV for fun.	57%	46%
I plan to visit places featuring science.	83%	74%
I plan to visit STEM-G websites.	67%	64%
I plan to read books about STEM-G.	58%	69%
I plan to attend STEM-G events when not in school.	66%	61%
I plan to talk to family members about STEM-G.	74%	78%
I plan to talk to friends about STEM-G.	60%	60%
I plan to find out more about the science covered during this event.	87%	88%
Overall	69%	68%

Given what students stated as to what they are likely to do after this event, the Student Symposium seems to have positive effect on students' involvement with STEM-G activities. Higher percentages on visiting places featuring science (83%, 74%), interest in finding out more about science covered in the event (87%, 88%), and plans to talk with family members about STEM-G (74%, 78) are indicators of the positive effect of the Student Symposium.

Goal 4: Inspire them

- I expect to apply what I learned during this event.
- This event was inspiring.

High ratings on students' plans to apply what they learned during this event as well as their responses as to how inspiring the Symposium was indicators that the Student Symposium reached its goals in having a long term effect on increasing student application and interest in STEM disciplines and careers.

Average rating, 1-5, 5=high

	May 2004	**May 2005**
I expect to apply what I learned during this event.	4.31	4.25
This event was inspiring.	4.41	4.38
Overall	4.36	4.32

Goal 6: Provide networking opportunities with students from other schools

- What did you like about this event?
- What would you change about this event?

What did you like about this event?

and % of students responding with these ideas

	May 2004		**May 2005**	
Separate elementary and middle school	4	24%	1	3%
More interactive team building	0		3	8%
Meet new people	13	76 %	33	89%

Conclusions and Recommendations

The symposium format and event are clearly a success. The opportunity incorporates significant experiences for students; preparing to talk about their own projects, traveling to a NASA Center, having an audience of NASA professionals and their peers, hearing talks by older students doing more sophisticated work, and meeting scientists/astronauts.

"So many great things and ideas done so professionally. Hats off to great people doing a super job."

"Students love it. It meant so much to them. A lifetime of memories."

Student responses to survey indicate that the Symposium was an inspiring academic and personal experience for those students who attended this event. Their excitement and enthusiasm of being involved with a NASA event was evident in their responses about the value of the Student Symposium and degree to which the event influenced their short and long term academic and career related plans.

Student comments about improvement of the event were related to logistics and arrangements of the event schedule as opposed to overall content and impact of the event itself. Although students greatly varied in their responses as to what logistical improvement they wanted to see, generally speaking, they wished to have more break between the activities, longer activities, better accommodations in terms food, lodging, and transportation. There were many fewer concerns in the second year. Many of the concerns also reflect the age groups' interest in social and "down" time over academic and organized events that are to be expected, but not completely accommodated in this situation.

It is recommended that the event, model and format be continued with more attention to highly interactive events to keep students interest and energy high, involve them in working together across schools and regions so they have more of an opportunity to get to know each other, and to continue to provide activities that they do without their teachers so that teachers have more energy for learning and getting to know their peers.

Student Symposium Agenda – see below

NASA EXPLORER SCHOOLS 2005 STUDENT SYMPOSIUM /LEADERSHIP INSTITUTE
MAY 13-17, 2005
Johnson Space Center
HOUSTON, TEXAS

Friday, May 13

7:00pm-9:00pm	**Welcome Reception for 2005 NASA Explorer Schools** Distribution of notebooks and nametags *(2005 team leads)*	Hilton

Saturday, May 14

8:30am	Breakfast buffet	Hilton
9:00am-10:00am	**Welcome and Introductions** *Peg Steffen, Program Manager NASA Explorer Schools, NASA HQ* *(2005 team leads)*	Hilton

10:00am-11:15am	What it means to be a NASA Explorer School (NES)
	• Expectations of NASA
	• Expectations of NASA Explorer Schools
	    o Strategic and Implementation Plans
	    o Technology Budget
	    o MOU Procedures
	• Use of NASA logo
	• Use of NASA Explorer Schools Website
	Peg Steffen, Program Manager, NASA Explorer Schools, NASA HQ
	John Entwistle, NASA Explorer Schools Technology Coordinator
	Leah Bug-Townsend, NASA Explorer Schools Communication Coordinator
	(2005 team leads)
		Hilton

11:15am-11:30am	Break	
11:30am-12:15pm	**Leadership Academy** Deborah Tucker *(2005 team leads)*	Hilton
12:15pm-1:00pm	Lunch buffet	Hilton
1:00pm-3:00pm	**Leadership Academy** Deborah Tucker *(2005 team leads)*	
3:00pm-7:00pm	**Registration of Student Symposium for NASA Explorer School** *(2004 students, 2004 teachers, 2003 students, 2003 teachers)*	Hilton Lobby
3:00pm-3:15pm	Break	
3:15pm-5:00pm	**DLN** *Bob Starr* *(2005 team leads)*	Hilton
5:00pm-5:15pm	**Closing Remarks** *(2005 team leads)*	Hilton
5:15pm	Adjourn	
5:30pm-6:30pm	Dinner buffet	Hilton
6:30pm-7:00pm	**Welcome** • Opening Remarks, *Peg Steffen* • Expectations of Educators and Students, *Peg Steffen*	Hilton
7:00pm-7:45pm	**Motivating the Future of the Space Program** *Astronaut Donald R. Pettit, PhD. (all)*	Hilton
7:45pm-8:00pm	**Question & Answer Session** *Astronaut Donald R. Pettit, PhD. (all)*	Hilton
8:00pm-9:00pm	**Student/Teacher Social** "Get-to-Know" one another *(2005 team leads, 2004 students, 2004 teachers, 2003 students, 2003 teachers)*	Hilton
10:00pm	**Curfew**	

Sunday, May 15

7:30am-8:30am	Breakfast buffet	Hilton
8:30am	Board buses and Leave for Space Center Houston	
9:00am-10:15am	**Ice Breaker Activities** *(2004 students, 2003 students)*	Space Center Houston
9:00am-10:00am	**Panel Forum: Lessons Learned for the 2005 NES Teams** *(2005 team leads, 2004 teachers, 2003 teachers)*	Blast Off Theater
10:00am-10:15am	Educators will meet their students	
10:15am-11:00am	Break	
11:00am-11:55am	**2004 NES Student Seminar Presentations**	
	Kennedy Space Center (KSC) & Ames Research Center (ARC)	Silvermoon
	Dryden Flight Research Center (DFRC) & Goddard Space Flight Center (GSFC)	Club Room
	Glenn Research Center (GRC) & Jet Propulsion Laboratory (JPL)	Classroom 1
	Johnson Space Center (JSC) & Langley Research Center (LaRC)	Board Room
	Marshall Space Flight Center (MSFC) & Stennis Space Center (SSC)	Classroom 2
	(2005 team leads, 2004 students, 2004 teachers, 2003 students, 2003 teachers)	
12:00pm–12:55pm	Lunch buffet	
1:00pm–2:15pm	**2004 NES Student Seminar Presentations**	
	KSC & ARC	Silvermoon
	DFRC & GSFC	Club Room
	GRC & JPL	Classroom 1
	JSC & LaRC	Board Room
	MSFC & SSC	Classroom 2
	(2005 team leads, 2004 students, 2004 teachers, 2003 students, 2003 teachers)	
2:15pm-2:55pm	Break	
=3:00pm-4:30pm	**2003 NES Student Seminar Presentations**	
	KSC & ARC	Silvermoon
	DFRC & GSFC	Club Room
	GRC & JPL	Classroom 1
	JSC & LaRC	Board Room
	MSFC & SSC	Classroom 2
	(2005 team leads, 2004 students, 2004 teachers, 2003 students, 2003 teachers)	
4:30pm-5:00pm	Return to hotel	
5:00pm-6:00pm	**Free time**	
6:00pm–7:15pm	**Dinner with SHARP Students**	Hilton *(all)*
7:30pm–10:30pm	**Students at Space Center Houston** *(2004 students, 2003 students)*	Space Center Houston
7:30pm-10:30pm	**Managing Inquiry Safely in the 'hands-on' classroom** *Juliana Texley, NSTA, Tom Gadson, ENC (2005 team leads, 2004 teachers, 2003 teachers)*	Space Center Houston
11:00pm	**Curfew**	

Monday, May 16

7:00am-8:00am	Breakfast buffet	Hilto
8:00am	Buses depart for Space Center Houston	
8:30am–8:45am	**Johnson Space Center Welcome** *Johnson Space Center Representative (all)*	Space Center Theater

8:45am-9:15am	**Historical Overview of JSC** *Jerry Woodfill, (all)*	Space Center Theater
9:15am–10:00am	**IMAX "To Be an Astronaut"**	Space Center Theater
10:05am–11:15am	**Robonauts** *Jennifer Rochlis, PhD (all)*	Blast Off Theater
11:15am-12:15pm	**Lunch with NASA** *15 Guest JSC Representatives (all)*	Space Center Houston
12:15pm-12:30pm	**Exploration Panel Activity Assignments**	Space Center Houston

Group A (to be determined)

12:30pm-2:15pm	**JSC Bus Tour**	Tram Boarding Area
2:15pm-3:00pm	**Gift Shop**	Gift Shop
3:00pm-3:45pm	**Robotics/Lego** *Ota Lutz*	Starship Theater
3:45pm-4:30pm	**Bot Ball** *Art Kimura*	Blast Off Theater

Group B (to be determined)

12:30pm-1:15pm	**Bot Ball**	Blast Off Theater
1:15pm-3:00pm	**JSC Bus Tour**	Tram Boarding Area
3:00pm-3:45pm	**Gift Shop**	Gift Shop
3:45pm-4:30pm	**Robotics/Lego**	Starship Theater

Group C (to be determined)

12:30pm-1:15pm	**Robotics/Lego**	Starship Theater
1:15pm-2:00pm	**Bot Ball**	Blast Off Theater
2:00pm-3:45pm	**JSC Bus Tour**	Tram Boarding Area
3:45pm-4:30pm	**Gift Shop**	Gift Shop

Group D (to be determined)

12:30pm-1:15pm	**Gift Shop**	Gift Shop
1:15pm-2:00pm	**Robotics/Lego**	Starship Theater
2:00pm-2:45pm	**Bot Ball**	Blast Off Theater
2:45pm-4:30pm	**JSC Bus Tour**	Tram Boarding Area

4:45pm	Buses return to Hotel	
5:00pm-6:15pm	**Recognition Dinner with NES Challenge and National Student Involvement Projects awardees**	Hilton *(all)*
6:15pm	Board buses to Seabrook Intermediate	School
7:00pm-8:00pm	**FMA Live! Presentation** *(all)*	Seabrook Intermediate
8:00pm	Board buses for hotel	
10:00pm	**Curfew**	

Tuesday, May 17

7:30am-8:30am	Breakfast Buffet	Hilton
8:00am	Check-out	
8:30am	Board Buses to Space Center Houston	
9:00am-11:00am	**2005 NASA Explorer Schools Announcement** ****, NASA Administrator, NASA HQ* *Dr. Adena Loston, NASA Associate Administrator for Education, Office of Education, NASA HQ* *Dr. Bernice Alston, Division Director for Elementary and Secondary Education, Office of Education, NASA HQ*	Space Center Theater
12:00pm	Boxed Lunches Begin Airport Departures	

Student Symposium Teacher Survey

Summary of Results
Overall teachers report that the event was pleasing, comfortable, and worthwhile in both 2004 and 2005 (4.3 in both years on a scale from 1 to 5). Highest responses were reported where teachers were asked about how inspiring the program was to their ability to inspire their students (4.8) and how the event inspired their students (4.8). Teachers reported that the event increased their ability to apply STEM knowledge and careers and use inquiry in the classroom (4.4 overall in 2004 and 4.3 overall in 2005). They reported that the event was a valuable, inspiring experience for both themselves and their students who attended the event (4.6 overall for each year). In 2004 teachers gave the lowest scores to the alignment of the instructional approaches to reflect national standards and state framework (3.6). For 2005 teachers also scored this area lowest (3.8).

Background
As described in the Effect on Students section, students and teachers from the 2003 and 2004 cohorts were invited to attend a 3-4 day symposium at Johnson Space Center in Houston.

The symposium's goals for teachers were to:
1. Provide a pleasing, comfortable, and worthwhile experience.
2. Provide additional knowledge and skills.
3. Inspire the teachers.
4. Influence the teachers to apply integrated STEM-G knowledge and careers into their instruction.
5. Encourage the teachers to use inquiry methods.
6. Encourage the teachers to share what they have learned and NASA resources with other educators.
7. Identify enablers and barriers to implementation.

Design
Teacher self-report tools asked participants to rate the quality of their experience, describe their current levels of interest/skill/confidence, and gauge its effects on the interests and behaviors in the future. The results of the survey analysis are presented here.

Participants
In the spring of 2004, the 2003 cohort's teams (50 teachers, 100 students) attended with the team leaders from the new 2004 cohort. In 2005 half of the 2003 and all of the 2004 teams (75 teachers, 150 students) and 2005 team leaders (50 teachers, no students) were invited to attend.

Teachers reported the following demographics: 85 students and 90 teachers completed surveys in 2004; 127 students and 99 teachers completed surveys in 2005.

Teacher Demographic Data

Gender	2004	2005
Male	77%	20%
Female	21%	79%
Ethnicity		
African-American/Black	77%	8%
Hispanic/Latino	11%	7%
Asian American	6%	0%
Native American or Alaskan	3%	0%
Caucasian/White	1%	86%
Other	1%	0%

Methods
Survey data was analyzed by teacher and student groups. For Likert scale items means were computed. For choices percentages of the respondents were computed. For open-ended responses a content analysis yielded frequency of key ideas. Items were grouped by goal for reporting.

Teacher Survey Results

Teachers' Ratings by Goal in 2004 and 2005

Teachers' Goals	2004	2005
Provide a pleasing, comfortable, and worthwhile experience.	4.3	4.3
Provide additional knowledge and skills.	4.6	4.6
Inspire them.	4.4	4.3
Influence them to apply integrated STEM-G knowledge and careers into their instruction.	4.1	4.0
Encourage them to use inquiry methods.	4.2	4.3
Encourage them to share what they have learned and NASA resources with other educators.	4.4	4.3

Results by Goal

1. Provide a pleasing, comfortable, and worthwhile experience.

	2004	2005
Average overall rating of this event.	4.3	4.5
Average overall rating of the content presented during this event.	4.4	4.4
The information provided during the event is relevant to my role.	4.4	4.4
The concepts and skills taught in the program can be used in my work.	4.3	4.4
My personal learning objectives were met.	4.1	4.0
Overall	4.3	4.3

2. Inspire teachers to use NASA resources to meet the needs of their students.

	2004	2005
This program was inspiring.	4.7	4.7

Using NASA resources to enhance my instruction.	4.5	4.4
NASA-related materials provided can be integrated into my curriculum.	4.5	4.5
Inspire my students.	4.8	4.8
I have a better understanding of NASA's mission.	4.6	4.5
I have a better understanding of NASA's support for education.	4.6	4.5
The event will impact the inspiration of my students.	4.8	4.8
Overall	4.6	4.6

3. Influence teachers to apply and integrate STEM knowledge and careers into their instruction.

	2004	**2005**
The concepts and skills taught in the program can be used in my work.	4.3	4.4
Integrating STEM-G into my instruction more.	4.2	4.1
Incorporating more instructional technology in my instruction.	4.2	4.1
I expect to apply what I learned in this program.	4.7	4.6
Integrating STEM-G into my instruction more than I did in the past.	4.2	4.1
The event will impact my application of STEM-G.	4.7	4.5
The event will impact instructional technology for students.	4.5	4.5
The event will impact instructional technology for teachers.	4.5	4.4
Overall	4.4	4.3

4. Encourage teachers to use inquiry methods.

	2004	**2005**
Incorporating inquiry activities in my instruction.	4.1	4.0

5. Provide additional knowledge and skills.

	2004	**2005**
This event will impact instructional technology for teachers.	4.5	4.4
I acquired the skills and knowledge offered to participants.	4.4	4.4
Aligning instructional approaches to reflect national standards/state framework.	3.6	3.8
Knowledge and skills gained about instructional technology for students.	4.5	4.5
After participating in the program, I feel confident in my ability to apply knowledge and skills learned.	4.1	4.2
Overall	4.2	4.3

6. Share with others.

	2004	**2005**
Anticipated sharing what you learned with other professionals.	4.2	4.1
Increased family involvement.	4.5	4.4
Overall	4.4	4.3

7. Identify enablers to implementation.

	2004	2005
Opportunity to use the skills/knowledge.	74%	77%
Sufficient knowledge and understanding.	65%	60%
Support of reinforcement from supervisors.	53%	49%
Support or reinforcement from colleagues.	62%	56%
Computer and/or technology resources.	77%	68%
Systems and processes within the school will support use of skills/knowledge.	39%	33%
Funding.	66%	65%
Alignment between local and/or state standards with NASA content.	47%	62%

Other enablers.

Question 11: Other Comments	
1	My desire to provide 21st century learning and opportunities for students, staff, families, community—working together for the future.
1	Cooperative spirit between science and English department.
1	Student need and desire to learn.
1	Need more #s of NASA people. I'll find answers on web site.
1	Will use the resources independent of the funding so students will see achievement is linked to effort and initiation, not $.
1	No obstacles are too big!

8. Identify barriers to implementation.

	2004	2005
Lack of opportunity to use the skills/knowledge.	13%	9%
Insufficient knowledge and understanding.	12%	15%
Lack of support or reinforcement from supervisors.	33%	39%
Lack of support or reinforcement from colleagues.	31%	28%
Lack of computer and/or technology resources.	43%	28%
Not enough time to integrate the material in the curriculum.	41%	46%
Lack of funding.	41%	46%
Systems and processes within the school will not support use of skills/knowledge.	24%	21%
Lack of alignment between local and/or state standards with NASA content.	4%	11%

Other barriers.

Question 12: Other Comments	
1	District-level cooperation.
1	Most of the science activities too high for third grade.
1	We will honor the initiative/integrity of those who seek adventure and see

	possibilities.

General Comments from 2005 Symposium Event

Question 5: What would you change about this NASA Explorer Schools event?		
61	33%	More time *(**6**-between events) (**16**-between presentations/shorten presentations) (**8**-for teacher/NES interaction) (**37**-days too long/more sleep) (**8**-breaks) (**2**-for students to do activities) (**1**-to fill out surveys)*
16	9%	More free time *(**3**-to explore local area) (**4**-to absorb experience/info) (**4**-"down")*
15	9%	More networking/sharing ideas *(**8**-for teachers) (**3**-for teachers w/o students present) (**1**-for teachers who have been in the event for a while)*
9	9%	Better elevators *(**2**-took forever) (**1**-just got to breakfast when last door prize was given)*
7	9%	More hands-on activities for students/teachers *(**2**-during presentations)*
5	9%	Make presentation rooms bigger/better setup
4	9%	More race diversity *(**2**-not only minorities) (**1**-in presenters so that the kids can see a person of color as a role model in science, math, and technology) (**1**-in NASA personnel, all students of NES schools should be treated equally, but this symposium made it clear that this isn't the case) (**1**-many underserved schools north of NYC)*
4	9%	Allow more students to participate
4	9%	Put students on same floor as teachers
4	9%	More organization/preparation *(**1**-reservations need to be checked) (**1**-between announcing event and due date) (**1**-more notice for out-of-state trips)*
3	9%	Hotel *(**3**-not equipped to handle large # of people)*
3	9%	Better tour *(**1**-of the places where the astronauts train) (**2**-of the pool) (**1**-of center)*
3	9%	Still overwhelmed with what being an NES means *(**2**-have questions)*
2	9%	Nothing
2	9%	Better communications *(**1**-answer of fax/e-mails) (**2**-to whole NES team)*
2	9%	More workshops *(**1**-for math, tech, English, etc.)*
2	9%	Less sitting down
2	9%	Group rooms *(**1**-by school/center) (**1**-by time zone)*
2	9%	Kids need all rides at Space Center (Houston) free
2	9%	Give out presentation order *(**1**-so students know when they're going on) (**1**-so teachers/students pick)*
2	9%	Would like a list of activities available from NASA
2	9%	Food *(**1**-kid friendly) (**1**-low-carb)*

Others ideas mentioned once were:

- Take the kids into the NBL.
- Too much info.

- More interactive learning events.
- Robotics presentations should have been activity sessions.
- Break up presentations into smaller groups.
- Some of the sessions were not informational.
- Take kids from landlocked states to the seashore.
- More monitoring of 2003-2004 schools.
- Change seating locations.
- Integrate different disciplines.
- More diversity in presentation style (all PowerPoints except for one overhead).
- Allow students to use LEGOs in teams.
- More ideas to integrate robotics, etc., into our school.
- Make sure students, adults, NASA adults stay seated during student presentations.
- Last morning is bad time for pictures and medals.
- No speeches/presentations during meals.
- More math, science, Olympic, engaging activities for students at night.
- A “night on the town.”
- One session that models how the tech/resources can be used.
- Spread out student presentations over days.
- Request roommates.
- Don’t plan talk after dinner on day of symposium.
- Presentations w/kids and adults was more entertainment and not as educational for adults.
- More content (**1**-math) (**1**-student).
- Breakfast sessions by level.
- Names of states on nametags.
- Make PCs available for transfer of projects.
- Put NASA on buses w/their center people.

Question 19: If you have (participated in other NASA-sponsored events), what were they?		
15	38%	Last year’s NES Student Symposium 2004 (1-activities)
7	18%	Summer workshop/conference (2-NES)
7	18%	Goddard (1-Earth Sci PD, summer team PD) (2-summer workshop)
4	10%	NSTA conferences/convention
3	8%	Workshops (1-teacher)
2	5%	JPL 2004
2	5%	NCTM conferences (1-2005)
2	5%	SEMAA conferences
2	5%	Glenn conference
2	5%	Technology immersion

2	5%	NEAT conference
2	5%	Challenger Learning Center learning
2	5%	AESP (1-individual PD)
2	5%	Downlink/Online
2	5%	Seattle 03
2	5%	Wallop (1-to land launch 2004)
2	5%	Space Camp
2	5%	New Mexico
2	5%	Dallas
2	5%	JASON project
2	5%	Glenn Research Center activities

Others mentioned once were:

- WHO
- Team planning in Langley 2004
- Langley Researchers Technology Immersion
- JASON
- Mercury Messenger training
- Dryden (new)
- Ames training
- NSIP
- Internet training
- Tech Trek
- NASA data
- Kansas Cosmosphere
- Space Foundation
- Robot cooking
- NES core team planning last summer
- Cali
- Houston
- NEWEST
- Amazing Space (Space Telescope Science Institute)
- Soldier System Educator
- Many at Glenn
- Langley preservice teachers
- Langley SOLAR
- Integrating technology for the 21st century
- Student satellite hardware program
- Colorado Space Grant
- Nanotechnology summer camp

- Puerto Rico Space Grant
- Desert RATS OLN event
- Inservice at our school
- Ota coming to visit and teach kids
- Videoconferences
- Summer institute
- Explorer school workshop
- JSC summer 2004
- GLOBE
- Sun-Earth Day
- SEEC
- John Young reception
- Professional development through NES
- NAESP administrators conference
- Activities
- Missions
- New Urban NES 2003
- NASMCC 2004
- Houston Summer ’04
- NCTM spring ’05
- Yellowstone NP
- Space Center 2001
- NES Blastoff
- 2003 school member
- Huntsville training
- DC-9 training
- NSIP judge

Additional Comments:	
27	Thank you ☺ (1-Keep up the great work!!) (10-For the wonderful experience) (1-For the great effort) (3-life-changing experience) (2-For support and knowledge).
2	Hope to attend next year (1-NASA inspired the kids).
1	Opportunity is lifelong dream. NASA will be the catalyst and conduit to bring my destiny and dreams into reality. One of which is to return to the medical field—I’m also a medical technologist.
1	See what other students, teachers, and schools are doing to make learning relevant to their lives.
1	Let the coordinators coordinate; one contact is easier to work with.
1	I hope more can be done to encourage high school students to participate in NASA programs. My concern is what will happen to our middle school students after they leave.

1	NASA must take the lead and provide a conference opportunity that models inquiry learning.
1	This is something the students have never been able to do and may never be able to again.
1	Consider the age of students participating.
1	E-mails of fellow NES leads for follow-up after symposium.
1	Veronica Yale did a great job at the symposium.
1	The 15-mile radius for participation in SHARP limits participation. AESP should locate possible internship sites @ businesses & universities near NES schools.
1	Had trouble connecting this to second grade students; most of it was for middle-high school kids. Plan to check out resources on web.
1	This event allows students to dispel reputation that we are less than other schools in our community, and gain knowledge and confidence we need. Slow, steady process.
1	Let everyone know how important administrators are from the beginning of the event to prevent public bashing of us. I've heard repeatedly that there are no bad teachers, just bad choices. Well, this is true of all professions. Facts: We applied for this first, we are not all bad apples, we are all here.
1	We will get more in depth in the summer w/the curriculum resources, alignment, and technology integration.

Conclusions and Recommendations

The symposium format and event were clearly a success. The opportunity incorporated significant experiences for students: preparing to talk about their own projects, traveling to a NASA center, having an audience of NASA professionals and their peers, hearing talks by older students doing more sophisticated work, and meeting scientists/astronauts.

"*Students love it. It meant so much to them. A lifetime of memories.*"

Both teacher and student responses to the survey indicate that the symposium was an inspiring academic and personal experience for those students who attended this event. Their excitement and enthusiasm of being involved with a NASA event was evident in their responses about the value of the student symposium and degree to which the event influenced their short- and long-term academic and career related plans.

It is recommended that the event, model, and format be continued with more attention to highly interactive events to keep students' interest and energy high, to involve them in working together across schools and regions so they have more of an opportunity to get to know each other, and to continue to provide activities that they do without their teachers so that teachers have more energy for learning and getting to know their peers.

Friday, May 13

7:00pm-9:00pm	**Welcome Reception for 2005 NASA Explorer Schools** Distribution of notebooks and nametags *(2005 team leads)*	Hilton
	Saturday, May 14	
8:30am	Breakfast buffet	Hilton
9:00am-10:00am	**Welcome and Introductions** *Peg Steffen, Program Manager NASA Explorer Schools, NASA HQ* *(2005 team leads)*	Hilton

10:00am-11:15am	What it means to be a NASA Explorer School (NES)
	• Expectations of NASA
	• Expectations of NASA Explorer Schools
	    o Strategic and Implementation Plans
	    o Technology Budget
	    o MOU Procedures
	• Use of NASA logo
	• Use of NASA Explorer Schools Website
		Hilton

Peg Steffen, Program Manager,	***NASA Explorer Schools, NASA HQ*** *John Entwistle, NASA Explorer Schools Technology Coordinator* *Leah Bug-Townsend, NASA Explorer Schools Communication Coordinator* *(2005 team leads)*	
11:15am-11:30am	Break	
11:30am-12:15pm	**Leadership Academy** Deborah Tucker *(2005 team leads)*	Hilton
12:15pm-1:00pm	Lunch buffet	Hilton
1:00pm-3:00pm	**Leadership Academy** Deborah Tucker *(2005 team leads)*	
3:00pm-7:00pm	**Registration of Student Symposium for NASA Explorer School** *(2004 students, 2004 teachers, 2003 students, 2003 teachers)*	Hilton Lobby
3:00pm-3:15pm	Break	
3:15pm-5:00pm	**DLN** *Bob Starr* *(2005 team leads)*	Hilton
5:00pm-5:15pm	**Closing Remarks** *(2005 team leads)*	Hilton
5:15pm	Adjourn	
5:30pm-6:30pm	Dinner buffet	Hilton
6:30pm-7:00pm	**Welcome** • Opening Remarks, *Peg Steffen* • Expectations of Educators and Students, *Peg Steffen*	Hilton
7:00pm-7:45pm	**Motivating the Future of the Space Program** *Astronaut Donald R. Pettit, PhD. (all)*	Hilton
7:45pm-8:00pm	**Question & Answer Session** *Astronaut Donald R. Pettit, PhD. (all)*	Hilton
8:00pm-9:00pm	**Student/Teacher Social** “Get-to-Know” one another *(2005 team leads, 2004 students, 2004 teachers, 2003 students, 2003 teachers)*	Hilton
10:00pm	**Curfew**	

Sunday, May 15

7:30am-8:30am	Breakfast buffet	Hilton
8:30am	Board buses and Leave for Space Center Houston	
9:00am-10:15am	**Ice Breaker Activities** *(2004 students, 2003 students)*	Space Center Houston
9:00am-10:00am	**Panel Forum: Lessons Learned for the 2005 NES Teams** *(2005 team leads, 2004 teachers, 2003 teachers)*	Blast Off Theater
10:00am-10:15am	Educators will meet their students	
10:15am-11:00am	Break	
11:00am-11:55am	**2004 NES Student Seminar Presentations**	
	Kennedy Space Center (KSC) & Ames Research Center (ARC)	Silvermoon
	Dryden Flight Research Center (DFRC) & Goddard Space Flight Center (GSFC)	Club Room
	Glenn Research Center (GRC) & Jet Propulsion Laboratory (JPL)	Classroom 1
	Johnson Space Center (JSC) & Langley Research Center (LaRC)	Board Room
	Marshall Space Flight Center (MSFC) & Classroom 2 Stennis Space Center (SSC)	
	(2005 team leads, 2004 students, 2004 teachers, 2003 students, 2003 teachers)	
12:00pm–12:55pm	Lunch buffet	
1:00pm–2:15pm	**2004 NES Student Seminar Presentations**	
	KSC & ARC	Silvermoon
	DFRC & GSFC	Club Room
	GRC & JPL	Classroom 1
	JSC & LaRC	Board Room
	MSFC & SSC	Classroom 2
	(2005 team leads, 2004 students, 2004 teachers, 2003 students, 2003 teachers)	
2:15pm-2:55pm	Break	
=3:00pm-4:30pm	**2003 NES Student Seminar Presentations**	
	KSC & ARC	Silvermoon
	DFRC & GSFC	Club Room
	GRC & JPL	Classroom 1
	JSC & LaRC	Board Room
	MSFC & SSC	Classroom 2
	(2005 team leads, 2004 students, 2004 teachers, 2003 students, 2003 teachers)	
4:30pm-5:00pm	Return to hotel	
5:00pm-6:00pm	**Free time**	
6:00pm–7:15pm	**Dinner with SHARP Students**	Hilton *(all)*
7:30pm–10:30pm	**Students at Space Center Houston** *(2004 students, 2003 students)*	Space Center Houston
7:30pm-10:30pm	**Managing Inquiry Safely in the 'hands-on' classroom** *Juliana Texley, NSTA, Tom Gadson, ENC* *(2005 team leads, 2004 teachers, 2003 teachers)*	Space Center Houston
11:00pm	**Curfew**	

Monday, May 16

7:00am-8:00am	Breakfast buffet	Hilto
8:00am	Buses depart for Space Center Houston	
8:30am–8:45am	**Johnson Space Center Welcome** *Johnson Space Center Representative (all)*	Space Center Theater

8:45am-9:15am	**Historical Overview of JSC** *Jerry Woodfill, (all)*	Space Center Theater
9:15am–10:00am	**IMAX "To Be an Astronaut"**	Space Center Theater
10:05am–11:15am	**Robonauts** *Jennifer Rochlis, PhD (all)*	Blast Off Theater
11:15am-12:15pm	**Lunch with NASA** *15 Guest JSC Representatives (all)*	Space Center Houston
12:15pm-12:30pm	**Exploration Panel Activity Assignments**	Space Center Houston

Group A (to be determined)

12:30pm-2:15pm	**JSC Bus Tour**	Tram Boarding Area
2:15pm-3:00pm	**Gift Shop**	Gift Shop
3:00pm-3:45pm	**Robotics/Lego** *Ota Lutz*	Starship Theater
3:45pm-4:30pm	**Bot Ball***Art Kimura*	Blast Off Theater

Group B (to be determined)

12:30pm-1:15pm	**Bot Ball**	Blast Off Theater
1:15pm-3:00pm	**JSC Bus Tour**	Tram Boarding Area
3:00pm-3:45pm	**Gift Shop**	Gift Shop
3:45pm-4:30pm	**Robotics/Lego**	Starship Theater

Group C (to be determined)

12:30pm-1:15pm	**Robotics/Lego**	Starship Theater
1:15pm-2:00pm	**Bot Ball**	Blast Off Theater
2:00pm-3:45pm	**JSC Bus Tour**	Tram Boarding Area
3:45pm-4:30pm	**Gift Shop**	Gift Shop

Group D (to be determined)

12:30pm-1:15pm	**Gift Shop**	Gift Shop
1:15pm-2:00pm	**Robotics/Lego**	Starship Theater
2:00pm-2:45pm	**Bot Ball**	Blast Off Theater
2:45pm-4:30pm	**JSC Bus Tour**	Tram Boarding Area

4:45pm	Buses return to Hotel	
5:00pm-6:15pm	**Recognition Dinner with NES Challenge and National Student Involvement Projects awardees**	Hilton *(all)*
6:15pm	Board buses to Seabrook Intermediate	School
7:00pm-8:00pm	**FMA Live! Presentation** *(all)*	Seabrook Intermediate
8:00pm	Board buses for hotel	
10:00pm	**Curfew**	

Tuesday, May 17

7:30am-8:30am	Breakfast Buffet	Hilton
8:00am	Check-out	
8:30am	Board Buses to Space Center Houston	
9:00am-11:00am	**2005 NASA Explorer Schools Announcement** ****, NASA Administrator, NASA HQ* *Dr. Adena Loston, NASA Associate Administrator for Education, Office of Education, NASA HQ* *Dr. Bernice Alston, Division Director for Elementary and Secondary Education, Office of Education, NASA HQ*	Space Center Theater
12:00pm	Boxed Lunches Begin Airport Departures	

Student Symposium Student Research Presentations Report

Abstract
Students presented to their peers projects they had done during the past year as a result of Explorer School involvement at the 2005 Symposium. A panel of NASA staff listened to their presentations, asked them questions and gave them written feedback. The results from a content analysis of the students' responses were analyzed. When asked how the project had changed their feelings/attitudes toward science, technology, engineering, mathematics, and geography (STEM-G), 49% of students reported that their interest in STEM increased, 29% report their knowledge increased as a result of their own project. When asked specifically about how the project had changed their knowledge of STEM-G, 76% responded that their knowledge had increased in specific areas such as Newton's laws, rockets or robots. When asked how the project had changed their interest in STEM-G careers, 50% responded they were more interested in STEM-G careers, 32% said they were more interested in NASA careers from astronaut to mission controller and astronomer, and 18% said they had become more aware of the variety of career options in STEM-G.

1- How did this project change your feelings/attitude toward STEMG?
As seen in table below, majority of students reported that the Student Symposium increased student interest in STEM disciplines through demonstration of STEM concepts in the DLN and other activities. Increase in student knowledge followed student interest in STEM.

	N=84	
41	48.81%	Interest Increased - *(28-science) (6-math) (6- engineering) (3-space) (2-tech) (2- in all subjects) (1- ISS downlink) (1-Changed my field of study)) (1-interdisiplinary subjects like music) (1-in protecting the Earth) (1-in robotics) (1-interdisiplinary subjects like music) (1- ISS downlink) (1-in projects) (1-after Signals for Springs) (1-activities) (1-STEM-G careers)*
24	28.57%	Knowledge Increased - *(5- math, science) (3-science) (2-math) (1-through NASA) (1-glad ISS crew spoke slowly) (1-the change of a hypothesis) (1-engineer) (1-the environment)*
9	10.71%	Motivated / Excited / Fun - *(2- math, science) (1-creating something)*
4	4.76%	Experience Increased - *(2-rockets) (1-hands on)*
2	2.38%	More Understanding of topic/science - *(1- of topics) (1-of science)*
2	2.38%	It didn't - *(1- we already knew about topic) (1-already thought that it was interesting)*
2	2.38%	Activities

2- How did this project change your knowledge of STEMG?

