Science education for girls: A partnership between Girl Scouts and Nasa

Anne Grisham

University of Nevada, Las Vegas

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SCIENCE EDUCATION FOR GIRLS: A PARTNERSHIP
BETWEEN GIRL SCOUTS AND NASA

By
Anne Grisham

Bachelor of Arts
University of Northern Colorado
1980

Master of Education
University of Nevada, Las Vegas
1993

A dissertation submitted in partial fulfillment of the
Requirements for the

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College of Education

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By the undersigned on April 12, 2006

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Dean of the Graduate College
ABSTRACT

Science Education for Girls: A Partnership between Girl Scouts and NASA

By

Anne Grisham

Dr. Martha Young, Examination Committee Chair
Professor of Teacher Education
University of Nevada, Las Vegas

This study investigated the evolution of the relationship between NASA and the Girl Scouts of the USA (GSUSA). The stories of three groups of key players; NASA, Girl Scout National Staff, and Girl Scout volunteers explained the scope and depth of this unique partnership. Common goals between GSUSA and NASA of encouraging girls to seek careers in science, technology, engineering, and math (STEM) were studied to determine if the goals were met as a result of this collaboration. Outcomes such as the Memorandum of Understanding, numbers of attendees at workshops, and artifact reviews aided in the collection of data.

The partnership between the Girl Scouts and NASA has not been without strife, and barriers such as funding and communication has delayed the goals of both organizations. Nevertheless, a partnership was forged and has grown since its inception in early 2001. Each of these national organizations has its own way of work and its own
culture. How then can two such large organizations find the common ground to partner together and create a new culture shared between them with a common mindset?

The timeline of how and when the two organizations began their collaborations and the outcome of their partnership was evaluated. Examination of the Girl Scout culture and goals as they are related to science was compared to the NASA goals of introducing more girls to STEM careers. The impact effect of how many different workshops, events, camps with space themes was analyzed. Girl Scout adult volunteers’ attitudes and beliefs about science were explored to determine if changes in beliefs occurred as a result of the experiences with NASA. Ultimately, data were scrutinized to determine if the relationship is sustainable and what efforts each organization must take to maintain a high-leveled partnership.
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DEDICATION

This dissertation is in memory of my mother, Ilo June McCray Grisham, who introduced me to many of my life's passions including Girl Scouting and science. Thanks Mom for always believing in me, and for helping me become the woman that I am.
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CHAPTER ONE

INTRODUCTION

Historically, women have not had the opportunities to enter science related careers (US Department of Labor, 2000), and currently only 22% of all scientists and engineers are women. Positions are plentiful for women in science and engineering as evidenced by the number of jobs posted for the National Aeronautical Space Agency (NASA) and other science industries (National Science Foundation, 2000). Despite this, private and public funded institutions such as NASA have felt the crunch of fewer students choosing science, math, and engineering courses in college and have opted out of science, technology, engineering, or math careers. In addition, an even larger percentage of girls as compared to boys are not selecting science careers in physics and chemistry. Schools have failed to encourage both boys and girls to take higher-level science courses such as physics, and chemistry. These courses are not required for graduation, and therefore are optional for students. By the time girls reach puberty, they begin to lag behind their male peers and do not see themselves as future scientists. These points lead to key questions: “How can we help girls see themselves as scientists and engineers?” “Who can provide the expertise, and knowledge of girls’ social and emotional development?” The answers may be in a unique partnership the Girl Scouts of the USA and the National Aeronautical Space Agency.
NASA and its long history of providing educational materials to formal educational settings has an expertise of methodology of sharing space science with youth. The Girl Scouts is the largest all girl organization in the United States, and is known for its understanding of girls’ development, growth, and interests. Girl Scouting provides a safe all-girl setting to explore different topics and issues that may be viewed as masculine such as auto mechanics, or space science. The Girl Scouts and NASA joined forces to provide girls with space science activities which would arouse girls’ interest in science. This study investigated the relationship between these two national organizations, its creation and growth, and how this interaction promoted and nurtured women to pursue careers in science, technology, engineering, and math.

Chapter One covers the background and rationale of this study, and why the problem of women not entering science careers continually persists. The research focus of the Girl Scout collaboration with NASA addresses how after-school programs can provide additional and positive science programs for girls in a setting free of gender pressures. An environment free of gender pressures is important because girls encounter barriers to science in coed science classes, perceive that science is a masculine activity, and that girls’ roles in society do not include the pursuit of science careers. The Girl Scouts of the USA and NASA both share the common goal of increasing the number of girls who enter STEM careers. An explanation of the conceptual framework of this study using an ethnographic method through a feminist epistemology lens concludes the chapter with the research questions.
Background and Rationale

Education in the United States has made significant and, in some cases, remarkable positive strides, especially in changing the opportunities and ratios of women to men in education and in the work place. Thirty-five years ago, women had few options in their choices of career paths, and data from the U.S. Department of Labor (2003) reflected that 43% women entered the work force. The impact of Title IX, a less restrictive culture, and concerted efforts to equalize education and the work place opportunities have led to significant changes and by 2002 close to 60% of women were in the work force (US Dept. of Labor, 2003) Although women were now given opportunities to seek careers in science, math, technology, and engineering, the number of women in the fields was not equal to their male counterparts (NSF, 2000). Figure 1 demonstrates the five year data trends related to women and men employed as federal scientists.

Figure 1: Employed federal scientists by gender
Figure 1 indicates the number of men scientists declined from 1998 to 2001, and although the number of women scientists increased slightly, there remained a vast disproportionate number of employed male scientists compared to female scientists. Almost two men were hired for every one female between 2001 and 2002. Although both genders increased in the number of scientists hired at the federal level, males increased by 8,000 while the females only increased by 4700 more scientists. Between the years of 1998 to 2002, there were 3.5 male scientists working for every one female scientist employed.

In 2002, females constituted 51% of the U.S. population and 60% of the work force, but only 22% of scientists and engineers were women according to the National Science Foundation (2000). Although the percentage of women majoring in science and technology increased since the 1960s, fewer women enrolled in computing, physical sciences, and engineering. According to the US Census Bureau (2000), only 10.6 of the employed engineers in 1999 were women with an all time high of 11% in 1998. In 1999, the percentage of computer science degrees awarded to women had dropped from 37 percent from 1984 to 20 percent in 1999.

Studies over the past 20 years have examined why school-age girls tend to score lower than male counterparts on standardized achievement tests, and are less likely to choose careers in science, mathematics, technology and engineering (Damarin, 1990; Leder, 1992). The gender gap in science, math, and technology has been researched, studied, and potential solutions have been presented. These solutions have included providing mentors for girls, updating textbooks that include girls as scientists in the pictures, and increasing girls’ self-efficacy in coed science courses. Although each
intervention has its merits and some success rate, no single solution has provided resolution to a very complicated and complex reason why girls do not pursue science, technology, engineering, or math (STEM) careers. Societal roles and expectations influence how girls and boys perceive themselves in the future. Women are expected to be caregivers to children, and not all STEM jobs are conducive to childcare hours. Although this study will not examine childcare issues, it is important to note that some women may have chosen to not pursue a STEM career due to family and childcare expectations.

The issue is larger than child-care issues as sometimes girls do not see themselves as scientists. This has become a social restraint that has overflowed in the education system. Girls have not always been encouraged to enter science careers, and often receive messages that science is hard for girls and is a masculine endeavor, which discourages their participation. As recently as January 2005, the president of Harvard, Lawrence Summers, made a statement that women do not have the same “intrinsic aptitude” for certain areas of science (Summers, 2005). Although he had no proof or studies to back his statement, he contended that genetics plays a factor into why girls do not excel in science.

In the last twenty years, interventions have been used to encourage girls to take higher-level science classes such as physics and chemistry leading to employment in a science field. Interventions such as mentors, role-models, and awareness of the issue for teachers, counselors, and students have been somewhat effective, but the problem of girls not excelling in science has remained. Studies (Sadker, 1999; Stabner, 2002) have determined that girls generally prefer to learn in social settings, work within cooperative
groups, and prefer discussion and hands-on materials versus a pure lecture format. However, girls in a mixed setting defer the participation in scientific activities to boys (Sadker & Sadker, 1994; Stabner, 2002). Girls will record results, offer to gather materials, but will hand the materials to the boys especially in the areas of physics and chemistry.

A large volume of research addresses attitudes and self-efficacy of girls in science. The American Association of University Women (AAUW) has studied the dynamics of science classrooms for the past twenty years. According to the AAUW research (1992), teachers tend to call upon boys more in science and math and ask higher level of questions of males. Boys are asked critical thinking skills, and to think as problem-solvers (D’Ambrosio & Hammer, 1996; Lee, 1997; Lee, 1994; Sadker & Sadker, 1994; Sandler, 1996). Conversely, teachers call upon girls and have higher expectations of girls in reading and writing skills. Thus, boys and girls quickly learn that boys are expected to do well in math and science, while girls are expected to do better in the area of literacy. The AAUW (1992, 1999) found that boys were more aggressive in answering science questions, quicker to take risks, and often dominated the materials. Girls were found to be less assertive, were more thoughtful about their answers, and the older the girl the more likely she was passive toward science. On the other side, girls in an all female setting was more willing to take risks and did not feel as though they had to compete with their male counterparts in the class (Sadker & Sadker, 1994).