	N=80	
61	76.25%	Knowledge Increased / Learned - *(14-math, data, graphs, angles) (14-astronomy / space) (13-science) (10-engineering) (7-forces of motion) (6-earth, ocean, atmosphere, weather) (6-robotics) (5-rockets) (4-technology) (4-Newton's laws) (2-in each subject) (2-volcanoes, earthquakes) (2- classroom learning: teaching to others, presenting) (1-broad range) (1-airports, flight properties) (1-teamwork) (1- kc135)*
9	11.25%	Interest Increased - *(2-science) (1-collecting data) (1-variety of fields) (1-NASA) (1-engineering)*
6	7.50%	Interest in STEMG careers Increased - *(2-scientist) (1-technology) (1-radiation)*
2	4.88%	Experience Increased - *(1-first flight, first sight of the ocean)*
2	2.50%	Learned how STEMG deals w/NASA

3- How did this project change your interest in a STEMG career?

	N=78	
39	50.00%	More Interest in STEM-G careers - *(17-scientist / science) (12-engineering / engineer) (5-math / mathematician) (2- space / astronomy) (1-because of tech and info learned) (1-in robotics) (1-technology) (1-radiation) (1- picked out school due to fieldtrip) (1-meteorology) (1-computer analyst) (1-paranormal investigator) (1-lawyer) (1-want to be doctor)*
25	32.05%	More Interest in NASA careers - *(11-space / astronaut)) (2-want to be an engineer for NASA) (1- science / scientist) (1-changed majors and will work at the Ames Research Center in astrobiology) (1-astronomer) (1-realize they need to study more STEMG to work at NASA) (1-computer scientist) (1-acountant) (1-mission controller) (1-sts designer)*
14	17.95%	More variety in career - *(1-marine biologist vs. oceanographer) (media/film) (1-computer programmer) (1-mechanical engineer, air force pilot) (1-robotics, engineering) (1-science teacher instead of a lawyer) (1-geological careers)*

Appendix: Student Interest Survey

Overview of Results

Students from Explorer Schools were asked to respond to an interest/career survey on science, math and technology content, processes and careers. Results were analyzed in terms of students' perceived competence, their knowledge, and their interest. After one year in the program, students report above average perceived competence in science and math, and significant increases from year 1 to year 2 in how successful they think they will be in a career requiring scientific ability. Also after one year, students report above average knowledge of math, science and technology. Students report an above average interest in careers using math, science and technology in all three cohort years, with the top choices being robotics engineer, astronaut, oceanographer, food scientist and mechanical engineer. Their open-ended responses to what math and science are differ from grades 4-6 to 7-12. Younger students report that science is fun, the study of the

Earth, experiments, the study of space and chemicals. Older students report that science is the study of living things, the Earth, life, technology, experiments, and most wisely, “everything.” They expect to use science in their jobs/careers as scientists, doctors or working for NASA. Students report that math is “numbers” and basic operations (=.-.x /) at all age levels, and for solving problems at the higher grades. They expect to use math in their future jobs/careers, for money, shopping, taxes/bills, in everyday life and for being a teacher. Students report a variety of definitions for NASA jobs they aspire to which are reported in detail.

Background

Teachers involved in the Explorer Schools program administered the student interest survey in the spring of 2003 and 2004 to their students resulting in three groups of data: (1) 2003 cohort taken in spring of 2004 after one year in the program; (2) 2003 cohort students taken in spring of 2005 after two years in the program; and (3) 2004 cohort students taken in the spring of 2005 after one year in the program.

The survey draws from Holland’s (1997[18]) theory of career development and from Krumboltz’(1996[19]) social learning theory. Widely used for career investigations, Holland’s theory suggests that people who choose careers that match their own personalities are most likely to be both satisfied and successful. Krumboltz suggests that career decision making and development is promoted through social learning, environmental conditions and events, and learning experiences both in and out of school.

The Student Interest survey monitors interest in different school subjects and topics, abilities, and general occupational knowledge and interest as a means to documenting and understanding changes in student interest in STEM and careers in STEM in the NASA Explorer Schools program.

Methods

The Survey of Student Interest has three categories of items:

- Perceived competence
- Knowledge
- Interest in STEM-G topics and careers

Perceived competence

- Item 3 asks students to rate their ability and performance in science class and in a career requiring scientific ability.
- Item 5 asks students to rate their ability and performance in math class and in a career requiring mathematical ability.

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[18] Holland, J.M. (1997). Making vocational choices: A theory of vocational personalities and work environments. Lutz, FL: Psychological Assessment Resources.

[19] Krumboltz, J. D. (1996). A learning theory of career counseling. In M. L. Savickas & W. B. Walsh (Eds.), Handbook of career counseling theory and practice. Davies-Black Publishing Company.

Knowledge

- Item 2 asks students to rate their knowledge of school subjects or topics of English, math, science, geography, engineering and technology.
- Item 4 asks students to describe what science is and how they might use it in the future.
- Item 6 asks students to describe what math is and how they might use it in the future.

Interest

- Item 1 asks students to identify how much they like the school subjects or topics of English, math, science, geography, engineering and technology.
- Item 7 asks students how much they like doing math and science, such as plotting locations, finding patterns in data, conducting observations and learning about force and motion.
- Item 8 asks students to rate how good they are at doing math and science, such as designing investigations, developing hypotheses, taking measurements, using math to explore solutions, finding patterns in data and presenting the results of an investigation.
- Item 9 asks students to rate the extent to which they are interested in specific STEM-based occupations such as aerospace engineer, biologist, lawyer, physicist and meteorologist.
- Item 10 asks students to select one specific STEM based occupation that are relevant to NASA's work they would most like to do. Item 10a and b asks students to describe what a person does in the NASA job they identified as being most interested in doing, and how that job helps NASA.

Data Collection

Characteristics of the sample: Teachers who are part of the NASA core team were the most likely to have their students take the survey.

Gender	03 yr 1	03 yr 2	04 yr1
Male	489	280	270
Female	442	276	277

Ethnicity	03 yr 1	03 yr 2	04 yr1
African American/Black	244	109	50
Asian American	56	24	48
Caucasian/White	223	200	220
Hispanic/Latino	168	124	125
Native American or Alaskan Native	21	14	7
Other	193	76	86

Grade levels	03 yr 1	03 yr 2	04 yr1

4	6	16	57
5	164	160	54
6	366	192	93
7	200	68	79
8	190	116	42
9	6	3	111
10	3	4	34
11	8	2	59
12	1	0	12
Total N by year	**944**	**561**	**541**
Total number of students possible by year (estimate)*	19600	20000	20000
Surveys analyzed as % of total population	4.82%	2.81%	2.71%

*49-50 teams/year, 5 team members, 80 students/team member

Findings

Perceived competence (Questions 3,5)

- Item 3 asks students to rate their ability and performance in science class and in a career requiring scientific ability.
- Item 5 asks students to rate their ability and performance in math class and in a career requiring mathematical ability.

An analysis of the data showed only one area of significant increase from year 1 to year 2 of the 2003 cohort: 3b. How successful do you think you would be in a career that required scientific ability?

3. Thinking about science (scale of 1-5)	03 1st yr	03 2nd yr	04 1st yr	03 sig yr1-yr2	03-04 sig yr1-yr1
g. How well do you think you will do in science this year?	3.85	3.85	3.68	.986	.002*
h. How successful do you think you would be in a career that required scientific ability?	**3.27**	**3.39**	3.19	**.049***	.161
i. When taking a science test you have studied for, how well do you do?	4.01	3.97	3.86	.442	.009*
j. How well have you been doing in science this year?	3.89	3.84	3.62	.336	.000*
k. In general, how hard is science for you?	2.52	2.59	2.66	.268	.025*
l. Compared to other school subjects you have taken or are taking, how hard is science for you?	2.66	2.66	2.71	.935	.421

One area showed significantly different results for math: 5f. Compared to other school subjects you have taken or are taking, how hard is math for you?

5. Thinking about math (scale of 1-5)	03 1st yr	03 2nd yr	04 1st yr	03 sig	03-04 sig
g. How well do you think you will do in math this year?	3.73	3.58	3.51	.014*	.001*
h. How successful do you think you would be in a career that required math ability?	3.66	3.54	3.42	.039*	.000*
i. When taking a math test you have studied for, how well do you do?	3.88	3.74	3.66	.023*	.000*
j. How well have you been doing in math this year?	3.69	3.52	3.45	.008*	.001*
k. In general, how hard is math for you?	2.69	2.79	2.82	.131	.071
l. Compared to other school subjects you have taken or are taking, how hard is math for you?	**2.80**	**2.99**	2.94	**.005***	.038*

<u>Knowledge (Questions 2,4,6,10a,b)</u>
No significant differences were found for positive change in any of the subjects
2. Rate how much you <u>know about</u> the following school subjects or topics.

	03 1st yr	03 2nd yr	04 1st yr	03 sig	03-04 sig
f. English	3.72	3.72	3.60	.984	.055
g. Math	3.83	3.69	3.56	.025*	.000*
h. Science	3.84	3.88	3.67	.500	.006*
i. Geography	3.08	2.99	2.94	.211	.040*
j. Technology	4.05	4.05	3.82	.895	.000*

Analysis of open-ended questions 4, 6, and 10

- Item 4 asks students to describe what science is (a) and how they might use it in the future (b).
- Item 6 asks students to describe what math is (a) and how they might use it in the future (b).
- Item 10 asks students to choose their top job choice from a list of NASA jobs.10a asks students to describe what a person does in the NASA job they identified as being most interested in doing, and 10 b asks them to describe how that job helps NASA.

944 student responses were collected for the 2003 in 2004 cohort, 561 were collected for the 2003 in 2005 cohort, and 541 were collected for the 2004 in 2005 cohort for a total of 2046 students responding to the survey. Each student gave a total of seven answers for questions 4, 6, and 10 for a total of 14,322 student responses. Analysis of student responses was divided into two groups, grades 4-6 and 7-12.

4a. To the best of your ability, describe what science is:
For students of the 2003 cohort in grades 4-6, the top three responses remained the same for both years with only the ranking of the three changing. Only "Fun" remained in all three cohorts in the top three responses. For grades 7-12, 2003 cohort students responded with science being the "Study of life/living things." In 2004, the most frequent response changed to "Experiments" for the 4-6 subgroup and the "Study of the Earth" for the 7-12 subgroup.

	Grades 4-6	**Grades 7-12**
2003 in 2004 (N=954)	9.7% - Fun 9.1 – The study of Earth 8.1 – Chemicals/chemistry	17.5% - Study of living things 8.4 – Technology/computers
2003 in 2005 (N=568)	11 – The study of Earth 9 – Fun 8.7 – Chemistry/chemicals	10.5 – Study of life 8.5 – Experiments
2004 in 2005 (N=551)	9.7 – Experiments 8.3 – Study of space 7.6 - Fun	17.6 – Study of the Earth 12.2 – Everything

Some of the more descriptive responses are listed below:

To the best of my ability, science is an activity that challenges my mind but is fun at the same time.

Science is learning from theories and evidence. Science tests your ability to learn with logic, and teaches you many things that you sometimes don't think are real. I would like to learn more of a variety of science rather than one area, but I will learn more in the future. I like science a lot, because even if you get some of your experiments wrong, you learn from that and it teaches you even more than you would learn if you didn't mess up.

A way of learning beyond what you would learn in any other subject. You also discover that the impossible isn't really impossible. You uncover the unexpected and unknown.

Science is all around us. Science is the medicine we take to make us feel better. Science is why we have cars and things of that sort today. If we didn't have science then we wouldn't have a lot of things that we have today. Science is how we found out about the planets and the stars. If it weren't for science, we wouldn't know anything about life. To me life is science. Everything around us is science.

Science is very dangerous.

I think it is a mystery

I believe science is like magic only not as powerful as magic

To me science is fun because it has technology and it has flowers.

4b. Describe how you might use science in your future.
When responding to how they might use science in the future, all sub-groups had "Job" among the three most common. In all cohorts, grade 7-12 students listed "Job" more frequently than their 4-6 classmates. In all the sub-groups but one, "Scientists" was the second most common response.

	Grades 4-6	Grades 7-12
2003 in 2004 (n=954)	11% - As a doctor/medical 10.4 – Scientists 8.7 – In my job	18.7 – In my job/career 15.3 – Scientists 11.6 – Doctor
2003 in 2005 (n=568)	11.9 - My job 8.9 – Be a scientist 7.6 – Working for NASA	13.3 – My job/career 5.9 – Doctor
2004 in 2005 (n=551)	12.9 – In my job 9.5 – Be a scientist	13.8 – In my job/career 11.2 – Be a scientist 10 – NASA scientist

Some of the more descriptive responses are listed below.
Science would help me in the future, because you may not notice, but you probably make hypotheses all the time. Science helps you go step by step, logically, to find the correct solution.

I might use science to give myself superpowers.

I might use science in the future because it might come in handy when someone is having a hard time. Science is a part of my life because it will help me to help my kids in the future.

Science in the future is going to be bigger and better than everything you see. We would live in space thousands of miles for earth. we will find the cure to the common cold. Earth has we know it will be filled with clones. But with all excitement will with has terrible wars and other madness that causes chaos on one side of the world. But with all we would bee unstoppable, of course until the sun blows to bits and pieces, and we all die, but like earlier we will find a way to make a whole new earth, wind, fire, water, sun, universe! It would marvelous outstanding, unstoppable.

6a. To the best of your abilities describe what math is.

When asked to describe what they believed math to be, 39.5 to 54.4% said that is was either "Numbers" or "Addition, Subtraction, Multiplication, and Division." In only one sub-group, 2003 in 2004 grades 7-12, was there any response more frequent than "Numbers" or "Addition, Subtraction, Multiplication, and Division."

	Grades 4-6	**Grades 7-12**
2003 in 2004 (n=954)	33.6% - Addition, subtraction, multiplication, and division 19.3 - Number	26.3% – Numbers 15.4 – Using numbers to solve problems 14.3 – Add, sub, mult, div
2003 in 2005 (n=568)	21.7 – Numbers 21 – Add, sub, mult, div	23.4 – Add, sub, mult, div 16.1 – Numbers
2004 in 2005 (n=551)	31.2 – Add, sub, mult, div 23.2 - Numbers	27.1 – Numbers 14.4 – Add, sub, mult, div

Some of the more descriptive responses are listed below:

Math is my favorite subject because it challenges me to think harder and stretch my mind with all the numbers.

Math is what mankind needs to move through our timeline. Without math we cannot solve equations, count, add, subtract and hundreds of other reasons. Math can show us measurements and time. Math and science cannot really be seperated from each other. If there was no science, math couldn't function properly. If there was no math science would just fall apart.

Math is probably one of the most important subjects to learn. Math is used in EVERY THING! stores, shapes, food, recipes, computers, jobs, getting jobs, you name math is in it. When you go out there into the real world you need to know about math because when you are ready to go and get a job it will involve a lot of math. Math is a great subject but will be difficult it you didn't learn it. Our teachers at our school do a great job at teaching us the right way also.

Math is also a thinking process that is step by step solving. You have to think a lot to find the correct and logically solved solution.

Math is a very interesting subject for my golf reasons.

To me math is taking numbers and doing weird things to try to make a different number

6b. Describe how you might you use math in your future.
When describing how they might use math in their future, grade 4-6 students all responded most frequently with "Job/career." Both 2003 groups decreased their percentage of responses for "job/career" and increased "Shopping." In the 2004 group, "Job/career" remained the most frequent in both the 4-6 and 7-12 groups and "Shopping" decreased from 4-6 to 7-12.

	Grades 4-6	Grades 7-12
2003 in 2004 (n=954)	17.2% - In my/a job 15.5 - Money	15.2% - Shopping 14.3 – In my/a job 11.8 – Money
2003 in 2005 (n=568)	12 – Job/career 7 – Teacher/teaching	8.8 – Everyday 7.5 – Shopping 6.9 – Job/career
2004 in 2005 (n=551)	14.4 – Job/career 9.4 – Shopping 9.4 – Teacher/teaching	16.5 – Job/career 9.5 – taxes/bills 8 – Shopping

Some of the more descriptive responses are listed below:

In my future I would need math if I become a comic designer, because if I tried to draw the same person or thing I would have to maybe need to measure them to make sure they are the same size.

I will probably use science in my future when I need to answer a question about the world or tell someone a fact about things that exist.

Well the one job that I always wanted to have was to be a chef and to be a chef you need to know your math for recipes and adding to them (measurements)

You might use math if you ever get a job. Math is going to be important to you no matter what. Everything you do has math.

<u>Interest (Questions 1,7,8,9,10)</u>

Interest

- Item 1 asks students to identify how much they like the school subjects or topics of English, math, science, geography, engineering and technology.
- Item 7 asks students how much they like doing math and science, such as plotting locations, finding patterns in data, conducting observations and learning about force and motion.
- Item 8 asks students to rate how good they are at doing math and science, such as designing investigations, developing hypotheses, taking measurements, using math to explore solutions, finding patterns in data and presenting the results of an investigation.
- Item 9 asks students to rate the extent to which they are interested in specific STEM-based occupations such as aerospace engineer, biologist, lawyer, physicist and meteorologist.
- Item 10 asks students to select one specific STEM based occupation that are relevant to NASA's work they would most like to do.

1. Rate how much you like the following school subjects or topics.
There was a significant increase in how much the 2003 cohort students liked technology.

	03 1st yr	03 2nd yr	04 1st yr	03 sig	03-04 sig
f. English	3.38	3.46	3.10	.171	.000*
g. Math	3.43	3.31	3.16	.100	.000*
h. Science	3.75	3.85	3.57	.115	.009*
i. Geography	2.92	3.01	2.83	.216	.234
j. Technology	**4.15**	**4.35**	3.94	**.000***	.001*

7. Rate how much you like the following:
There was a significant increase in how much students liked one of the areas of study and ways of knowing by the 2003 cohort: Studying how energy is made in ecosystems (7d).

	03 1st yr	03 2nd yr	04 1st yr	03 sig	03-04 sig
i. Conducting observations and measurements as part of an investigation or project.	3.07	3.15	2.94	.193	.050*
j. Learning about the motion of a vehicle and how force can be saved with simple machines.	3.25	3.28	3.13	.715	.080
k. Finding patterns and relationships in data.	3.11	3.10	2.93	.773	.009*
l. Studying how energy is made in ecosystems and used through food networks.	3.18	3.37	2.95	.006*	.000*
m. Using computers with science data.	3.76	4.02	3.48	.000*	.000*
n. Plotting locations of volcanoes and earthquakes to find patterns.	3.29	3.39	3.04	.143	.001*

o. Using math in science.	3.24	3.23	2.89	.910	.000*
p. Learning about how the earth, sun, and moon work together and how gravity holds all the parts of the solar system together.	3.66	3.70	3.50	.549	.020*

8. Rate how good you are at each of the following.
There were no areas of significant increase in how the 2003 students reported how good they were at different STEM-G activities.

	03 1st yr	03 2nd yr	04 1st yr	03 sig	03-04 sig
j. Designing and planning an investigation or project.	3.43	3.49	3.42	.280	.823
k. Developing a hypothesis.	3.37	3.46	3.32	.173	.487
l. Testing a hypothesis.	3.54	3.64	3.49	.161	.396
m. Making observations.	3.56	3.57	3.48	.761	.229
n. Taking measurements.	3.47	3.49	3.34	.754	.062
o. Using computers with science data.	3.74	3.93	3.56	.004*	.009*
p. Finding patterns and relationships in data.	3.32	3.28	3.11	.536	.002*
q. Using math to explore solutions to problems.	3.37	3.33	3.15	.572	.003*
r. Presenting results of an investigation or project to the class.	3.32	3.38	3.19	.380	.098

9. How much would you like to have the following jobs?
Astronaut, mechanical engineer and robotics engineer are consistently ranked highest by students.

Means on scale of 1-5

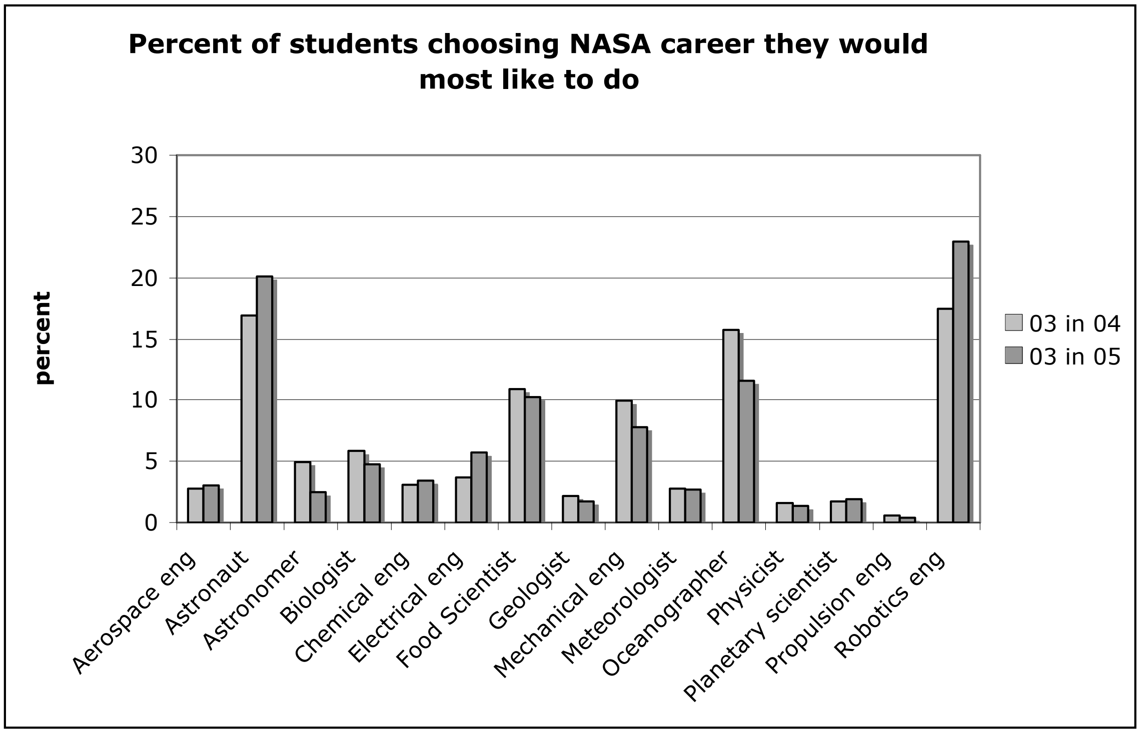
N=	956	584	526
	03 in 04	*03 in 05*	*04 in 05*
Aerospace engineer	2.76	2.80	2.60
Astronaut	**3.08**	**3.13**	**2.91**
Astronomer	2.80	2.72	2.71
Biologist	2.80	2.92	2.63
Chemical engineer	2.97	3.00	2.75
Electrical engineer	2.94	2.95	2.76
Food scientist	2.94	2.89	2.76
Geologist	2.73	2.65	2.51
Mechanical engineer	**3.08**	**3.11**	**2.85**
Meteorologist	2.64	2.74	2.55
Oceanographer	3.11	3.05	2.84
Physicist	2.78	2.77	2.85
Planetary scientist	2.82	2.83	2.57
Propulsion engineer	2.60	2.68	2.50
Robotics engineer	**3.38**	**3.50**	**3.10**

10. This is a list of NASA jobs. Select the job that you would most like to do.

Students were asked to choose a job from a list of NASA careers that they would most like to do. 1522 student responses were recorded. In both the 2003 in 2004 and 2003 in 2005 groups, Robotics Engineer was chosen most often followed by Astronaut. The third most popular choice for both groups was Oceanographer. The fourth most popular was Food Scientists. The least chosen career was Propulsion Engineer. Responses were summer across grades.

Percentage of students choosing each profession

	03 in 04 (n=954)	03 in 05 (n=568)
Robotics eng	17.5	23.0
Astronaut	16.9	20.1
Oceanographer	15.8	11.6
Food Scientist	10.9	10.2
Mechanical eng	9.9	7.8
Biologist	5.8	4.7
Astronomer	4.9	2.5
Electrical eng	3.7	5.7
Chemical eng	3.1	3.4
Aerospace eng	2.7	3
Meteorologist	2.7	2.7
Geologist	2.2	1.7
Planetary scientist	1.7	1.9
Physicist	1.6	1.3
Propulsion eng	0.6	0.4



10a. To the best of your ability, describe what a person working this job does.

Individual student responses from 2003 cohort students in 2004 (after 1 year in program)

Aerospace Engineer	*A person who makes airplanes and studies aeronautics* *Designs rockets and planes* *Makes connections between the air and space*
Astronaut	*Discoverer of life on other planets* *Goes into space to work on the shuttle and other rockets* *Gets to stand on the moon* *Goes to other planets in search of aliens* *Takes care of satellites* *A person who loves space and wants to know what is out there*
Astronomer	*Goes to the moon* *Looks at the stars through telescopes* *Studies other worlds*
Biologist	*Studies plants and animals* *Studies living organisms* *Studies life and how it changes and grows* *Trying to make solutions to problems humans have made*
Chemical Engineer	*Test chemicals and use chemicals to create new things* *Mix chemicals together to try to make new things for space travel* *Do lots of experiments*
Electrical Engineer	*Puts wires into houses and makes a lot of money* *Fixes electronic things* *Decides on the electricity for NASA jobs*

Food Scientist	*Study food to learn how to make new foods* *Tests food to see that there is nothing wrong with it* *Invents food for astronauts* *In this job people try to figure out what type of food they should take up in space and take out the water out the food and should try to find new foods that could last in space. They have to do this because if they don't have the right food it will make it heavy.* *Likes to look at and eat food*
Geologist	*Digs in dirt to find fossils, artifacts, and other objects* *Studies the Earth and how it was made* *Studies new things about the Earth and other worlds*
Mechanical Engineer	*Works on engines and other mechanical stuff* *Builds things like cars and trucks and takes lots of things apart* *Fixes things* *A person working this job builds and designs things for certain jobs. They also head the production process of all the things they design*
Meteorologist	*Tells the weather* *The person on the news that tells the weather* *Studying the weather and helping people*
Oceanographer	*A person working on this job studies the ocean and someone working on this job can help NASA observes the fish, tide and ocean life* *Look for weird species on the ocean floor* *Explore new environments, learning the difference between the land and the sea*
Physicist	*Helps other people overcome their problems* *Knows people and their body parts* *Prescribes medicine to those who need it*
Planetary Scientist	*Study the planets* *This person studies planets of our solar system. They study how the planets were made. They look for life on the planets or if life can exist. They look for new planets. They try to figure out what the orbit of the planets will be.*
Propulsion Engineer	*Designs ways that propulsion can move things* *Experiments with ways to give propulsion to vehicles* *Studies why things move*
Robotics Engineer	*Builds robots* *Designs and builds robots* *Design robots that make things easier for humans* *These people have to be very creative*

Individual student responses from 2003 students in 2005

Aerospace Engineer	*They probably fly in like spacecrafts or airplanes.* *Designing Space Ships, new space propulsion systems, better super computers, using holograms to create a simulation of what may happen and create better tools for space travel*
Astronaut	*They conduct experiments that could not be done on earth* *A person that has this job would have to have a lot of training. They would have to exercise because in space, your muscles don't need to work that hard so they would start to become weak. They would have to go through space sickness and be used to microgravity. They would have to know what to do if something goes wrong and what to do in most situations. Then you would have to know things about space. You would have to know math also. Many kinds of math are needed to get the right trajectories and the right angle to be in for a safe landing.* *Explores other planets* *Gets to go into space and look back at the Earth*
Astronomer	*An astronomer studies stars and planets in space. Also to find out if we can live on other planets and if there is other life forms then us.* *Learns about the stuff in space* *Works at night*
Biologist	*Studies life* *Finds out what happened to life on Earth in the past* *Work with science and investigators to learn about life*
Chemical Engineer	*I think you would test chemicals to make sure they rae safe.* *They work with chemicals to find balances between 2 or more so that They may work together properly in a mechanism.* *produce and test chemicals and substances that assist in the performance of technology*
Electrical Engineer	*Checks all of the computer programs and checks the wiring corrects the problem* *Works with lights and electricity* *Measures the flow of electricity*
Food Scientist	*They check food for dangerous diseases and poisons and stuff like that* *Uses chemicals to test food* *Discover new foods to eat*
Geologist	*I would want to study bones and see how some of the bones got in the Earth. How do some of the bones got in the Earth?* *Do lots of things related to rocks and oil* *Dig for what they are looking for*
Mechanical Engineer	*This person would work on cars and other mechanical stuff.* *Fixes broken and damaged things* *Understands how things work*
Meteorologist	*Helps people with the weather to plan their lives, studies weather and reports it on TV, or helps the TV people* *Studies the weather* *Decides if a rocket can be launched because of the weather*
Oceanographer	*I think a person that would have this job as an oceanographer takes studies of different patterns and waves of what happens every day out in the ocean. Also the winds of the waves.* *Studies the ocean and its living creatures*

	You can study the ocean and see many cool things you can see whales and other sea animals
Physicist	*Help people with their problems* *Discover new medicines* *Work on physics problems and experiments*
Planetary Scientist	*Studies the solar system* *Studies the planets and the life on them* *Learns how planets form and get destroyed*
Propulsion Engineer	*The person in this job usually studies rockets and hoe they can make them safer, faster, and more reliable.* *Learns to make things go*
Robotics Engineer	*A robotic engineer can create robots to do what they are programmed to do, or stand around as if they were decorations for a home. They can make a robot that they made do wild stuff like jump of a cliff and survive. A robotic engineer uses their time wisely when they are making a robot in tip-top shape.* *A robotics engineer works on robotic things, like robots, things that may relate to robotics, like the derby robotic car things etc… I don't know much but I'd love to know more.* *He makes, test and designs robots or other mechanical stuff that does anything for you automatically*

b. How does someone working in this job help NASA?

Individual student responses for 2003 cohort in 2005 (after 2nd year of program)

Aerospace Engineer	*By probably looking at something or testing how something flies* *A person with this job could design all the spacecraft needed to learn about space and everything in it. They could also improve on old designs, such as the space shuttle* *By exploring new planets and galaxies by building more advance features to the orbiter, SRB, and platform*
Astronaut	*Work at the space station and launch satellites* *They help NASA by expanding their knowledge and sending information about what is happening. They can help people learn more about what it is like in space. If something goes wrong(which is very bad..) they would be able to fix that problem so the next people would not have that problem.* *They help NASA know more about space and about problems that may occur. They can also help people learn more about if there is a chance that we can live in space* *By telling NASA what they discovered on the different planets*
Astronomer	*Someone in this job helps NASA by telling them about planets and other things in space as in asteroids and life forms* *It helps them figure things out that could only be possible in space* *Watch the astronauts while they are in space and keep an eye on their spacecraft*
Biologist	*This job works with NASA by looking at different animals they take to space* *They cure the people that are sick* *They probably help by finding out how the inside of bodies work in space*

Chemical Engineer	*If NASA were to find a weird looking rock or something you could do a chemical check to make sure it is a safe thing to have* *They help by telling them if things are dangerous* *Keep dangerous chemicals from mixing while in space*
Electrical Engineer	*Correct problems build or get better technology and make your status better* *They help NASA by keeping electricity up and running. They also keep their computers free of viruses and spam. They make sure mission control stays in contact with the space shuttle. They finally make sure the families of astronauts can watch them from the time they takeoff to the time they are back at home* *This person can probably fix shuttles and possibly fix any other space equipment*
Food Scientist	*By testing the food to see if it would be safe to take in space* *By telling NASA what types of foods that the astronauts can eat in space* *They help them decide what to send in space and what not to send in space*
Geologist	*Study rocks* *Determine where meteorites have come from* *Study pictures of Mars for water and life forms*
Mechanical Engineer	*They make the rockets, SRB's, and the E.T.* *They make new inventions for space travel* *They could help NASA fix the space shuttle if something was wrong with it* *They help NASA by building spacecraft for NASA. Without them there would be no space crafts*
Meteorologist	*NASA needs to know what the weather is to launch shuttles and to help people who might be where hurricanes or tornadoes are* *Help to find the weather around the world* *See what the weather on the other planets is like*
Oceanographer	*I think an oceanographer helps NASA by telling them what the winds and different studies they found different.* *Oceanographers would help NASA understand why there might be water on Mars or why there isn't water on a certain planet.* *I think it help hem because when the SRB's (solid rocket boosters) fall in the water if the water is already mapped they know exactly where to go*
Physicist	*A physicist working for NASA can create a fuel light enough so the rocket may travel faster and go further into space. Helping our ability to learn about distant planets and stars* *Works with the other scientists to solve problems* *They find new technology for the shuttle*
Planetary Scientist	*They figure out the easiest way to get into space* *When NASA needs to be on a specific planet or needs to know what exact time to be on a planet. Is the planet safe or unsafe? Is this planet dangerous? Will it give the astronauts disease? All these questions are answered by planetary scientists* *Seeing if there is another planet in the universe and send something to see what the planet looks like*
Propulsion Engineer	*Learn how to use new fuel sources* *They might find new things that can help like a fuel that can make a shuttle go faster to another planet like Mars* *How it helps NASA is by telling what is happening on the planets*
Robotics	*Someone doing this job can help the other people made the rovers so that*

Engineer	*they can have the required things that a rover would need on a mission to Mars or any other planet.* *They could give NASA new ways to improve their work on a new space ship or shuttle, or they could help NASA with putting some technology together to make or create different things* *This person might repair the shuttle or make a robot to do something in space instead of a man*

Details from Analysis of Open-Ended Student Interest Survey Responses to Questions 4, 6, and 10

2003 student responses in 2004 (grades 4-6, N=535)

N	%	Student response
50	9.7	Fun
47	9.1	The study of earth
42	8.1	Chemicals/chemistry
34	6.6	Nature
32	6.3	Experimenting
29	5.6	Study of the solar system/space
26	5.0	The study of living things/life
26	5.0	Technology/computers
26	5.0	You learn about how things are made/work
26	5.0	The study of the universe
13	2.5	The study of the stuff around us
11	2.2	Hard
10	1.9	Boring
10	1.9	Animals
10	1.9	Cool
8	1.6	Discovery
8	1.6	Observing
8	1.6	Easy
8	1.6	Science is weather, plants, human body science
8	1.6	The solar system, mixtures and solutions , micro worlds, and nutrition
8	1.6	Study of the human body
7	1.3	Physics
7	1.3	Science is a type of method used for making and inventing things.
7	1.3	The study of everything
7	1.3	Magic
5	0.9	Learning about the body
5	0.9	Chemicals, mixtures, microscopes
5	0.9	Interesting
5	0.9	Everything
5	0.9	Ecosystems
3	0.6	People, places, and things
3	0.6	Reactions

The following ideas were mentioned once:
I think it is a mystery, Science is somewhere people can use their science skills, Some things that are a completely different than math, English, and other subjects, The study of knowledge,

Science is when you work in a group of people and do things like projects, Don't know, Science is some thing scientist do, that would help people, Science is an educational activity that teaches you about different things, Inventing, Aeronautics, Science is a real life thing. When you have to do think like go to space and do other thing, Science is a work of knowledge, Science is like to work with wires and stuff, Plants and animals, Science is everything there are no words to describe it, Educated questions, The study of the unknown, Testing things, Exciting, A best guess, Something to learn from, The exploration of new things, Oceanography, A good subject to learn about, Something new.

2003 students in 2004 (grades 7-12, N=419)

N	%	Student Response
71	17.5	The study of living things/life
34	8.4	The study of technology/computers
30	7.4	The study of living and non-living things
30	7.4	Nature
23	5.8	The study of earth
21	5.2	You learn about how things are made/work
21	5.2	The study of everything
18	4.5	Study of the human body/humans
16	3.9	Experimenting
16	3.9	Study of the solar system/space/astronomy
13	3.2	The study of our world
11	2.6	Fun
11	2.6	Hard
9	2.3	Easy
8	1.9	The study of plants and animals
8	1.9	Ecosystems/Environment
6	1.6	Chemicals/chemistry
6	1.6	Discovery
5	1.3	The study of the universe
5	1.3	Science is plants and human body science
5	1.3	Don't know
4	1.0	Boring
4	1.0	Exploring
4	1.0	Anything
2	0.6	The guide to everything
2	0.6	Interesting
2	0.6	The study of things
2	0.6	Important
2	0.6	Testing things

The following ideas were mentioned once:
Looking at things that are microscopic, Dissecting, Science is a type of method used for making and inventing things, Learning about all different things, Science is the study of scientific things, Aeronautics, It is about solving problems, The study of cells, Exciting, Geography, Dumb.

2003 students in 2005 (grades 4-6) (n=368)

N	%	Student Response
38	11	Study of Earth
31	9.0	Fun
30	8.7	Chemicals/chemistry
22	6.3	Technology/computers
21	6.0	Experiments
20	5.7	Space/Solar system
17	5.0	Nature
13	3.7	Science is like math
12	3.3	Exploring the world
10	3.0	Systematic way of exploring our world
10	3.0	Everything
10	3.0	Science is life
9	2.7	Testing
9	2.7	Hard
8	2.3	Planets
8	2.3	Learning about living and nonliving things
7	2.0	Research
7	2.0	Study of the human body
7	2.0	Learning how to build things
7	2.0	Study of animals
6	1.7	Nature and life
5	1.3	A subject involving life
5	1.3	Easy
3	1.0	Understanding
3	1.0	Learning and discovering
3	1.0	Making hypothesis
3	1.0	How things work
2	0.7	Learning new things

The following ideas were mentioned once:
Learning about what scientists did, Test medicine, To find out about things that you have never found out before, Like a book, Space and math, A way to figure out what goes where, A way to make better environments for the future, Bio systems, Some thing that you can make or create, Dangerous, Study of the galaxy, An element of learning, Electricity, magnets, water, Where you dissect frogs, Trying something new, Science is about some stuff that happened in the past, Find out something new everyday, I think science is short of a sneak preview of the future, I don’t know, A way to describe things, The answer to everyone’s questions, Animals and bugs, Universe, Study and invent.

2003 students in 2005 (grades 7-12, N=240)

N	%	Student Response
24	10.5	Study of life
20	8.5	Experiments
15	6.5	How things work
15	6.5	Chemicals/chemistry

13	5.5	Technology/computers
13	5.5	Everything
12	5	Space/Solar system
10	4.5	Nature
8	3.5	Study of Earth
8	3.5	Learning about living and nonliving things
7	3	Physics
7	3	Exploring the world
6	2.5	Fun
6	2.5	Study of the human body
6	2.5	Using the scientific method to problem solve
5	2	Testing
3	1.5	Hard
3	1.5	Easy
3	1.5	Systematic way of exploring our world
3	1.5	Study of the universe
3	1.5	Study of animals
3	1.5	Dumb, boring, and/or stupid
3	1.5	Science is like math
3	1.5	Observation
2	1	Investigating the world
2	1	A subject involving life
2	1	Study of the environment
2	1	All around us
2	1	Another way of life
2	1	Nature and life
2	1	The systematic search for answers
2	1	Biology
2	1	Discovery

The following ideas were mentioned once:
Thinking a lot, Solving problems, Prehistoric life, Learning how to build things, Something they make you do, Labs, Process of evaluating empirical work, Method used to figure out what something is, Working on the functions and cycles of life, Being a doctor, Figuring things out, Finding solutions, An educated guess, Another type of math, Dissecting, Working with life, Connections of life, Creating a hypothesis, I don't know.

2004 students in 2005 (grades 4-6, N=204)

N	%	Student Response
19	9.7	Experiment
16	8.3	Study of space
15	7.6	Fun
13	6.9	Study of Nature
13	6.9	Study of the earth
12	6.2	Hard
11	5.5	Rock and rock cycles
11	5.5	The study of living things

8	4.1	Science is life
8	4.1	Chemistry
7	3.4	Technology
7	3.4	I don't know
7	3.4	Electricity
7	3.4	Math
5	2.8	The use of plants, animals, and technology
4	2.1	How things work
4	2.1	Math and formulas
4	2.1	Interesting
4	2.1	The study of what things are made of
4	2.1	A study of all matter
4	2.1	Discovering something new
3	1.4	A study of life

The following ideas were mentioned once:
Something that makes the world go around, Where you use your mind and technology, An ability everyone should have, New things people find out, Animals, To help the world, How to use your head, Where you learn about mass, Projects, Studying, Science is the language of math, Studying things, Learning about energy, Study of the human body, Very exciting, Research about things that we don't know, Studying all things around us, Important and helpful, Easy, Writing down what you think will happen.

2004 students in 2005 (grades 7-12, N=347)

N	%	Student Response
56	17.6	Study of the earth
39	12.2	Everything
24	7.6	The study of living things
19	6.1	Study of Nature
17	5.3	Fun
17	5.3	Study of space
17	5.3	Experiment
15	4.6	Rock and minerals
12	3.8	How things work
10	3.1	Study of the environment
10	3.1	Science is life
10	3.1	Boring
7	2.3	NASA
5	1.5	Studying the world around us
5	1.5	Technology
5	1.5	Exploring the universe and everything in it
5	1.5	Biology
5	1.5	Chemistry/chemicals
5	1.5	Geography
5	1.5	Figuring out problems
5	1.5	Animals

The following ideas were mentioned once:

Plants, Projects, Physics, Study of Earth's past, Describes the Earth, The test or study of every things, I don't know, Math, How things work and are made, A way of learning new things, The study of what things are made of, Learning how to do new things, Exploring and discovering new things, Dissecting, Thinking differently, The art of logically and systematically figuring out why things do what they do, Where people dig up bones, Form of math, History with chemicals and stuff like that, The universe.

2003 students in 2004 (grades 4-6, N=535)

N	%	Student Response
50	11.0	As a doctor/medical
48	10.4	Scientists
40	8.7	In my job
37	8.1	Science teacher/teaching
20	4.3	Cooking/food science
20	4.3	Computers/technology
20	4.3	In school
16	3.5	Astronaut
16	3.5	Inventing/inventor
15	3.2	Cars
15	3.2	Veterinarian
15	3.2	Marine biologist/Oceanographer
12	2.6	I don't plan to use science in the future
11	2.3	I don't know
11	2.3	Join/work for NASA
9	2.0	Astronomy
8	1.7	Chemists/chemistry
6	1.4	Rocket scientists
6	1.4	Archeologists
6	1.4	Engineer
6	1.4	Astronomy
5	1.2	Forensics
3	0.9	Military
3	0.9	Making a robot
3	0.9	Fix things
3	0.9	Herpetologists
3	0.9	Technical work
2	0.6	Weather
2	0.6	Paleontologists
2	0.6	For writing/science fiction
2	0.6	Making things that I need
2	0.6	Everyday life
2	0.6	Determine how things work
2	0.6	For fun
2	0.6	Solve unanswered questions of the world
2	0.6	To make the world a better place
2	0.6	Science show

The following ideas were mentioned once:
Pilot, Have a science fair, To get through college, Try to get to see a black hole, I will do math, Science will save mankind, To get through my hardest things, A job that includes it, As a tool, I will use science carefully so I don't waste it, Help others, Making solar ovens, To use a compass, Electronics, Explorer, To create electricity, Use solar energy, Fire fighting, To be an actress, Curing my bad golf swing, CSI agent, Everything, Roller coaster designer, Aerospace engineer, Science fair, Create machines, To fly a jet, Making video games, To determine the force of an object, Improve life on earth, To help achieve my goals, To help mankind, In art, Teach my kids how not to get sick, Measuring, To plant plants, Ship building, Where ever I go, Aircraft, Finding solutions, Discovering things, Weather, Doing my own projects.

2003 students in 2004 (grades 7-12, N=419)

N	%	Student Response
78	18.7	In my job/career
64	15.3	Scientist
49	11.6	Doctor
28	6.8	Chemistry/chemicals
28	6.6	Experiments
21	5.1	Medicine
15	3.5	Work for NASA
15	3.5	Inventing
13	3.2	In school/college
11	2.7	Won't use science in the future
11	2.6	Teacher
10	2.4	Veterinarian
10	2.3	Cooking
9	2.1	Don't know
8	1.8	Oceanographer
7	1.7	Biologist
6	1.4	Engineer
6	1.4	Meteorologist
5	1.1	Building things
4	0.9	Weather
3	0.8	Every day life
3	0.8	To help the world
3	0.6	Learn more about space
2	0.5	To tell my kids stories
2	0.5	To help clean the Earth
2	0.5	Launch rockets
2	0.5	Lawyer
2	0.5	Study rocks and a geologist
2	0.5	Look for life on other planets
2	0.5	Video game design
2	0.5	Rocket lab
2	0.5	Learn more about the world

The following ideas were mentioned once:

Hair dresser, Create video games, To help with my training, Look for bugs in my body, Design playgrounds, Figuring out something that is wrong, Writing music, Clothing design, Solve the mysteries of life, Zoo keeper, Make cars better with gas, Running a business.

2003 students in 2005 (grades 4-6, N=368)

N	%	Student Response
42	11.9	My job
31	8.9	Be a scientists
27	7.6	Working for NASA
22	6.3	Teacher/Teaching
19	5.3	Invent things
18	5.0	Medicine
15	4.3	Doctor
13	3.6	Cars
13	3.6	Veterinarian
13	3.6	Working with computers
12	3.3	To make rockets and robots
9	2.6	Experiments
9	2.6	Cure for sickness/disease
9	2.6	Astronaut
8	2.3	I will not use science in the future
8	2.3	Study the solar system
8	2.3	Don't know
7	2.0	Marine biologists
6	1.7	In technology
6	1.7	In school
6	1.7	Engineer
5	1.3	Chemistry
5	1.3	Weather person
4	1.0	Designing video games
4	1.0	Geology
4	1.0	Astronomy
4	1.0	Discover new planets
2	0.7	To get to Mars
2	0.7	Paleontology
2	0.7	Solve problems
2	0.7	Build new things
2	0.7	Cooking
2	0.7	Dentist

The following ideas were mentioned once:
Doing things at home, In planets, To save farm land, As the key to nature, To help people, As a detective, Build things, When I become the first woman president, New technologies, Helping my children, Stop global warming, All the time, Collecting data from space, Take care of my body and stay healthy, Don't know yet, To discover other creatures living among us, Using a telescope, Find things out, Growing a garden, I won't, I'll be home watching TV, In baseball, As

a pilot, Testing things, Playing soccer, In everything, Designing clothes, To help our country, To write science books, Play with magnets, Pharmacist.

2003 students in 2005 (grades 7-12, N=240)

N	%	Student Response
30	13.3	My job/career
13	5.9	Doctor
11	4.8	I will not use science in the future
11	4.8	Engineer
10	4.3	In every day life
10	4.3	Cars
8	3.7	Working for NASA
8	3.7	In school
8	3.7	Learn about animals
7	3.2	Medicine
7	3.2	Be a scientists
7	3.2	Computers
6	2.7	Measuring and weighing
6	2.7	Everything
6	2.7	Study the solar system
5	2.1	Solve problems
5	2.1	Architect
5	2.1	Gravity and Newton's three laws
5	2.1	Veterinarian
5	2.1	Chemistry
5	2.1	Weather person
5	2.1	Invent things
4	1.6	Teacher/Teaching
4	1.6	Don't know
2	1.1	Fixing things
2	1.1	Discovery
2	1.1	Figuring out how something moves
2	1.1	Cure for sickness/disease
2	1.1	In technology
2	1.1	Experiments
2	1.1	To figure things out
2	1.1	Astronaut

The following ideas were mentioned once:
Working in a museum, Searching for planets, Lifting something, Cooking, In technology, To get things right, Decision making, Explaining things, Marine biologists, Studying nature, Planting things and working in the garden, Creating video games, Learning math, Design cruise liners, Make a better life, Improve our economy, Writer.

2004 students in 2005 (grades 4-6, N=204)

N	%	Student Response
24	12.9	In my job
18	9.5	Be a scientists
13	6.9	NASA scientists
10	5.2	Computers
8	4.3	Doctor
8	4.3	Veterinarian
8	4.3	Rocks and Minerals
8	4.3	Electricity
8	4.3	Astronaut
6	3.4	Weather
6	3.4	Chemistry/chemicals
6	3.4	Invent things
6	3.4	Fix things
5	2.6	Earthquakes
5	2.6	Teacher
5	2.6	Cooking
5	2.6	Invent things
5	2.6	I won't use science in the future
5	2.6	Experiments
3	1.7	Technology
3	1.7	In school
3	1.7	Figure things out
3	1.7	Make something new

The following ideas were mentioned once:
Travel further, Studying animals, Cure sick animals, Making food products, Time capsule, Fly planes, Study disease, Driving a car, Weather robots, Write video games, Pilot, Finding out if someone did something, Make my life easier, Create new stuff, Build a rocket, To not eat fungus, To fix our planet, At home, I don't know, Learn new things, Make the world a batter place, As a horse trainer, Investigate, Archeologists, Discover new things, Keeping my body healthy, While camping in the woods, Make new things, Flying an airplane, Build a pair of rocket shoes, Work for JPL.

2004 students in 2005 (grades 7-12, N=347)

N	%	Student Response
48	13.8	In my job/career
39	11.2	Be a scientists
35	10	NASA scientists
26	7.6	Doctor
24	7	Teacher
24	7	Don't know
22	6.3	Computers
20	5.7	In school/college
18	5.2	I won't use science in the future
16	4.5	Astronaut

16	4.5	Measurements
12	3.6	Technology
12	3.6	Marine Biologists
9	2.7	Every day life
7	2	Marine biologist
3	1	Chemistry/chemicals
3	1	Rocks and Minerals
2	0.7	Veterinarian
2	0.7	Electronics

The following ideas were mentioned once:
Find things out, Weather, Forensics, Learn about the world, Planting plants, Geologists, Owning a therapeutic horse farm, Video game designer, Make the world a better place, Making music, Invent things, Orthodontists, Wild life preservation, How stuff works, Find rocks, Learn about the human body, Breading horses, Build rockets, Mapping, Piloting an airplane, Anything having to do with golf, Astronomy, Investigate a crime, Architect, Helping kids, Study physiological effects of medicine, Airplane specialists, Experiment.

2003 students in 2004 (grades 4-6, N=535)

N	%	Student Response
173	33.6	Multiplication, division, subtraction and addition
99	19.3	Numbers
38	7.4	Using numbers to solve problems
23	4.5	Fun
21	4.0	Using numbers in everyday life
19	3.6	Fractions
16	3.1	Formulas/equations
15	2.9	Easy
13	2.6	Hard
10	1.9	The most important thing for a job
9	1.7	The relationship between numbers and operations
9	1.7	Counting something
6	1.2	Decimals
6	1.2	I don’t know
5	1.0	Geometry
5	1.0	Shapes
4	0.7	Algebra
4	0.7	Times tables
4	0.7	Finding values
4	0.7	Learning stuff
4	0.7	Measuring
4	0.7	Mixture of numbers and words
4	0.7	The study of mathematics
3	0.5	Math is everything

The following ideas were mentioned once:
A subject everyone should know, Math things, Something that will be with you all the time, Nothing but knowledge and common sense, Skill, Learning and counting, The study of equations, A way to organize a large amount of information, A tool of thinking, An exact answer, Something to practice a lot, Something that I am not good at, A way of life, Seeing numbers in a whole new way, Math is just math, Almost everything I know, Making greater or lesser numbers, Adding, Something times something, Very important to help you count your money, The relationship between quantities, A complicated type of science.

2003 students in 2004 (grades 7-12, N=419)

N	%	Student Response
106	26.3	Numbers
62	15.4	Using numbers to solve problems
57	14.3	Multiplication, division, subtraction and addition
27	6.7	Using numbers in everyday life
24	5.9	Formulas/equations
14	3.5	Figuring out problems
12	3.0	Geometrical shapes and areas/geometry
11	2.8	Hard
10	2.4	Algebra
8	2.0	Easy
8	2.0	Decimals
7	1.7	Fractions
6	1.5	Calculate measurements
6	1.5	Using math to solve everyday problems
6	1.5	Graphs
4	1.1	Having fun
4	1.1	Math is the work of life
4	0.9	Very important to help you count your money
3	0.7	Math is everything
2	0.4	Math is basically life
2	0.4	Scrambling numbers together to get a problem
2	0.4	Is for the real world
2	0.4	Something that should be unnecessary

The following ideas were mentioned once:
Learn how to figure things out quicker, A whole bunch of problems, Math is arithmetic, All about numbers and letters, Probability, Math is cool, What we use everyday, Something you will need in the future, A boring class, Something that you cannot explain, A lot of work, Using number to determine outcomes, Math is not that hard, I am not sure.

2003 students in 2005 (grades 4-6, N=368)

N	%	Student Response
76	21.7	Numbers
73	21.0	Adding, subtracting, multiplying, dividing
21	5.9	Hard

21	5.9	Adding and subtracting
14	4.1	Easy
14	4.1	Solving problems
13	3.8	Fun
11	3.1	Numbers and words to make problems
10	2.8	Number we use in life
10	2.8	Equations
8	2.4	Calculating
8	2.4	Geometry
7	2.1	Measuring
7	2.1	Boring
6	1.7	Solving questions
5	1.4	It is a lot of problems and you answer them
5	1.4	Everyday
3	1.0	Learning about life
2	0.7	Need for every day life
2	0.7	A lot of work
2	0.7	How to figure out things
2	0.7	A way to count
2	0.7	Math is a way of thinking
2	0.7	Like art
2	0.7	Money

The following ideas were mentioned once:
Really cool, Math tells you what science keeps hiding, The thing that helps with building houses, More as a sport, The best subject, Combining science and geometry, Scientific notation, Writing a lot, If you know all you can, you can do anything with math, Height, weight, length, What you need for the future, Working with number to find answers, Like science, hard and complicating, Putting numbers together to form new ones, A way to be successful in life, Easier way of geometry, Using your brain, A way to understand science, Learning how to count, Some thing you need to get done in school, Relationship of numbers.

2003 students in 2005 (grades 7-12, N=240)

N	%	Student Response
54	23.4	Adding, subtracting, multiplying, dividing
37	16.1	Numbers
12	5.4	Adding and subtracting
12	5.4	Equations
10	4.4	Fun
8	3.4	Hard
8	3.4	Geometry
8	3.4	Everyday
7	2.9	Solving problems
6	2.4	Need for every day life
6	2.4	Easy
6	2.4	Boring
5	2.0	Height, weight, length

5	2.0	Measuring
5	2.0	Everything
5	2.0	Calculating
5	2.0	Learning about life
5	2.0	Really cool
3	1.5	Solving questions
3	1.5	Number we use in life
3	1.5	Math is a way of thinking
3	1.5	How to figure out things
2	1.0	A lot of work
2	1.0	Working with money
2	1.0	Numbers and words to make problems

The following ideas were mentioned once:
A way to count, Like art, Angles and measures, It is a lot of problems and you answer them, Lining in life, Patterns in numbers, The theory of numbers, Learning how to work with numbers, Numbers and shapes, Problem solving.

2004 students in 2005 (grades 4-6, N=204)

N	%	Students Response
60	31.2	Addition, subtraction, multiplication, division
44	23.2	Numbers
11	5.8	Hard
11	5.8	Adding and subtracting
11	5.8	Fun
7	3.6	Problems that you have to solve
6	2.9	Problems with numbers
6	2.9	Graphs
4	2.2	Calculating
4	2.2	Problems and solutions
4	2.2	Equations and formulas
4	2.2	Figuring out stuff
4	2.2	Examining numbers
3	1.4	Calculations and answers

The following ideas were mentioned once:
A brain workout, Adding and times tables, Using your brain, Putting numbers together to get a sum, Calculating to get an answer, A worthless class that you have to take, A helpful ability, Numbers and shapes, The thing that makes you smart, Things that you use your whole life, Logic, Easy problems waiting to be solved, Everything, The future, How to pay bills, Algebra, Counting, Making things right with math skills, Equations that tease your brain, Numbers put together for us to solve, Using the left side of your brain, Easy, A series of numbers and operations, Everywhere, Subject that requires brains and memory, Evil, Figuring out puzzles, Figuring things out, A science with numbers instead of words, Difficult, Solving problems, Determining how much you need or don’t need.

2004 students in 2005 (grades 7-12, N=347)

N	%	Student Response
86	27.1	Numbers
46	14.4	Addition, subtraction, multiplication, division
19	5.9	Problems that you have to solve
14	4.3	Everything
12	3.7	Adding and subtracting
12	3.7	Fun
12	3.7	Equations and formulas
12	3.7	Problems with numbers
9	2.7	Calculations of numbers and letters
9	2.7	Cool
9	2.7	Problems and solutions
7	2.1	Counting
7	2.1	Problems
7	2.1	Hard
7	2.1	Easy
5	1.6	Numbers in every day life
5	1.6	Don't know
5	1.6	Numbers put together to figure out
3	1.1	Measuring
3	1.1	Fractions
3	1.1	Shapes

The following ideas were mentioned once:
A procedure to help you figure things out, Fractions and maps, Things that you use in life, Computing numbers in equations to get answers, Calculations and information, A class that requires a lot of thinking, Multiplication, Comparing numbers, Using various methods, The theory of numbers, Logical explanation of problems, How to count the measure of the universe, Solving different logical problems, Adding things together for no reason, Studying numbers and letters, Relationship between numbers and variables, Probability, Subject that requires brains and memory, Figuring things out.

The Teaching, Learning, and Computer Teacher Survey Results –

The First Three Years 2003-2005

Background

Recent research regarding cognitive functioning and learning has facilitated the development of constructivist ideas. Constructivist principles predicate teaching and learning based on the premise that learning is about knowledge construction rather than reproductions. Constructivism utilizes open-ended questions, analysis, and evaluation to establish new levels of understanding. Students build knowledge upon what they already know. Constructivism is grounded on the notion that learning is affected by the context in which an idea is taught as well as by students' beliefs and attitudes (Caine & Caine, 1991). Thus, improvements in learning are expected when teachers and students are immersed in inquiry-based teaching and learning environments.

The Teaching, Learning, and Computer Teacher's Survey (Becker, 2000) is a self-report questionnaire that yields data on five constructs aligned with constructivist principles for teaching and learning. The original version, used in a national survey that assessed 4,100 teachers, was made up of 21 pages that took approximately 60-75 minutes to complete. Becker & Anderson (1998) demonstrate the validity of this instrument elsewhere. For this evaluation, the four versions of the TLC were combined into a single questionnaire consisting of the following five constructs:

- Technical Skill
- Constructivist Teaching Strategies
- Attitude Toward Technology
- Constructivist Teaching Philosophy
- Constructivist Uses of Technology

Rationale for use with Explorer School Teachers

These constructs align with specific goals articulated by the NASA Explorer Schools program. The NASA Explorer Schools program aims to increase the active participation and professional growth of educators in science, mathematics, and technology; the program also intends to increase the academic assistance for and technology use by educators in schools with populations of underserved students. This instrument yields insights about whether the skills and attitudes of teachers are increased as a result of participation in the NASA Explorer Schools program.

Cohort year	When TLC taken	Number of teachers
2003	Fall 2003	121
	Spring 2004	193
	Spring 2005	146
2004	Spring 2004	189
	Spring 2005	149
2005	Spring 2005	104

Methods and Data Analysis

The scale used to gauge constructivist perspectives and beliefs ranged from 1 (very traditional) to 5 (very constructivist). To determine whether significant changes occurred in perspectives related to evaluation constructs, five independent sample's t-tests were conducted on the means of each evaluation construct were conducted utilizing questionnaires from the Fall (pre) and Spring (post). T-tests for independent groups were run to gauge growth of 2003 cohort over two years, and 2004 for one year. T-tests for matched pairs were run on subset of participants for whom data was available from the 2003 cohort for the fall '03, spring '04 and spring '05 administrations, and from the 2004 cohort where data was available for the spring '04 and spring '05 administrations. Analysis of covariance among constructs was done on the matched pair data.

Data was collected in online survey forms in the fall of the first year and in the spring of subsequent years. There were 49 or 50 teams in each year. The program requires teams to keep five team members at all times, so the potential # of the actual and potential survey responses are listed in the table below. Data without identifying year or participant was eliminated before analysis. Numbers of participants for the matched pairs analysis range from 60 to 104 and are given in the finding section.

Construct	**03 in fall 03**	**03 in spr 04**	**03 in spr 05**		**04 in spr 04**	**04 in spr 05**		**05 in fall 05**
Total possible surveys	250	250	250		250	250		250
Surveys analyzed	121	193	146		189	149		193
% sample	48%	77%	58%		76%	60%		77%

Findings

Significant increases in 2003 teacher's Technical Skills from fall 2003 to spring 2005, Attitude Towards Technology in the 2003 cohort from fall 2003 to spring 2004 and from fall 2003 to spring 2005, and in teacher's Constructive Use of Technology from fall 2003 to spring 2004 and from fall 2003 to spring 2005 were found. Significant increases in 2004 teachers' Technical Skills, Constructivist Teaching Strategies, Attitude Towards Technology, and Constructivist Use of Technology were found from spring 2004 to Spring 2005. See Appendix for mean, median, mode, standard deviation, and variance for each construct in the table below.

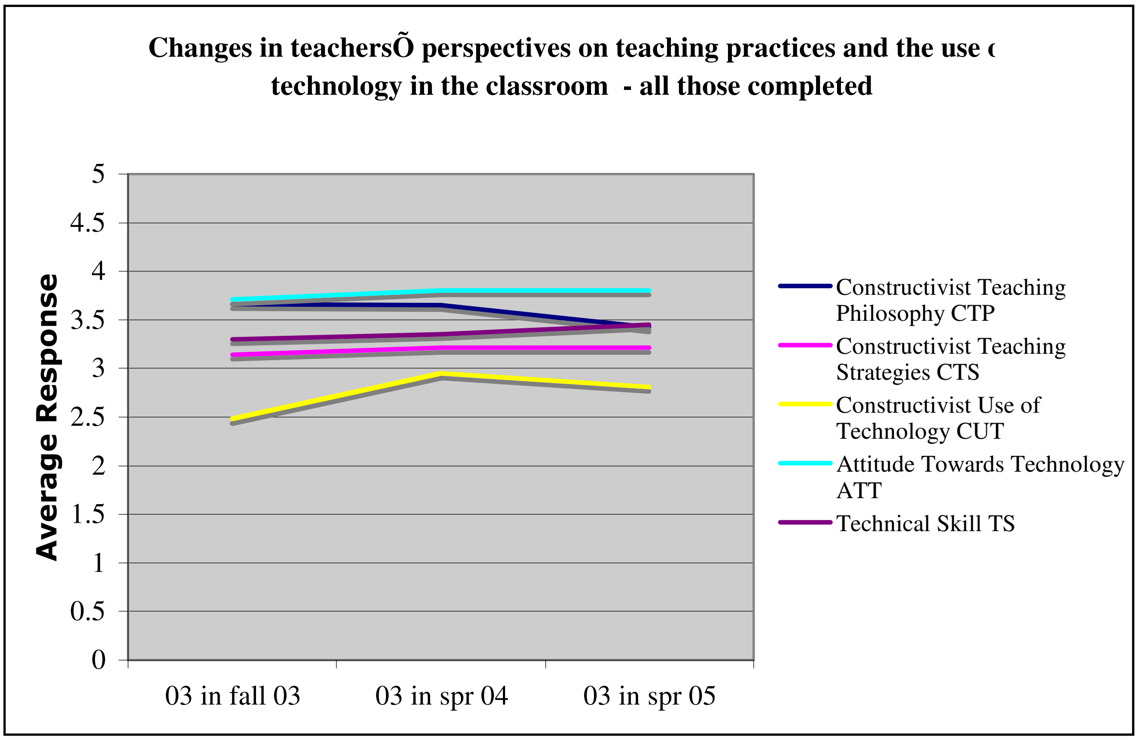
Methods and Data Analysis

The scale used to gauge constructivist perspectives and beliefs ranged from 1 (very traditional) to 5 (very constructivist). To determine whether significant changes occurred in perspectives related to evaluation constructs, five independent samples t-tests were conducted on the means of each evaluation construct utilizing questionnaires from the Fall (pre) and Spring (post). T-tests for independent groups were run to gauge growth of 2003 cohort over two years, and 2004 for one year. T-tests for matched pairs were run on subset of participants for whom data was available from the 2003 cohort for the fall '03, spring '04 and spring '05 administrations, and from the 2004 cohort where data was available for the spring '04 and spring '05 administrations. Analysis of covariance among constructs was done on the matched pair data.

Changes in teachers' perspectives on teaching practices and the use of technology in the classroom - all those completed

Construct	**03 in fall 03**	**03 in spr 04**	**03 in spr 05**	**04 in spr 04**	**04 in spr 05**	**05 in fall 05**
N=	121	193	146	189	149	104
Constructivist Teaching Philosophy CTP	3.66	3.65	3.42*	3.62	3.40*	3.73
P value			<0.01		<0.01	
Constructivist Teaching Strategies CTS	3.14	3.21	3.21	3.01	3.24*	3.08
P value					<0.01	
Constructivist Use of Technology CUT	2.48	2.95*	2.81*	2.88	3.02	2.74
P value		<0.01	<0.01			
Attitude Towards Technology ATT	3.71	3.80*	3.80*	3.76	3.85*	3.75
P value		0.03	0.03		0.03	
Technical Skill TS	3.30	3.35	3.45*	3.28	3.52*	3.36
P value			0.04		<0.01	

- Significant differences from year one



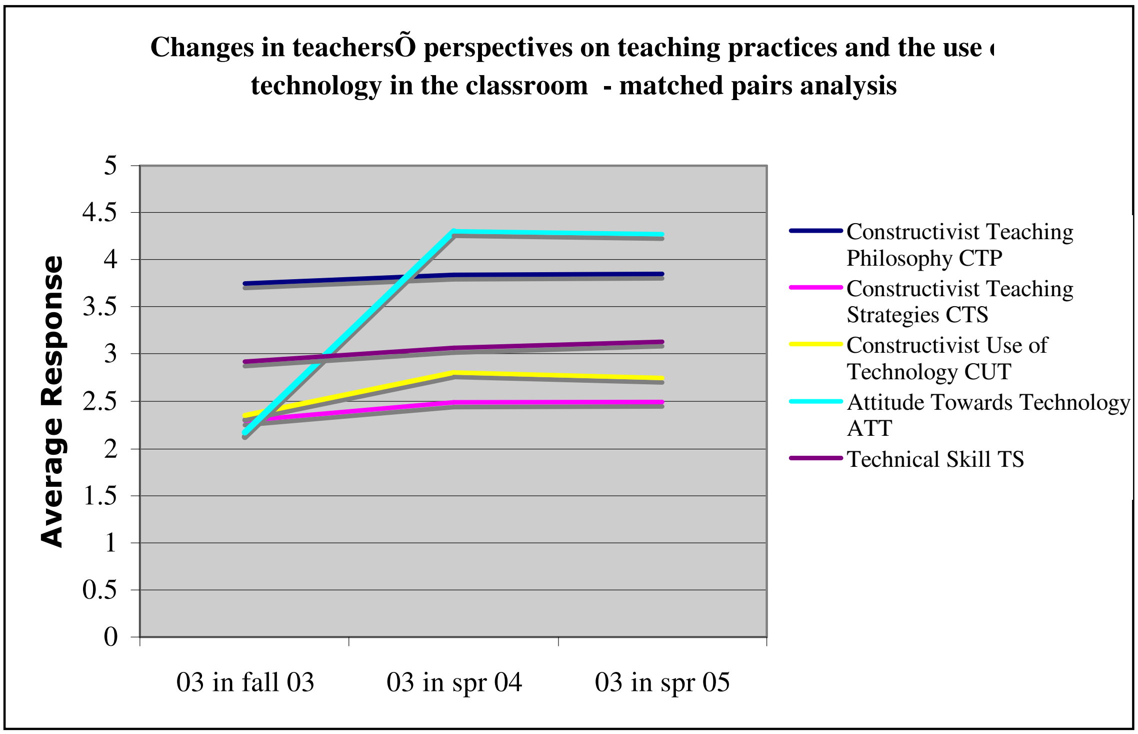
Of the 121 2003 cohort teachers who first took the survey in the fall of 2003, 104 of them also took the survey in 2004 (86%) and 60 took the survey all three years (50%). Teachers were matched by first and last names and a matched pairs t-test analysis was performed on each of the cohorts for each of the constructs. The data show significant growth from the fall of 2003 to the spring of 2004 and 2005 for the Technical Skills and Attitude Towards Technology constructs. Significant growth was found for 2004 cohort teachers from the fall of 2004 to the spring of 2005 in Technical Skills, Constructivist

Teaching Strategies, Attitude Towards Technology, and Constructivist Teaching Philosophy constructs.

Changes in teachers' perspectives on teaching practices and the use of technology in the classroom - matched pairs analysis

Construct	**03 in fall 03**	**03 in spr 04**	**03 in spr 05**	**04 in spr 04**	**04 in spr 05**
N=	60	60	60	124	124
Constructivist Teaching Philosophy CTP	3.75	3.84	3.85	3.60	3.40†
P value from first year		0.22	0.21		<-0.01
Constructivist Teaching Strategies CTS	2.30	2.49*	2.50**	3.01	3.27†
P value from first year		0.01	<0.01		<0.01
Constructivist Use of Technology CUT	2.35	2.81*	2.75**	3.88	3.86
P value from first year		<0.01	0.01		0.35
Attitude Towards Technology ATT	2.17	4.30*	4.27**	3.75	3.82†
P value from first year		<0.01	<0.01		0.04
Technical Skill TS	2.92	3.06*	3.13**	3.26	3.51†
P value from first year		0.01	<0.01		<0.01

*Significant differences for 2003 cohort from 03 to 04
** Significant differences for 2003 cohort from 03 to 05
† Significant differences for 2004 cohort from 04 to 05



Covariance Analysis

Covariance analysis of the groups resulted in two pairs with moderate coefficients. First, Constructivist Teaching Philosophy co-varies positively with Constructivist Teaching Strategies. Second, Constructivist Use of Technology co-varies positively with Technical

Skill. It was anticipated that as teachers gained an increased understanding of constructivist teaching ideas, applications, and thought that they would begin to use constructivist teaching strategies more often and with greater effectiveness. Additionally, it was anticipated that as teacher's proficiency with technology increased their ability to use technology within constructivist teaching practice would also increase. The data suggests that these two connections are emerging as positive outcomes of the NES program.

Covariance Analysis of Group Data

	CTP and ATT	**CTP and CUT**	**CTP and CTS**	**CTS and ATT**	**CTS and CUT**	**TS and ATT**	**TS and CUT**
2003 in Fall 2003	0.03	0.10	0.17	0.07	0.27	0.15	0.39
2003 in Spring 2004	0.05	0.06	0.15	0.06	0.18	0.16	0.28
2003 in Spring 2005	0.02	-0.03	0.10	0.05	-0.04	0.10	0.02
2004 in Fall 2004	0.02	0.12	0.10	0.02	0.21	0.08	0.27
2004 in Spring 2005	0.01	0.05	0.06	0.04	0.18	0.09	0.19

Analysis of the matched pair data revealed moderate coefficients of covariance for Constructivist Teaching Philosophy with Constructivist Teaching Strategies. This would indicate that the emphasis on inquiry and the increases seen in the cohorts from year to year on this construct are affecting the teachers' constructivist teaching strategies.