Girls may perceive science as a masculine domain (Tobin & Garnett, 1987; Rosser, 1990; Ridell, 1992). A cultural stereotype of science is that science is tough, rigorous, impersonal, and unemotional. All of these traits are considered masculine traits.
(Harding, 1991; Rossiter, 1982). The masculine message of science is bombarded toward girls in many forms. Parents often do not expect their daughters to do well in science and math classes and may excuse their poor performance in the classes, where sons are expected to do well. Toys such as chemistry sets, telescopes, blocks, Legos, and robot kits are packaged in bold colors with boys as central figures. Girls are depicted in pictures but are often in the background of toys that involve chemistry or physics (Miller, 1987; Reynolds, 1994). In 1992, Mattel toys marketed the first talking Barbie. Her first words were "Math class is tough." The message was once again clear to girls that math will be tough for them. Mattel experienced criticism for this message, and the Barbie dolls were pulled from the shelves. Barbie was once again muted, instead of using Barbie to provide positive messages about math and science. Perhaps, Barbie is expected to be seen and not heard to speak pro-science and math messages to young girls (Jovanovic & Dreves, 1995).

So, if Barbie is silenced, who can provide a voice that will encourage girls to pursue math, science, and technology careers? Current female role models in science are not available to all girls in all segments of the population, same gender classes are not always feasible, and pictures of women scientists in textbooks are not enough to gain girls' interest in science. Girls need experiences with science in settings where they do not defer to boys, can gain confidence in their abilities, and can become learners that are risk-takers.
Research Focus

Perhaps one voice can be the largest organization for girls in the United States, the Girl Scouts. Girl Scout troops and groups are in every state and have a membership of 2.8 million girl members between the ages of 5 and 18 (GSUSA, 2006). The Girl Scouts do not extend membership to boys under the age of eighteen, and therefore girls do not defer to boys in a group social setting. The Girl Scouts rely upon adult volunteers to offer female traditional activities such as cooking, sewing, child-care, and arts; as well as male-dominated opportunities such as sports, auto mechanics, and science. In 1912 girls were able to earn badges such as “Aviation” and “Electricity” and today over 75 science, math, or technology badges are offered to girls of all ages. The Girl Scout organization prides itself with being a contemporary organization for girls, and evolves as societal needs and changes occur.

Out-of-school programs can provide students a safe place after school and offer informal academic instruction that can improve test scores (Lumsden, 2003). Youth organizations such as Girl Scouts, Boy Scouts, 4-H, and other structured organizations have seized the opportunity to provide quality and affordable programs for students after school. Successful programs give youth a sense of belonging, leadership skills, and opportunities for input, and decision-making abilities in programs that are challenging and interesting (AYPF, 2006). The American Youth Policy Forum noted that out-of-school activities have shown that participating youth have a stronger school attachment, have a supportive relationship with adults, and have an increased academic achievement. Students have a higher self-esteem, self-concept, and an outlet to demonstrate creativity. The Girl Scouts believe that activities should be planned in a partnership with adults.
Girls are encouraged to pursue leadership opportunities, plan and complete projects, and work with a variety of different people.

Studies at all girl schools have indicated that girls may do better in science classes, and are more apt to pursue science careers (Gould, 1995; Hollinger, 1993; Stabner, 2002). The all girl science class scenario provides girls a safe environment in which they can learn about science, ask questions, and explore scientific principles without the fear of competing with boys, deferring to boys, appearing smarter than boys, and vying for the teacher’s attention or materials. However, Title IX did not allow for same sex settings in public education classes until 2001 when the guidelines became more lenient as a result of an amendment because of the No Child Left Behind Act (NCLB).

Influences Affecting Girls in Regards to Science

Several factors affect girls’ success in science classes and their decisions to pursue physics/engineering majors and/or careers in physics or engineering. These factors include:

1. teachers’ perceptions of girls in science classes
2. access to science materials in class
3. the perceived masculinity of science, and
4. the societal role that girls are expected to fulfill

In the early formative years, boys are given toys that require building, manipulating, or working machines. Boys experience physical principles and are allowed the time to play with objects and in turn have a stronger sense of how things work. Girls
often are not exposed to these types of experiences, and therefore enter the science
classroom with less inherit knowledge than their male peers. In elementary school, girls
and boys have an equal self-efficacy toward science and mathematics. However, by
middle school girls self-efficacy in science and math drops significantly compared to
boys (Lent, Lopez, & Bieschke, 1991; Pajares & Miller, 1994; Wigfield, Eccles, &
that 43% of high school physics students are girls. This number has dramatically
increased since the early 1990s. However, according to the same report very few of the
girls major in physics in college. Physics, engineering, and computer sciences are not
attracting women as quickly as other fields.

The societal stereotype of scientist is one who is a male, competitive, achievement
oriented, anti-social, and working in a lab wearing a white lab coat. When students are
given the “Draw-A-Scientist Test”, both boys and girls mirror the societal stereotype in
their drawings. Although girls will occasionally draw a woman scientist, it is even rarer
for a boy to draw a female scientist. (Chambers, 1983; Dickerson, Saylor, & Finch, 1990;
Finson, Riggs, & Jesunathadas, 1999; Fort & Varney, 1989). Thus, not only do we need
to change the image of scientists for girls, but we also need to change the image for boys
if we want the stereotype images to disappear. As boys and girls grow-up and become
parents, they will pass on their beliefs to their children. The problem of the masculinity
of science becomes cyclical and perpetuated if the notions of who is a scientist is not
changed in their minds. Girls tend to believe the societal stereotypes of masculine
science if strong influences from teachers, parents, and mentors do not intervene.
Programs such as the Lockheed Martin Science Career Exploration Fund offer a
supportive and mentor environment for girls in the Girl Scouts. The fund supports grants to individual councils to provide career fairs, workshops, mentor activities, and "hand-on" activities that promote engineering and physical sciences.

Students often indicate that mass media, especially television, is their major source of information (Baker, 2001). Media images of scientists prevail in cartoons, television and film. Scientists are depicted as "mad scientists", old white men in lab coats, or as unpopular "nerds." Students make decisions about their abilities in science, math, and technology through the implicit and explicit messages that are received from teachers, parents, and media (Zelden & Pajares, 2000). Although shows such as the popular CSI series depicted women as scientists in a positive light, elementary students were not part of the demographic watching this type of television show. Experiences in the elementary years heavily influence how girls perceive themselves as science learners (Kloosterman, Raymond, & Emanaker, 1996). Role models, authentic science experiences, as well as true depictions of women scientists are crucial for this age group.

There has been a growing perception in the general media that boys are scoring below girls on achievement tests (Newsweek, 2006). When Newsweek printed this story a flurry of media attention proposed that since the attention was given to girls in math and science, the boys were beginning to fall behind in academics. Factual information based on standardized tests (ACT, 2004; NAEP, 2000) indicated that since 1998 there had been a decline in reading and language arts scores for boys, but girls' scores in science had not increased nor had it surpassed the scores of boys. No doubt the issue of boys scoring lower on reading and writing sections of any test should be addressed, but the declining
scores were not a direct causation of the girls receiving more gender-fair science instruction.

Progress Toward Closing the Achievement Gap

Progress toward closing the achievement gap in math and science is measured by the outcomes of standardized normed test scores. Three different assessments which tests in the areas of science indicated that boys continue to outscore girls in science. The National Assessment of Educational Progress (NAEP), the American College Testing program (ACT), and the Trends in International Mathematics and Science Study (Martin, Mullis, Gonzalez, & Chrostowski, 2004) found gaps between genders in science.

The NAEP tests in the area of science periodically. The latest NAEP results (2000) indicated a gap that has widened between 1996 and 2000. The 2005 results will become available in the summer of 2006.

| Table 1: NAEP score gap points in science results between males and females |
|------------------|---|---|
|                  | 1996 | 2000 |
| Grade 4*         | 2    | 5    |
| Grade 8*         | 2    | 7    |
| Grade 12         | 5    | 3    |

*Significantly different from 2000. (nces.gov/nationsreportcard)

Table 1 indicates the gap between male and female scores has widened significantly in grades four and eight, and although there was a difference in the grade 12
scores, the widening of difference was not significant. Although several interventions have been tried in the formal school setting such as non-gender biased textbooks, girls continue to score lower than boys on science. Instruction and access to science for girls needs to change if the gap is to narrow and eventually close. The NAEP test data was comparable to the ACT data from 2004.

The ACT tests are required or preferred by more colleges and universities than any other college entrance exam. According to ACT, the test is designed to measure critical reasoning and higher order thinking skills in four curriculum areas: English, mathematics, reading, and science. The composite score is an average of the scores on each of the components on a scale from 1 to 36, with a mean of 18 for the sample of students who take the test nationally. Table 2 demonstrates the overall score differences between girls and boys as demonstrated on the ACT.

Table 2: Composite score differences between girls and boys as demonstrated on the ACT

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<td>Males</td>
<td>20.9</td>
<td>21.0</td>
<td>21.0</td>
<td>21.1</td>
<td>21.2</td>
<td>21.1</td>
<td>21.2</td>
<td>21.1</td>
<td>20.9</td>
<td>20.9</td>
<td>21.0</td>
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<tr>
<td>Females</td>
<td>20.7</td>
<td>20.7</td>
<td>20.8</td>
<td>20.8</td>
<td>20.9</td>
<td>20.9</td>
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<td>20.9</td>
<td>20.7</td>
<td>20.7</td>
<td>20.9</td>
</tr>
</tbody>
</table>

According to ACT, composite scores must be different by more than 0.2 points to be significant at the 95 percent level of confidence. As the above table indicates males scored higher than females from 1994 to 2004 with at least a 0.2 score difference. The 2004 national ACT scores (ACT, 2004) indicated that males out-scored females in
science and math, and females outscored males in reading and English. The national overall composite score of both genders, for all four curriculum areas tested, remained the same from 2002 to 2003, even though there was a record number of test-takers. Fewer students from both genders are currently taking challenging high school courses in math and science, and girls are less likely to take higher level of science classes, (ACT, 2004). The 2003 results from the Trends in International Mathematics and Science Study (TIMSS) assessment gender differences favoring boys in overall eighth grade science scores. Table 3 displays the United States average scale scores for the three strands of science by gender.