Covariance Analysis of Matched Pair Data

	CTP and ATT	**CTP and CUT**	**CTP and CTS**	**CTS and ATT**	**CTS and CUT**	**TS and ATT**	**TS and CUT**
2003 in Fall 2003	-0.14	-0.21	0.19	-0.06	-0.06	-0.28	-0.30
2003 in Spring 2004	0.03	0.01	0.07	0.17	0.07	0.22	0.02
2003 in Spring 2005	0.12	-0.04	0.13	0.14	-0.03	0.17	0.01
2004 in Fall 2004	0.01	-0.09	0.11	0.01	-0.08	0.07	-0.11
2004 in Spring 2005	0.02	-0.04	0.07	0.06	0.02	0.09	-0.01

Conclusions from Teaching, Learning and Computing Survey

With the emphasis in the Explorer Schools Program on the constructivist use of technology, it is expected that there would be significant increases on all constructs as a result of the program. In both an analysis of the cohort groups and matched pairs this is the case, with the exception of the Constructivist Use of Technology. The need to focus on this in professional development has been recognized and is being addressed. Specifically, the Digital Learning Network Learning Experiences are being revised to use inquiry and the content workshop using handheld technology used an inquiry approach. Further efforts to use technology in inquiry learning could occur during the summer workshops, NES updates at conferences and special professional development events such as Winter's Story. The covariance analysis indicates that working with teachers about their philosophy of teaching as well as strategies and uses of technology can have a positive effect.

Additional detail on Constructs
TLC Data Detail (mean, median, mode, standard deviation, and variance)

CUT 2005 in 2005 (n=104)

	C2avg	C5Aavg	C7avg	CUT
mean	3.33	2.70	2.20	2.74
median	3.40	2.63	1.97	2.67
mode	5.00	3.38	1.61	1.00
std dev	1.35	0.88	0.76	0.86
var	1.82	0.78	0.58	0.75

CUT 2004 in Fall 2004 (n=189)

	C2avg	C5Aavg	C7avg	CUT
mean	3.36	3.02	2.30	2.88
median	4.20	3.00	2.33	2.99
mode	4.20	5.00	1.00	1.00
std dev	1.43	1.15	0.82	0.91
var	2.28	1.60	0.70	0.87

CUT 2004 in Spring 2005 (n=149)

	C2avg	C5Aavg	C7avg	CUT
mean	3.58	3.01	2.48	3.02
median	4.20	3.00	2.45	3.02
mode	5.00	4.00	2.94	1.00
std dev	1.26	1.04	0.79	0.82
var	1.59	1.08	0.63	0.67

CUT 2003 in Fall 2003 (n=121)

	C2avg	C5Aavg	C7avg	CUT
mean	2.63	2.68	2.08	2.48
median	2.60	2.75	1.95	2.52
mode	1.80	2.63	1.00	1.04
std dev	1.32	0.88	0.86	0.87
var	1.74	0.78	0.74	0.75

CUT 2003 in Spring 2004 (n=193)

	C2avg	C5Aavg	C7avg	CUT
mean	3.46	2.87	2.50	2.95
median	4.20	2.88	2.58	3.16
mode	4.20	2.75	3.18	1.00
std dev	1.32	0.85	0.79	0.84
var	1.74	0.72	0.62	0.71

CUT 2003 in 2005 (n-146)

	C2avg	C5Aavg	C7avg	CUT
mean	3.34	2.52	2.57	2.81
median	3.40	2.32	2.58	2.86
mode	5.00	2.00	2.58	3.26
std dev	1.40	1.02	0.88	0.89
var	1.96	1.04	0.77	0.80

TS 2005 in 2005 (n=104)

	C8avg	C10avg	C13avg	TS
mean	3.75	3.31	3.02	3.36
median	4.00	3.22	3.29	3.44
mode	4.00	3.22	3.67	3.21
std dev	0.86	0.99	0.64	0.65
var	0.75	0.97	0.41	0.42

TS 2004 in Fall 2004 (n=189)

	C8avg	C10avg	C13avg	TS
mean	3.63	3.29	2.92	3.28
median	3.67	3.22	3.10	3.33
mode	3.50	3.67	3.67	4.14
std dev	0.84	1.05	0.67	0.68
var	0.71	1.10	0.45	0.46

TS 2004 in Spring 2005 (n=149)

	C8avg	C10avg	C13avg	TS
mean	3.94	3.51	3.10	3.52
median	4.00	3.67	3.29	3.59
mode	5.00	3.67	3.67	4.11
std dev	0.73	1.02	0.60	0.60
var	0.54	1.03	0.36	0.35

TS 2003 in Fall 2003 (n=121)

	C8avg	C10avg	C13avg	TS
mean	3.59	3.38	2.93	3.30
median	3.58	3.22	3.10	3.30
mode	4.50	2.78	3.67	4.04
std dev	0.92	1.12	0.69	0.74
var	0.84	1.25	0.48	0.55

TS 2003 in Spring 2004 (n=193)

	C8avg	C10avg	C13avg	TS
mean	3.74	3.30	3.02	3.35
median	3.86	3.22	3.29	3.35
mode	5.00	2.78	3.67	3.94

std dev	0.85	1.04	0.68	0.70
var	0.72	1.08	0.46	0.50

TS 2003 in 2005 (n=146)

	C8avg	C10avg	C13avg	TS
mean	3.89	3.31	3.15	3.45
median	4.00	3.22	3.29	3.51
mode	5.00	3.22	3.67	3.81
std dev	0.83	1.03	0.55	0.59
var	0.70	1.07	0.30	0.34

ATT 2005 in Fall 2005 (n=104)

	C9avg	C12avg	C14avg	C15avg	C16avg	ATT
mean	4.25	4.12	4.23	4.08	2.09	3.75
median	5.00	5.00	4.41	4.33	1.89	3.81
mode	5.00	5.00	4.41	4.50	2.19	4.07
std dev	1.02	1.19	0.56	0.83	0.93	0.42
variance	1.04	1.43	0.31	0.69	0.86	0.18

ATT 2004 in Fall 2004 (n=189)

	C9avg	C12avg	C14avg	C15avg	C16avg	ATT
mean	4.11	4.05	4.11	4.26	2.29	3.76
median	3.67	5.00	4.11	4.33	1.94	3.82
mode	5.00	5.00	3.67	5.00	1.59	3.84
std dev	0.96	1.18	0.59	0.89	1.11	0.44
variance	0.93	1.39	0.35	0.79	1.24	0.19

ATT 2004 in Spring 2005 (n=149)

	C9avg	C12avg	C14avg	C15avg	C16avg	ATT
mean	4.33	4.49	4.10	4.29	2.03	3.85
median	5.00	5.00	4.11	4.33	1.81	3.91
mode	5.00	5.00	4.11	5.00	1.44	4.10
std dev	0.82	0.88	0.52	0.65	0.86	0.35
variance	0.67	0.77	0.27	0.42	0.73	0.12

ATT 2003 in Fall 2003 (n=121)

	C9avg	C12avg	C14avg	C15avg	C16avg	ATT
mean	4.14	4.13	4.21	4.07	2.02	3.71
median	3.67	5.00	4.26	4.17	1.81	3.75
mode	5.00	5.00	5.00	5.00	1.30	4.38
std dev	1.00	1.21	0.57	0.86	0.87	0.45
variance	1.00	1.46	0.33	0.74	0.76	0.20

ATT 2003 in Spring 2004 (n=193)

	C9avg	C12avg	C14avg	C15avg	C16avg	ATT

mean	4.18	4.35	4.21	4.17	2.05	3.80
median	5.00	5.00	4.26	4.33	1.74	3.86
mode	5.00	5.00	4.11	5.00	1.44	4.20
std dev	1.04	0.96	0.63	0.81	0.93	0.42
variance	1.08	0.92	0.39	0.66	0.86	0.18

ATT 2003 in 2005 (n=146)

	C9avg	**C12avg**	**C14avg**	**C15avg**	**C16avg**	**ATT**
mean	4.26	4.47	4.22	4.13	1.98	3.80
median	5.00	5.00	4.26	4.33	1.81	3.90
mode	5.00	5.00	5.00	5.00	1.59	3.85
std dev	0.87	1.01	0.62	0.84	0.78	0.40
variance	0.76	1.01	0.38	0.70	0.60	0.16

CTS 2005 in Fall 2005 (104)

	B4avg	**B5avg**	**B6avg**	**CTS**
mean	3.00	3.97	2.28	3.08
median	2.86	4.00	2.13	3.04
mode	2.71	5.00	2.13	2.54
std dev	0.7527	0.825	0.638	0.599
var	0.57	0.68	0.41	0.36

CTS 2004 in Fall 2004 (n=189)

	B4avg	**B5avg**	**B6avg**	**CTS**
mean	2.95	3.86	2.22	3.01
median	3.00	4.00	2.13	3.04
mode	2.14	4.00	2.00	2.71
std dev	0.7044	0.79	0.593	0.567
Var	0.50	0.62	0.35	0.32

CTS 2004 in Spring 2005 (n=149)

	B4avg	**B5avg**	**B6avg**	**CTS**
Mean	3.65	4.01	2.09	3.24
median	4.00	4.00	2.00	3.33
Mode	4.00	5.00	2.00	3.00
std dev	0.9224	0.931	0.853	0.653
Var	0.85	0.87	0.73	0.43

CTS 2003 in Fall 2003 (n=121)

	B4avg	**B5avg**	**B6avg**	**CTS**
Mean	3.12	3.94	2.36	3.14
median	3.00	4.00	2.25	3.15
Mode	3.00	4.00	1.88	3.06
std dev	0.7819	0.8	0.715	0.67
Var	0.61	0.64	0.51	0.45

CTS 2003 in Spring 2004 (n=193)

	B4avg	B5avg	B6avg	CTS
mean	3.14	4.00	2.48	3.21
median	3.14	4.00	2.40	3.23
mode	3.00	4.00	2.63	3.54
std dev	0.7735	0.79	0.71	0.606
var	0.60	0.62	0.50	0.37

CTS 2003 in 2005 (n=146)

	B4avg	B5avg	B6avg	CTS
mean	3.19	3.97	2.47	3.21
median	3.14	4.00	2.40	3.15
mode	3.29	4.00	2.13	3.38
std dev	0.7328	0.805	0.653	0.602
var	0.54	0.65	0.43	0.36

CTP 2005 in Fall 2005 (n=104)

	A1avg	A2avg	A3avg	A4avg	A5avg	CTP
mean	3.53	3.77	3.68	3.81	3.86	3.73
median	4.00	3.80	3.72	3.75	3.80	3.72
mode	4.00	4.00	3.88	4.00	3.80	3.94
std dev	1.17	0.62	0.59	0.60	0.65	0.50
variance	1.36	0.38	0.35	0.36	0.42	0.25

CTP 2004 in Fall 2004 (n=189)

	A1avg	A2avg	A3avg	A4avg	A5avg	CTP
mean	3.39	3.61	3.54	3.77	3.79	3.62
median	3.33	3.60	3.56	3.75	3.80	3.60
mode	4.00	3.80	3.56	4.00	4.00	3.81
std dev	1.01	0.65	0.53	0.62	0.72	0.46
variance	1.03	0.42	0.28	0.38	0.52	0.21

CTP 2004 in Spring 2005 (n=149)

	A1avg	A2avg	A3avg	A4avg	A5avg	CTP
mean	3.49	3.39	2.62	3.85	3.79	3.40
median	3.67	3.40	2.68	4.00	3.80	3.41
mode	4	3.2	2.28	4	4	3.5713
std dev	1.128	0.538	0.508	0.6725	0.736	0.3692
variance	1.272	0.289	0.259	0.4523	0.542	0.1363

CTP 2003 in Fall 2003 (n=121)

	A1avg	A2avg	A3avg	A4avg	A5avg	CTP
mean	3.43	3.71	3.55	3.86	3.77	3.66
median	3.67	3.80	3.52	4.00	3.80	3.67
mode	4	4.2	3.88	4	3.8	3.04
std dev	1.15	0.681	0.633	0.6133	0.749	0.533
variance	1.323	0.464	0.4	0.3761	0.561	0.2841

CTP 2003 in Spring 2004 (n=193)

	A1avg	A2avg	A3avg	A4avg	A5avg	CTP
mean	3.52	3.67	3.52	3.81	3.73	3.65
median	3.67	3.60	3.44	4.00	3.80	3.63
mode	4	3.8	3.72	4	3.8	3.584
std dev	1.039	0.628	0.66	0.6957	0.816	0.5179
variance	1.08	0.394	0.435	0.484	0.665	0.2682

CTP 2003 in 2005 (n=146)

	A1avg	A2avg	A3avg	A4avg	A5avg	CTP
mean	3.48	3.39	2.49	3.91	3.84	3.42
median	3.67	3.40	2.52	4.00	3.80	3.42
mode	4	3.4	2.36	4	4	3.422
std dev	1.163	0.446	0.534	0.6518	0.754	0.3404
variance	1.353	0.199	0.285	0.4248	0.569	0.1159

Summer Workshop Feedback 2005

Teachers reported having a very positive overall experience while at the summer workshops. Teachers reported they would highly recommend the workshop to other teachers (4-75 to 4.96 on a 1 to 5 scale). Teachers also highly rated the event as a valuable experience, relevant to their work, inspiring to them and worthwhile in building a better understanding of NASA. Overall, the ratings by teachers were very high for all three workshops: 4.67 for Orientation Workshops, 4.56 for Content Workshops and 4.49 for Sustainability Workshop.

Results by Construct		Means	
	Orientation N=141	Content N=133	Sustainability N=168
Overall quality of workshop	4.92	4.83	4.71
8a. This event was a valuable experience	4.94	4.88	4.77
8c. I expect to apply what I learned in this event	4.88	4.79	4.70
8d. This event was inspiring.	4.90	4.83	4.72
10a. The entire week or event	4.93	4.81	4.65
10b. The overall content	4.91	4.83	4.66
10c. The kind of recommendation you would give someone who asks you about applying to this event	4.96	4.85	4.75
Effect on Teachers			
Relevance to Teachers	4.82	4.73	4.54
1a.The information provided in the event is relevant to my role in education	4.84	4.73	4.52
1b. The concepts and skills taught in the event can be used in my work.	4.85	4.69	4.45
1d. My personal learning objectives were met.	4.64	4.61	4.41

8a. This event was a valuable experience	4.94	4.88	4.77
Teacher Confidence			
1c. After participating in the event I feel confident in my ability to apply the knowledge and/or skills learned.	4.49	4.47	4.41
Teacher Understanding of NASA	4.84	4.73	4.56
1e. I have a better understanding of NASA's mission.	4.88	4.77	4.58
1g.I have a better understanding of NASA's support for education	4.90	4.77	4.64
4f: Increase AFTER event: Using NASA resources to enhance my instruction.	4.77	4.62	4.49
8b. NASA related materials provided can be integrated in your curriculum.	4.82	4.76	4.52
Inspiring to teachers			
8d. This event was inspiring.	4.90	4.83	4.72
Teacher Skills and Knowledge			
1f. I acquired the skills and/or knowledge offered to participants	4.74	4.69	4.54
Instructional technology for teachers	4.57	4.43	4.23
2d. Impact of this event on: Instructional technology for teachers	4.67	4.59	4.35
4h. Increase AFTER event: Incorporating more instructional technology in my instruction	4.47	4.27	4.11
Planning for use			
8c. I expect to apply what I learned in this event	4.88	4.79	4.70
Working with colleagues			
4a. Increase AFTER event: Sharing what you learned with other professions	4.38	4.04	4.31
Instructional approaches	4.32	4.18	4.09
4b. Increase AFTER event: Aligning instructional approaches to reflect national and /or local standards and/or state frameworks.	4.09	3.84	4.00
4c. Increase AFTER event: Incorporating problem-solving activities in my instruction.	4.44	4.27	4.10
4d. Increase AFTER event: Incorporating inquiry activities in my instruction.	4.46	4.36	4.17
4e. Increase AFTER event: Using cooperative team strategies in my instruction.	4.31	4.23	4.10

Teacher STEM-G			
Integration of STEM-G	4.74	4.61	4.45
2a. Impact of this event on: Integration of career education of science, technology, engineering, mathematics, and/or geography	4.82	4.66	4.59
4g. Increase AFTER event: Integrating science, technology, engineering, mathematics, and/or geography into my instruction more than I did in the past.	4.59	4.42	4.26
8b. NASA related materials provided can be integrated in your curriculum.	4.82	4.76	4.52
Application of STEM-G			
2b. Impact of this event on: The application of science, technology, engineering, mathematics and/or geography.	4.83	4.77	4.59
Interest in STEM-G	4.34	4.21	4.32
12a. Level of Interest: Science	4.70	4.58	4.60
12b. Level of Interest: Technology	4.56	4.52	4.58
12c. Level of Interest: Engineering	3.96	3.67	4.02
12d. Level of Interest: Mathematics	4.23	4.11	4.13
12e. Level of Interest: Geography	4.26	4.16	4.29
Importance in contemporary life	4.34	4.43	4.61
13a. Importance in Contemporary Life: Science	4.39	4.52	4.67
13b. Importance in Contemporary Life: Technology	4.47	4.64	4.78
13c. Importance in Contemporary Life: Engineering	4.22	4.23	4.51
13d. Importance in Contemporary Life: Mathematics	4.46	4.55	4.69
13e. Importance in Contemporary Life: Geography	4.16	4.20	4.40
<u>Effect on students</u>			
Inspiring students			
2e. Impact of this event on: Inspiring my students	4.94	4.88	4.76
Instructional technology for students			
2c. Impact of this event on: Instructional technology for students	4.75	4.68	4.43
<u>Family Involvement</u>			
2f. I Impact of this event on: Increasing family involvement	4.62	4.20	4.57

Effect on technology use	4.63	4.51	4.29
2d. Impact of this event on: Instructional technology for teachers	4.67	4.59	4.35
2c. Impact of this event on: Instructional technology for students	4.75	4.68	4.43
4h. Increase AFTER event: Incorporating more instructional technology in my instruction	4.47	4.27	4.11
Total	4.67	4.56	4.49

2005 Cohort Attitudes toward Computers

	Agree
I would like every student in every classroom to have an access to a computer	87%
Computer skills are essential to students	100%
I would like all students to be able to use computers	100%
Computers should be incorporated into classroom curriculum	87%
Computers enhance classroom instruction	100%

2005 Cohort Concerns and Issues

	Yes	No	Not sure
Concerned about the time that will take teachers to implement the program	67%	27%	3%
Fear that the Explorer schools program may be overwhelming	54%	46%	8%
Concerned about the time that will take me to coordinate the program	65%	27%	8%
Satisfied with the emphasis of this program on teacher professional growth	87%	9%	6%
Satisfied with the emphasis of this program on student STEM learning	89%	0	11%
Satisfied with the emphasis of this program on student STEM career interest	86%	3%	11%
Satisfied with the emphasis of this program on family involvement	92%	0	8%
Believe the program will increase teacher professional growth by the end of year 3	92%	3%	5%
Believe the program will increase student interest in STEM careers by the end of year 3	92%	3%	5%
Believe this program will increase student interest in STEM disciplines by the end of year 3	92%	3%	5%

Want to know if we will be a better school after the three year	87%	8%	5%

2005 Cohort Administrator Support

	Yes
Planning to actively participate in the implementation of strategic plan	
Planning to represent the team's interest and concerns to higher levels of administration	
Prepared to implement lasting changes to school policies based on the team's strategic plan	
Prepared to implement lasting changes to district policies based on the team's strategic plan	
Encourage responsible risk taking on the part of teachers and other administrators related to implementing the strategic plan	
Encourage teachers to use NASA educational products in the classroom	
Support teacher attendance to professional development conferences and workshops	
Support family events organized at the school	
Planning to provide teachers release time to help the NASA Explorer Schools team members to implement the plan	

2005 Cohort External support

	Yes
Plans to encourage the district leaders to maintain interest in the NASA Explorer Schools program	
Plans to seek additional funding from the district to supplement those provided by the partnership with NASA	
Plans to seek personnel support from some of the businesses in the community	
Plans to seek funding from some of the businesses in the community	
Plans to seek personnel support from some of the universities in the community	
Plans to seek funding from some of the universities in the community	

2003 and 2004 cohort Attitudes toward computers

	2003	2004
I would like every student in every classroom to have an access to a computer	98%	95%
Computer skills essential to students	98%	100%
I would like all students to be able to use computers	98%	95%
Computers should be incorporated into classroom curriculum	95%	100%
Computers enhance classroom instruction	95%	98%

2003 and 2004 Concerns and Issues

The administrators from the 2003 and 2004 cohorts took the survey in the spring or summer 2005. Since baseline data were not collected from the neither of the cohorts, administrators' concerns and issues are displayed in Table # as percentages representing their views after having experienced the program for sometime.

As seen in Table #, 2003 concerns about time it takes to implement the program is lower than the administrators of 2004. Time is being one of the internal concerns in the teacher change literature is expectedly lower for 2003 cohort than 2004 cohort. Concerns-Based Adoption Model (CBAM) delineates seven stages of change individuals move through as they implement a change. These states are further grouped as internal and external changes. According to this model, teachers' internal concerns (their awareness, informational, personal, and management concerns) are expected decrease and external concerns (consequence, collaboration, and refocusing) increase over time as they implement a change effort. This means after having experienced the program for over two years, the administrators from 2003 is less concerned about the time it takes teachers to implement the program and them coordinate the program than those of 2004. As expectedly, having experienced the program a year longer than 2004 administrators, 2003 participants gained more confidence and became less concerned about time (an internal concern). Higher concerns of the 2004 cohort indicate that they are still in the early stages of the change effort.

Table # below also indicates administrators' satisfaction with the emphasis of the Explorer Schools program on student STEM learning and career interest, family involvement, and professional growth. When the post data from 2003 and 2004 cohorts become available, means scores of each variable will be compared to describe administrators' satisfaction with the program at the end of year 3.

	2003	2004
Concerned about the time that takes teachers to implement the program	32%	66%
Feel overwhelmed by the Explorer schools program	30%	51%
Concerned about the time that will take me to coordinate the program	48%	66%
Satisfied with the emphasis of this program on teacher professional growth	90%	90%
Satisfied with the emphasis of this program on student STEM learning	91%	87%
Satisfied with the emphasis of this program on student STEM career interest	88%	88%
Satisfied with the emphasis of this program on family involvement	80%	88%
Believe the program will increase professional growth by the end of year 3	86%	93%
Believe the program will increase student interest in	87%	95%

STEM careers by the end of year 3		
Believe this program will increase student interest in STEM disciplines by the end of year 3	87%	95%
Want to know if we will be a better school after the three year	80%	88%

2003 and 2004 Cohort Administrative Support

	2003	2004
Actively participated in the implementation of strategic plan	92%	98%
Represent the team's interest and concerns to higher levels of administration		
Prepared to implement lasting changes to school policies based on the team's strategic plan		
Prepared to implement lasting changes to district policies based on the team's strategic plan		
Encourage responsible risk taking on the part of teachers and other administrators related to implementing the strategic plan		
Encourage teachers to use NASA educational products in the classroom		
Support teacher attendance to professional development conferences and workshops		
Support family events organized at the school		
Planning to provide teachers release time to help the NASA Explorer Schools team members to implement the plan		

2003 and 2004 External Support

	Yes
Plans to encourage the district leaders to maintain interest in the NASA Explorer Schools program	
Plans to seek additional funding from the district to supplement those provided by the partnership with NASA	
Plans to seek personnel support from some of the businesses in the community	
Plans to seek funding from some of the businesses in the community	
Plans to seek personnel support from some of the universities in the community	
Plans to seek funding from some of the universities in the community	

CENTER FOR CHILDREN & TECHNOLOGY

NASA Explorer Schools

Report on Focus Group Research

April 15, 2005

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INTRODUCTION

EDC's Center for Children and Technology (CCT), a not-for-profit, independent education research organization, was asked by the contracted evaluators at the Center on Educational Technologies (CET), Wheeling, W.V., to conduct focus groups with the 49 NASA Explorer School teams from the 2003 cohort, analyze the data, and report the findings. The purpose of the focus groups was to learn how school teams experienced the program, examine the implementation of their strategic plans, gauge the nature and extent of the support they received from NASA field centers, and note their evaluative perspectives.

This report documents the results of these focus group interviews. It has three sections: methodology, findings, and concluding remarks.

METHODOLOGY

CCT researchers used focus group interviews to investigate NES school team members' experiences and views about the program. Focus groups, also known as focus group interviews, are essentially guided group discussions used in qualitative research to generate an understanding of participants' experiences. In focus groups, participants facilitate each other's understanding of the issues, are less constrained by their role as the interviewee, and are able to elaborate and defend their views in the company of their peers, thus providing rich qualitative data (Stewart & Shamdasani, 1990; Morgan, 1997; Merriam, 1998; Bloor, et al., 2002). A focus group methodological approach to examining the NASA Explorer Schools program helped us discern patterns of experiences of the school teams involved in the program.

Preparation for Conducting Focus Group Interviews

To prepare for the focus groups, CCT researchers worked in collaboration with CET to develop the interview protocol and focus group scheduling. CET staff took the lead on both activities.

Instrument development. CCT staff reviewed the focus group interview protocol devised by CET staff and provided feedback. This process helped CCT staff to understand the rationale behind the questions asked and some of the answers expected by CET staff. It also provided opportunities to fine-tune the instrument. The final protocol included questions that probed how the school teams work as a unit, implement their school's strategic plan, what they perceive to be the impact of the program on themselves and their students, what are their evaluation plans, and what are their understandings of the NES goals.

Scheduling the focus groups. One CET staff member coordinated all the scheduling logistics. She convened and arranged the focus group meetings, providing CCT staff with at least two weeks advanced notice of the focus group meeting dates.

The preparation process of the focus groups, prior to conducting them, ensured a naturalistic interaction between researchers and school teams (Rubin & Rubin, 1995; Seidman, 1998). After CET staff arranged the focus group meetings with each participating team as well as provided the final protocol for the focus group, CCT staff started conducting the focus group sessions in late December 2004.

Data Collection

At the beginning of each focus group interview, participating school team members were introduced to the CCT evaluation team; given an explanation about the purpose of the evaluation and the focus group; and informed that the focus group interview would be audio taped, transcribed, and used to write a report (excluding their names to protect their privacy).

CCT staff conducted 49 focus groups via telephone between December 27, 2004 and February 25, 2005 (see Appendix), despite some scheduling problems due to weather, under prepared teams, and mistakes in times due to time zone miscalculations. Two CCT researchers conducted thirty-two of the focus groups; one researcher conducted the remaining focus groups. When two CCT researchers conducted the focus groups, one served as the moderator and took the lead on asking the questions from the protocol, while the other acted as an "assistant moderator" and took detailed notes (Krueger, 1998).

In ten out of the 49 focus groups, only one team member was available to participate in the focus group because of scheduling issues or because other team members did not have time to participate. Most of these ten individual interviews were conducted with Team Leads.

Forty-eight of the 49 focus groups were audio taped and transcribed. One focus group was not recorded because of technical malfunctions; however, interview notes are available. Although the focus group sessions varied in terms of length of time, most of them lasted between 45 minutes to an hour.

Data Analysis

CCT researchers analyzed the data for emerging themes \ organized around four research questions:

1. How are school teams experiencing the program?
2. How are they implementing their strategic plans?
3. How do they assess the support they receive from NASA field centers?
4. What are their evaluative perspectives?

The findings were refined based on our field notes, focus group summaries, and the transcripts.

Limitations

Like all designs, this one has its limitations. The data are valuable, and will be even more revealing if triangulated with other data sources—surveys, document reviews, and school data, such as courses established, student attendance of those courses, etc.

Some limitations of this method include the following: first, the interviews were generally limited to 45 minutes due to time constraints on the part of the teachers. Speaking with teams for forty-five minutes (or less) did not allow the interviewers to probe deeply into the experiences that teachers were having with the program. Second, the protocol asked about the experiences of other teachers in the school, as well as of students. However, the interviewees could only report this information second- or even third-hand. Third, the focus group interviews were conducted over the phone, meaning the researchers conducting the interviews could not see the facial expressions or gestures of the interviewees. They needed to guess at some of the dynamics that were occurring on the other end of the phone line, especially when an administrator from the school or district was present. Finally, in a small number of cases, individual interviews were conducted, and therefore the perspective of only one team member, usually the team lead, was represented.

FINDINGS

The findings are organized into four sections that correspond with the four research questions: (a) the ways school teams are experiencing the NES program; (b) the ways teams are implementing their strategic plans; (c) school teams' assessment of the nature and extent of the support they are receiving from NASA field centers; and (d) school teams' evaluative perspectives.

Ways School Teams Experience the Program

Overall, we discerned some common patterns across the school teams. First, working as a team was considered very important for program implementation; schools that had problems with the team generally had problems implementing the program. Second, educators reported that the program had a rejuvenating effect on them. Third, the program brought a positive spotlight to participating schools through the activities of teachers in their classrooms and the schoolwide activities planned by the teams, but teams often had problems getting other teachers involved. Finally, team members reported that the program had a positive impact on students.

Working as a Team

Working as a team was considered very important for the implementation of the program. Team stability and understanding of the NES goals seems to be important function of successful teams, although sometimes changes in team members contributed to making the team more successful (i.e., changing from one teacher from each grade, to all the teachers in the 8th grade). The NES teams were often composed of four teachers and an administrator (school principal, assistant principal). One of the teachers on the team, often a science teacher, serves as the Team Lead, which means that they provide leadership in the day-to-day implementation of the program, as well as deal with NES paperwork.

Having an administrator on the team seems to be important for program implementation; administrators help communicate the importance of the program to the school and district, cut through red tape, and prioritize.

Teams generally have a regularly scheduled meeting, whether it is once a week or once a month, in additional to informally communicating through email and conversations in the hallway.

Reasons team members gave about the importance of the team included:

"The team can build on each other's strengths. So I think that's an important aspect of it that it's not left to one person and to share the responsibility but also to make sure that any kind of gaps are filled in and bringing in different kinds of expertise to make it a better program for everybody."

"[W]e … rely on each other. If we can't get something done or we don't have time to do something, we need the team to help us out."

"[W]e all work together on each one of the goals that we have set for ourselves. We each have a particular job that we bring to the team that we have, the expertise that we work on, so we all kind of work together that way."

"We work as a well-oiled machine…. The younger people [on the team] have more energy. The older people have more time because the younger people have children. So we just trade off when we know we have to…. we have a very well functioning team. We're very lucky. Everybody does the work that needs to be done, and everyone is very willing to pitch in and do the task that we identify that needs to be done."

Some team members gave presentations about the NES program at their school, at local conferences, to other educators in their district, and to local community groups. They often also led their grade level colleagues in professional development activities such as curriculum mapping and technology integration, and shared information from conferences and institutes with colleagues. They made presentations to large groups, such as all science teachers in the district, or all new teachers in the district, where they discussed NASA and the NES program, and distributed NASA resources.

Challenges related to the teams include the following:

- The biggest challenge noted by teams was time: the time to meet and to do the extra work, such as filling out forms, required by the grant. In terms of time to meet, team members noted that many members worked in after-school projects. In some schools, members had different schedules, which made it difficult to find mutually agreeable times to meet.

- When teachers are the only team members at their school, they find it hard to disseminate information and get other teachers involved. They explain that there is "no critical mass."

- Original team members found it difficult to get new members "up to speed." They felt they could not adequately convey the "passion" inspired by the summer team training at the regional NASA center and maintained by attendance at conferences and summer institutes to new team members and especially to new administrator team members.

- If a key team member, such as the one who wrote the grant or had the initial connection to NASA, left the school, some teams experienced problems in continuing to work as a unit and implementing the strategic plan.

- Teams that faced challenges in working as a unit, whether because of turnover, because they worked at different school sites, because of an unsupportive administrator, or because of conflict, generally faced challenges in implementing their strategic plans.

- In a minority of cases where the administrator was the team lead there was a perception by team members that the administrator was too busy taking care of other school-related work to pay attention to managing this program. These teams recommended that an administrator should not necessarily be the team lead.

Understanding NES Goals

Almost all teams expressed an understanding of the NES goals, namely, to foster engagement in math, science, and technology and related careers among underserved middle school students. They engaged in the following implementation activities: attending professional development events, acquiring technology resources, using the NASA resources in their instruction, and involving other teachers and community members in the program.

Findings about the NES program's impact are organized around the teams, the schools, and the students.

Impact on Teams

The teachers in the NES teams concurred that the NES program has made them better teachers, while the administrators (Principals, Assistant Principals) on the teams said that they appreciate the support and resources provided to their students, teachers, and community by the NES program.

The NES program has impacted the ***teachers*** on the teams personally and professionally. It has increased their access to educational resources and professional development opportunities at the national and local level; raised their level of motivation about teaching; and helped them improved their teaching practices. According to a 22 year-old veteran educator, participating in the program was the best experience for her because of “all the opportunities, and a giant pat on the back.” This experience increased the teachers’ love for science, especially among those who are not teaching math, science, or technology. All the NASA training has been “mind-boggling exciting stuff. It stretches your mind.”

Increased access to educational resources and professional development opportunities. The teachers appreciate the educational and financial support provided through the NES grant, which included access to NASA web sites, astronauts and other NASA experts, field sites, workshops and national conferences. They have greater access to high quality teaching resources and opportunities. “Having the robotics equipment is blowing my mind,” said one teacher. Another teacher said that she had no textbook, “NASA was my whole curriculum;” in addition, she reports she is more involved with her students (i.e., she does the middle grades science club and has done more field trips). In a few cases where there was a librarian on the team, we found that they felt that the program allow them to share NASA resources with teachers, students, and parents. They agreed with the teachers that participants were enthusiastic about the types of knowledge and learning afforded by the NASA resources.

The professional development provided through the grant was beneficial and helpful. The teachers conferred their highest praise to the professional development opportunities, and NASA professional development in particular. “As huge and big as NASA is, they are every day, ordinary people, willing to teach children. If it’s an astronaut or … [AESP] or somebody in Washington DC, they are all willing to help. They never put you off. Everyone is congenial, open, they have the time to speak.” The national conferences (NSTA, NSTM, etc.) that they attended provided not only travel opportunities to visit other places in the country, but also networking opportunities with other team leaders, administrators, and experts across the country, as well as opportunities to learn more about science, math and technology. Furthermore, they learned about the many career opportunities at NASA, which opened their eyes to new science and technology developments such as robotics. “NASA has given us opportunities we never would have had otherwise. … [For example] at Goddard, first year, we met with all these scientists who are working with problems you didn’t even know NASA dealt with, like aerosols.”

They have become aware of NASA’s involvement in areas such as health issues, the environment, biology, and technology, and have been able to expand their curricular materials.

Increased motivation to teach, especially among those who have been teaching for many years. The NES program activities have re-energized the teachers in their work. Some of the phrases and sentences used to express this feeling of rejuvenation included: “It’s dragged me out of my rut,” “[I’m] excited about teaching again,” “After teaching for 30-odd years, it's reviving, stimulating and basically it's fun to do with kids,” and “It’s kept me interested and motivated in the job.” One reason they are more motivated about teaching is because of the degree of involvement of their students in the program. They feel that they are better teachers because of the motivation to learn exhibited by their students. “It’s made me more excited about getting the children more involved in math, science and technology. It showed me how much they need it, because it is their world.” “I’m proud to say I’m a NASA educator,” declared another teacher. Furthermore, they enjoy collaborating with their colleagues in a team format, within which they feel more supported in their teaching. As a result, they have a lot more motivation to perform better in the classroom.

Improved teaching practices. Teachers felt that the NES program helped them better integrate science, math and technology into their teaching. This was accomplished in the following interrelated areas: (1) content, by increasing their knowledge about science, math and technology; (2) curriculum development, by encouraging the revision of their existing curriculum based on their teaching needs and students’ learning needs; and (3) pedagogy, by providing strategic uses of science, math and technology activities in the classrooms. One teacher, who has a relationship with NASA going back about six years, said, “Unequivocally, NASA has changed my life. It has…done amazing things to the quality of my teaching.” Another teacher said, it “made me a better teacher… it’s a rebirth.”

Through the NES program they say that they have gained more mastery of the teaching of science content, especially difficult science concepts, such as DNA, forces and motions, and aerospace. They have gained knowledge about NASA’s contribution to every day life and are better equipped to lead hands on activities in their classrooms. They feel more confidence in teaching science, math, and technology in their classrooms. One teacher said that before the program she was not “a science type of person” but now is excited about science. A math teacher said that he learned more about science and felt more competent in science. After teaching English for 12 years, one team member was told by her former principal, “You’re going to teach life science.” After struggling for two years, she then became part of the NES team and took part in the Ames training after which “my whole attitude toward science changed.” Now she has a passion for what she's teaching in science, and for inspiring kids. She called it, "a complete 360."

Teachers are making revisions to their existing curriculum based on their teaching and students’ needs, as well as because of access to new curriculum ideas, and a lot of freedom to create new activities. As a result, some of the teachers have entirely revamped their science curriculum. “When I got involved, I became enthusiastic. I sought out new things.” It is a personal excitement because of the relationships they have forged with NASA scientists, astronauts, and other educators. “I’ve done space education for 30 years. The last couple of years, with infusion, have given me a professional growth that we couldn’t have had otherwise.” A math teacher said that the training “gets your brain working in different ways,” and that after he got back from NASA training he “changed the whole geometry unit.” In addition, they have increased their use of technology by integrating it into their curriculum activities. Some of them are using PDAs in their classrooms, videoconferencing system for distance education, and other technologies made available through the NES grant. These experiences have helped expand their curriculum offerings.

Finally, teachers have changed their teaching practices of science and math. The program has provided new opportunities and understanding of how student learn the inquiry process. They are spending more time on hands-on science activities; are using more inquiry-based teaching, and have learned how to set up and conduct science research projects. A teacher said that his participation in the NES program has changed him "from a paper-and-pencil teacher" to using more hands-on activities, which he believed helped make learning about science more fun. One teacher said, "Hands-on activities helped me think about what's more relevant and that more learning was going on [than] if I had just lectured." Another teacher reported that he is doing more hands-on activities and being more open to learning from the students. "This changed the way I teach my students. Now I use inquiry-based learning almost exclusively. I changed the way I assess my students."

The administrators on the teams said that they are grateful to NASA for trying their best to respond to their schools' science, math, and technology needs. "They have made everything available to us." The ***administrators*** (Principals, Assistant Principals) in the teams indicated that they appreciate the support and resources provided to their students, teachers, and community by the NES program. The program has:

- Increased their understandings of NASA's work, and made them appreciate the learning and teaching involved in NASA's science, math and technology education programs. One administrator noted that he has become more aware of technology and what his teachers are capable of doing with the appropriate resources and support. Another administrator said that he learned a lot about what's available in math, science, and technology for his students and teachers.
- Influenced positively their teachers, especially those in the NES teams, and their students. They recognized that their teachers received quality professional development activities that they would not have otherwise had access to in the last two years, due to budget constraints.
- Increased their involvement with the community and parents, and helped boost the image of their schools in their communities. The visits by astronauts (e.g., Barbara Morgan, an Educator Astronaut, and Jim Voss, a former NASA astronaut) to NES schools were highlights in the program implementation that drew a lot of attention in local media outlets. These visits left huge impressions on other teachers, students, and parents, and changed the whole outlook of the NES program in most of the participating schools. According to one administrator, "the program is a real bonus for our school. It has boosted our image in the community. The school is more recognized in the district, and we have obtained more support from parents." In some cases, they said that being part of the NES program has even brought them recognition at the state level.

Impact on Schools

Most NES teams acknowledged that they are still working on expanding the program into their school, district, and community. For some, it is part of the second year of their strategic plan; others have already made considerable strides in raising awareness of the program in their schools, and are starting to see some of the positive impact that the program is having on their colleagues and community in terms of learning more about current NASA science events and educational activities, and participating in schoolwide NES events (e.g., videoconferences, parents' nights, NASA days). "People are thinking in scientific terms where they weren't previously," said one teacher. Ways that the NES program has impacted participating schools include (1) increased involvement of other teachers, (2) increased community involvement, (3) increased access to networks and funding for science programs and activities, (4) expanded availability of technology infrastructure, and (5) the development of new educational programs.

Increased involvement of other teachers. Other teachers are excited and curious about the program. They are excited about the availability of NASA's educational resources (e.g., schools' NES libraries) and professional development opportunities. One Team Lead said, "I've been able to get other teachers excited. One is just as excited as I am and now does a lot more hands on activities." The computer lab teacher on the team who does robotics noted that "more teachers are starting to ask questions" about the program. A teacher from another team reported that other teachers at her school are excited about it and want to know how they can incorporate NASA materials. Teachers note that more resources are now available in the library for science teachers and to share at the elementary level. They are routinely seeking out and asking about NASA resources, and are requesting additional NASA professional development. According to the NES teams, teachers, who attended NASA trainings (e.g., NES school teams, summer trainings, History of Winter, JPL, Goddard), received excellent professional development in math, science, and technology. One Team Lead said that the 22 teachers on staff went through three or four NASA workshops at the school last year and "everything I heard was positive." A science teacher, who took the History of Winter course, mentioned the many useful resources for the environmental science program that came out of the course. In one school, the AESP did a lot of outreach ("was a sales person" for the program) to other teachers, setting up times for what to meet with them, visiting with them in their classrooms, and requesting time to meet with the math and science departments. In some cases, teams provided professional development to their school colleagues, such as a workshop on Mars conducted by one NES teams that gave them an opportunity to share their science, math and technology knowledge gained in the program.

As a result, other teachers are using NASA materials (e.g., mapping resources, the NASA websites for ideas about lesson plans, the KC-135 activities, e-missions) and are more comfortable doing scientific and technology activities such as robotics and rocketry with their students. Some of these teachers are involved in more science teaching, are learning more about science, are interested in science education and trainings, and are using more hands-on activities and inquiry approaches in math. In one school, the team said that there is a greater focus on physical science now at the middle school level as compared to before the NES program when they did mostly biology/life sciences.

In some schools, all the science teachers are involved in the program and sometimes social studies, math, and language arts teachers are included as well. All get to use the equipment. "It [the NES program] has brought our faculty closer together. One of the Active boards was put in the media center and we offered a professional development session on how to use it; all teachers participated." The NES program, which targets middle schools (grade 6-8), is being expanding into some elementary and high schools. Team members are sharing the NASA materials with these teachers. And they are using the materials in cross-curricular unit, including social studies, English, math and science. Last year, one of the high school science teachers came often for NASA materials at the middle school. The team has now made available resources to other teachers in their schools and is expanding the program into other grades.

Those teams, who had only minimal success in involving other teachers in the program, suggest that they need additional administrative support in order to remedy this situation.

Increased community involvement. A major impact of the program for many NES communities has been an increased awareness of NASA and its educational programs and increased parental involvement. Parents have become more aware of NASA, and appreciate their children's school being associated with NASA. The NES program is well perceived in the communities it serves, and has generated a new sense of community pride. Some parents are starting to request that their children be part of the NES classes. One of the teachers said, "We have parents coming from other schools in the area bringing their children because everyone seems to be so interested in what we're capable of doing. From what I can tell, I see a lot more parents wanting to send children to this area. People [are] moving into the Phoenix City area because we are a 'NASA Explorer School.'"

In most NES communities, involvement with the NES program has centered on special school events (e.g., the family/parents nights, NASA days, science fairs) organized by the NES teams with support from other teachers, parents, and local businesses. Attendance at these events is often very high. In one school, over 1,000 people attended one of the family nights. These events have allowed parents to participate in school activities and children' learning about science, math and technology.

Increased access to networks and funding for science programs and activities. The NES program and NASA affiliation are beginning to help some of the schools to open doors that weren't open before, such as accessing grant funds from philanthropic organizations and foundations and building new partnerships with local businesses and universities. In several schools, being affiliated with NASA has opened doors in terms of partnerships, networking, funding, and mentoring. One example is a school team that said that the Women In Technology Group had done some workshops as well as provided some grant money; their school also had a National Science Foundation I-TEST pre-proposal that was one of 14 (out of 340) accepted for a final submission, made connections with the local university's engineering department for a collaboration involving the KC-135, and have developed corporate partnership with a major corporation for project-based learning. The team commented, "The professional development through NES has given the school a solid foundation" for all these initiatives. At another school, the NES team received a check for $2,500 from a local power company to spend on technology, something the school team ascribes to a NASA staff member's visit and their resulting heightened profile. At another school, the connection of the NES team with the department of education at the local university allowed pre-service teachers to get involved with the schools in the district.

Increased access to advanced technologies. The program has been the catalyst to improve the technology infrastructure in some of the schools. The schools also received videoconferencing equipment and telescopes from NASA, and purchased computer technologies (e.g., Laptops, LCDs) and science instruments (e.g., probes). This has a huge impact because many students at participating NES schools access technology primarily at school.

Increased development of new educational programs. In a few of the NES schools, the program aligns nicely with and amplifies already existing programs. The knowledge gained by teachers is a springboard for other things like the JASON Project and technology integration efforts. The NASA resources have allowed them to implement and transition to magnet programs, and are a real catalyst for some schools' science programs. In one of the NES school districts, for example, the superintendent wants to start a robotics competition in the district.

Impact on Students

The program's positive impact on the NES teams and schools influenced students in the following ways:

- Increased access to learning resources and opportunities
- Increased confidence, self-esteem, and interest in learning
- Increased interest in NASA and greater awareness of careers at NASA
- Increased achievement test scores

Increased access to learning resources and opportunities. The program is providing many learning opportunities to students. The underserved students from rural and urban areas alike are being exposed to many science activities they would not otherwise have access to, such as simulations (e.g., e-missions), visitors from the field (astronaut, engineers, scientists, technicians), science-related performances, and videoconferencing with people around the globe. These learning resources and opportunities are giving them an in-depth view of science beyond what their print-based curriculum could provide. As one teacher puts it: They are "excited about using technology" and learning "aside from the textbook." Students have become more aware of the ways that math, science and technology are used in the world. Teachers report that many or even most students in NES schools have not been outside of local community. "Many were students who had never been in an airport before, never been on an airplane – and they're in the aerospace program. Just to see them put the knowledge they studied in books together with real life was thrilling." At another school, one teacher said that generally, "Our kids don't find a sense of hope in school, or see it as an opportunity," but that NES participation was changing that attitude. Students did an evaluation of their e-mission project and "gave it huge marks -- the students were proud that no one lost their lives because of their efforts."

Increased confidence and self-esteem, and interest in learning. Stories about how individual students changed their behaviors toward school and learning about science abound in these focus groups, especially about students struggling academically at school and girls. One teacher said, “It's not cool to be smart [but] that image is changing a bit.” According to the teachers interviewed, the NES program has helped heighten students’ regard for science; has connected them to real world issues; have increased their motivation, attendance, engagement with the work, and excitement about learning through the use of technology, as well as lessened discipline issues. “They look stuff up on the computers because they want to, not because it’s homework.” Students are excited about doing science, and remember activities “months later.” They looked forward to doing NASA activities. One teacher indicated that after the e-mission was conducted at her school, students talked “for weeks about how cool it was.”

According to some teachers, their students are more involved in the NES program than in other classroom activities. They are reading more, are using technology more, are learning more about science, and are discovering a whole new world of science, professionals and experts. At one NES school, one student about whom teachers feared, “We were in danger of ‘losing’ him” was in charge of the Montserrat mission last year. On the day of the interview, he had scored the highest out of the class on the algebra test. At another school, “one young man, not very interested in school but part of NASA Club, has an agreement that he’ll come to school and do his work” if he wants to participate in club. “This would have been a student we would have lost academically. One young lady, her conduct isn’t appealing. She promises to do well if she can be part of the club. It’s an incentive to be better.” One teacher at another school noted that “a boy last year, he did all the computer technology for the Wallis Island rocket launch. He’s doing very well in high school, and this is a kid we almost lost.” Moreover, there are less behavior problems in some schools as a result the program activities. At one school, the teachers said that all their students are engaged during NASA-related activities and “loving it”. At another school, one teacher said that the “most difficult kid” who usually has discipline problems has none whatsoever during the NASA activities. Girls are notably engaged. In some cases, teachers indicated that the program has specifically ***increased girls’ interest in science***. They are excited about designing robots, looking at rockets, engineering, and talking about weather, force, and motion. One teacher noted how excited it was to hear them “tell me, an engineer, what to change and what they think we should do.” In another school, the number of girls involved in the NASA aerospace course increased from three to nine. The teacher at this school noted that the “biggest impact is girls' interest in engineering. They see NASA scientists….” One teacher said, “I never heard that many students say they’re interested in math, science, tech., especially the girls.”

Most teachers attribute these changes in attitude to the students’ NASA experiences. Students “feel special” because of the professional manner that the NASA staff treat them. Students felt treated as “celebrities” at Kennedy Space Center and seek more and more information about NASA after they meet NASA scientists and astronauts. Attending NASA organized events and being visited by NASA staff had an impact on students. One teacher said these opportunities had “changed the kids’ lives,” in terms of confidence and self-esteem building.

Increased interest in NASA and greater awareness of careers at NASA. The NES program has increased students’ knowledge about NASA and awareness of its programs. There is an increased awareness about NASA, both in terms of current events and scope of work (that NASA does aeronautics in addition to space exploration). Student interest in NASA is high. “One kid left a month ago for Kansas City. She wrote to another kid, she’s not sad she had to move, but she misses NASA.” NASA has opened up students’ world and provided them with increased interest in the world of science through a process of exposing the workings of the agency and its people, especially those NASA staff (AESP and astronauts) who visited the students at schools, and providing students with opportunities to attend NASA-sponsored events. Students are realizing that you don’t need to a “rocket scientist” in order to work at NASA.

This demystification of NASA has helped students unleash their interests in the agency and imagination about seeking NASA careers in the future. Students are now curious about the people working for the agency. They are becoming aware of how different people make contributions at NASA and the careers that are available. The NES Program has helped students become more aware of aerospace careers at NASA. As a result, students have become more open to careers in science. Some of the students have indicated to their teachers that they want to pursue careers in science, math, and technology, and even to work for NASA in the future. One teacher commented, “Kids who didn’t talk about going to college are now talking about what they’re going to do after their degrees. They see that the scientists are ‘normal people,’ they relate well to the kids, the kids think, I can do this.” Another teacher said that one eighth-grader at her school, who is captain of the Lego Robotics team, is so enthused that he wants to do robotics. At another school, where the NES team surveyed students, almost all fifth-graders (n=50) said that they would consider a NASA career. One student who went to the symposium came back wanting to work with NASA in some capacity, maybe as the first Hmong to become an astronaut. At another school, the two students who attended the symposium last year had no interest in science or math beforehand, but when they came back they said they wanted to be scientists or astronauts. In one school, one hundred students went on a field trip to Kennedy and Epcot, and according to their teacher, “they’re still talking about it in terms of, what they can do with their lives, how can they get a job working with NASA.” One student at another school who got to ask a question during an International Space Station downlink has since then become very interested and wants to be an astronaut; and he’s so excited that the astronaut he spoke with was visiting at the end of January. According to his teacher, he said: “there's so many different things you can do at NASA. If I can't be an astronaut I can do something else. I want to work for NASA.” His teacher also noted that English is not his first language and that his family is “economically disadvantaged. In one school, some high school students are very interested in the SHARP program and NASA internships.

Ways School Teams Implement Strategic Plans

This section is organized around professional development activities, technology, family and community activities, student activities, and implementation challenges.

Professional Development Opportunities and Activities for Educators
Participants engaged in a range of professional development activities, including attending (1) introductory, week-long NES workshop at the NASA regional offices; (2) other week-long NASA institute opportunities such as robotics, rocketry, handheld computers, GLOBE, History of Winter, Web Wonders, MatheMagic, Mission Geography, etc.; and (3) national conferences such as NSTA, NCTM, and NECC featuring special NES sessions that accompanied the conferences. Participants singled out several features of these professional learning opportunities as being particularly important:

- Feeling like they were treated as professionals in every instance
- Being able to attend events with another colleague
- Meeting scientists of various kinds
- Being able to choose what to attend
- Enhancing their knowledge of math, science and technology
- Learning about career opportunities at NASA that they could then convey to students
- Meeting other NES educators and sharing experiences with them
- Better understanding NASA's contributions to society and "every day life" aside from space exploration
- Improving content knowledge, especially in "cutting edge" scientific areas such as robotics and rocketry

Technology
Participation in the NES program has allowed school sites to enhance their existing technology capacities in several major ways. Sites have used the funding from the NES grant to purchase:

- Computer equipment such as laptop computers along with Smartboards or projectors, for the use of core NES team members
- Computer equipment that supported NES initiatives such as Lego Robotics
- Computer equipment that contributed to multimedia production (e.g., digital video and still cameras)
- Scientific technologies such as electronic telescopes, laboratory equipment, and probe ware
- Scientific technologies that support NES-related activities such as the GLOBE program, plants-in-space, etc.
- "Consumables" related to science, mathematics and technology

Teams were grateful for the flexibility to purchase items they thought were necessary for the project. Apart from purchasing technology and equipment, NASA-provided hardware (e.g., videoconferencing equipment, refurbished computers), software (e.g., NASA websites), and training (e.g., Web Wonders, PDA institute) have enabled schools to better integrate technologies into instruction.

Family and Community Activities
NES teams have put on special NASA-related events, such as family nights and NASA Day, related to science, math, and technology activities for the community. Other family events included weekend activities and breakfasts. They report holding one to four of these events per year, at least one of which typically involved a visiting astronaut, the AESP, or other NASA staff. Community members were often invited to these events. Popular activities during these events included stargazing, robotics, technology, and space exploration -- Mars in particular.

The events usually included a variety of hands-on activities. Those held at the beginning of the year exposed parents to NASA-related information and resources, while those held later in the year showcased student work. Interview participants considered these "successful" and they often mentioned an increase in attendance at these nights over previous family events. Some sites have involved parents in other ways; for instance, parents volunteer to help with NASA-related after-school activities. In order to get information to parents, some sites have an NES newsletter and some work with the school's parent organization.

The AESPs appear to have been instrumental in establishing these family nights. AESPs contributed in myriad ways, from helping to generate ideas to bringing equipment and artifacts, from conducting activities and giving talks to helping arrange the attendance of NASA scientists, administrators, and astronauts. Some sites have experienced difficulties organizing family nights or otherwise getting parents involved. It seems that the AESP's contributions are critical in this area, since some team members did not know where to start in organizing such a school-wide event.

Student Activities
Teachers used the NASA resources in different ways to engage their students in the NES-related activities. Some teachers made changes to their curriculum based on what they learned from their NES experiences. For example, they added electives in aerospace, aeronautics, or space exploration to the curriculum; organized science learning around monthly four-hour events called "NASA rotations;" or included modules such as Signals of Spring or Mission Geography into their science curriculum. Moreover, they are teaching about topics such as rocketry, robotics, and astronomy in their classrooms and after-school programs. In addition, they are engaging their students in a range of NES activities including participation in the following:

- e-Missions -- Challenger e-Mission simulations -- all students, regardless of academic achievement, were able to contribute
- After-school science clubs and competitions (in, e.g., robotics, aeronautics, and rocketry)
- Hands-on activities in classrooms
- Video-conferencing, where students get to see different scientists at work, and other NES schools

- Student symposium at Kennedy (two students per site), and follow-up events such as speaking at school assemblies and to the media
- Special NASA-related events that involve visits from NASA astronauts and other staff (engineers and technicians), and NASA artifacts such as a life-size shuttle replica (These events are known as Space Week, Flight Week, Blast-Off Day, etc.)
- Field trips to NASA sites where students meet with NASA staff
- Special NASA opportunities, such as the ones at Wallis Island, Wallup, Marsapalooza, KC-135, and reduced gravity flights.

A few schools have set up specialized rooms for NES materials and activities, especially at schools that lack a science laboratory. Schools have also used NES funding to set up outdoor scientific exploration areas related to rocketry, the natural world, and weather.

In addition, several participants mentioned that participation in the NES activities is for all students in their schools, not just an “elite” group. Participants noted that girls, and students who are isolated because of poverty or geography, have been especially affected. These students have been exposed to things they probably would not have otherwise seen, in terms of people and resources.

Implementation Challenges

The following implementation challenges are shared by many of the NES schools:

- Time: time to meet and work together as a group as well as time to implement NES activities.
- Inadequate access to computer equipment, due to school’s technology infrastructure or school or district technical support.
- Problems with the videoconferencing equipment (e.g., there are or were problems with installation [tech support, asbestos abatement, firewall issues, no space in school to put it, improper wiring]).
- Conflicts between NASA-related activities and local or state curricula, standards, pacing guidelines, or testing mandates.
- Difficulties finding or incorporating appropriate NASA activities. Some participants mentioned that they would like smaller activities that are more flexible to incorporate; this is especially true for the teachers of mathematics. Some participants had trouble finding activities appropriate for a specific topic; sometimes the wealth of materials overwhelmed participants. A small number of participants mentioned that the time it took to adapt existing materials for their student populations was onerous.
- Lack of local support. This ranged from an unsupportive principal to turnover of administrators to district politics to district bureaucracy for purchasing procedures, for example. This also included lack of technical support.

Several schools share the following implementation challenges:

- The NES money arrived late.
- Problems with NASA paperwork or communication. Participants mentioned that while NES personnel were supportive, administratively they needed to be more

sensitive to school culture and the school calendar. An oft-cited example was how a request for some paperwork came shortly before the Christmas break with a deadline at the end of December. Also mentioned was the need to submit paperwork multiple times due to computer glitches or a change of personnel at NASA. Finding time to fill out paperwork was sometimes an issue. Some NES liaisons or AESPs seem to be more helpful for teams than others. Team members wanted to remind NASA that their primary jobs are as educators.

- Participants found it challenging to disseminate information to and motivate other teachers to participate. Sometimes the reason was teacher turnover in the school. Other times the challenges were more related to communicating to non-science teachers the value of these materials. Team members noted that their colleagues need more than a pointer to a website; they need information about how to incorporate the website into their instruction, i.e., specific activities and lesson plans.
- Additional funding was often cited as an obstacle to carrying out the strategic plans. For example, funding was needed for field trips and substitute teachers.
- Losing a key team member was a factor. When a key team member left the school, some teams could not regain traction.

The following implementation challenges are unique to a small number of schools:

- Maintaining enthusiasm and motivation for the project.
- Finding activities for subject areas other than science, especially for mathematics.
- The timing of NES activities (this, for a year-round school).
- Sustainability concerns.
- Parental involvement.
- Having the team in three locations.
- Forces of nature (i.e., hurricanes) that disrupted the school calendar and took away days for professional development.

In a few cases, teams had problems with their school or district's purchasing procedures. For example, one school team had to purchase specific brands and even models of video cameras, computers and scientific probe ware. The prices at the "preferred" vendors were higher than they had found elsewhere, so as a result they were able to purchase fewer units.

In a small minority of cases, it appears that there were issues with receiving and spending funds. Several sites did not receive funding until very late in the prior school year or had not yet received their funding for this year, which meant that they could not do the activities that they had planned.

School Teams' Evaluative Perspectives

Few teams had plans for any sort of formal or systematic evaluation of their programs. Teams indicated that they need support in terms of guidance (NASA's expectations for evaluation must be made more explicit), - and resources (e.g., instruments and ideas). However, most teams met at the end of the year to review what worked, what did not work, which aspects of their plan they were able to accomplish and which they were not, what they need to do more of, and what they need to do less of. In some cases, team members pointed to science achievement test data; others had no gauge because science assessments were not yet implemented in their state. They acknowledged that evaluation is an important step in the implementation process, and some of them were curious to know if increased student interest will lead to improved student achievement.

Some teams indicated that their students' test scores increased in science, math, or technology as a result of the NES program. Those who mentioned test scores spoke about classroom tests, state tests, and nationally norm referenced tests. One teacher proudly pointed to the fact that students who were tested last year "outperformed DC and the nation in five out of seven areas. [Of] Last year's third-graders, 89% scored basic or above average in science [and] 79% of the fifth-graders were basic or above." Students' test scores in science increased 7 points, and 15 points at two different schools. One of the fourth-grade teachers who taught moon phases gave a test on the order of the moon phases. A kid came up to her and said, "Look. I got an A on this. I never made an A before in my life." In couple of schools, their math test scores improved. One teacher said, "Our math test scores … went from a low level 4 to a level 5, the highest level." At one school, students' technology scores in the SAT tests and ACT went up about 5 points. One teacher ascribes their success – i.e., increase in student test scores – to NASA's long-term presence at the school and the teacher professional development. However, most of teachers in the NES teams are still curious about whether their use of the NES program will translate into increased test scores for their students.

Several teams explicitly asked for feedback, in the form of evaluation reports, based on these focus group interviews.

When asked about evaluation activities, some teams mentioned the student surveys that had been administered at the end of the last school year. They would also like the results of those surveys. Furthermore, several educators pointed out that the timing of the surveys last year did not work for their schools; in many areas of the country, the school year ends some time in mid-May.

School Teams' Assessment of NASA Field Center Support

The staff in the NASA regional and national offices provided assistance and services to NES teams and schools, in the form of sharing special opportunities; providing professional development to other teachers at the school (e.g., modeling activities in classroom, conducting workshops); attending parent nights and other special assemblies; providing input on how to organize special events; assisting in carrying out the paperwork; recommending strategies for carrying out the strategic plans; and helping communicate to stakeholders within the educational community and beyond. Some AESPs acted as "sales" people for the program, going into classrooms and modeling activities for teachers, while others either allowed professional development sessions to be opened up to teachers in the whole county or came to the school and took a more traditional approach, giving a workshop for teachers after school. The number of AESPs' visits to school sites ranged from one to four or more during the school year. Successful AESPs and Program Managers managed to make participants feel supported and helped them continue to be motivated about the NES Program. The majority of the teams felt the NASA staff were responsive and attentive to their needs.

"We're in constant communication with [the NASA Regional Office staff]. They're always very willing to help and that makes it easy. Whenever we have a question about anything, they'd be able to answer it or direct us to the person who can't answer it… If we didn't have the support staff there, I think I would be at a loss in terms of what to do or having our visions as a NASA Explorer School revealed and actually being professional with the things that we like to do."

Many team members were effusive in their praise of their AESP:

"[H]e is an excellent master teacher and [the children] are totally enthused.… The fact that he has been more than willing to train teachers is great. He is of such value that I just can't see us not having him. He makes the ultimate connection. He connects us to community, to family night. He is also the master when it comes to presentation in front of a big crowd."

Another team commented:

"Whatever we asked for, that wasn't costly, they were able to provide us. Copies of curriculum for staff members…Pictures and posters for Japanese counterparts. Assistance in putting together Young Astronaut program. [Our AESP] rearranged some personal events so he could be with us. He didn't have to do that. They are willing to be flexible with us."

A number of schools experienced turnover in their AESP, some in the middle of the school year. This sometimes caused disruption but in a fair number of cases, relationships with the new AESP were better than with the old one. Some comments in this vein include:

"From my [team leader] perspective, last year was rough because I think our former educational specialist belonged to the old school … He didn't buy into the new NES initiative … last year they did the minimum that they could. [T]his year … the motivation is there, the desire is there, the energy level is there and they're willing to work with us to help us achieve our objective and not shoving down, you know, a rigid old [NASA Regional Office] system."

An important element in a successful relationship between the AESP and the school seems to be the AESP's willingness to "reach out" rather than wait to be contacted. One site put it this way:

"One of the challenges we've found is [our previous] liaison, he was constantly here and he was spurring us on to do things… it was really helpful because he came up with the ideas and helped us carry them out…[the new AESP] got us the [20 refurbished] computers and he's willing to do whatever we want [but] it's up to us to get together and

give him some ideas of what we want him to do or what we want to have him come into the school and help us with."

Some AESPs are more responsive than others. Overall, many schools noted a decrease in the availability of their AESP between the first and second years.

As mentioned in the "Implementation Challenges" section, one aspect of interaction with the NASA Regional Offices that participants found challenging was the paperwork. Many teams felt that the Regional Offices were not sensitive to the school calendar or school culture, in terms of deadlines. Also, many sites had to submit and re-submit paperwork due to "glitches" in the computer system or changes in personnel, something they found very frustrating.

The shift from personal emails to mass emails was viewed as positive by some, who welcomed the decrease in the number of email messages, and negatively by others, who missed the personal nature of the communication. The latter group felt that their NASA liaison was able to point out relevant opportunities, and that the mass emails took longer to go through to see if there was anything relevant. The lack of a personal connection made it, in the words of one team, "harder to get pumped up" about the opportunities. Participants found the large amount of information conveyed by NASA via email was both good and bad. On the one hand, team members said that some of the information was valuable, while on the other hand it could be overwhelming.

Some teams experienced problems with their school districts in terms of scheduling attendance at conferences and institutes due to lack of money for substitute teachers, scheduling conflicts with testing, or other school calendar issues (e.g., one school is a year round school).

Some schools would like more assistance in finding relevant materials (e.g., something for a specific topic and grade, or inquiry-based activities around a certain topic). They would also like NASA to facilitate more contact with other NES teams, sharing across NES schools, either within a region or across the country.

Educators from one group asked us to communicate the following: they would like more NASA-related artifacts to have and keep at the school.

CONCLUDING REMARKS

From focus group interviews, it seems that the NES Program is being successfully implemented into school settings across the country through the formation of implementation teams, the allocation of financial support to schools, and the allotment of quality educational resources to teachers, students, and school communities. In this process, critical to the successful implementation of the program are the school-based teams of educators, and the support of the NASA Regional Offices.

Team members feel re-energized by the program, which grants them increased access to educational resources and professional development opportunities, access to new curriculum ideas, opportunities to master teaching difficult science content, use of inquiry-based activity and technology, and use of a student-centered approach to teaching. Administrators appreciate the support and resources provided to their schools. The program appears to have had positive effects on students, especially among those taught by teachers in the NES teams. It has increased students' access to learning resources and opportunities; confidence, self-esteem, and interest in learning; and interest in NASA and awareness of careers at NASA.

Although the program is at an early expansion stage in most schools, some teams have shown signs of long-term impact, including encouraging other teachers and community members to get involved, accessing outside networks and funding for science programs and activities, securing additional technology infrastructure resources, and developing new educational programs.

The program also faces implementation challenges at the team, school and district, and overall programmatic levels.

Challenges related to the teams include the following:

- Lack of time to meet, and fill out grant paperwork
- Lack of immediate support from colleagues at the school level, especially when the program is being implemented at different school in a district
- Difficulty getting new team members "up to speed"
- Difficulty disseminating information to and motivating other teachers to participate
- Maintaining traction with the loss of a key team member
- Lack of focused attention when administrators serve as Team Leads
- Lack of formal or systematic evaluation of their programs

Challenges related to schools and districts include the following:

- Lack of time to meet, and implement NES activities
- Inadequate access to computer equipment, due to school's technology infrastructure or school or district technical support
- Lack of local administrative support. This ranged from an unsupportive principal to turnover of administrators to district politics to district bureaucracy for purchasing procedures, for example.

Challenges related to the NES program include the following:

- Problems with the videoconferencing equipment
- Conflicts between NASA-related activities and local or state curricula, standards, pacing guidelines, or testing mandates.
- Difficulties finding or incorporating appropriate NASA activities.
- Late arrival of NES funding.
- Problems with the amount of NASA paperwork or communication.

- Lack of additional funding was often cited as an obstacle to carrying out the strategic plans. For example, funding was needed for field trips and substitute teachers.

In response to the above challenges, the following is a list of recommendations:

- Request that school administrators provide more time to Team Leads for adequate management of the program (grant paperwork, organizing meetings, etc.), and teachers to implement the activities in their classrooms
- Provide additional support to teams implementing the project district-wide
- Provide evaluation support to teams in terms of resources (e.g., instruments and ideas, feedback from this evaluation and other relevant evaluation studies)
- Request that Team Leads not be part of the school or district administration
- Provide more technical support to schools struggling with the videoconferencing system
- Develop manageable and appropriate (age, topic) activities ready to be incorporated in classroom teaching, especially true for the teachers of mathematics.
- Provide additional computer technologies

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APPENDIX

NES Focus Group Protocol

1. **Introduction**

My name is _________ and this is my colleague _______. We are from the Center for Children and Technology in New York, and have been asked by the contracted evaluators at the Center on Educational Technologies, Wheeling WV, to conduct focus groups with school teams like your own.

The purpose of the focus group is to help the program staff better understand how the program operates in schools in order to improve the program. We will ask you questions about your views about the Explorer Schools program, your school's strategic plan, your project team, your project impact, and your evaluation practices. We encourage honest and candid responses to our questions because there are no right or wrong answers to our questions.

The information you provide is confidential. It will be used to write a report, which will be shared with the contractor and NASA officials responsible for the Explorer Schools program. Your name will never appear in any report.

Before we start here are a few guidelines for this discussion.

- Give your name the first few times you speak so we know who you are.
- Take turns talking and listen while another person talks.
- Follow the cues that I will provide as I structure and direct the session.
- Remember this is a directed discussion rather than a free flowing discussion between team members.

2. **Please state your full name followed by a brief statement about your role in the project and school.**

3. **Views about NES Program**
   - What's your understanding about the NASA Explorer Schools program? (Probe: goals, objectives, etc.)

4. **Your school's strategic plan**
   - What are the major aspects of your school strategic plan?
   - To date, what specifically has been accomplished?
   - What major challenges or problems, if any, has your team encountered while carrying out the plan?
   - How have these challenges or problems been addressed, resolved or managed?
   - How has staff from the NASA Regional Office assisted you in implementing your school's strategic plan?

- How valuable do you find the assistance received from NASA Regional staff?

5. **Working as a team**
    - How important is your team in carrying out your Explorer Schools strategic plan?
    - Has your team faced any challenges or problems operating as a team? If yes, how were these managed?

6. **Impact and evaluation**
    - How has the Explorer Schools program helped you personally?
    - What is the impact of these individual changes on your students?
    - How has the Explorer Schools program helped other teachers at your school?
    - What is the impact of these changes on their students?
    - How are you formally evaluating the impact of your school strategic plan? Probe: evaluation perspectives, approaches, etc.)

Closing

Thank you for participating. Information you provided will help us understand the Explorers Schools Program and hopefully improve it for other schools.