<table>
<thead>
<tr>
<th>Life Science</th>
<th>Chemistry</th>
<th>Physics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>540</td>
<td>519</td>
</tr>
<tr>
<td>Females</td>
<td>534</td>
<td>506</td>
</tr>
</tbody>
</table>

The TIMSS assessment is given in 49 countries and in 34 countries the boys outscored females in the areas of physics and chemistry with the United States as no exception. The United States boys’ outperformed girls in all three of the content areas in 2003, with the largest score differences in physics and chemistry. Girls have historically scored lower in chemistry and physics on the TIMSS assessment, however in 15 countries girls score on an equitable level as the boys.

As evidenced by three different normed tests, boys still out perform girls in science. These differences become even more noticeable in physics and chemistry.
Eighth grade girls are the most likely to not score as well as their male peers. Therefore, interventions must take place before girls enter the junior high years. Waiting for girls to enter high school or college before encouraging them to seek STEM careers may be too late for many girls. Agencies, such as the Girl Scouts, serve the needs of girls and may be able to help close the achievement gap.

Girl Scouts of the USA Promote Science Education

All girl organizations such as the Girl Scouts, have provided science experiences for girls outside of the school day in order to attempt to close the achievement gap. Up until recently, public schools did not offer single sex classes due to Title IX written in 1975. Title IX did allow for the establishment of single-sex schools and classrooms as long as comparable education opportunities are created for the excluded sex. These classes could be created to remedy past discrimination to allow girls and women to overcome historical barriers to equal education. However, these opportunities for girls were rare and only recently are more schools considering offering all girls science classes and all boys literature classes. Limited education funds can be used to establish single sex classrooms as long as the programs are in compliance with Title IX and civil rights laws. Most schools do not offer the courses and therefore other options must be explored.

Small studies and research papers have been written on the success of some of the Girl Scout council’s interventions such as the Mathematics Day held at Indiana State University (Raymond & Raymond, 1998). Short-term effects have been noted on survey instruments taken after the mathematics day finished. Girls generally felt more confident
in their mathematical abilities and reasoning skills. This particular math experience was held for elementary age students, and groups of girls rotated through math stations. The girls did not feel inhibited to participate unless there was parental interference. Parental interference resulted in girls feeling uneasy about their answers, and the girls became more inhibited with parents present. The overall outcome, however, was very positive toward increasing girls’ self-efficacy in their mathematical abilities.

Local councils throughout the United States have had similar success stories (Schriver, Strickland & Wolfe, 1995; US Dept. of Education, 2001). However, the emphasis of encouraging girls to pursue math, science, and technology activities in and out of school is not a new concept to the Girl Scouts. Various programs and partnerships such as “The Girls at The Center” in the early 1990s focused on offering science experiences to girls at science museums. Bridging the Gap in 1998 purchased science kits for Girl Scout groups and was initially funded through a National Science Foundation partnership with the Hornets’ Nest Girl Scout Council. Intel’s partnership of “Play Fair” and the Lockheed partnership provided funds to the national organization and to local councils to provide math, science, and technology opportunities to girls throughout the United States. Initiatives of this type led to the union between GSUSA and NASA.

NASA Promotes Science Education for Women

The NASA and GSUSA had its formal beginnings in 1999 through an informal relationship with the Solar Science Mission Directorate Education and Public Outreach Support Network at JPL. Prior to 1999 several NASA centers worked with nearby local
councils to provide some science programming. During the time span of 1999 and 2001, the national component of Girl Scouts began a discussion with NASA that would lead eventually to a formalized relationship. In 2001, a solar system camp session was piloted at a council operated camp. In April 2002, the first workshop on solar system was given to 30 trainers. This group of trainers received three week long workshops. A second cadre of trainers received training in December 2004. Both groups of women trainers were empowered to provide NASA science activities and experiences to girls throughout the USA. These activities often happened at camps, but were not limited to camps. The settings for these activities included troop meetings, council-wide events, nationally sponsored events, and inter-council events. The training provided for the first cadre of adults took place on three different occasions, each time building the participants’ content knowledge while providing “hands-on” activities for the different ages of girl members. Besides the training cadres, GSUSA and NASA planned “Destinations” for older girls. “Destinations” are travel/learning opportunities with a particular theme that are enjoyed by a smaller percentage of the older girls. NASA in partnership with GSUSA and the council in Hawaii planned a “Destination” for July 2005, with another “Destination” planned to occur in Arizona. These experiences coupled with the relationship between the two considerable organizations are evaluated to determine if and why the relationship is productive, sustainable, and if it can be duplicated.
After-school Science Programs

The purpose of this study was to examine the Girl Scout culture and goals, the NASA culture and goals, and the relationship between the two organizations. An all female setting outside of the regular classroom may provide quality science experiences in which girls can gain confidence in their science abilities. Previous research of informal educational settings such as the Girl Scouts has determined that many students cite these experiences as powerful means in which they gained a large amount of knowledge and were able to make personal decisions about various issues (Howe & Disinger, 1988). One reason that these programs are successful is that the instruction is more “hands-on,” relevant, and engaging to the students. Real-life scenarios, field trips, problem-posing type inquires are examples of the instructional practices that are used in the informal classroom setting versus the typical classroom with a textbook and lecture format.

Conceptual Framework and Research Design

The conceptual framework of this study interweaves a research design with the concept of girl’s belief systems related to science. The research design of this study combines an ethnographic perspective, using an feminist epistemology lens to examine the stories of the Girl Scout volunteer participants, how their own belief systems changed in relation to science, and their perspective on the relationship between the Girl Scouts and NASA. The Girl Scout volunteers are the key players in bringing the science back to their local councils. Epistemology is the study of knowing, and how people come to understand what they know (Johnson, 1995). Female epistemology considers the
individual gender of the participant as a culture filter through which each person sieves their experiences. The participants in this study are Girl Scout volunteers, and women scientists who are involved with the content delivery of the science information to the adult women volunteers. Their emotions, change of beliefs about science, and the impact of the partnership on the individual volunteers was examined as part of this study. A feminist epistemology contains the emotions, feelings, and real-life experiences of the women who have helped shape the science experience for girls at both national and local council levels. Harding (1991) wrote that feminist epistemology allows for the viewpoint of women without male bias. Women agents of knowledge or women as “knowers” provide perspectives to this research that lacks the male bias. Both the female researcher, and the many of the participants in the study, spoke with a feminist voice, which brings to light the beliefs and actions of the Girl Scout movement. Harding (1991) referred to women researchers in gender studies as “outsiders within.” Collins (1990) described this type of research as a feminist standpoint theory. Standpoint theory explains contributions made by a group of whom the researcher is a member. A standpoint theorist believes that a culture’s beliefs and knowledge are socially situated. The distinctive resources used in this type of qualitative research allow for more accurate descriptions of the culture and provides for richer explanations. Guba (1990) stated that the researcher’s epistemological premise is based upon a set of beliefs that guides action. The feminist paradigm has criteria of lived experience, dialogue, caring, gender, race, emotion, and concrete grounding (Denzin & Lincoln, 1998).

As a member of the Girl Scout organization for the past 40 years, this researcher is a situated knower. A situated knower in feminist epistemology is one who is immersed
in the situation (Anderson, 2004). As one of the original Girl Scout volunteers trained in 2002 by NASA, the researcher has been immersed in the culture that has formed as a result of the partnership between NASA and GSUSA. As an adult volunteer the researcher served in many roles including a troop leader, trainer, council staff member, camp director, and national volunteer. As a national volunteer, the researcher has provided other science trainings for adult volunteers at the national training center in the early 1990s and has witnessed the development of several science initiatives. Some of these have been funded by the National Science Foundation. The knowledge of the Girl Scout movement, its core values, and knowledge of its roots provided the researcher a valuable insight into the science programs offered by the Girl Scouts. This is very similar to what Spradley (1980) would define as a participant observer.

Based in ethnography, this study utilized interviews, documents, and included the voices of people who were being studied (Straus and Corbin, 1990). Patterns of beliefs, attitudes, and actions were dimensions of this study. Spradley (1980) defined the study of culture through three aspects of the human experience; cultural behavior, cultural knowledge, and cultural artifacts. Comparisons as well as the use of matrixes identified levels of interactions between groups and plausible relationships within the data. This researcher was the primary person collecting, sorting, categorizing, and analyzing the data. As in this research, the ethnography reflected upon real-life situations, culture, and in this case the relationship between NASA and the Girl Scouts of the USA.
Research Questions

The following research questions were designed to illuminate how the partnership between GSUSA and NASA evolved and how it addressed the issues raised in the foregoing discussion.

1. What are the key components of GSUSA and NASA’s support for science programs for girls, and how has this support evolved over the past five years?

2. What are the values and belief systems held by GSUSA and NASA that underpin the development of a successful science education program for girls?

3. What evaluation components exist and how do these support the relationship between GSUSA and NASA in providing science education programs for girls?

Analysis of the ethnographic data was based on interviews with NASA and GSUSA staff members who have been instrumental in the development of the relationship and development of the partnership which led to a formal Memorandum of Understanding. The Memorandum of Understanding was also analyzed. Interviews were conducted with the GSUSA research team, and the NASA team to ascertain the ways in which the relationship was evaluated from both perspectives. The Girl Scout trainers were interviewed to determine how they had taken the NASA activities back to the girls. Domain analysis was utilized to determine cultural patterns in the data from
the interviews, and artifacts. The embedded data were scrutinized to determine cover terms for each domain.

Definitions

*Council* refers to a local chartered Girl Scout organization that has geographical boundaries. Councils govern themselves but must adhere to national standards in regards to finances, program, and membership. There are 315 councils in the United States.

*Destination* is an event that is nationally available to girls across the country and often open to international Girl Guides. Destinations are often hosted by councils that have available resources to create a learning experience or theme. These events were formally known as wider opportunities.

*JPL* refers to the NASA entity of the Jet Propulsion Lab located in Pasadena, California.

*NASA Explorer Institute (NEI)* is a granting entity within NASA that supported at least two of the Girl Scout trainings.

*National GSUSA* refers to the national organization of the Girl Scouts of the USA. The national organization employs a number of staff members who focus on membership, program, and financial development. The national organization through its volunteer national board of directors bestows charters to the local 315 councils. Councils receive charters based upon a three year evaluation cycle that analyzes girl and adult membership, adherence to Girl Scout program, and sustained financial support.

*Partnerships* refer to any organization that has joined with either the local council or national organization to help provide science program to girls. Partnerships can be purely
a funding source (such as a grant from AAUW), or they can be a combination of funding and personnel such as partnerships with NASA.

*STEM* refers to science, technology, engineering, and math careers.

**Summary**

This chapter introduced the focus of this study which was the NASA and GSUSA partnership and their joint goal of encouraging girls to consider STEM careers. An ethnographic perspective using a feminist epistemology lens to view women and girls’ beliefs related to science, was the conceptual framework of this study. The Girl Scout volunteers’ evolving stories as they became more engaged with science was introduced as a considerable source of data and analysis. This chapter provided a background and rationale for the study, the research focus, an introduction to the various influences that affect girls’ achievement in science, progress made in closing the achievement gap, commonalities of how NASA and the Girl Scouts have encouraged girls to consider STEM careers, and how after-school science programs for girls was a potential way to positively impact the way girls’ perceive science.

Chapter Two provides the literature review that includes not only examples of previous papers written about Girl Scouts and science activities, but also the multiple reasons why girls have not pursued science careers and higher level classes in science. Chapter Three focuses on the research methodology using a ethnographic approach with the lens of a feminist epistemology. Chapter Four presents the data, the domains, taxonomies and information gleamed from documents and interviews. Chapter Five reflects conclusions based on the data, implications and offers recommendations.
CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter addresses girls' consistent lower test scores in science, the reasons why girls have not chosen science as a career, girls' science experiences in school, the masculine image of science, societal, parental and cultural influences on girls' decisions to pursue science careers, same gender settings for science, and how after-school programs have an affect on student achievement.

The topic of gender equity in science education and the reason why girls do not choose science as a career has been the focus for several studies over the past 20 plus years. In 1992, the American Association of University Women (AAUW) published a now highly cited report that raised a national level of concern regarding girls' abilities in science and girls' perceptions of science. Girls' perceptions of science along with their classroom experiences greatly determine the girls' willingness to participate in physics and chemistry and even ultimately pursue science as a career. Other factors that play a vital role in girls' decisions to pursue science include: deflated test scores in science, socio-economics, ethnicity/cultural norms, parents' beliefs and attitudes about science, media bombardment of girls' roles in society, and the perceived masculinity of science.
Test Scores

In 1988, students in the United States scored well below the mean in an international assessment of science achievement (Lapointe, Mead, & Phillips, 1989). Females and non-white students scored even lower. Test scores reported on the National Assessment of Educational Progress (NAEP, 1992, 1998, 2001) indicated that although the gap has narrowed, girls’ test scores in the areas of science are much lower than the scores of boys. And although the gap has narrowed as indicated on the NAEP tests, the numbers of girls entering higher level of science courses or entering a science related career is about the same. Boys may have the advantage of having out of school science experiences, but for the most part girls do not have these experiences. These experiences may lead to some of the discrepancy in test scores between girls and boys, especially in the areas of physics and chemistry.

The NAEP conducts assessments in science in four content areas: Life Science, Physical Science, Earth and Space Science, and the Nature of Science. In the Life Science area, girls and boys showed improvement at the same rate until the age of 17, when the boys show an increase in improvement in science over girls. In Physical Science, at the age of 17, boys jump ahead of the girls by nearly 15 points in mean proficiency scores. Any difference beyond 3 points is considered statistically significant. The disparity also is evident in the 9-year-old bracket in physical science, as boys increased beyond the girls’ improvement by 6 points. In Earth and Space Sciences, males again outscored girls at the ages of 9 and 17. However, in the Nature of Science category, girls outscored their male counterparts by at least 5 points at all three age levels. The typical pattern suggested that boys perform better in physics, and in the area
of biological sciences the scores were different by only a narrow margin especially at the younger age levels (Bruschi & Anderson, 1994).

Klein (1989) reported the results of the National Assessment Test, the Minnesota Assessment Test, and the British Columbia Test was comparable to the NAEP results. These tests indicated that girls in grades four, eight, and eleven had less direct experience with materials. These materials are those that strengthen students' spatial abilities such as mechanical toys, puzzles, and problem-solving computer games. Boys outscore girls in spatial abilities at all age levels; however, the large disparity occurs at the eighth grade and continues through high school.

The test results show that girls are not succeeding at the same level as the boys, but the reason is not due to cognitive abilities. Tests such as the IQ test do not indicate that there should be a large difference in girls and boys ability to learn science. The achievement test scores such as those as the NAEP scores, measures the success of boys and girls learning science, but do not disclose how girls and boys differ in their approaches to solving science problems (Levin, Sabar, & Libman, 1991). There may be a causal relationship between the ways girls are treated by teachers in the science classroom and student achievement. Teachers may see science as a masculine avenue and not necessarily important for girls. If the teachers have a gender bias in their perceptions of the scientific abilities of their students, it may influence the teachers' pedagogy and sends a negative message about science to girls. The teachers' perceptions may cause the teachers to employ different methodology that can lead to deflated test scores.
Classroom Experiences, Materials, and Teachers’ Perceptions

A number of studies have indicated teachers treat girls differently than boys in science classes beginning in elementary school and this treatment continues through college (Jones and Wheatly, 1990). Questions, which require higher levels of thinking, are more often asked of boys rather than girls (Smith & Farina, 1984). Teacher pedagogy and classroom structures have been scrutinized to determine if the treatment of boys and girls in classroom has become more balanced (Meyer, 1998). Meyer suggested that teachers should utilize a student-engaged pedagogy to help create the gender equity and a balance in the classroom. The engaged pedagogy included collective efforts among students, active participation, and numerous opportunities to make connections to life experiences. Meyers discussed that in order to effectively teach all students, a teacher must face their own bias. The author suggested several examples from a personal teaching experience, which included adjusting the verbiage on the physics college course syllabus to words that held more meaning for the students. Real life experiences were connected to the concepts taught in the course. The classroom experiences were meaningful and applicable to everyday life. The environment that was established was inclusive and invited risk from the students. However, the author noted, there were other obstacles in the way of creating an equitable classroom. These obstacles included both boys’ and girls’ perceptions of science, equitable science materials, and a prevailing culture that does not encourage girls to take risks.

Gender differences in the desire to learn science are complex. Meece and Jones (1996) found that girls as young as third grade reported less confidence in their ability to
learn science as compared to other subjects such as reading. However, the research also indicated that third graders had the same desire to learn science regardless of gender. The girls desired to learn science but had less confidence in their ability to learn science. The lack of science efficacy prevails throughout the course of girls' school-age years and often beyond the college years.

The interactions between teachers and students are different in the classroom depending on the subject taught and the gender of the students. Girls received more attention during literacy lessons while boys receive more attention in science and math (AAUW, 1992). Girls were focused on pleasing the teacher, while boys resisted the teacher when asked to put away materials. Boys often would continue to manipulate the equipment while the girls were busy cleaning up after an experiment. The extra time with equipment and materials did seem to give the boys some advantage of learning the science concept (Meece & Jones, 1996). Additionally, boys who were behavior problems, and boys who academically performed well in class received the most attention from the teacher (Sadker & Sadker, 1994).

Both boys and girls show a preference in learning in small cooperative groups versus whole class atmospheres. Previous research in this area indicated that girls might be rote learners. Meece and Jones (1996) could not find evidence to support these findings. Kahle and Damnjanovic (1994) concluded that an inquiry approach to science would diminish the gap between girls and boys in their attitudes about science. They concluded that active participation increased students' enjoyment, confidence, and ease in performing physical science activities. Girls reported that after the inquiry experience, they understood more about a concept such as electricity and liked learning about it.
Prior to the inquiry experience, girls did not feel confident in their ability to understand electricity and did not feel they would enjoy the experience. In contrast, boys felt both confident and eager to work with electricity. The responses from boys and girls were very similar after the experience, with both groups reporting that they felt confident and enjoyed learning about electricity.