Brief Summary of Focus Group Schedule

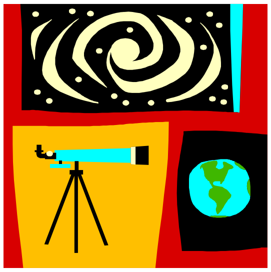
Order No.	DATE	TIME (EDT)	NASA CENTER	TEAM
1	12/27/04	6:00 PM	ARC	Chapman School
2	1/3/05	3:00 PM	SSC	Florence Middle School
3	1/3/05	5:20 PM	DFRC	Black Mountain Elementary & Middle School
4	1/4/05	3:30 PM	GRC	Southfield SD
5	1/7/05	1:00 PM	JSC	Fort Worth ISD
6	1/11/05	3:30 PM	GSFC	Sheridan Communications and Technology Magnet School
7	1/14/05	9:00 AM	GRC	Lorain Middle School
8	1/14/05	12:00 PM	ARC	Waimea Middle School
9	1/14/05	2:00 PM	KSC	Oscar Patterson Elementary School
10	1/14/05	3:30 PM	LARC	Winston-Salem Forsyth
11	1/19/05	5:00 PM	JPL	Sycamore Hills ES_
12	1/20/05	9:00 AM	MSFC	Bolivar Elementary School
13	1/20/05	2:45 PM	KSC	Stewart Magnet Middle School
14	1/20/05	4:00 PM	SSC	Magnolia Middle School (Formerly Ed Mayo)
15	1/24/05	12:00 PM	JSC	Solen-Cannon Ball SD #3
16	1/24/05	3:30 PM	SSC	Choctaw Central Middle School
17	1/24/05	2:10 PM	GSFC	Central Park Middle School
18	1/24/05	4:30 PM	ARC	Poplar Middle School
19	1/25/05	9:00 PM	MSFC	Phoenix City intermediate School
20	1/25/05	12:00 PM	MSFC	Belle Chasse Academy
21	1/25/05	2:00 PM	KSC	Carol City Elementary School
22	1/26/05	3:30 PM	DFRC	Flagstaff USD #1 (Flagstaff MS; DeMiguel ES)
23	1/27/05	9:45 AM	GSFC	Anne Beers Elementary School
24	1/31/05	12:00 PM	JSC	Tohajiilee Community School
25	1/31/05	4:30 PM	MSFC	Sioux Central Middle School
26	2/1/05	9:00 AM	GRC	Anwatin Middle School
27	2/1/05	12:00 PM	KSC	Bunche Middle School
28	2/1/05	2:00 PM	LARC	Lee County Middle School
29	2/1/05	4:40 PM	JPL	Shirley Avenue Elementary
30	2/1/05	6:00 PM	GRC	Crossroads Elementary School
31	2/2/05	4:15 PM	JPL	153rd Street Elementary School
32	2/2/05	6:30 PM	JPL	Washington Middle School
33	2/7/05	1:15 PM	LARC	School District of Newberry County
34	2/7/05	3:15 PM	GSFC	Matthew J. Kuss Middle School
35	2/7/05	5:30 PM	ARC	Jim Bridger Middle School
36	2/8/05	9:00 AM	GSFC	North Country Union JHS
37	2/8/05	2:00 PM	LARC	Carver Edisto Middle
38	2/8/05	4:30 PM	GRC	Joyce Kilmer Elementary School
39	2/15/05	3:15 PM	LARC	Radcliff Middle School
40	2/15/05	4:30 PM	SSC	Bay-Waveland Middle School
41	2/16/05	11:30 AM	DFRC	Kennedy Elementary School
42	2/16/05	2:05 PM	SSC	North Gulfport
43	2/16/05	4:15 PM	JSC	Pender Public School

44	2/16/05	5:45 PM	DFRC	Gifford C. Cole Middle School
45	2/17/05	7:00 PM	ARC	Chiefess Kamakahelei Middle School
46	2/17/05	3:30 PM	DFRC	Edwards Middle School
47	2/17/05	11:20 AM	KSC	Howard W. Bishop Middle School
48	2/21/05	4:30 PM	MSFC	Langston Aerospace & Environmental
49	2/25/05	11:00 AM	JSC	Vista Middle School

Student Content Knowledge Answer Key

FORM A		
Physical Science	**Set 1: Changing Temperature**	**Set 2: Physical and Chemical Changes**
	1) A 2) A 3) D 4) A	1) B 2) D 3) C 4) C
Earth Science	**Set 1: Spring and Neap Tides**	**Set 2: Seasons**
	1) B 2) D 3) D 4) B	1) C 2) D 3) D 4) A
Life Science	**Set 1: Yarrow**	
	1) A 2) B 3) D 4) A 5) C 6) A	
FORM B		
Physical Science	**Set 1: Physical and Chemical Reactions**	**Set 2: In Hot Water**
	1) D 2) A 3) B 4) D	1) C 2) C 3) B 4) C
Earth Science	**Set 1: Moon Phases**	**Set2: Our Solar System**
	1) B 2) C 3) D	1) B 2) D 3) C

	4) C	4) D
Life Science	**Set 1: Field Mice**	
	1) B 2) B 3) B 4) C 5) B 6) D	



NASA Explorer Schools: Every Family Involved!

End of the School Year Needs Assessment

Dear Parent, Guardian or Caregiver:

We need your help again! As you know, our school is constantly working to improve the connections between family and school and how we can all work together to help our students succeed.

This year, we have been a NASA Explorer School focusing on Science, Math, Engineering, Technology and Geography. We asked you what you and your child needed and liked at the beginning of school and now we want to know how we did this year. We need to know what you think to help us all do the best job we can.

In this survey there are three groups of questions about – 1) your involvement, 2) your child, and 3) your school and community.

Your answers will help us know what we have been doing well and where we can continue to improve.

Please be as complete as possible. We promise that no individual will ever be identified. So please be completely honest!

Your few minutes now mean we will continue to grow in our partnership of families and the school working together to help all our children know that they can learn, and strive to have careers in Science, Technology, Engineering, Math and Geography.

Thank you for your help!

STEM+G refers to:

Science, **T**echnology, **E**ngineering, **M**athematics, + **G**eography

Please tell us a little about yourself - *(please print)*

Name: ______________________________ Date: ______________________________

School: ______________________________ District: ______________________________

Ages of children enrolled in this school: ____

Part 1: Your Involvement

1. Has the school reached out to you to become involved in STEM+G activities this year? __ Yes __ No

If yes, how?

2. What would make you want to participate in family activities offered by the school?	Not at all	Perhaps	Some what	Definitely
Activities where I work with my child	○	○	○	○
Activities where I work with other adults	○	○	○	○
Activities that stimulate conversation between me and my child	○	○	○	○
Activities that lead to family activities and conversations at home	○	○	○	○
Science, technology, engineering, and mathematics experts	○	○	○	○
Community experts helping out	○	○	○	○
Content that is new to me	○	○	○	○
Content that is relevant to my life and local area	○	○	○	○
Activities that let me and my child discover ideas, often called inquiry activities	○	○	○	○
Other (please describe)	○	○	○	○

3. Have you participated in school activities in the past? __ Yes __ No

If yes, how often?	__ 1 time /year	__ 2 times /year	__ 3 times /year	__ 4 times /year	__ More than 4 times /year
What kind?	__ Family Night	__ Star Party	__ Interactive Family Tour	__ In-Class Activity	__ After School Activity
	__ Other, please describe:				

How did you find out about them?	__ My child	__ Parent/teacher meeting	__ Letter sent home
	__ A teacher	__ Another family	__ Community organization
	__ Email	__ Radio/TV/newspaper	__ Telephone
	__ Other, please describe:		

4. How do you think your participation has affected your child so far?	Not at all	A little	Somewhat	A lot
Attends school more often	○	○	○	○
Is involved in more after-school activities than before the Explorer Schools Program	○	○	○	○
Is performing better in mathematics	○	○	○	○
Is performing better in science	○	○	○	○
Attitude toward school has improved	○	○	○	○
Is more interested in a career in the field of math, science, engineering, technology, or geography	○	○	○	○
Other (please describe)	○	○	○	○

5. What STEM+G have you used to support your child? Check all that apply.

__ Ideas for activities to do together
__ Websites my child can use
__ Recommendations for books about careers
__ Recommendations for books about technology
__ Recommendations for books about geography
__ Magazines my child can read about engineering
__ Activities my child can do alone
__ Websites with information for me
__ Recommendations of books about science
__ Recommendations of books about math
__ Local activities and things to do
__ Other (please describe)

6. What do you talk about with your child's school?	Not at all	Someti mes	Often	Always
My child's strengths	○	○	○	○
Learning preferences	○	○	○	○
Where to locate resources	○	○	○	○
How to encourage your child's interest in STEM+G subjects	○	○	○	○
How to encourage your child in a STEM+G career	○	○	○	○
Other (please describe)	○	○	○	○

7. How comfortable are you now with your child's questions about:	Not at all	Sometimes comfortable	Usually comfortable	Very
STEM+G topics?	○	○	○	○
STEM+G careers?	○	○	○	○
STEM+G activities to do?	○	○	○	○
STEM+G current events?	○	○	○	○

8. What do you do NOW when your child asks questions about STEM+G topics?	Never	Some times	Usually	Always
Think it through with him/her	○	○	○	○
Get him/her to figure it out on their own	○	○	○	○
Tell him/her what you know and understand	○	○	○	○
Look it up for him/her	○	○	○	○
Help him/her look it up	○	○	○	○
Go to the library	○	○	○	○
Go to the Internet	○	○	○	○
Ask the child's teacher	○	○	○	○
Other (please describe)	○	○	○	○

9. What prepared you to help with your child's STEM+G questions?	Not at all	Some times	Usually	Always
More family/caregiver workshops on STEM+G	○	○	○	○
More family nights where we do things together	○	○	○	○
Fiction and nonfiction books I should buy	○	○	○	○
Easier access to computers	○	○	○	○
More information /ideas from school	○	○	○	○
Internet sites	○	○	○	○
Other (please describe)	○	○	○	○

10. Were you involved in school volunteer programs? __ Yes __ No

If YES, what do you do? Check all that apply.

__ Volunteer in my child's classes	__ Volunteer in other classes
__ Help out at special events	__ Make contact with other people who can help
__ Be a guest speaker	__ Collect materials for projects and experiments
__ Lead activities for students	__ Lead activities for families
__ Help with after school activities	__ Other (please describe):

Part 2: Your Child's Involvement

1. Did the school reach out to you with information and ideas to help your child with STEM+G? __ Yes __ No

If yes, what do they do?

2. How well did the school meet your child's needs in STEM-G?

Not at all	Some what	Usually	Definitely
O	O	O	O

3. What STEM+G content does your child get?	None	Some	Regularly	A lot
Careers	O	O	O	O
Math	O	O	O	O
How to figure things out	O	O	O	O
Science	O	O	O	O
Engineering	O	O	O	O
How to build things	O	O	O	O
Technology	O	O	O	O
Geography	O	O	O	O
How to test things	O	O	O	O
Other (please describe	O	O	O	O

4. Did you get information or go to workshops with your child?	Not at all	Some times	Usually	Always
To help you improve your child's problem solving skills	O	O	O	O
To help you work with your child to learn more about STEM+G	O	O	O	O
To help you help your child meet class expectations	O	O	O	O
To help you help your child do well on assessments in STEM+G	O	O	O	O

Please give an example of information you got that was helpful:

Part 3: Your School and Community's Involvement

1. How did the school communicate with you about NASA Explorer School and STEM+G activities?	Not at all	A little	Some what	A lot
Letters sent home with my child	○	○	○	○
E-mail	○	○	○	○
In the regular weekly folder	○	○	○	○
Telephone	○	○	○	○
Parent/Teacher Meetings	○	○	○	○
Website	○	○	○	○
Other (please describe)	○	○	○	○

2. Did your school have a family information center that provided training and support this year? __ Yes __ No

If yes, did you use it? __ Yes __ No

How often did you use it? __ Daily __ Weekly __ 2 times /month __ 4 times /month

3. What information did the school provided to <u>YOU</u> about STEM+G? (check all that apply)

__ Pamphlets __ Web Site __ Articles

__ Hands-On Activities __ Interviews with NASA Scientists

__ Other (please describe)

4. What STEM+G information was offered to <u>you</u> from your child's school?	None	Some times	Often	Always
Careers	○	○	○	○
Math	○	○	○	○
How to figure things out	○	○	○	○
Science	○	○	○	○
Engineering	○	○	○	○
How to build things	○	○	○	○
Technology	○	○	○	○
Geography	○	○	○	○
How to test things	○	○	○	○
Other (please describe)	○	○	○	○

5. How clear was the information provided to you about:	Not at all clear	Sometimes clear	Usually clear	Always very clear
Family nights	○	○	○	○
Volunteer opportunities	○	○	○	○
Interactive homework	○	○	○	○
Community opportunities	○	○	○	○
Resources	○	○	○	○
Materials	○	○	○	○
Other (please describe)	○	○	○	○

6. How well did STEM+G and NASA Explorer School activities take into account …	Not at all	Some times	Usually	Always
Your family's needs	○	○	○	○
Your schedule/When you can attend activities	○	○	○	○
Volunteer opportunities	○	○	○	○
Your language needs	○	○	○	○
Your child care needs (for younger children)	○	○	○	○

7. Were families/caregivers included in the planning or decision making process about STEM+G at your child's school this year? __Yes __No

If so, how? (please describe)

8. Were there opportunities for educators and families/caregivers to interact at formal events? __ Yes __ No

For example? (please describe)

9. Did you or any other families attend conferences, workshops, or symposiums with the students on STEM+G? __ Yes __ No

For example? (please describe)

10. Were partnerships developed with local business and service groups to advance student learning and to assist schools and families/caregivers with: __ Yes __ No

STEM+G topics? __ Yes __ No

STEM+G careers? __ Yes __ No

For example? (please describe*)*

Other Comments:

Student Interest Survey – NASA Explorer Schools

Your teacher ________________________________ Date_____________
(First) (Last)
What is the name of your school? ________________________________
What is the name of your NASA center? ___________________________

We are hoping to learn from you about the kinds of things students like and do, so that we can develop projects and lessons that work. There are only 13 questions here. Please answer each one as truthfully as you can—we know that everyone doesn't like everything. That's okay.

Here's an example of the kinds of questions we will ask you:

How much do you like chocolate chip cookies?
(Select 5 if you like them a lot, and 1 if you don't like them at all.)

	Don't like				Like a lot
Chocolate chip cookies	1	2	3	4	5

A lot of the questions we ask are like this one: You select 1 if you don't like it and 5 if you do. If your answer falls somewhere in between 1 and 5, select the number that comes closest to where your answer fits.

These are examples of how other students answered the chocolate chip cookie question:

Daleesha likes chocolate chip cookies, but prefers mint chocolate chip ice cream. She selected choice 4. Please select choice 4 for her.

	Don't like				Like a lot
Chocolate chip cookies	1	2	3	4	5

Enrique gets sick if he eats chocolate. He selected choice 1. Please select choice 1 for him.

	Don't like				Like a lot
Chocolate chip cookies	1	2	3	4	5

Begin to write your answers here. Please ask a teacher if you need help with directions.

1. Rate how much you like the following school subjects or topics.

	Don't like				Like a lot
	1	2	3	4	5
English					
Science					
Technology					
Engineering					
Math					
Geography					

2. Rate how much you <u>know about</u> the following school subjects or topics.

	Don't know				Know a lot
	1	2	3	4	5
English					
Science					
Technology					
Engineering					
Math					
Geography					

3. Thinking about science

	Not at all				Very
	1	2	3	4	5
How well do you think you will do in science this year?					
How successful do you think you would be in a career that required scientific ability?					
When taking a science test you have studied for, how well do you do?					
How well have you been doing in science this year?					
In general, how hard is science for you					
Compared to other school subjects you have taken or are taking, how hard is science for you?					

4. (a) To the best of your ability, describe what science is:

(b) Describe how you might use science in your future.

5. Thinking about math.

	Not at all				Very
	1	2	3	4	5
How well do you think you will do in math this year?					
How successful do you think you would be in a career that required math ability?					
When taking a math test you have studied for, how well do you do?					
How well have you been doing in math this year?					
In general, how hard is math for you?					
Compared to other school subjects you have taken or are taking, how hard is math for you?					

6. (a) To the best of your abilities describe what math is.

(b) Describe how you might you use math in your future.

7. Rate how much you like the following:

	Don't like 1	2	3	4	Like a lot 5
Conducting observations and measurements as part of an investigation or project.					
Learning about the motion of a vehicle and how force can be saved with simple machines.					
Finding patterns and relationships in data.					
Studying how energy is made in ecosystems and used through food networks.					
Using computers with science data.					
Plotting locations of volcanoes and earthquakes to find patterns.					
Using math in science.					
Learning about how the earth, sun, and moon work together and how gravity holds all the parts of the solar system together.					

8. Rate how good you are at each of the following.

	Not at all 1	2	3	4	Very Good 5
Designing and planning an investigation or project.					
Developing a hypothesis.					
Testing a hypothesis.					
Making observations.					
Taking measurements.					
Using computers with science data.					
Finding patterns and relationships in data.					
Using math to explore solutions to problems.					
Presenting results of an investigation or project to the class.					

9. How much would you like to have the following jobs?

	Not at all				Like a lot
	1	2	3	4	5
Aerospace engineer					
Astronaut					
Astronomer					
Biologist					
Chemical engineer					
Computer programmer					
Crime scene investigator					
Doctor (Physician)					
Electrical engineer					
Fire fighter					
Food scientist					
Geologist					
Lawyer					
Mechanical engineer					
Meteorologist					
Oceanographer					
Physicist					
Planetary scientist					
Police officer					
Professional athlete					
Propulsion engineer					
Robotics engineer					
Secretary					
Teacher					

a. This is a list of NASA jobs. Select the job that you would most like to do.

Check ONLY ONE.

- ☐Aerospace engineer
- ☐Astronaut
- ☐Astronomer
- ☐Biologist
- ☐Chemical engineer
- ☐Electrical engineer
- ☐Food scientist
- ☐Geologist
- ☐Mechanical engineer
- ☐Meteorologist
- ☐Oceanographer
- ☐Physicist
- ☐Planetary scientist
- ☐Propulsion engineer
- ☐Robotics engineer

a. To the best of your ability, describe what a person working this job does.

b. How does someone working in this job help NASA?

11. When you are doing something in Science, Technology, Engineering, Math or Geography outside of school, how often do you use the following resources to answer your questions?

	Never				Every week
	1	2	3	4	5
Think it through with a parent, family member or other adult.					
Figure it out on your own.					
Ask a parent, family member, or other adult to tell you what they know.					
Get help looking it up.					
Go to the library.					
Ask a parent, family member or other adult to find out for you.					
Go to the Internet.					
Wait and ask your teacher.					
Use science materials in your home.					
Other (please describe):					

12. Has someone from your family or someone who takes care of you gone to any school activities in the past year? YES NO

If yes, how often?	___ Once	___ Twice	___ Three times
	___ Four times	___ Six times	___ Once a month
What kind? *(check all that apply)*	___ Family night	___ Star party	___ Family tours
	___ In your class	___ After-school	___ Field trip
	___ Other (please describe):		
How do they find out about the activity? (check all that apply)	___ You told them	___ Letter sent home	___ Parent-teacher meeting
	___ A teacher	___ Another family	___ Community organization
	___ E-mail	___ Telephone	___ Radio/TV Newspaper
	___ PTO		

__ Other (please describe):

13. How often do you do Science, Technology, Engineering, Math or Geography with your parents, family or caregivers?

	Not at all				Every week
	1	2	3	4	5
Do homework.					
Watch science television shows together.					
Talk about current events in science.					
Attend school events like science fairs or family nights.					
Go places that have science or technology like science museums.					
Buy magazines about science or technology.					
Talk about things you have read about science.					
Ask questions about how things work.					
Try to figure out how things work.					
Build or fix things together.					
Other (please describe)					

Your Ethnicity

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

Circle the grades you teach or administer

1	5	9
2	6	10
3	7	11
4	8	12
Other		

Your Gender

- ○ Male
- ○ Female

Your Race

- ○ Hispanic or Latino
- ○ Not Hispanic or Latino

Other comments? Write them here. *(Use the back of this paper if you need more space to write.)*

Thank you for answering our questions. We will read through your answers carefully. We want to learn from you.

STUDENT INTEREST SURVEY

We are hoping to learn from you about the kinds of things you like and do so that we can develop projects and lessons that work. Please answer each item as truthfully as you can—we know that everyone doesn't like everything. That's OK.

Write your answers on the Scantron sheet. Use a Number 2 lead pencil to fill in the bubbles completely. Please ask a teacher if you need help with directions.

Rate how much you like the following school subjects or topics.

	Don't like				Like a lot
	1	2	3	4	5
1. English					
2. Science					
3. Technology					
4. Engineering					
5. Math					
6. Geography					

Rate how much you know about the following school subjects or topics.

	Don't know				Know a lot
	1	2	3	4	5
7. English					
8. Science					
9. Technology					
10. Engineering					
11. Math					
12. Geography					

Thinking about science.

	Not at all				Very
	1	2	3	4	5
13. How well do you think you will do in science this year?					
14. How successful do you think you would be in a career that required scientific ability?					
15. When taking a science test you have studied for, how well do you do?					
16. How well have you been doing in science this year?					
17. In general, how hard is science for you?					
18. Compared to other school subjects you have taken or are taking, how hard is science for you?					

Thinking about math.

	Not at all				Very
	1	2	3	4	5
19. How well do you think you will do in math this year?					
20. How successful do you think you would be in a career that required math ability?					
21. When taking a math test you have studied for, how well do you do?					
22. How well have you been doing in math this year?					
23. In general, how hard is math for you?					
24. Compared to other school subjects you have taken or are taking, how hard is math for you?					

Rate how much you <u>like</u> the following:

	Don't like				Like a lot
	1	2	3	4	5
25. Conducting observations and measurements as part of an investigation or project.					
26. Learning about the motion of a vehicle and how force can be saved with simple machines.					
27. Finding patterns and relationships in data.					
28. Studying how energy is made in ecosystems and used through food networks.					
29. Using computers with science data.					
30. Plotting locations of volcanoes and earthquakes to find patterns.					
31. Using math in science.					
32. Learning about how the Earth, sun, and moon work together and how gravity holds all the parts of the solar system together.					

Rate <u>how good you are</u> at each of the following:

	Not at all				Very Good
	1	2	3	4	5
33. Designing and planning an investigation or project.					
34. Developing a hypothesis.					
35. Testing a hypothesis.					
36. Making observations.					
37. Taking measurements.					
38. Using computers with science data.					
39. Finding patterns and relationships in data.					

40. Using math to explore solutions to problems.					
41. Presenting results of an investigation or project to the class.					

How much would you like to have the following jobs?

	Not at all				Like a lot
	1	2	3	4	5
42. Aerospace engineer					
43. Astronaut					
44. Astronomer					
45. Biologist					
46. Chemical engineer					
47. Computer programmer					
48. Crime scene investigator					
49. Doctor (Physician)					
50. Electrical engineer					
51. Firefighter					
52. Food scientist					
53. Geologist					
54. Lawyer					
55. Mechanical engineer					
56. Meteorologist					
57. Oceanographer					
58. Physicist					
59. Planetary scientist					
60. Police officer					
61. Professional athlete					
62. Propulsion engineer					
63. Robotics engineer					
64. Secretary					
65. Teacher					

When you are doing something in science, technology, engineering, math, or geography outside of school, how often do you use the following resources to answer your questions?

	Never				Every week
	1	2	3	4	5
66. Think it through with a parent, family member, or other adult.					
67. Figure it out on your own.					
68. Ask a parent, family member, or other adult to tell you what he or she knows.					
69. Get help looking it up.					

70. Go to the library.					
71. Ask a parent, family member, or other adult to find out for you.					
72. Go to the Internet.					
73. Wait and ask your teacher.					
74. Use science materials in your home.					

How often do you do science, technology, engineering, math or geography with your parents, family, or caregivers?

	Not at all				Every week
	1	2	3	4	5
75. Do homework.					
76. Watch science television shows together.					
77. Talk about current events in science.					
78. Attend school events, such as science fairs or family nights.					
79. Go places that have science or technology, such as science museums.					
80. Buy magazines about science or technology.					
81. Talk about things you have read about science.					
82. Ask questions about how things work.					
83. Try to figure out how things work.					
84. Build or fix things together.					

85. How often has someone from your family or someone who takes care of you gone to any school activities in the past year?

1 Once	2 Twice	3 Three times	4 Four times	5 5 or more times

86. What kind of school activities has someone from your family or someone who takes care of you gone to in the past year?

1 Family night	2 Star party	3 In your class	4 After-school	5 Field trip

87. How does your family or someone who takes care of you find out about school activities?

1 A teacher	2 You tell them	3 Parent-teacher meeting	4 Community organization	5 Radio/TV/ Newspaper

88. What is your race?

1 Asian	2 American Indian or Alaska Native	3 Black or African-American	4 Native Hawaiian or Other Pacific Islander	5 White

89. What is your ethnicity?

1 Hispanic or Latino	2 Not Hispanic or Latino

Thank you for answering our questions. We will read through your answers carefully. We want to learn from you.

Teacher Survey
on Involvement with NASA
and Family Involvement

Beginning of the School Year Needs Assessment

Dear Teacher:
We need your help! As part of being a NASA Explorer School focusing on Science, Math, Engineering, Technology and Geography, we need feedback from teachers like you to help us all do the best job we can.

In this survey there are two groups of questions: 1) about family involvement at your school; 2) about your thoughts on the NASA Explorer Schools program.

Your answers will help us know what you feel works for your school and how to involve more parents/caregivers and children during this school year.

Please be as complete as possible. We promise that no individual will ever be identified. So please be completely honest!

Thank you for your help!

STEM+G refers to: **S**cience, **T**echnology, **E**ngineering, **M**athematics +**G**eography

GENERAL INFORMATION (please print)

Name: ____________________________ Date: _____________________

School: ___________________________ District:____________________

City: _____________________________ State: _____________________

Have you ever participated in other NASA-sponsored events? ___Yes __ No

If yes, please list the NASA-sponsored events in which you have participated?

Your Ethnicity	Circle the grades you teach or administer			Your Gender
○ Asian	1	5	9	○ Male
○ American Indian or Alaska Native	2	6	10	○ Female
○ Black or African American	3	7	11	**Your Race**
○ Native Hawaiian or Other Pacific Islander	4	8	12	○ Hispanic or Latino
○ White	Other			○ Not Hispanic or Latino

Part 1: Family Involvement

1. Does your school reach out to parents/caregivers to encourage them to become involved in STEM+G activities? __ Yes __ No

If yes, how?

2. How much would your students' parents/caregivers be interested in attending the following STEM-G family activities offered by the school? *Check the 1 box if you are not at all interested and the 4 box if you are very interested or somewhere in between to say how you feel.*

	Not at all interested		Very	
Activities where they work with their child				
Activities where they work with other adults				
Activities that stimulate conversation between them and their child				
Activities that lead to more family activities and conversations at home				
Activities with science, technology, engineering, and mathematics experts				
Activities with community experts				
Activities with content that is new to them				
Activities that are relevant to their lives and local area				
Inquiry activities that let them and their child discover ideas				
Activities where babysitting is provided for younger children.				
Evening activities where they share a meal with other parents and students.				
Other (please describe)				

3. Has your school offered STEM+G activities in the past? __ Yes __ No

If yes, how often? __ once/year __ twice/year __ three times/year

__ four times/year __ six times/year __ once a month

4. How many STEM+G activities have you personally participated in? __ none

If yes, how often? __ once/year __ twice/year __ three times/year

__ four times/year __ six times/year __ once a month

What kind? __ Family night __ Star party __ Family tours

__ In-class activity __ After-school activity __ Demonstrations

__ Other (please describe):

How do you find out about them? __ The students __ Letter sent home __ Parent-teacher meeting

__ Another teacher __ Faculty meeting __ NASA team member

__ PTO __ Other (please describe):

5. How do you think parent/caregiver participation has affected your students in the past?
Check the 1 box if you are not at all interested and the 4 box if you are very interested or somewhere in between to say how you feel.

	Not at all			Very Interested
	1	2	3	4
Attends school more often				
Is involved in more after-school activities than before the Explorer Schools Program				
Is performing better in mathematics				
Is performing better in science				
Attitude toward school has improved				
Is more interested in a career in the field of math, science, engineering, technology, or geography				
Other (please describe)				

6. What STEM+G content do you need to support your students and their parents/caregivers?
Check all that apply.

__ Ideas for activities to do together.
__ Activities your child can do alone.
__ Web sites your child can use.
__ Web sites with information for you.
__ Books/magazines/information about careers.
__ Books/magazines/information about science.
__ Books/magazines/information about technology.
__ Books/magazines/information about math.
__ Books/magazines/information about geography.
__ Books/magazines/information about engineering.
__ Local activities and things to do.
__ Local places to visit.
__ Other (please describe):

7. What do you recommend parents/caregivers do when their child asks questions about STEM+G topics?

	Never			Always
	1	2	3	4
Think it through with him/her				
Get him/her to figure it out on their own				
Tell him/her what you know and understand				
Look it up for him/her				
Help him/her look it up				
Go to the library				
Go to the Internet				
Ask the child's teacher				
Other (please describe)				

8. Do you use parent/caregiver/family volunteers in your classroom? __ Yes __ No

If yes, how often?	Not at all	3-6 times/year	Every Month	Every Week
Volunteer in their child's classes				
Help out at special events				
Be a guest speaker				
Lead activities for students				
Help with after school activities				

Volunteer in other classes				
Make contact with other people who can help				
Collect materials for projects and experiments				
Lead activities for families				
If other, please describe:				

If no, what would you like them to do?	Not at all	3-6 times/year	Every Month	Every Week
Volunteer in my child's classes				
Help out at special events				
Be a guest speaker				
Lead activities for students				
Help with after school activities				
Volunteer in other classes				
Make contact with other people who can help				
Collect materials for projects and experiments				
Lead activities for families				
If other, please describe:				

9.This past year, how many parents/caregivers helped you and your students? Check one.

__None __ 1-5 __ 6-15 __ 16-30 __ More than 30

10. How many parent/caregiver helpers did you typically have in one week? Check one.

__None __ 1-5 __ 6-15 __ 16-30 __ More than 30

11. How often are the families/caregivers of your students involved with their education?

	Not at all	3-6 times/yr	Every Month	Every Week
Homework				
Watching science television shows together				
Talking about current events in science				
Attending school events like science fairs or family nights				
Going places that have science or technology like science museums				
Buying magazines about science or technology				
Talking about things you have read about science				
Asking questions about how things work				
Trying to figure out how things work				
Building or fixing things together				

Part 2: Your Involvement in the NASA Explorer Schools Program

12. How many NASA activities have you participated in in the past?

__ None __ 1-5 times/yr __ 6-15 __ 16-30 __ >30

If so, what did you attend?

If so, did you share what you learned with your colleagues? __ None __ Minimal __ Some __ A lot

13. How often do you expect to be involved in NASA activities this year?

__ None __ 1-5 times/yr __ 6-15 __ 16-30 __ >30

If so, what do you expect to be involved with?

14. Please rate your level of comfort in the following areas.

	Not at all				Very comfortable
	1	2	3	4	5
Science					
Technology					
Engineering					
Mathematics					
Geography					

15. Please rate your level of interest in the following areas.

	Not at all				Very interested
	1	2	3	4	5
Science					
Technology					
Engineering					
Mathematics					
Geography					

16. What do you think is the value of each of these areas in contemporary life?

	Not at all				Very valuable
	1	2	3	4	5
Science					
Technology					
Engineering					
Mathematics					
Geography					

17. To what extent do you agree with the following?

	Not at all				Totally agree
	1	2	3	4	5
This program will be a valuable experience.					
NASA-related materials provided can be integrated into my curriculum.					
I expect to apply what I learned from this program.					
This program will be inspiring.					

18. *A**s an educator, please indicate WHAT YOU** THINK the program's impact will **be?***

	Not impact				Very great impact
	1	2	3	4	5
Integration of career education about science, technology, mathematics, and/or geography.					
The application of science, technology, mathematics, and/or geography by students.					
Instructional technology use for my students.					
Instructional technology use by me.					
Ways to inspire my students.					

Increasing family involvement.					

19. WHAT DO YOU anticipate you will change as a result of being a NASA Explorer School, compared to what you did before?

	No change				Great change
	1	2	3	4	5
Aligning instructional approaches to reflect national standards/state framework.					
Incorporating inquiry activities in my instruction.					
Integrating more space science into my instruction more than I did in the past.					
Integrating more technology into my instruction more than I did in the past.					
Integrating more geography into my instruction more than I did in the past.					
Incorporating more instructional technology in my instruction.					
Integrating more engineering into my instruction more than I did in the past.					
Incorporating more STEM-G careers in my instruction.					

20. What enablers or opportunities will probably support you in applying the knowledge and/or skills you anticipate gaining by participating in this program? Check all that apply.

__ Opportunity to use the skills/knowledge	__ Computer and/or technology resources
__ Sufficient knowledge and understanding	__ Systems and processes within the school to support using skills/knowledge
__ Support or reinforcement from supervisors	__ Funding
__ Support or reinforcement from colleagues	__ Alignment between local and/or state standards with NASA content
__ Other (please describe)	

21. What barriers, if any, might prevent you from applying the above knowledge and/or skills you will gain by participating in the program? Check all that apply.

__ Lack of opportunity to use the skills/knowledge	__ Not enough time to integrate the material into the curriculum
__ Insufficient knowledge and understanding	__ Lack of Funding
__ Lack of support or reinforcement from supervisors	__ Systems and processes within the school will not support the use of skills/knowledge
__ Lack of support or reinforcement from colleagues	__ Lack of alignment between local and/or state standards with NASA content
__ Lack of computer and/or technology resources	
__ Other (please describe)	

ADMINISTRATOR SURVEY

(PRE)

NASA Explorer Schools

Name: ______________________________

Title: ______________________________

School: ______________________________

Field Center: ______________________________

Cohort: 2005______________________________

PART A: YOUR TEACHING PHILOSOPHY

A2. Indicate how much you disagree or agree with each of the following statements about teaching and learning.

Mr. A
"Teachers are facilitators. Teachers' main role is to provide opportunities and resources for their students to discover or construct concepts for themselves."

Ms. B
"That's all nice, but students really won't learn the subject unless you go over the material in a structured way. It's teachers' job to explain, to show students how to do the work, and to assign specific practice."

❑ Definitely Mr. A ❑ Tend toward Mr. A ❑ Can't decide ❑ Tend toward Ms. B ❑ Definitely Ms. B

Mr. A
"The most important part of instruction is the content of the curriculum. That content is the community's judgment about what children need to be able to know and do."

Ms. B
"The most important part of instruction is that it encourages "sense-making" or thinking among students. Content is secondary."

❑ Definitely Mr. A ❑ Tend toward Mr. A ❑ Can't decide ❑ Tend toward Ms. B ❑ Definitely Ms. B

Mr. A
"It is useful for students to become familiar with many different ideas and skills even if their understanding for now, is limited. Later, in college, perhaps, they will learn these things in more detail."

Ms. B
"It is better for students to master a few complex ideas and skills well, and to learn what deep understanding is all about, even if the breadth of their knowledge is limited until they are older."

❑ Definitely Mr. A ❑ Tend toward Mr. A ❑ Can't decide ❑ Tend toward Ms. B ❑ Definitely Ms. B

Mr. A
"It is critical for students to become interested in doing academic work – interest and effort are more important than the particular subject-matter they are working on."

Ms. B
"While student motivation is certainly useful, it should not drive what students study. It is more important that students learn the history, science, math and language skills in their textbooks."

❑ Definitely Mr. A ❑ Tend toward Mr. A ❑ Can't decide ❑ Tend toward Ms. B ❑ Definitely Ms. B

Mr. A
"It is a good idea to have all sorts of activities going on in the classroom. Some students might produce a scene from a play they read. Others might create a miniature version of the set. It's hard to get the logistics right, but the successes are so much more important than the failures."

Ms. B
"It's more practical to give the whole class the same assignment, one that has clear directions, and one that can be done in short intervals that match students' attention spans and the daily class schedule."

❑ Definitely Mr. A ❑ Tend toward Mr. A ❑ Can't decide ❑ Tend toward Ms. B ❑ Definitely Ms. B

A2. Indicate how much you disagree or agree with each of the following statements about teaching and learning.	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderatel y Agree	Stro Ag
a. Teachers know a lot more than students; they shouldn't let students muddle around when they can just explain the answers directly	❑	❑	❑	❑	❑	❑
b. A quiet classroom is generally needed for effective learning	❑	❑	❑	❑	❑	❑
c. Students are not ready for "meaningful" learning until they have acquired basic reading and math skills	❑	❑	❑	❑	❑	❑
d. It is better when the teacher – not the students–decide what activities are to be done	❑	❑	❑	❑	❑	❑
e. Student projects often result in students learning all sorts of wrong "knowledge."	❑	❑	❑	❑	❑	❑
f. Homework is a good setting for having students answer questions posed in their textbooks	❑	❑	❑	❑	❑	❑
g. Students will take more initiative to learn when they feel free to move around the room during class	❑	❑	❑	❑	❑	❑
h. Students should help establish criteria on which their work will be assessed	❑	❑	❑	❑	❑	❑
i. Instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly	❑	❑	❑	❑	❑	❑
j. How much students learn depends on how much background knowledge they have – that is why teaching facts is so necessary	❑	❑	❑	❑	❑	❑

Part B: your ATTITUDES ToWARD computers

B1. The following statements address general attitudes towards computer use. Select the answer that best reflects your agreement.	Strongly Disagree	Disagree	Neutral	Agree	Strong Agre
I would like every student in every classroom to have access to a computer	❑	❑	❑	❑	❑
Computer skills are essential to students	❑	❑	❑	❑	❑
I feel tense when people start talking about computers	❑	❑	❑	❑	❑
I feel pressure from others to have teachers use computers in their classroom	❑	❑	❑	❑	❑
I would like all our students to be able to use the computer more	❑	❑	❑	❑	❑
Computers are dehumanizing	❑	❑	❑	❑	❑
I avoid the computer whenever possible	❑	❑	❑	❑	❑
Computer instruction is just another fad	❑	❑	❑	❑	❑
The use of computers should be confined to computer courses	❑	❑	❑	❑	❑
I like using the computer to solve complex problems	❑	❑	❑	❑	❑
More training would increase my use of the computer at work	❑	❑	❑	❑	❑
Computers diminish my role as an administrator	❑	❑	❑	❑	❑
Computers should be incorporated into the classroom curriculum	❑	❑	❑	❑	❑
Computers make my job easier	❑	❑	❑	❑	❑
Computers further the gap between students along socio-economic lines	❑	❑	❑	❑	❑
Computer skills will help me as a professional	❑	❑	❑	❑	❑
Learning computers make high demands on my professional time	❑	❑	❑	❑	❑
Computers change my role as an administrator	❑	❑	❑	❑	❑
I can help others solve computer problems	❑	❑	❑	❑	❑
Computers enhance classroom instruction	❑	❑	❑	❑	❑

PART C: Your Concerns and Issues

C. In the following statements, please indicate how truly they each reflect your concerns and issues about the implementation of the NASA Explorer Schools program at your school.	Not true	Somewhat true	True	Very true	D kn
I am concerned about the time that it will take for teachers to implement the program at my school	❑	❑	❑	❑	
I fear that the NASA Explorer Schools program may be overwhelming	❑	❑	❑	❑	
I am concerned about the time it will take me to coordinate the NASA Explorer Schools program	❑	❑	❑	❑	
I am satisfied with the emphasis of this program on teacher professional growth	❑	❑	❑	❑	
I am satisfied with the emphasis of this program on student STEM learning	❑	❑	❑	❑	
I am satisfied with the emphasis of this program on student STEM career interest	❑	❑	❑	❑	
I am satisfied with the emphasis of this program on family involvement in student learning	❑	❑	❑	❑	
I believe this program will increase teacher professional growth by the end of year 3	❑	❑	❑	❑	
I believe this program will increase student interest in STEM careers by the end of year 3	❑	❑	❑	❑	
I believe this program will increase student interest in STEM disciplines by the end of year 3	❑	❑	❑	❑	
I want to know if we will be a better school after the three year partnership with NASA	❑	❑	❑	❑	

PART D: Your Support

D. In the following statements, please indicate how truly they each reflect the support that you are planning to provide to the NASA Explorer Schools team at your school.	Not true	Somewhat true	True	Very true	D Kn
I am planning to actively participate in the implementation of the team's strategic plan at our school	❑	❑	❑	❑	
I am planning to represent the team's interests and concerns to higher levels of administration	❑	❑	❑	❑	
I am prepared to implement lasting changes to school policies based on the team's strategic plan	❑	❑	❑	❑	
I am prepared to implement lasting changes to district policies based on the team's strategic plan	❑	❑	❑	❑	
I will encourage responsible risk taking on the part of teachers and other administrators related to implementing the strategic plan	❑	❑	❑	❑	
I will actively encourage teachers to use NASA educational products in their classrooms	❑	❑	❑	❑	
I will support teacher attendance to professional development conferences and workshops	❑	❑	❑	❑	
I will support family events organized at my school	❑	❑	❑	❑	
I am planning to provide teacher release time to help the NASA Explorer Schools team members implement their strategic plan	❑	❑	❑	❑	

PART E: External Support

E. In the following statements, please indicate how truly they each reflect the external support that you will be seeking in implementing the NASA Explorer Schools program at your school.	Not true	Somewhat true	True	Very true	D kn
I have plans to encourage the district leaders to maintain an interest in our efforts with the NASA Explorer Schools strategic plan.	❑	❑	❑	❑	
I am planning to seek additional funding from the district to supplement those provided by the partnership with NASA	❑	❑	❑	❑	
I am planning to seek personnel support from some of the businesses in the community	❑	❑	❑	❑	
We have plans to seek funding from some of the businesses in the community	❑	❑	❑	❑	
We have plans to seek personnel support from some of the universities in the community	❑	❑	❑	❑	
We have plans to seek funding from some of the universities in the community	❑	❑	❑	❑	

ADMINISTRATOR SURVEY (POST)

NASA Explorer Schools

Name: ___________________________

Title: ____________________________

School: __________________________

Field Center: ______________________

Cohort: ❑ 2003 ❑ 2004

PART A: YOUR TEACHING PHILOSOPHY

A2. Indicate how much you disagree or agree with each of the following statements about teaching and learning.

Mr. A
"Teachers are facilitators. Teachers' main role is to provide opportunities and resources for their students to discover or construct concepts for themselves."

Ms. B
"That's all nice, but students really won't learn the subject unless you go over the material in a structured way. It's teachers' job to explain, to show students how to do the work, and to assign specific practice."

❑ Definitely Mr. A ❑ Tend toward Mr. A ❑ Can't decide ❑ Tend toward Ms. B ❑ Definitely Ms. B

Mr. A
"The most important part of instruction is the content of the curriculum. That content is the community's judgment about what children need to be able to know and do."

Ms. B
"The most important part of instruction is that it encourages "sense-making" or thinking among students. Content is secondary."

❑ Definitely Mr. A ❑ Tend toward Mr. A ❑ Can't decide ❑ Tend toward Ms. B ❑ Definitely Ms. B

Mr. A
"It is useful for students to become familiar with many different ideas and skills even if their understanding for now, is limited. Later, in college, perhaps, they will learn these things in more detail."

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"It is better for students to master a few complex ideas and skills well, and to learn what deep understanding is all about, even if the breadth of their knowledge is limited until they are older."

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"While student motivation is certainly useful, it should not drive what students study. It is more important that students learn the history, science, math and language skills in their textbooks."

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Mr. A
"It is a good idea to have all sorts of activities going on in the classroom. Some students might produce a scene from a play they read. Others might create a miniature version of the set. It's hard to get the logistics right, but the successes are so much more important than the failures."

Ms. B
"It's more practical to give the whole class the same assignment, one that has clear directions, and one that can be done in short intervals that match students' attention spans and the daily class schedule."

❑ Definitely Mr. A ❑ Tend toward Mr. A ❑ Can't decide ❑ Tend toward Ms. B ❑ Definitely Ms. B

A2. Indicate how much you disagree or agree with each of the following statements about teaching and learning.	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderatel y Agree	Strongly Agree
a. Teachers know a lot more than students; they shouldn't let students muddle around when they can just explain the answers directly	❑	❑	❑	❑	❑	❑
b. A quiet classroom is generally needed for effective learning	❑	❑	❑	❑	❑	❑
c. Students are not ready for "meaningful" learning until they have acquired basic reading and math skills	❑	❑	❑	❑	❑	❑
d. It is better when the teacher – not the students–decide what activities are to be done	❑	❑	❑	❑	❑	❑
e. Student projects often result in student	❑	❑	❑	❑	❑	❑
f. Homework is a good setting for having students answer questions posed in their textbooks	❑	❑	❑	❑	❑	❑
g. Students will take more initiative to learn when they feel free to move around the room during class	❑	❑	❑	❑	❑	❑
h. Students should help establish criteria on which their work will be assessed	❑	❑	❑	❑	❑	❑
i. Instruction should be built around problems with clear, correct answers, and around ideas that most students can grasp quickly	❑	❑	❑	❑	❑	❑
j. How much students learn depends on how much background knowledge they have – that is why teaching facts is so necessary	❑	❑	❑	❑	❑	❑

Part B: your ATTITUDES ToWARD computers

B1. The following statements address general attitudes towards computer use. Select the answer that best reflects your agreement.	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I would like every student in every classroom to have access to a computer	❑	❑	❑	❑	❑
Computer skills are essential to students	❑	❑	❑	❑	❑
I feel tense when people start talking about computers	❑	❑	❑	❑	❑
I feel pressure from others to have teachers use computers in their classroom	❑	❑	❑	❑	❑
I would like all our students to be able to use the computer more	❑	❑	❑	❑	❑
Computers are dehumanizing	❑	❑	❑	❑	❑
I avoid the computer whenever possible	❑	❑	❑	❑	❑
Computer instruction is just another fad	❑	❑	❑	❑	❑
The use of computers should be confined to computer courses	❑	❑	❑	❑	❑
I like using the computer to solve complex problems	❑	❑	❑	❑	❑
More training would increase my use of the computer at work	❑	❑	❑	❑	❑
Computers diminish my role as an administrator	❑	❑	❑	❑	❑
Computers should be incorporated into the classroom curriculum	❑	❑	❑	❑	❑
Computers make my job easier	❑	❑	❑	❑	❑
Computers further the gap between students along socio-economic lines	❑	❑	❑	❑	❑
Computer skills will help me as a professional.	❑	❑	❑	❑	❑
Learning computers make high demands on my professional time	❑	❑	❑	❑	❑
Computers change my role as an administrator	❑	❑	❑	❑	❑
I can help others solve computer problems	❑	❑	❑	❑	❑
Computers enhance classroom instruction	❑	❑	❑	❑	❑

Earth Science Survey of Student Knowledge – Form A

PART C: Your Concerns and Issues

C. In the following statements, please indicate how truly they each reflect your concerns and issues about the implementation of the NASA Explorer Schools program at your school.	Not true	Somewhat true	True	Very true	D kn
I am concerned about the time that it takes for teachers to implement the program at my school	❑	❑	❑	❑	❑
I feel overwhelmed by the NASA Explorer Schools program	❑	❑	❑	❑	❑
I am concerned about the time it takes me to coordinate the NASA Explorer Schools program	❑	❑	❑	❑	❑
I am satisfied with the emphasis of this program on teacher professional growth	❑	❑	❑	❑	❑
I am satisfied with the emphasis of this program on student STEM learning	❑	❑	❑	❑	❑
I am satisfied with the emphasis of this program on student STEM career interest	❑	❑	❑	❑	❑
I am satisfied with the emphasis of this program on family involvement in student learning	❑	❑	❑	❑	❑
I believe this program will increase teacher professional growth by the end of year 3	❑	❑	❑	❑	❑
I believe this program will increase student interest in STEM careers by the end of year 3	❑	❑	❑	❑	❑
I believe this program will increase student interest in STEM disciplines by the end of year 3	❑	❑	❑	❑	❑
I want to know how we are a better school now than we were before joining the NASA Explorer Schools program	❑	❑	❑	❑	❑

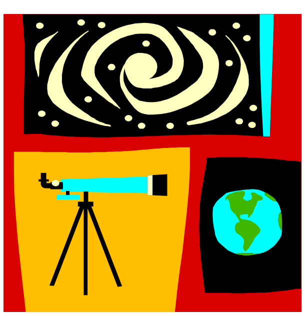
PART D: Your Support

D. In the following statements, please indicate how truly they each reflect the support that you have provided to the NASA Explorer Schools team at your school.	Not true	Somewhat true	True	Very true	D Kn
I have actively participated in the implementation of the team's strategic plan at our school	❑	❑	❑	❑	❑
I have represented the team's interests and concerns to higher levels of administration	❑	❑	❑	❑	❑
I have helped implement lasting changes to school policies based on the team's strategic plan	❑	❑	❑	❑	❑
I have helped implement lasting changes to district policies based on the team's strategic plan	❑	❑	❑	❑	❑
I have fostered and supported responsible risk taking on the part of teachers and other administrators related to implementing the strategic plan	❑	❑	❑	❑	❑
I have actively encouraged teachers to use NASA educational products in their classrooms	❑	❑	❑	❑	❑
I have supported teacher attendance to professional development conferences and workshops	❑	❑	❑	❑	❑
I have actively been involved with family events organized at my school	❑	❑	❑	❑	❑
I have provided teacher release time to help the NASA Explorer Schools team members implement their strategic plan	❑	❑	❑	❑	❑

Earth Science Survey of Student Knowledge – Form A

PART E: External Support

E. In the following statements, please indicate how truly they each reflect the support that you have received from the district in implementing the NASA Explorer Schools program at your school.	Not true	Somewhat true	True	Very true	D kn
The district leaders have maintained an interest in our efforts with the NASA Explorer Schools strategic plan	❑	❑	❑	❑	❑
The superintend has maintained interest in the NASA Explorer Schools program at our school	❑	❑	❑	❑	❑
The school board leaders have maintained interest in the NASA Explorer Schools program at our school	❑	❑	❑	❑	❑
The district has allocated additional funds to supplement those provided by the partnership with NASA	❑	❑	❑	❑	❑
The district is planning to allocate additional funds to supplement those provided by the partnership with NASA	❑	❑	❑	❑	❑
The district has plans to allocate funds after the end of 3 year partnership with NASA	❑	❑	❑	❑	❑
The district has encouraged collaboration between my school and the other schools in the district to model the gains from the program	❑	❑	❑	❑	❑
We have received personnel support from some of the businesses in the community	❑	❑	❑	❑	❑
We have received funding from some of the businesses in the community	❑	❑	❑	❑	❑
We have received personnel support from some of the universities in the community	❑	❑	❑	❑	❑
We have received funding from some of the universities in the community	❑	❑	❑	❑	❑



NASA Explorer Schools:
Every Family Involved!

<u>Beginning</u> of the School Year Needs Assessment

Dear Parent, Guardian, or Caregiver:

Earth Science Survey of Student Knowledge – Form A

We need your help! Our school is constantly working to improve the connections between family and school and how we can all work together to help our students succeed.

As part of being a NASA Explorer School focusing on science, math, engineering, technology and geography, we need feedback from parents and caregivers like you to help us all do the best job we can.

In this survey there are two groups of questions: 1) about your involvement; 2) about your child.

Your answers will help us know what we have been doing that works for you and how to involve you and your child during this school year.

Please be as complete as possible. We promise that no individual will ever be identified. So please be completely honest!

Your few minutes now mean a whole year of powerful activities for you and your child!

Thank you for your help!

STEM+G refers to:

Science, **T**echnology, **E**ngineering, **M**athematics, + **G**eography

Earth Science Survey of Student Knowledge – Form A

GENERAL INFORMATION (please print)

Name: ______________________________ Date: ______________________________

School: ______________________________ District: ______________________________

Ages of children enrolled in this school: ____

Part 1: Your Involvement

1. Has the school reached out to you before to become involved in Science, Technology, Engineering, Math and Geography activities? __ Yes __ No

If yes, how?

2. How much would you be interested in attending the following family STEM+G activities offered by the school? *Check the 1 box if you are not at all interested and the 4 box if you are very interested or somewhere in between to say how you feel.*

	Not at all Interested			Very Interested
	1	2	3	4
Activities where you work with your child.				
Activities where you work with other adults.				
Activities that stimulate conversation between you and your child.				
Activities that lead to more family activities at home.				
Activities that feature experts in science, technology, engineering, mathematics & geography.				
Activities with community experts.				
Activities with content that is new to you.				
Activities that are relevant to your life and local area.				
Inquiry activities that let you and your child discover ideas.				
Activities where babysitting is provided for your younger children.				
Evening activities where you share a meal with other parents and students.				
Other (please describe):				

3. Have you participated in school STEM+G activities in the past? __ Yes __ No

If yes, how often?	__ once/year	__ twice/year	__ three times/year
	__ four times/year	__ six times/year	__ once a month
What kind? (check all that apply)	__ Family night	__ Star party	__ Family tours
	__ In-class activity	__ After-school activity	__ Demonstrations
	__ Other (please describe):		
How do you find out about them? *(check all that apply)*	__ Your child	__ Letter sent home	__ Parent-teacher meeting
	__ A teacher	__ Another family	__ Community organization
	__ E-mail	__ Telephone	__ Radio/TV/Newspaper
	__ PTO	__ Other (please describe):	

4. How do you think your participation in STEM+G activities has affected your child so far?

	Not at all			A lot
	1	2	3	4
Attends school more often.				
Is involved in more after-school activities than before the Explorer Schools program.				
Is performing better in mathematics.				
Is performing better in science.				
Attitude toward school has improved.				
Is more interested in a career in the field of math, science, engineering, technology, or geography.				
Other (please describe):				

5. What STEM+G content do you need to support your child? Check all that apply.

__ Ideas for activities to do together.	__ Activities your child can do alone.
__ Web sites your child can use.	__ Web sites with information for you.
__ Career information/books/magazines.	__ Science information/books/magazines.
__ Technology information/books/magazines.	__ Math information/books/magazines.
__ Geography information/books/magazines.	__ Engineering information/books/magazines.
__ Local activities and things to do.	__ Local places to visit.
__ Other (please describe):	

6. How often do you talk with your child's school about each of the following?

	Never			Regularly
	1	2	3	4
Your child's strengths.				
Learning preferences.				
Where to locate resources.				
How to encourage your child's interest in STEM+G subjects.				
How to encourage your child in a STEM+G career.				

Other (please describe):				

7. How comfortable are you with your child's questions about:

	Not at all			Very Comfortable
	1	2	3	4
Science topics?				
Technology topics?				
Engineering topics?				
Mathematics topics?				
Geography topics?				
STEM+G careers?				
STEM+G activities to do?				
STEM+G current events?				

8. What do you do when your child asks questions about STEM+G topics?

	Never	Sometimes	Usually	Always
Think it through with them.				
Get them to figure it out on their own.				
Tell them what you know and understand.				
Look it up for them.				
Help them look it up.				
Go to the library.				
Go to the Internet.				
Ask the child's teacher.				
Use science materials in your own home.				
Other (please describe)				

Earth Science Survey of Student Knowledge – Form A

9. How often do you do STEM-G activities with your child?

	Not at all	3-6 times/year	Every Month	Every Week
Doing homework				
Attending school events together like science fairs or family nights				
Watching science television shows together				
Talking about current events in science				
Going places that have science or technology like science museums				
Talking about things you have read about science				
Trying to figure out how things work				
Asking questions about how things work				
Building or fixing things together				
Buying magazines about science or technology				

10. What would help you to be better prepared to help with your child's STEM+G questions?

	Not at all			Very helpful
	1	2	3	4
Family/Caregiver workshops on STEM+G.				
Family nights at school where you do things together.				
Fiction and nonfiction books you should buy.				
Access to computers.				
Information and ideas from school.				
Internet sites.				
Community-based activities.				
Other (please describe):				

Earth Science Survey of Student Knowledge – Form A

11. Are you involved in school programs? __ Yes __ No

If yes, how often?	Not at all	3-6 times/yr	Every Month	Every Week
Volunteer in my child's classes				
Help out at special events				
Be a guest speaker				
Lead activities for students				
Help with after school activities				
Volunteer in other classes				
Make contact with other people who can help				
Collect materials for projects and experiments				
Lead activities for families				
If other, please describe:				

If no, what would you like to do?	Not at all	3-6 times/yr	Every Month	Every Week
Volunteer in my child's classes				
Help out at special events				
Be a guest speaker				
Lead activities for students				
Help with after school activities				
Volunteer in other classes				
Make contact with other people who can help				
Collect materials for projects and experiments				
Lead activities for families				
If other, please describe:				

12. How often do you talk to your child about what he or she is doing in class?*(circle one)*

Not at All 1-2 times/month Every week Every day

*13. How important do you think your child's success in school will help them to be successful in life?***(circle one)**

Not at all Very important

1 2 3 4

Earth Science Survey of Student Knowledge – Form A

Part 2: Your Child's Involvement

1. Do you expect the school to reach out to you with information and ideas to help your child with STEM+G? __ Yes __ No

If so, how?

2. What STEM+G content do you think the school should offer your child?

	Not at all			Very Interested
	1	2	3	4
STEM+G Careers				
Science				
Technology				
How to test things				
Engineering				
How to build things				
Math				
How to figure things out				
Geography				

3. How interested is your child in STEM+G content?

	Not at all			Very Interested
	1	2	3	4
STEM+G Careers				
Science				
Technology				
How to test things				
Engineering				
How to build things				
Math				
How to figure things out				
Geography				

Earth Science Survey of Student Knowledge – Form A

4. How important is each of the following for your child to have a STEM+G career?

	Not at all			Very Important
	1	2	3	4
STEM+G Careers				
Science				
Technology				
How to test things				
Engineering				
How to build things				
Math				
How do figure things out				
Geography				

5. What NASA Explorer School family/caregiver information or workshops would you like to have in the future? (check all that apply)

__ Improving your child's problem-solving skills.
__ Working with your child to learn more about STEM+G topics.
__ Helping your child meet class expectations.
__ Helping your child do well on assessments in STEM+G topics.
__ Other (please describe):

6. Do you think your child will go into a career that uses STEM+G? __ yes __ no

Earth Science Survey of Student Knowledge – Form A

7. How likely do you think it is that your child will have the following jobs?
Check the 5 box if you think it is very likely and 1 if you think it is not possible at all or somewhere in between.

	Not at all likely				Very likely
	1	2	3	4	5
Aerospace engineer					
Astronaut					
Astronomer					
Biologist					
Chemical engineer					
Computer Programmer					
Crime Scene Investigator					
Doctor (Physician)					
Electrical engineer					
Fire fighter					
Food scientist					
Geologist					
Lawyer					
Mechanical engineer					
Meteorologist					
Oceanographer					
Physicist					
Planetary scientist					
Police officer					
Professional Athlete					
Propulsion engineer					
Robotics engineer					
Secretary					
Teacher					

Your Race

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

Grades of your children in an Explorer School

1	5	9
2	6	10
3	7	11
4	8	12

Your Gender

- ○ Male
- ○ Female

Your Ethnicity

- ○ Hispanic or Latino
- ○ Not Hispanic or Latino

Please write your comments here. *(Use the back of this paper if you need more space to write.)*

Thank you for your thoughts! We want to learn from you!

Your Ethnicity

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

Circle your grade

1	5	9
2	6	10
3	7	11
4	8	12

Your Gender

- ○ Male
- ○ Female

Your Race

- ○ Hispanic or Latino

Earth Science Survey of Student Knowledge – Form A

○ White	Other	○ Not Hispanic or Latino

Set 1: Spring and Neap Tides

Tides are periodic changes in ocean level. Tides are caused by the gravitational forces between the Moon, Sun, and Earth. Spring tides occur when the Sun, Earth, and Moon are directly in line (Figure 1).

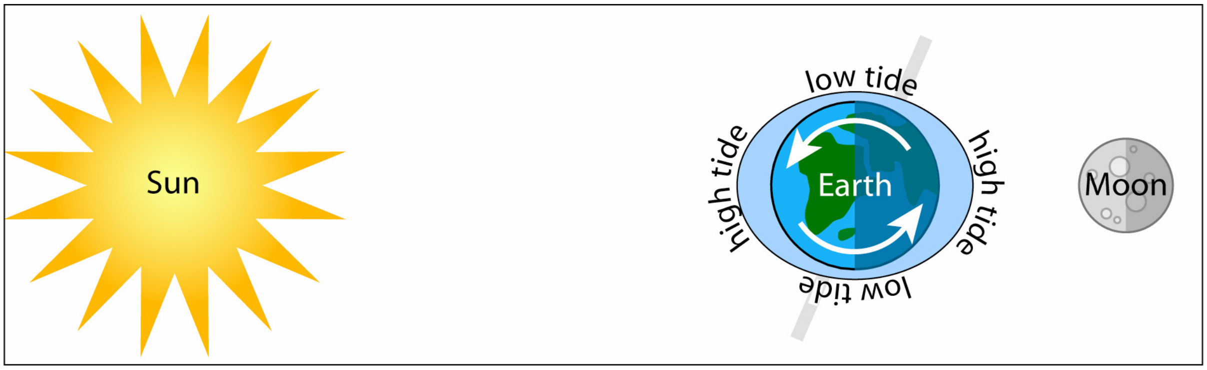


Figure 1 Spring Tide

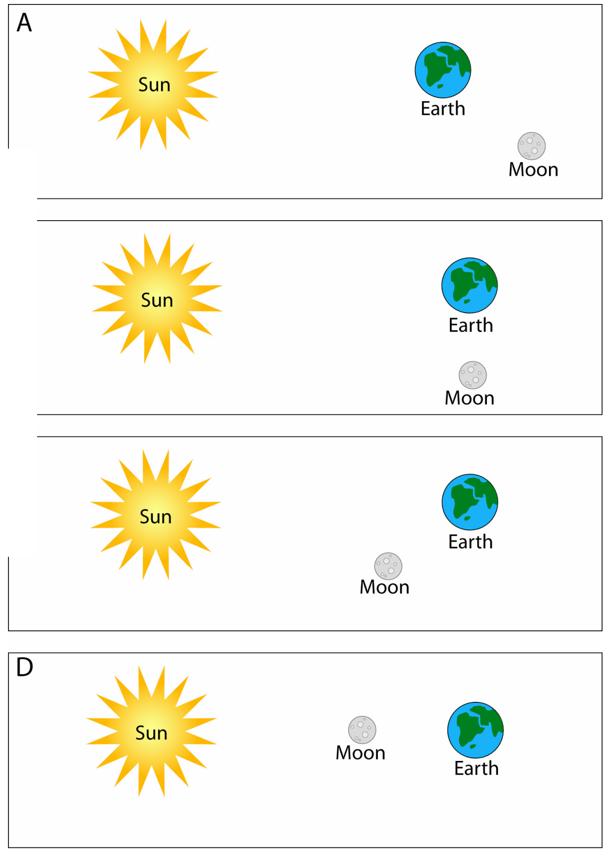
Neap tides occur when Sun, Earth, and Moon form a 90^{o} angle (Figure 2).

Figure 2 Neap Tide

1. ***The Earth completes one full rotation every 24 hours. With this in mind, about how much time passes between low tide and the next high tide?***
   A. 3 hours
   B. 6 hours
   C. 12 hours
   D. 24 hours

Earth Science Survey of Student Knowledge – Form A

2. Which other arrangement of the Sun, Earth, and Moon would produce a spring tide?



3. Which change in the moon's location and size would cause the greatest increase in Earth's high tides?

A. If the moon were smaller and farther away
B. If the moon were smaller and closer
C. If the moon were larger and farther away
D. If the moon were larger and closer

4. ***During the full moon of a spring tide, why does the moon appear to be a circle?***

A. Because the entire surface of the moon is lit by the sun.
B. Because we see the entire half of the moon that is lit by the sun.
C. Because sunlight reflects off of the Earth's surface directly on the moon.
D. Because the moon blocks sunlight that would normally reach the Earth.

Earth Science Survey of Student Knowledge – Form A

Set 2: Seasons

We know that:

- Earth rotates at an angle that is tilted 23.5^{o} compared to its orbit around the Sun (Figure 1).
- One day is the length of time for the Earth to complete one rotation.
- The Earth orbits the sun along an elliptical path that is off-center.
- At its closest point, Earth is 147 million km from the Sun.
- At its farthest point, it is 152 million km.
- One year is the length of time for the Earth to complete one orbit around the Sun.

1. Which of these is most responsible for causing the seasons?

A. Amount of the Sun's light reaching the Earth's surface
B. Distance between the Earth and the Sun
C. Location of the Sun's direct rays on the Earth's surface
D. Speed at which the Earth rotates on its axis

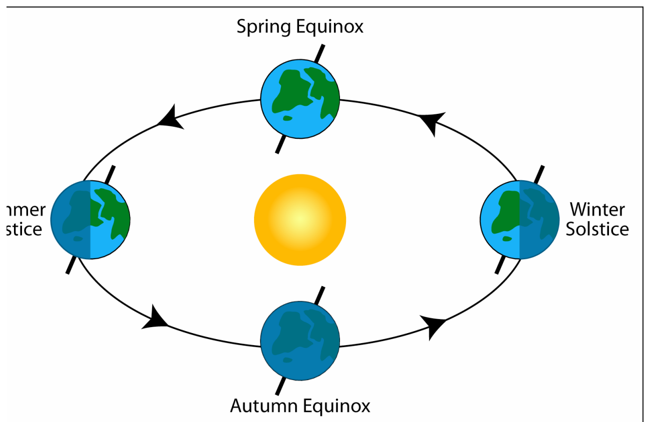


Figure 1 Earth's Orbit Around the Sun

2. For a person living in North America, which day of the year has the least hours of daylight?

A. Spring Equinox
B. Summer Solstice
C. Fall Equinox
D. Winter Solstice

3. On the winter solstice, a person standing at which location would have the longest shadow?

A. 23.5^{o} south of the equator
B. On the equator
C. 23.5^{o} north of the equator
D. 45^{o} north of the equator

4. The number of hours of daylight per day changes throughout the year. Which factor is mainly responsible for this difference?

A. Tilt of Earth on its axis
B. Distance of the Earth from the Sun
C. Speed at which Earth rotates on its axis
D. Speed at which Earth orbits the Sun

Life Science Survey of Student Content Knowledge – Form A

Set 1: Moon Phases

Here's what we know:

- The phases of the Moon change throughout the Moon's 28-day orbit around the Earth (Figure 1).
- The part of the lit side of the Moon that is visible from Earth depends on the relative positions of the Sun, Earth and Moon.
- For example, the Moon appears fully lit when the Sun and Moon are located on opposite sides of the Earth (see 4). This phase, called the Full Moon, is only visible from Earth at night.
- During the First Quarter, only the right side of the Moon appears lit.

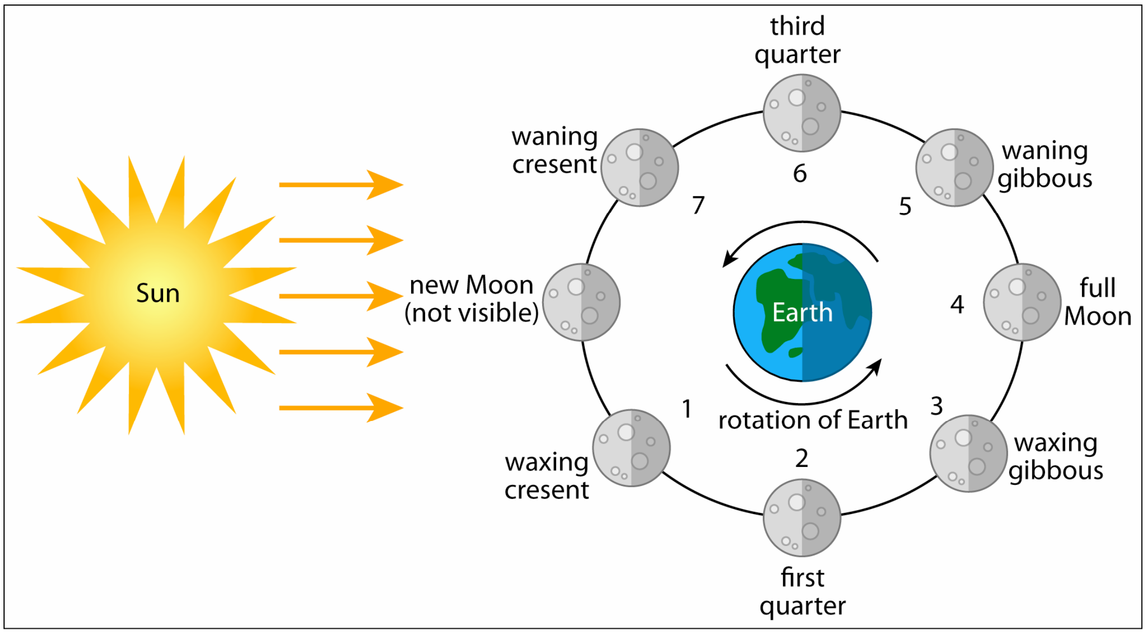
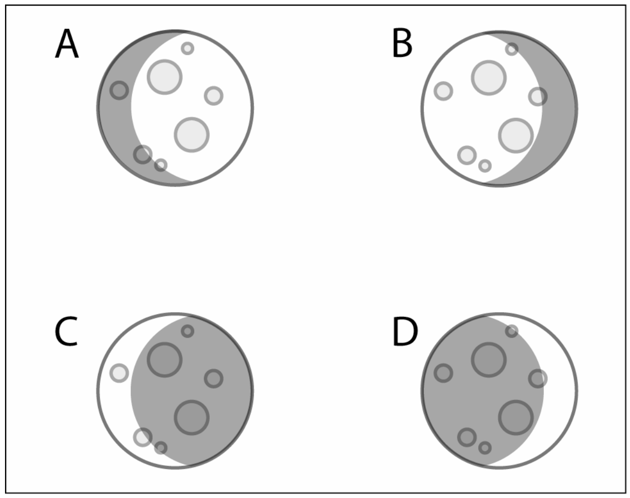


Figure 1 The Phases of the Moon

1. ***Suppose an observer is standing on the Earth's surface. The full moon would most likely be directly overhead at which time of day?***

   A. 6 PM
   B. 12 midnight
   C. 3 AM
   D. 9 AM

2. ***Using white to represent the lit portion of the Moon that is visible from Earth, which illustration best shows the appearance of the moon during the waning crescent in the Northern Hemisphere?***



3. ***If viewed from the Sun, how would the Moon appear during the phase called New Moon?***

A. Completely dark
B. Right side would be lit and left side would be dark
C. Left side would be lit and right side would be dark
D. Fully lit

4. ***A lunar eclipse occurs when the Earth's shadow blocks the Sun's light from reaching the Moon. During which phase of the Moon would a lunar eclipse occur?***

A. New Moon
B. First Quarter
C. Full Moon
D. Waning Crescent

Life Science Survey of Student Content Knowledge – Form A

Set 2: Our Solar System

Here's what we know:

- Our solar system contains one star, called the sun, and nine planets.
- The inner planets are closest to the sun. They include Mercury, Venus, Earth, and Mars. The outer planets include Jupiter, Saturn, Uranus, Neptune, and Pluto.
- Earth, Mars and all the outer planets have at least one moon (not shown)

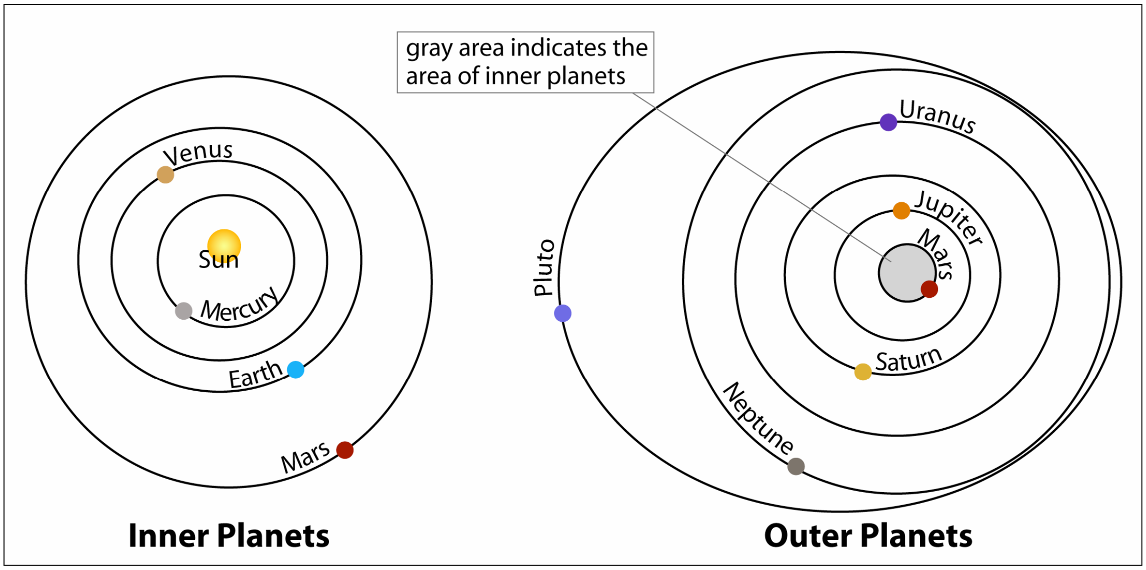


Figure 1: The Inner and Outer Planets

1. Which of these objects orbits the Earth?

A. The Sun
B. The Moon
C. The inner planets
D. The outer planets

2. Which of these planets is closest to the Sun?

A. Jupiter
B. Mars
C. Neptune
D. Venus

Life Science Survey of Student Content Knowledge – Form A

3. ***Which of these planets would take the longest amount of time to orbit the sun?***

   A. Jupiter
   B. Mercury
   C. Neptune
   D. Venus

4. ***Which factor determines the length of the day on Venus?***

   A. Its distance from the Sun
   B. The speed at which it orbits the Sun
   C. The amount of time it takes to orbit the Sun
   D. The speed at which it rotates on its axis

Your Ethnicity	**Circle your grade**	**Your Gender**
○ Asian	1 5 9	○ Male
○ American Indian or Alaska Native	2 6 10	○ Female
○ Black or African American	3 7 11	**Your Race**
○ Native Hawaiian or Other Pacific Islander	4 8 12	○ Hispanic or Latino
○ White	Other	○ Not Hispanic or Latino

Your Ethnicity	**Circle your grade**	**Your Gender**
○ Asian	1 5 9	○ Male
○ American Indian or Alaska Native	2 6 10	○ Female
○ Black or African American	3 7 11	**Your Race**
○ Native Hawaiian or Other Pacific Islander	4 8 12	○ Hispanic or Latino
○ White	Other	○ Not Hispanic or Latino

<u>Set 1: Yarrow</u>

Life Science Survey of Student Content Knowledge – Form A

Here's what we know:

- Yarrow grows in the Sierra Nevada Mountains (Figure 1).
- The average height of yarrow reaches 75 cm at low elevations (Site A), but only 20 cm at the highest elevations (Sites F and G).
- Researchers collected 100 seeds from plants at Sites A, C, F, and I.
- They planted the seeds in a garden near Site A and measured the heights of the full-grown plants later that season (Table 1).