Most researchers agree that science should be an inquiry approach with hands-on learning since both girls and boys preferred this type of learning environment. One study, (Meece & Jones, 1996) indicated that boys seem to fare well whether in lecture or in hands-on classrooms. Girls, on the other hand, do not do well in pure lecture formats, especially if boys are present. Teachers often instruct their students in the same manner in which they were taught. Most teachers were instructed in a lecture format; therefore, they use the lecture format to teach. Even though research indicates that an inquiry method is effective in meeting girls' learning needs, a lecture method heavily driven by the use of the textbook, may be the reality in the classroom. In order for this to change, teachers will need to shift their paradigms and pedagogical beliefs about science education.

Unfortunately, classrooms tend to fail in providing environments that are conducive to girls learning science. Boys are encouraged to think on a deeper level, while girls are allowed to give-up when the questions get tough (Baker & Leary, 1995). Perceptions that the teachers hold about their students may influence how a teacher interacts with their students and assigns or not assigns various responsibilities within the science classroom. If elementary teachers perceive girls lacking in scientific ability as a cognitive process, then teachers are more likely to assign tasks and responsibilities during
science class that are passive. Teachers, who believe that boys have more cognitive abilities, ask boys to participate in demonstrations and assist in experiments. Additionally, teachers utilize different questioning strategies for boys. Girls are more often asked process-related questions that require the stating of procedures and observations. Boys are asked higher-level questions that require interpreting, and explanation of results (Shepardson & Pizzini, 1991; Smith & Farina, 1984). As a result of her study, Greenfield (1997) suggested that girls need hands-on lab work combined with structured collaborative learning. She found this to be true especially at the elementary level. She further suggested girls should become visible in the classroom in non-passive roles. Klein (1989) suggested that besides providing more hands-on activities to girls, same-sex schooling should be considered for science and math courses. Both genders would receive the same content but would be segregated from each other. This would possibly alleviate the pressures girls face in science class.

The gender of the students is not the only problem in elementary science education. Teaching the science content becomes a large issue for elementary teachers, who are mostly female, and who do not feel comfortable with science topics. Many elementary teachers are faced with the dilemma that they are not adequately trained to teach science. Elementary teachers may also not perceive science as important for their students. After all, they argue, one must teach a child how to read, write, and calculate before they can understand science. Other reasons for not teaching science include the lack of materials, the lack of time in the instructional day for science, and the high-stakes tests that do not test in the area of science.
Since many elementary teachers are females, they may not have received a solid science education in their formative years. As a teacher, they may have taken one or two science content courses with a science methods course in their preparation to become a teacher. The format of the content courses was most likely a lecture format. The science methods courses offered in many institutions are not inquiry-based but are also lecture format. Science methods courses should practice the use of inquiry and develop positive attitudes about teaching science (Ginns & Foster, 1983). McDevitt, Heikkinen, Alcorn, D’Ambrosio, and Gardner (1993) offered several suggestions based on their evaluation of the preparation of elementary teachers in science and mathematics. First, they proposed the enlistment of experienced elementary teachers to redesign the content and methods courses taken by pre-service teachers. These courses should include the use of inquiry. Second, pre-service teachers also need to learn how to create science experiences that relates to the students’ previous understandings and interests. Third, pre-service teachers should be encouraged to develop cohorts and develop a sequence of courses. Finally, they must address the needs of all learners and minimize the barriers that the students might encounter.

Minimizing barriers includes being gender sensitive. Ironically, many methods courses in science do not have a gender equity component. Discussions on gender equity tend to focus in the problems of equity and not on solutions. Science methods textbooks rarely address the issue. College professors’ responses on surveys indicated that they thought gender equity was important, but there was not time to learn about equity in a methods course. Other barriers to not teaching about equity were a lack of knowledge,
lack of resources, and the perception that gender equity was marginal topic (Campbell & Sanders, 1997).

Textbooks, classroom materials, science games and toys can lead to the disparity that exists between boys’ and girls’ achievement in science (Bazler & Simonis, 1991; Bianchini, 1993; Biraimah, 1989; Jones & Wheatley, 1988). Although most textbooks have become more equitable in their portrayal of women in science, the achievements of men are highlighted three times more often than women (Rosser, 1997). The language of textbooks is more gender neutral, and women are depicted in illustrations. However, men are depicted in action roles while women are more often illustrated in passive roles. Women may be mentioned in a margin highlight in the textbook, but men are mentioned in the actual text.

Masculinity of Science

According to Harding (1986), there is no other area in which women have been systematically excluded other than front time warfare which has only recently changed. The masculine image of science has been studied for over two decades. The masculine image of physical sciences began after World War I, when new national science organizations took the place of the women who dominated in the nature study of science. Women were becoming invisible in science, not only because men were ignoring them, but also because women were no longer interested in advancing the cause of science among girls (Tolley, 2003). Women were beginning to be viewed more as victims and thus needed to be taken care of by males. The new male leaders placed a greater emphasis of science in elementary education with textbooks that portrayed scientists as
male and engaged in physical science studies (Tolley, 2003). Women could hold auxiliary positions in science such as high school science teachers, assistants, technicians, or editors for science journals (Rossiter, 1982). At the same time, women wanted to elevate their status and social standing of women’s work in the house. By the end of the World War II, women stepped down from positions to provide jobs for the men returning home. Women left jobs at three times the rate that they were laid off because of the patriotism felt by the women. During the war, many of the women took positions outside of the home to assist with the war effort. With the end of the war, women felt once again that their duty was to give back the positions to the men. This was especially true for women who held jobs as electricians and engineers (viewed as male positions). The government also subsidized college education, which swelled the demographic numbers in a number of fields including science. In many cases, women could no longer take the courses in science and engineering in order to make space for the males enrolling in the classes. The managers of science, the decision-makers in science institutions, are usually male. Women often still work in subordinate positions under a patriarchal domination (Rose, 1983).

Today, the masculine image of science is perpetuated when boys receive preferential treatment over girls in the classroom. Science demonstrates its masculinity through language and methods. In science, sexism and racism are interlocking systems of dominations (hooks, 1990). Science reinforces the position of the dominant group. These values permeate the climate of the environment in which science is conducted (Jones, 1998). The prerequisite to learn science is to find out how scientists work (usually male), and how textbooks (written by males) explain it. Illustrations in
textbooks, along with portrayals of physicists in movies still depict white men. There is nothing feminine for girls to seek attachment. Science is steeped in masculinity thus limiting access and inclusiveness. Girls often associate math with science. Mathematics also has the stigma of being masculine (Rosser, 1997). Additionally, girls do not see real adult women role models engaged in science, especially in the physical sciences. For example, two popular science shows for children are: Bill Nye the Science Guy, and Mr. Wizard. Although the science presented is considered to be sound educationally, the two main characters are white men, who dress in lab coats, and who usually work within a lab. The shows often include girls as part of the children contingent on the program, but the main scientist is either Bill Nye or Mr. Wizard. These men perpetuate the masculinity of science and who is and who is not a scientist. One show that has a female main character is the Magic School Bus. In the cartoon show, Ms. Frizzle is a teacher of science. Although the show teaches basic science concepts, it does so in a way that is often magical and non-realistic. Media depictions, science stereotypes, and treatment in the classroom lead girls to perceive science as a spectator sport, and therefore, not for them. In order for this to change, women will need to form a critical mass, which has a voice in science and science teaching (Meyer, 1998).

Girls may be responsible for some of the problem. An important piece of research that needs further investigation is why girls become spectators in mixed classrooms even when the teacher employs cooperative learning, and inquiry-based learning. Why do girls defer to their male counterparts in science and math classes especially as they grow older? The feminists researchers contend that the oppression of women and the gender role expectation handed down through the past generations have
greatly affected how girls interact with boys in the classroom. The effect of gender stereotyping begins in early childhood and continues through a woman's life, which discourages girls from excelling in science. The roles that girls perceive they must play are in deference to boys and their terrain (Harding, 1986).

Societal and Cultural Influences

The low representation of women in science cannot be explained by a lack of interest, ability, or motivation since the research evidence does not support such theories. The myth of women historically not involved in science is a common one. However, women were educated in science and involved in scientific pursuits prior to the 20th century especially if they were from affluent homes. At the turn of the 20th century, women's opportunities were limited due to changing social expectations and beliefs about gender roles (Jeffe, 1995). Women do make the decisions about their life differently than men. This occurs because of the multiple life roles, self-identify, interactions with people, and experiences in the world (Baker & Leary, 1995). Women see their roles in terms of relationships: mothers, wives, lovers, and children. They do not necessarily identify with academic or professional success (Arnold, 1992).

Parents may be one of the biggest influences that deter girls from entering a science career (Klein, 1989). Parents express warmth and used emotional words more with their daughters while the boys were encouraged with activity and aggression. Risk is encouraged with boys, and safety is encouraged in girls (Sadker & Sadker, 1994). The very nature of science requires risk-taking behaviors. Science is the study of the unknown. This means that there may not be any one right answer to a science question.
Girls tend to like to please their parents and teachers. The wanting to please often influences how a girl will answer a question by not risking a potentially wrong answer. If a girl is unsure of an answer, she will refrain from answering the question.

When parents support their child's endeavor in science, then the girl's attitudes toward science are higher (Schräver, Strickland, & Wolfe, 1995). Parents either significantly discourage or encourage their daughters to do well in science. Parents are more likely to hold different expectations for their sons than for their daughters, thus stereotypes are perpetuated. Negative influences include expecting math and science to be difficult, discounting the importance of higher-level science courses; not providing access to home computers even if money is not the issue, and providing few opportunities for out-of-school science experiences. Adults' beliefs, aspirations, and expectations are considered important because they serve to influence the achievement and behaviors of children. (Parsons, Adler, & Kaczala, 1982). If parents believe that science is difficult or uninteresting, the child's achievement will be affected (Leung, 1990). In many cases, when a girl was headed toward a science career, the emotional response was very large. Girls with the strongest commitment to science are emotionally connected because of the influence of the parent or grandparent. The relationship between the parent and the child has a strong tie to a girl's self-efficacy in science. Girls do not separate their feelings between science and the relationship they have with their parents. For instance, in the study by Baker and Leary (1995), a girl was interested in science because her deceased mother was a scientist. Another girl had fond memories of her grandfather showing her the stars at night and therefore, the girl thought she might want to become an astronomer. These girls did not have exceptionally good or poor experiences with science in school.
The influence of the parent or grandparent was very strong. Parents and teachers are a part of a bigger society. Until parents and teachers see girls in active roles of science, they will not perceive science to be important for girls. Socioeconomic status including family income, father’s occupation, mother’s occupation, level of parents’ education, and household possessions also influences girls. Girls who are affluent are more likely to pursue higher-level courses in science and science related careers, but the advantage is relatively small (Baker, 1988).

Girls often picture themselves in traditional roles. When asked to draw a scientist, girls are more likely to draw boys. It is important to note here that girls, upon occasion, will draw a woman scientist, but boys only draw men as scientists. Boys have the image of only men as scientists, thus perpetuating the masculinity of science. Both boys and girls draw scientists in much the same way; mostly white, male, in the lab, and mostly benevolent (Chambers, 1983; Fort & Varney, 1989; Schibeci & Riley, 1986; Schibeci & Sorenson, 1983; Sumrall, 1995). Girls feel that both biological and physical sciences are interesting to study, but the physical science related careers are unrelated to girls’ concerns (Baker & Leary, 1995). Relationships that include caring, responsibility, and meeting affective needs provide the framework by which girls make decisions regarding science. Competition is not a favored forum by most girls. Girls prefer equitable situations, because equals are most likely to be friends. They prefer instruction that allows them to interact with each other rather than the textbook that isolates them from the rest of the group.

Levin, Sabar, and Libman (1991) found that the performance gap in science was largely due to the lower opportunity to learn. They felt that the girls had unequal science-
related experiences. They also attributed the difference in performance based on their evidence of cultural stereotyping of female roles and career orientation.

Peers do not seem to have a large influence on girls’ choices of science careers. Role models are scarce in science and are abundant in traditional female roles. The media and society at large do greatly influence girls’ decisions to not enter science as a career. Out of school and home experiences also influences girls’ decisions about science (Baker & Leary, 1995). If girls are exposed to activities, which promote science, they are more likely to enjoy science and have a positive attitude about science. These experiences may be included in all girls’ organizations, camps, informal educational groups, or clubs. However, boys are more likely to have out-of-school science experiences (Kahle & Damnjanovic, 1994). Girls lack positive experiences both in and out of the classroom compared to the experiences of boys. The lack of positive experiences, the pressure of society, parental expectations, and the masculine image of science begins to develop a belief system within the female culture. This belief system can be examined using the lens of a feminist epistemology.

Feminist Epistemology

Feminist epistemology is a method to value the feelings and emotions of a person or group within a cultural setting. This way of knowing includes understanding the language used to describe belief systems, feelings, and thought patterns (Brickhouse, 2001). By using a feminist epistemology lens, one can examine the beliefs that girls and adults have about science. Women are situated knowers in that they have lived through common experiences and can explain their understandings through language that is
familiar to all who have had similar experiences (Stoetzler & Yuval-Davis, 2002). The female experience can be explored at a particular historical moment or geographical site to identify interactive relations between people within the culture and cross-cultural relationships (Harding & Pribram, 2004). Scientific knowledge, like other forms of knowledge, is culturally situated and reflects the gender and racial ideologies of societies. Science cannot produce culture-free, gender-neutral knowledge because science is permeated with cultural meanings of gender. The defined values associated with masculinity (objectivity, reason, and mind) are the same values most closely aligned to science (Brickhouse, 2001). Based on the premise that girls identify science as a masculine image, perhaps girls should have an all female cultural settings in which to learn science.

Same-Sex Science Education as a Potential Solution

Gender equity in science is obviously not a simple problem with a simple solution. The complexities of this problem have been examined from every angle. Solutions often focus on addressing one part of the problem without considering the other factors. As stated before, there has been a small improvement in test scores, and overall girls’ interests in science (NAEP, 1998). However, other factors such as parental and societal influences continue to heavily influence girls’ decisions to enter science-related careers. Solutions to counteract the masculine image of science, and provide experiences comparable to boys’ experiences must be further researched. One possible solution is for more same-sex schools to lessen the competition between girls and boys. Same-sex schools have been illegal in the public education system and are decreasing in the private
sector. However, the findings are clear that girls achieve more especially in math and science in same-sex settings (Hollinger, 1993; Sadker & Sadker, 1994). Girls might do better, and be more interested in science if they were in same-sex settings, and for a while it looked as though the Title IX rules and regulations would hamper that from ever happening in the public school setting. However, in the No Child Left Behind Act of 2001, an amendment sponsored by Senators Kay Bailey Hutchinson (a Republican from Texas), and Hillary Clinton (a Democrat from New York), provided for single-sex schools and programs as one of the twenty-seven “Innovative Assistance Programs.” In the spring of 2002, the Department of Education announced they would bend the guidelines of Title IX to allow for single-sex education (Stabiner, 2002).

Boys tend to like a competitive atmosphere, where girls do not. The less competitive and more cooperative classroom climate of single-sex environments, coupled with an awareness of gender issues permits females to develop problem-solving skills, use higher level thinking skills, and increase their self-efficacy in math and physical sciences (AAUW, 1994). Data from the Women’s College Coalition (Sebrechts, 1995; Sharpe, 1995) indicated that women who attended all women’s’ colleges are one and a half times more likely to earn degrees in life and physical sciences than women in coeducational institutions. Liberal arts colleges are more likely to produce doctorates in sciences versus the larger state universities. For example, the private colleges of Mount Holyoke and Bryn Mawr rank in the top 5% of colleges graduating high numbers of women earning doctorates in chemistry, math and physical science. Gould (1995) concluded in a study of an all girl math setting that ingrained interaction patterns were difficult to alter even when teachers are aware of the problem. Her research suggested
that boys and girls have qualitatively different perceptions and experiences in school. These experiences are more advantageous to males. The recent attacks on Affirmative Action may render the impossibility of same-sex classrooms in the public school. However, the success of single-sex settings at the liberal arts colleges certainly challenges the coeducational institutions. More research is needed to determine the successful components of the single-sex environments and then determine if these factors could be implemented in the co-educational programs. Another consideration is to remember that although the number of women receiving doctorates in science is higher at all women’s colleges, there are fewer women’s colleges than co-educational colleges. Other variables should be factored in this equation as well. Outside influences such as parents’ perceptions and expectations will influence a girl’s decision to enter a science career. Mentors and role models are also very influential to girls and the decision to take higher levels of science and consider a science related career. If a larger number of girls in all women’s colleges had mentors/and or parents who had science expectations of their daughters, then the higher number may be attributed to those factors versus the same-sex setting of the college.

One important factor is the pedagogical practice in the classroom. Many students in an all female setting feel they have an advantage because they are players versus spectators (Sadker & Sadker, 1994). If girls are players, then they do not have to play the feminine role of deferring to boys. It is the hope that girls gain experience and self-efficacy in the area of science in same-sex settings, so that when they are in mixed settings they are able to rise above the gender stereotyping either imposed by others or by themselves.
Stabiner (2002) who is a mother and an investigative reporter conducted a qualitative study of two all-girl schools. She was concerned about her own daughter's education in a coed high school. She had also heard the stories that occurred in single-sex schools of eating disorders, single-minded academic competition, and an overly protective environment that did not prepare girls to meet the challenges of society as a whole. She studied two groups from two very different schools as they progressed through high school and then on to college. One group of girls was from an elite prep private school whose demographics indicated the students were from an affluent and very privileged background. The other school was for gifted girls in Harlem who came from impoverished backgrounds, and was a public school that existed in controversy. The girls in both schools received science in a cooperative and collaborative classroom. Girls had access to materials and were able to perform well on tests in all areas of science. Although the grades of the girls were similar, and in some cases, the grades were better in public schools, the girls from private, elite prep schools were immediately accepted to their colleges of choice. The girls who required financial aid to attend college were often deferred during their initial application. Some of the girls who went to the private school did not finish more than two years of college, and their families gave them lavish opportunities outside of school. The girls from the public school in Harlem eventually were accepted to college, but were not always accepted to their first choice. When interviewed, the girls from Harlem were still on track with their dreams and more determined than ever to finish college. When asked if the same-sex high school made a difference, they responded that the high school and the same-sex setting was the deciding factor of why they were successful in school. The classes were smaller, there were
mentors and role models, and they received individual attention. Schools, like the one in Harlem are rare, and due to budget restraints less school districts are likely to undertake initiatives such as same-sex classrooms.