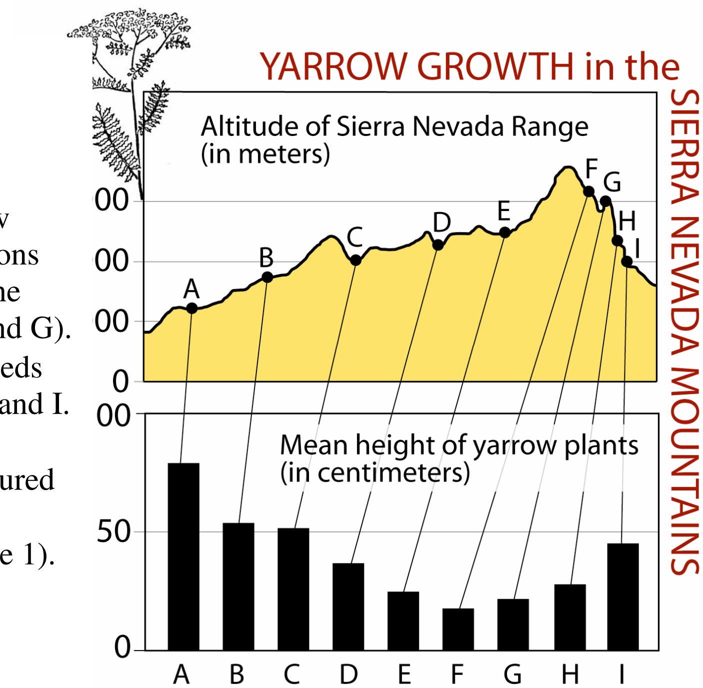


Figure 1. Average height of yarrow plants and elevation

Original Location of Seeds	Height of plants when grown at Site A
Site A	70
Site C	55
Site F	35
Site I	50

Table 1 Height of plants when grown in a garden at Site 1

1. ***According to the data, at an elevation of 1000 meters, can a yarrow plant grown from seed reach a height of 70 cm?***
   A. Yes, if the seed is collected from a plant growing at that same elevation.
   B. Yes, if the seed is collected from a plant growing at an elevation of 3000 meters.
   C. No, because the average height of yarrow plants is about 40 cm.
   D. No, because the majority of yarrow plants are shorter than 50 cm.

2. ***Suppose the researchers collected seeds from Site E and planted them in a garden at Site A. Based on the results presented, about how tall would the yarrow plants be?***
   A. Less than 20 cm
   B. Between 25 and 30 cm
   C. Between 50 and 55 cm
   D. Greater than 70 cm

3. ***Suppose the researchers collected seeds from Sites A and F and planted them in a garden at Site F. Which result would support the conclusion that plant height is caused by genetics and not by the environment?***
   A. Plants from both Sites A and F reach an average height of 20 cm.
   B. Plants from both Sites A and F reach an average height of 70 cm.
   C. Plants from Site A reach an average height of 20 cm, while plants from Site F reach an average height of 70 cm.
   D. Plants from Site A reach an average height of 70 cm, while plants from Site F reach an average height of 20 cm.

4. ***Plants grown from seeds collected from Site A reach an average height of 65 cm when grown in a garden at Site I. This observation provides the strongest support for which conclusion about plant height?***
   A. Both genetic and environmental factors influence height.
   B. Genetic factors influence height, but environmental factors do not.
   C. Environmental factors influence height, but genetic factors do not.
   D. Plant height varies randomly.

5. ***Which result from Table 1 would have provided the strongest support for the conclusion that plant height is mainly determined by the environment in which it grows?***
   A. Seeds from Site A reached an average height of 65 inches when grown in a garden near Site A.
   B. Seeds from Site C reached an average height of 50 inches when grown in a garden near Site A.
   C. Seeds from Site F reached an average height of 60 inches when grown in a garden near Site A.
   D. Seeds from Site I reach an average height of 55 inches when grown in a garden near Site A.

6. ***If grown in a garden near Site F, plants from which location would most likely be tallest?***
   A. Site A
   B. Site C
   C. Site E
   D. Site G

Physical Science Survey of Student Content Knowledge – Form A

Set 1: Field Mice

Records were kept on a small population of field mice in an area of Northern New England. At the beginning and end of each season, biologists would capture and release mice to determine the number and characteristics of the population. They recorded the mouse's coat color and its thickness and summarized their data in the table below. The scientists also collected the weather data for the winter.

Mouse Coat Color	Coat Thickness	Number at start of winter	Number at end of winter	Survival Percentage
Brown	15mm (thick)	85	65	76%
Brown	8mm (thin)	63	18	29%
White	15mm (thick)	77	71	92%
White	8mm (thin)	82	45	55%

1. ***Based on the percentage of mice that survived the winter, what was the weather like during that season?***

   A. It was cold and dry with very little snow cover
   B. It was cold and the ground was often snow covered
   C. It was mild and dry with very little snow cover
   D. It was mild and the ground was often snow covered

2. ***Looking at the table, what was the best physical characteristic for survival during this season?***

   A. Thick brown coat
   B. Thick white coat
   C. Thin brown coat
   D. Thin white coat

3. ***What is the best explanation for why the white mice with thin fur survived better than the brown mice with thin fur?***

   A. White fur is a better insulator than brown fur
   B. Brown fur contrasts more with the surroundings making them easier to be spotted by predators
   C. Brown fur is a better insulator than white fur
   D. White fur contrasts more with the surroundings making them easier to be spotted by predators

4. ***Based on the survival percentages, what will be the largest group of mice at the start of the season next year?***

   A. Brown mice with thick fur
   B. Brown mice with thin fur
   C. White mice with thick fur
   D. White mice with thin fur

5. ***Suppose that over a ten-year period, the weather gradually became warmer and drier. What would happen to the population of mice?***

   A. They would remain the same because the weather could change cold and snowy again.
   B. They would slowly change from a population of white mice with thick fur to a population of brown mice with thin fur
   C. They would rapidly change to be a population of mice with brown thin fur in anticipation of the changing climate
   D. The mice would slowly change during the year and pass on their changes to their offspring

6. ***Suppose that the population of red fox, the primary predator of these mice, was reduced because of disease. What would happen to the population of mice?***

   A. There would be no change in the population of mice because they are not influenced by changes on other species
   B. The population of mice would continue to change to reflect changes in the climate only
   C. The population of mice would change rapidly to be more uniform in color
   D. The population of mice would most likely become white and brown with the removal of that form of natural selection

Your Ethnicity

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

Circle your grade

1	5	9
2	6	10
3	7	11
4	8	12
Other		

Your Gender

- ○ Male
- ○ Female

Your Race

- ○ Hispanic or Latino
- ○ Not Hispanic or Latino

Physical Science Survey of Student Content Knowledge – Form A

Set 1: Changing Temperature

Students performed an investigation. Here's what we know:

- Students drilled holes A, B, C, and D along an iron rod.
- They placed a thermometer inside each hole.
- Each thermometer matched the room temperature of 70^{o}C.
- The students lit a Bunsen burner and placed it under one end of the rod and left it there for 30 minutes.
- Then they took a picture of the result (Figure 1).

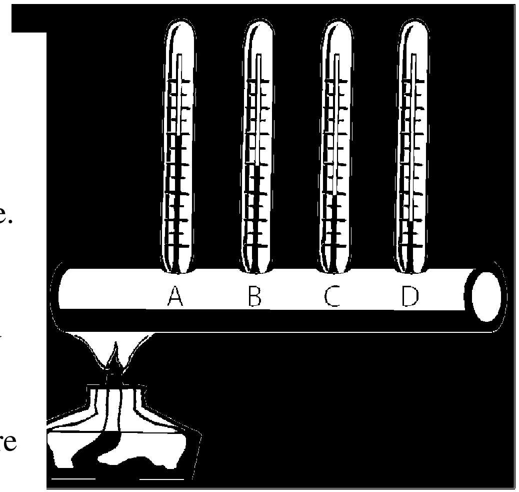
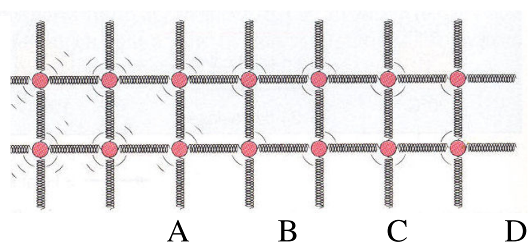


Figure 1 Thermometers and rod after 30 min of heating

1. Suppose the flame is removed at 30 minutes and then temperatures are observed during the next 60 minutes. Which is the best description of how the temperature of the rod will change?

A. The temperatures of A, B, C, and D, will decrease at the same time, but the rate of decrease will be greatest for A.
B. First A will return to room temperature, and then B will return to room temperature, followed by C and then D.
C. A will become cooler while the temperatures of B, C, and D will increase and then decrease, as a wave of heat passes through.
D. The average temperature will remain constant, but the energy will spread out evenly across A, B, C, and D.

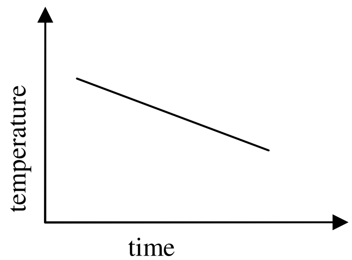
A student drew this diagram to depict molecular motion along the length of the rod after 30 minutes of heating. The lines around the circles represent molecular motion.



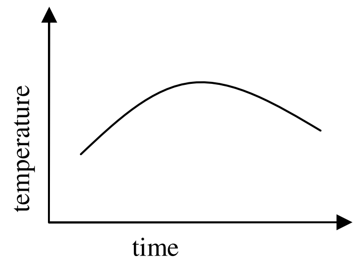
2. Does the student's illustration accurately represent molecular motion?

A. Yes, because kinetic energy increases with temperature.
B. Yes, because potential energy increases with temperature.
C. No, because kinetic energy depends on the composition of the rod, but not its temperature.
D. No, because potential energy depends on the location of the rod, but not its temperature.

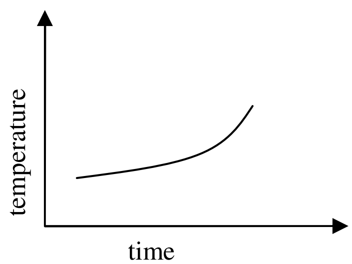
3. Which graph best shows how the temperature reading of A changed during the 30 minutes of heating?



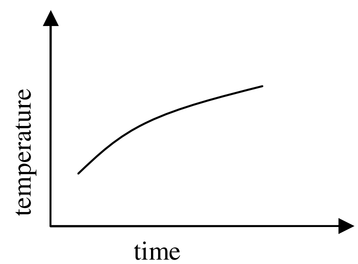
A.



B.

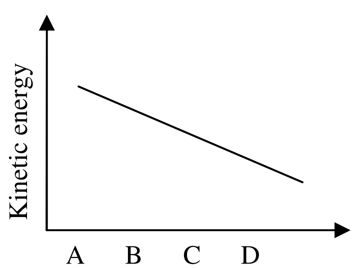


C.

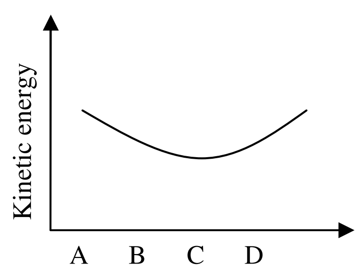


D.

4. Which graph best shows the kinetic energy of molecules in the rod shown in Figure 1?



A.



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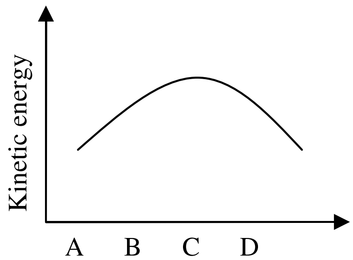

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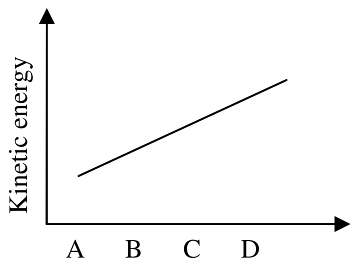

D.

Set 2: Physical and Chemical Changes

Students studied several unknown substances and recorded their results (Table 1).

- First, they observed the appearance of the substance.
- Second, they added a small sample of each substance to a beaker of pure water.
- Third, they placed a small amount of each substance on a watch glass and added 5 drops of dilute hydrochloric acid (HCl).
- Fourth, they placed a small sample of each substance on a spoon and held it over a flame.

Substance	Appearance	*Observation when tested*		
		Water	HCl (acid)	*Flame*
A	White crystalline	Dissolves clear	No bubbles	*No change*
B	White powdery	Dissolves cloudy	Bubbles form	*No change*
C	White crystalline	Dissolves clear	No bubbles	*Melts, turns brown, smokes*
D	Tan crystalline	Drops to bottom	No bubbles	*No change*
E	White powdery	Floats and clumps	No bubbles	*Turns brown and smokes*
F	*Gray metallic*	*Drops to bottom*	*No bubbles*	*No change*

Table 1: Observations When Examining Substances

1. Which substance appeared to undergo a chemical reaction when HCl was added?

A. Substance A
B. Substance B
C. Substance C
D. Substance D

2. Does Substance E undergo a chemical reaction?

A. No, because it can only react with water if it can dissolve in water.
B. No, because bubbles were not produced when HCl was added.
C. Yes, because it forms clumps when added to water.
D. Yes, because it turns brown and smokes when heated over a flame.

Students ran out of time, so they left the materials in the lab. When they returned the next day, they noticed that the water containing Substance F had turned an orangey-brown.

3. Do these observations support the idea that a chemical reaction had taken place?

A. No. The results in Table 1 indicate that Substance F simply dropped to the bottom when added to the beaker with water.
B. No. Students did not control for temperature and time, nor did they replicate their observations.
C. Yes. The water most likely turned brown because a new water-soluble substance was produced.
D. Yes. Anytime a solid substance is added to water, some kind of chemical reaction takes place.

4. Which substance appeared to undergo a chemical reaction when heated over a flame?

A. Substance A
B. Substance B
C. Substance C
D. Substance D

Your Ethnicity

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

Circle your grade

1	5	9
2	6	10
3	7	11
4	8	12
Other		

Your Gender

- ○ Male
- ○ Female

Your Race

- ○ Hispanic or Latino
- ○ Not Hispanic or Latino

Set 1: Physical and Chemical Reactions

Students performed several investigations in the laboratory. Here's what we know:

Investigation	*Description*
1	*They put a piece of ice into a beaker and placed the beaker on a hot plate. The ice melted to produce water. After a while, the water began to boil and some of it turned to steam.*
2	*They sprinkled calcium chloride on top of a layer of frozen water on a sidewalk and watched the ice melt around each chunk of calcium chloride.*
3	*They added sodium chloride to a beaker full of distilled water. Then they boiled off the water and recovered a white crystalline substance.*
4	*They dropped a piece of copper into a test tube containing nitric acid solution. Bubbles formed on the surface of the copper and an aqua colored substance dissolved into the solution.*
5	*They broke a large chunk of calcium carbonate into small pieces until it was just a powder.*
6	*They placed a stick over a Bunsen burner flame and allowed the stick to burn.*

1. ***During which investigation did the students observe a chemical change?***

   A. Investigation 1
   B. Investigation 2
   C. Investigation 3
   D. Investigation 4

2. ***During which 2 investigations did the students observe a substance undergo a change of phase?***

   A. Investigations 1 and 2
   B. Investigations 2 and 5
   C. Investigations 3 and 4
   D. Investigations 4 and 6

3. ***Which of these observations is a key characteristic of a chemical reaction?***
   A. A substance that is solid is converted into a substance that is either liquid or gas.
   B. A substance with one set of properties is converted into a substance with different properties.
   C. A substance that has a particular shape or size is converted into a substance with a different shape or size.
   D. A substance that is changed through a chemical reaction cannot be converted back into its original form.

4. ***Suppose students start with a mixture of 50% ethanol and 50% water. They heat the mixture at increasingly higher temperatures until most of the ethanol evaporates. The remaining mixture is 95% water. Is this an example of a chemical reaction?***
   A. Yes, because most of the ethanol is driven off, changing the composition of the mixture.
   B. Yes, because the boiling point of the original mixture is lower than the boiling point of the final mixture.
   C. No, because a small portion of the ethanol and water join together to form larger molecules that cannot evaporate.
   D. No, because the chemical structures of ethanol and water remain unchanged.

Set 2: In Hot Water

Students performed an investigation. Here's what we know:

- Students obtained two identical ceramic mugs.
- They filled Mug A with steaming hot water
- They filled Mug B with ice-cold water from which all the ice was removed.
- They placed the mugs at opposite ends of a table.
- Every 5 minutes, they measured the temperature of water in each mug and recorded their results in a graph (Figure 1).

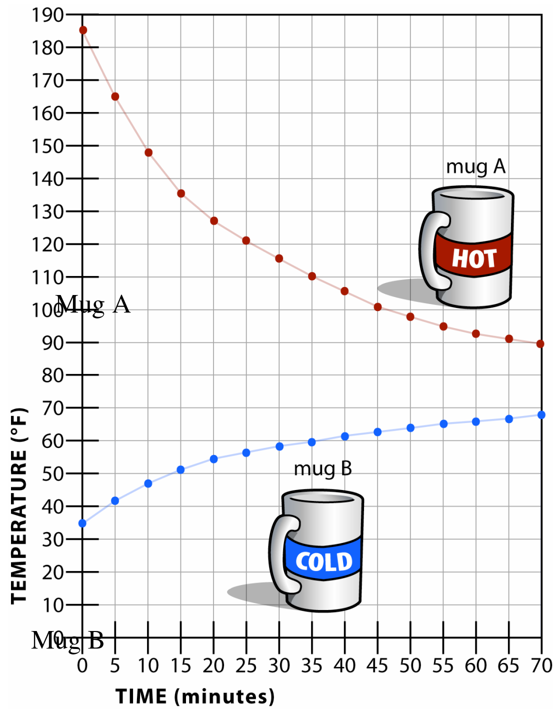

Figure 1 Temperature of water in Mugs A and B

1. ***Suppose that, at 10 minutes, the students combined equal amounts of water from Mugs A and B. What would be the approximate final temperature of the mixture?***
   A. 50^0F because the cold water would absorb most of the heat
   B. 80^0F because that is halfway between the temperatures of water in Mugs A and B when they reach equilibrium
   C. 100^0F because that is halfway between the temperatures of water in Mugs A and B at 10 minutes
   D. 140^0F because the hot water would absorb most of the cold

2. ***Which of these is the best explanation for why the temperature decreased in Mug A?***
   A. Cold entered Mug A from the room.
   B. Cold water from Mug B absorbed the heat from Mug A.
   C. Heat from Mug A was absorbed by air in the room.
   D. Heat from Mug A was converted into potential energy.

3. ***How would the results for Mug B be different if students had left ice cubes floating in the water?***
   A. The temperature would drop below the freezing point until the last piece of ice had melted, and then would increase as shown in Figure 1.
   B. The temperature would stay the same until the last piece of ice melted, and then would increase as shown in Figure 1.
   C. The temperature would stay the same until the last piece of ice melted, and then would increase more slowly than that shown in Figure 1.
   D. The temperature would immediately begin to increase, but would rise more slowly than that shown in Figure 1.

4. ***The initial rate of temperature change of water in Mug A was greater than that for water in Mug B. Which of these is the best explanation for this observation?***
   A. Heat enters cool areas more quickly than it leaves warm areas.
   B. The air absorbs heat from warmer objects more quickly than it absorbs heat from cooler objects.
   C. The rate of heat transfer increases with the magnitude of the temperature difference between two objects.
   D. It is a natural for the temperature of objects to decrease as heat moves into the environment.

Your Ethnicity	**Circle your grade**	**Your Gender**
○ Asian	1 5 9	○ Male
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○ Black or African American	3 7 11	**Your Race**
○ Native Hawaiian or Other Pacific Islander	4 8 12	○ Hispanic or Latino
○ White	Other	○ Not Hispanic or Latino

Set 1: Moon Phases

Here’s what we know:

- The phases of the Moon change throughout the Moon’s 28-day orbit around the Earth (Figure 1).
- The part of the lit side of the Moon that is visible from Earth depends on the relative positions of the Sun, Earth and Moon.
- For example, the Moon appears fully lit when the Sun and Moon are located on opposite sides of the Earth (see 4). This phase, called the Full Moon, is only visible from Earth at night.
- During the First Quarter, only the right side of the Moon appears lit.

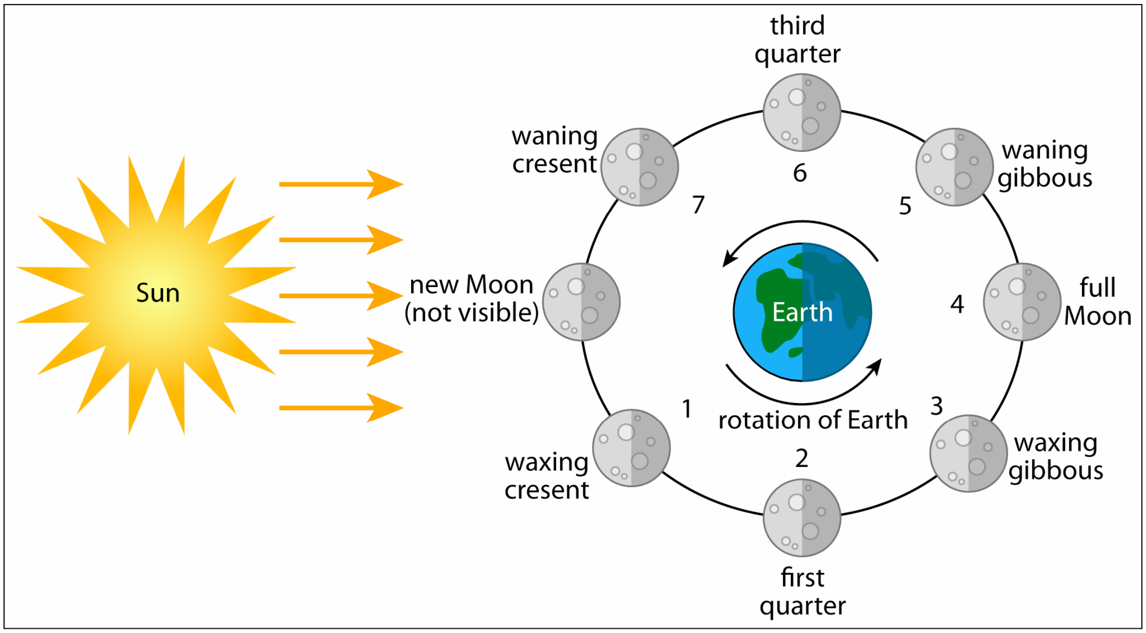
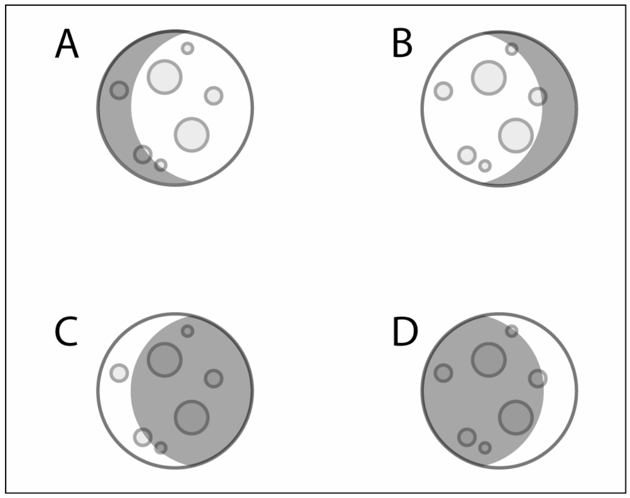


Figure 1 The Phases of the Moon

5. *Suppose an observer is standing on the Earth's surface. The full moon would most likely be directly overhead at which time of day?*

A. 6 PM
B. 12 midnight
C. 3 AM
D. 9 AM

6. ***Using white to represent the lit portion of the Moon that is visible from Earth, which illustration best shows the appearance of the moon during the waning crescent in the Northern Hemisphere?***



7. ***If viewed from the Sun, how would the Moon appear during the phase called New Moon?***

   A. Completely dark
   B. Right side would be lit and left side would be dark
   C. Left side would be lit and right side would be dark
   D. Fully lit

8. ***A lunar eclipse occurs when the Earth's shadow blocks the Sun's light from reaching the Moon. During which phase of the Moon would a lunar eclipse occur?***

   A. New Moon
   B. First Quarter
   C. Full Moon
   D. Waning Crescent

Set 2: Our Solar System

Here's what we know:

- Our solar system contains one star, called the sun, and nine planets.
- The inner planets are closest to the sun. They include Mercury, Venus, Earth, and Mars. The outer planets include Jupiter, Saturn, Uranus, Neptune, and Pluto.
- Earth, Mars and all the outer planets have at least one moon (not shown)

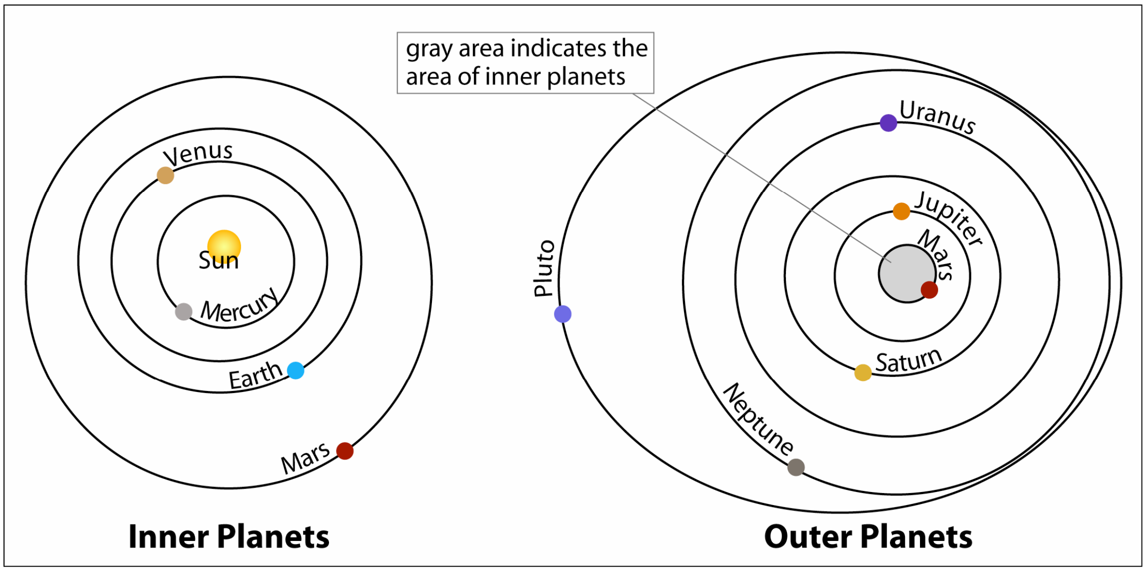


Figure 1: The Inner and Outer Planets

5. Which of these objects orbits the Earth?

A. The Sun
B. The Moon
C. The inner planets
D. The outer planets

6. Which of these planets is closest to the Sun?

A. Jupiter
B. Mars
C. Neptune
D. Venus

7. ***Which of these planets would take the longest amount of time to orbit the sun?***

   A. Jupiter
   B. Mercury
   C. Neptune
   D. Venus

8. ***Which factor determines the length of the day on Venus?***

   A. Its distance from the Sun
   B. The speed at which it orbits the Sun
   C. The amount of time it takes to orbit the Sun
   D. The speed at which it rotates on its axis

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Set 1: Field Mice

Records were kept on a small population of field mice in an area of Northern New England. At the beginning and end of each season, biologists would capture and release mice to determine the number and characteristics of the population. They recorded the mouse's coat color and its thickness and summarized their data in the table below. The scientists also collected the weather data for the winter.

Mouse Coat Color	Coat Thickness	Number at start of winter	Number at end of winter	Survival Percentage
Brown	15mm (thick)	85	65	76%
Brown	8mm (thin)	63	18	29%
White	15mm (thick)	77	71	92%
White	8mm (thin)	82	45	55%

2. ***Based on the percentage of mice that survived the winter, what was the weather like during that season?***

   E. It was cold and dry with very little snow cover
   F. It was cold and the ground was often snow covered
   G. It was mild and dry with very little snow cover

H. It was mild and the ground was often snow covered

3. Looking at the table, what was the best physical characteristic for survival during this season?

E. Thick brown coat
F. Thick white coat
G. Thin brown coat
H. Thin white coat

3. What is the best explanation for why the white mice with thin fur survived better than the brown mice with thin fur?

E. White fur is a better insulator than brown fur
F. Brown fur contrasts more with the surroundings making them easier to be spotted by predators
G. Brown fur is a better insulator than white fur
H. White fur contrasts more with the surroundings making them easier to be spotted by predators

5. ***Based on the survival percentages, what will be the largest group of mice at the start of the season next year?***

   E. Brown mice with thick fur
   F. Brown mice with thin fur
   G. White mice with thick fur
   H. White mice with thin fur

5. ***Suppose that over a ten-year period, the weather gradually became warmer and drier. What would happen to the population of mice?***

   E. They would remain the same because the weather could change cold and snowy again.
   F. They would slowly change from a population of white mice with thick fur to a population of brown mice with thin fur
   G. They would rapidly change to be a population of mice with brown thin fur in anticipation of the changing climate
   H. The mice would slowly change during the year and pass on their changes to their offspring

6. ***Suppose that the population of red fox, the primary predator of these mice, was reduced because of disease. What would happen to the population of mice?***

   E. There would be no change in the population of mice because they are not influenced by changes on other species
   F. The population of mice would continue to change to reflect changes in the climate only
   G. The population of mice would change rapidly to be more uniform in color
   H. The population of mice would most likely become white and brown with the removal of that form of natural selection

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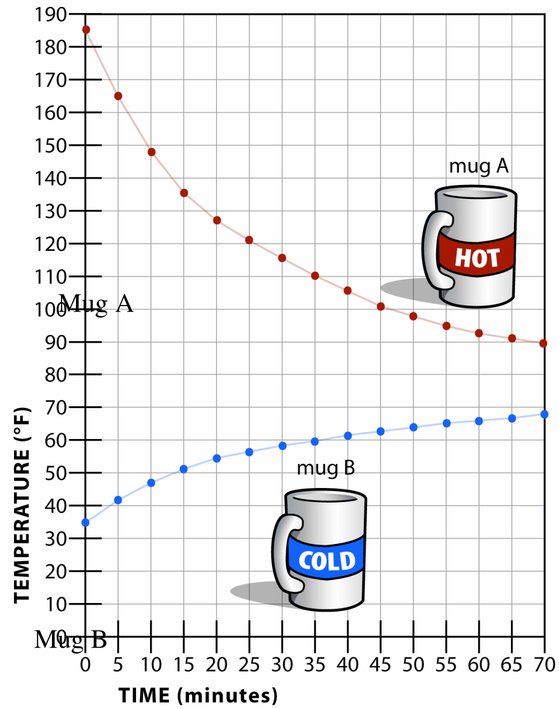

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Student Content Knowledge Answer Key

FORM A		
	Set 1: Changing Temperature	**Set 2: Physical and Chemical Changes**
Physical Science	5) A 6) A 7) D 8) A	5) B 6) D 7) C 8) C
Earth Science	**Set 1: Spring and Neap Tides**	**Set 2: Seasons**

	5) B 6) D 7) D 8) B	5) C 6) D 7) D 8) A
Life Science	**Set 1: Yarrow**	
	7) A 8) B 9) D 10) A 11) C 12) A	
FORM B		
Physical Science	**Set 1: Physical and Chemical Reactions**	**Set 2: In Hot Water**
	5) D 6) A 7) B 8) D	5) C 6) C 7) B 8) C
Earth Science	**Set 1: Moon Phases**	**Set2: Our Solar System**
	5) B 6) C 7) D 8) C	5) B 6) D 7) C 8) D
Life Science	**Set 1: Field Mice**	
	7) B 8) B 9) B 10) C 11) B 12) D	