Girl Scout Science Programs

With the decline of same-sex schools and battles whether same-sex schools are legal under Title IX and Affirmative Action, other options must be explored. Researchers have suggested after school programs that provide all-girl settings in which girls have equal opportunities to ask questions, receive feedback, and are encouraged to take risks (Davis, 1997). There is a glimmer of hope in the arena of providing quality out-of-school experiences for girls in an all girl setting. Outside agencies that provide informal educational opportunities such as the Girl Scouts of the USA, are providing girls science activities that include physics. These activities provide girls with the physical science experiences that they lack. The Girl Scouts and other agencies often provide an informal learning environment and seek out mentors and role models for girls in engineering and physics.

One partnership, funded by the National Science Foundation (NSF) is a program that partnered the Girl Scouts of the USA, and the Franklin Institute Science Museum in Philadelphia. The NSF grant paid for kits and leader training so that Girl Scout troops would have the necessary supplies to conduct scientific inquiry-based investigations. Evaluation results for this program were based on interviews, questionnaires, and observations by the researchers. One year after using the kits, a number of girls reported enjoying the hands-on activities and had participated in other Girl Scout sponsored
science activities since they had the initial experience with the Franklin Institute science materials. Girls believed the activities they did were different from school science because they had the opportunity to work together and the activities were hands-on. Most of the girls reported that their attitude toward science improved after their experiences with the kits and the activities. An important finding was that girls who had participated seven years earlier as a young Brownie Girl Scout (age 6-9) and were currently Cadette Girl Scouts (Middle School) remembered the activities in the kits, and several of the girls had returned to work with younger girls because they had found the kits to be interesting and fun (United States Department of Education, 2001).

Other entities have partnered with the Girl Scouts to provide science activities for girls in same-sex settings. The University of Michigan-Dearborn partnered with the Girl Scouts of Michigan Metro Council for day camps that were one week in duration beginning in 1991. The university professors provided the labs, and the site, while the Girl Scouts handled the registration and funding. The girls at the camp received hands-on activities throughout the week. One important outcome of this program is that girls connected with university professors and graduate students who became mentors for the girls (Benore-Parsons, Fisher & Heady, 1995). A similar program funded by the National Science Foundation partnered with the Girl Scouts of the San Antonio and the Edgewater School District in San Antonio. The project focused on Latina girls and the subject of aviation. Results were gathered quantitatively and qualitatively. The analysis indicated that there was a significant change in the girls’ science skills and knowledge, as well as their attitudes toward science, math, and careers in technology (Marshall & Buckingham, 1995). A Girl Scout science and math camp sponsored by Georgia Southern University
provided opportunities for girls to explore various types of science in 1994. The areas of science included anatomy, chemistry, botany, and zoology. Girls had favorable responses to the activities after experiencing the camp and were more positive about science, and wanted to return to camp again for more science. Schriver, Strickland, and Wolfe (1995) concluded that this experience was beneficial to the girls. Their research indicated the importance of out-of-class science experiences for girls, positive female role models, encouragement, and exposure to a wide range of math and science activities.

Other outreach programs have also found to be successful. Summer opportunities such as the one conducted by the physics department at the University of Maryland had promising results (Bardasis, 1995). Every summer 25 middle school girls attend a two-week hands-on course in physics. Girls must apply to the program and must have two references that speak to the girls’ general interest in inquiry but not necessarily an interest in science. As part of the evaluation of the program, participant notebooks are read and reviewed to determine the success of the program. The notebooks contain the girls’ observations as well as their thoughts and opinions of how the day progressed. Girls mentioned in their notebooks that they enjoyed meeting other girls who shared an interest in science. The girls created a comfort level with each other since they did not have to be aware of their femininity as compared to mixed settings. Many of the girls went on to take physics in high school, and although some still felt that physics was difficult, their self-efficacy was raised due to the summer program.

The Lake Tahoe Watershed Project based on the Sierra Nevada College was granted a two-year project through funds from the Department of Energy. This program focused on female middle school students who explored and investigated the watershed...
and the drainage area of Lake Tahoe, Nevada. The instructional strategies included self-pacing, small group discussions, and non-graded hands-on activities. The girls who participated connected with each other in the group, especially those of the same age and grade level. After the experience, most of the girls felt positive about what they had accomplished and learned at camp (Rohrer & Welsch, 1997).

The long-term effects of many of these programs have not been studied. Many of the Girl Scout Councils across the country have provided science activities for the past 20+ years. The national organization of Girl Scouts since its inception has offered girls non-traditional programs that have introduced girls to non-traditional female skills and occupations. Science and technology has not been an exception but rather the norm for Girl Scout program. Obviously, not all girls are Girl Scouts, and not all Girl Scouts have experienced the science programs offered by the various entities and Girl Scout councils. The problem with long-term effect studies is finding the past participants. In the national Girl Scout sponsored programs, several thousands of girls have participated, but the tracking of these girls over time has been too labor intensive and costly to follow. Therefore, it is impossible to retrieve data to determine if the girls took higher level of science courses in high school or college, and if they entered a science related career.

Discussion

Girls and boys need female role-models in science, they need mentors, and they need to feel free from the gender stereotyping that prevails in the classroom and society. One course of action is in same-sex settings whether that is during the public education instructional day, or in after-school programs. The classrooms need to be inquiry-based,
collaborative and cooperative in nature. Girls need access to female role models and mentors, and time to manipulate the science materials. The image of science also needs to change in the media, on toy packaging, and in our own expectations of girls. This complex issue does not have a single simple solution, and for the past 20 or more years the causes have been explored to the reasons why girls do not excel in science.
CHAPTER THREE

METHODOLOGY

The purpose of this ethnographic study was to investigate GSUSA and NASA's commitment to support science education for girls and the encouragement of girls to pursue STEM careers. An unique relationship between GSUSA and NASA was understood through examining the beliefs and values that unite the common purpose of encouraging girls to consider STEM careers. Interview transcriptions, key documents and evaluation components were studied to determine the shared authority and focus of science education programs for girls. Beyond the relationship between the two national organizations the changes of attitudes toward science by the adult women volunteers was also analyzed to determine if the partnership impacted the participants on a personal level.

This chapter begins with a description of the strategies used to investigate the relationship between GSUSA and NASA and describes the researcher's conceptual perspective of an ethnography using a lens of a feminist epistemology (Anderson, 2004; Brickhouse, 2001; Duran, 1991; Harding, 1991; Strauss & Corbin, 1990). The second section lists the procedures for data analysis, coding, and methods that validate the study (Spradley, 1980), and the third section identifies ethics, assumptions and limitations of this study.
Qualitative Design

The conceptual framework of this study was an ethnographic study using the lens a feminist epistemology that included the use of the stories of Girl Scout volunteers, Girl Scout staff, and NASA employees. These accounts added richness to the story that gave it more depth and understanding. An ethnography is a descriptive and interpretive study of a small group of people which includes the groups' beliefs and actions within their environment or culture (Carspecken, 1996; Emerson, Fretz, & Shaw; 1995; Denzin & Lincoln, 1998; Geertz, 1973). A feminist epistemology allows the researcher to examine the emotions, feelings, and real-life experiences of the women as they were engaged in science. Duran (1991) defines feminist epistemology as a female knower that is able to articulate the acquisition of knowledge from different perspectives, which include the female, as well as from another whose knowledge is assumed and not questioned. Guba (1990) states that the researcher's epistemological premise is based upon a set of beliefs that guides action. The feminist paradigm has criteria of lived experience, dialogue, caring, gender, race, emotion, and concrete grounding (Denzin & Lincoln, 1998). This methodology allowed for comparison between data sources such as the field notes, program materials and the outcomes of interviews (Merriam, 1998).

Research questions and data collection

The following questions are addressed by this study:

1. What are the key components of GSUSA and NASA's support for science programs for girls, and how has this support evolved over the past five years?
The data collection for this question included interviews with current GSUSA trainers, NASA staff members, and national Girl Scout staff members that have been directly responsible for overseeing these programs. The participation of this researcher allowed for a shared familiarity of the NASA workshops with the participants that allowed for a deeper understanding of the experiences. A researcher’s immersion into a situation can provide information that is more meaningful (Emerson, Fretz, & Shaw, 1995).

The data analysis included a timeline to show the phases of the interaction between the Girl Scouts and NASA. The timeline delineated the year in which significant events or meetings occurred and how events led to the next step in the evolution of the partnership, which ultimately led to the development of the formal Memorandum of Understanding between the Girl Scouts of the USA and NASA.

2. What are the values and belief systems held by GSUSA and NASA that underpin the development of a successful science education program for girls?

Strategic goals from both organizations were examined, and interviews with staff from both NASA and GSUSA were conducted to determine layers of the belief system. Interviews of volunteer Girl Scout trainers were conducted to determine if the goals of both organizations were being met and what barriers if any were present that hampered the meeting of those goals. Changes of attitudes toward science were examined as a means to determine the effectiveness of the partnership. The use of conditional matrixes, which employs overlapping sets of circles, was helpful in seeing the impact of the
partnership. Each circle represented a different layer of information from the farthest removed from the action to the immediate action (Denzin and Lincoln, 1998).

3. What evaluation components exist and how do these support the relationship between GSUSA and NASA in providing science education programs for girls?

GSUSA evaluated the effectiveness of the trainings provided to the volunteers and to a new set of volunteers. In addition, NASA has maintained a database of all NASA activities provided to girl members and other Girl Scout adults because of the efforts of the trainers. The database, the evaluation results, and interviews with the trainers were analyzed to determine if the evaluation components support the relationship between GSUSA and NASA.

Significance of the study

Questions related to this partnership sought to uncover the dynamic between the two organizations, the evolvement over time, duplication potential with other organizations, the goals of the relationship, and the impact of the partnership on the participants. Beyond the relationship itself, this research also unearthed the belief systems of both the organizations and the people within each organization as it pertained to girls entering STEM careers and engaging in science activities. New collaborations with both organizations could benefit from the knowledge base of this research and parallel research conducted by NASA or GSUSA. Data collection included interviews with key players from both organizations which led to the understanding of how the partnership was created, barriers encountered, and the lessons learned.
Data Collection

For each question, data were categorized into domains and sorted into tables, and figures. Table 4 outlines the type of data that were collected and the analysis used.

<table>
<thead>
<tr>
<th>Research Questions</th>
<th>Kind of Data collected</th>
<th>Process of Analysis</th>
<th>Literature</th>
<th>Time of Collection</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. What are the key components of GSUSA and NASA's support for science programs for girls, and how has this support evolved over the past five years?</td>
<td>Participant interviews with GSUSA staff and volunteers, NASA staff. Science materials given to Girl Scouts from NASA. MOU between GSUSA and NASA.</td>
<td>Domain analysis Semi-formal interview notes Conditional matrixes</td>
<td>Spradley Emerson, Fritz, and Shaw</td>
<td>August 2005-December 2005</td>
</tr>
<tr>
<td>2. What are the values and belief systems held by GSUSA and NASA that underpin the development of a successful science education program for girls?</td>
<td>GSUSA program goals NASA mission goals Interviews with GSUSA volunteers and staff, NASA staff.</td>
<td>Domain analysis Semi-formal interview notes</td>
<td>Spradley Emerson, Fritz, and Shaw</td>
<td>August 2005-December 2005</td>
</tr>
<tr>
<td>3. What evaluation components exist and how do these support the relationship between GSUSA and NASA in providing science education programs for girls?</td>
<td>Copies of evaluations, Interviews with GSUSA staff members, NASA staff. Data base of activities</td>
<td>Domain analysis</td>
<td>Denizen and Lincoln Spradley</td>
<td>August 2005-December 2005</td>
</tr>
</tbody>
</table>
For the three research questions, a domain analysis was utilized to identify types of roles, interactions, characteristics, programs, and artifacts. According to Spradley (1980), an analysis is the search for patterns in behavior, artifacts, and the knowledge that people have learned or created. Domains were created to determine categories or broad headings. Examples of domain covers constructed were: kind of attitude, kind of barrier or kind of experience. Interviews were conducted that led to creating a taxonomy of the domains. A taxonomy allowed for another layer of analysis of patterns within a culture. In this case, the study of two cultures, Girl Scouts of the USA and NASA are vital to understanding how the inter-relationship developed over time.

A pilot study was conducted in November 2005 to determine if the semi-formal questions developed would engage the participants into a more in-depth conversation. Three of the Girl Scout volunteers were interviewed to determine if the semi-formal questions (Appendix A) led to in-depth conversations. One question was altered as a result from the pilot study. The original question of “What do you think your organization has learned from this experience?” was too general. The Girl Scout volunteers do not interact with the national Girl Scout organization on a regular basis and understood the question to mean at the national level. All three of the participants in the pilot study stated that they did not have enough information about the national level to address the question, but all three did offer how the partnership had impacted their individual councils. The question was changed to then ask how had the partnership had impacted them as individuals and their council or other councils in which they volunteer (Appendix B).
Interview data collection began in December 2005, with Girl Scout volunteers, national GSUSA staff members, and with NASA staff (Appendix C). The participants in this study live throughout the United States and are rarely at the same place at the same time. Therefore, long distance phone calls were utilized to make contact. After the interviews were transcribed, notes were coded and sorted into different categories. Interview questions were directly linked to the research questions. Some interview questions provided data for more than one research question. Table 5 reflects the relationship between the interview question and the research questions.

<table>
<thead>
<tr>
<th>Research Question #1</th>
<th>Research Question #2</th>
<th>Research Question #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the key components of GSUSA and NASA's support for science programs for girls, and how has this support evolved over the past five years?</td>
<td>What are the values and belief systems held by GSUSA and NASA that underpin the development of a successful science education program for girls?</td>
<td>What evaluation components exist and how do these support the relationship between GSUSA and NASA in providing science education programs for girls?</td>
</tr>
<tr>
<td><strong>Interview Question</strong></td>
<td><strong>Interview Question</strong></td>
<td><strong>Interview Question</strong></td>
</tr>
<tr>
<td>How did you become involved with the Girl Scout/NASA partnership?</td>
<td>What have been your observations of the collaboration between NASA and GSUSA?</td>
<td>What have been your observations of the collaboration between NASA and GSUSA?</td>
</tr>
<tr>
<td><strong>Interview Question</strong></td>
<td><strong>Interview Question</strong></td>
<td><strong>Interview Question</strong></td>
</tr>
<tr>
<td>What have been your observations of the collaboration between NASA and GSUSA?</td>
<td>What do you think your council or any council you work with has learned from this experience?</td>
<td>What do you think your council or any council you work with has learned from this experience?</td>
</tr>
<tr>
<td><strong>Interview Question</strong></td>
<td><strong>Interview Question</strong></td>
<td><strong>Interview Question</strong></td>
</tr>
<tr>
<td>How does or has the collaboration benefited your organization's goals?</td>
<td>How does or has the collaboration benefited your organization's goals?</td>
<td>How does or has the collaboration benefited your organization's goals?</td>
</tr>
<tr>
<td><strong>Interview Question</strong></td>
<td><strong>Interview Question</strong></td>
<td><strong>Interview Question</strong></td>
</tr>
<tr>
<td>Walk me through the time line of the development of the MOU. What obstacles or barriers did you face from either organization?</td>
<td>What would you like to say to the other organization?</td>
<td>Walk me through the time line of the development of the MOU. What obstacles or barriers did you face from either organization?</td>
</tr>
<tr>
<td><strong>Interview Question</strong></td>
<td><strong>Interview Question</strong></td>
<td><strong>Interview Question</strong></td>
</tr>
<tr>
<td>What has been your experience with this collaboration?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A componential analysis was utilized to find contrasts in the data, patterns, and to verify the information gathered through observations and interviews (Spradley, 1980). A componential analysis searches for the attributes within each domain. The use of a componential analysis identified the kinds of information or data needed or missing from each domain. Follow up interviews or reviewing documents such as the MOU provided information needed to complete the analysis of the interactions between the Girl Scouts of the USA and NASA.

Criteria for selecting data

For the purpose of this study, artifacts selected were physical documents such as the MOU between the Girl Scouts of the USA and NASA, NASA science program materials, evaluation forms from the trainings given to the GSUSA volunteers, and entries from the Girl Scout volunteers into the database maintained by NASA. These artifacts provided data to support the statements made in the interviews by the participants. GSUSA trainers shared in the interviews their experiences with giving NASA themed events for their councils. The interview notes were compared with the data base notes that included numbers at each event and other anecdotal evidence that the volunteer submitted.

NASA publishes many educational resources for classroom use, but only those that have been directly introduced to the Girl Scout volunteers were examined. These materials were designated for particular grade levels, which translated to program levels within the Girl Scouts. For example, materials written for grades 4-6 were appropriate for Junior Age girls. Materials for high school students were appropriate for Senior
Scouts or Studio 2B girls. However, many of the volunteers stated that they adapted the materials to be more “leader friendly.” When this occurred the researcher asked for samples of the adaptations and made a comparison between the adapted materials and the original NASA documents.

The sources of information for this study included the volunteers in different councils who are currently engaged in providing science activities using the NASA materials. The following table depicts the Girl Scout volunteer group that was selected from the 30 potential Girl Scout volunteer participants. All 30 of the volunteers had returned the signed permission for inclusion in this study, but due to time restraints only 9 of the 30 volunteers were selected at random.

Table 6: Demographic table of Girl Scout volunteer participants

<table>
<thead>
<tr>
<th>Participant</th>
<th>Race</th>
<th>Age</th>
<th>Region</th>
<th>Positions in Girl Scouting</th>
<th>College degree</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>White</td>
<td>58</td>
<td>West</td>
<td>Leader, trainer, staff</td>
<td>no</td>
<td>Local council staff</td>
</tr>
<tr>
<td>B</td>
<td>White</td>
<td>43</td>
<td>East</td>
<td>Leader, trainer, staff</td>
<td>yes</td>
<td>Part-time Girl Scout staff</td>
</tr>
<tr>
<td>C</td>
<td>White</td>
<td>55</td>
<td>West</td>
<td>Leader, trainer</td>
<td>yes</td>
<td>Computer programmer</td>
</tr>
<tr>
<td>D</td>
<td>White</td>
<td>35</td>
<td>Midwest</td>
<td>Leader, trainer</td>
<td>no</td>
<td>Homemaker</td>
</tr>
<tr>
<td>E</td>
<td>White</td>
<td>53</td>
<td>Mid west</td>
<td>Leader, trainer</td>
<td>yes</td>
<td>Librarian</td>
</tr>
<tr>
<td>F</td>
<td>White</td>
<td>50</td>
<td>Mid west</td>
<td>Leader, trainer</td>
<td>no</td>
<td>Preschool teacher</td>
</tr>
<tr>
<td>G</td>
<td>White</td>
<td>45</td>
<td>Midwest</td>
<td>Leader, trainer, camp staff</td>
<td>yes</td>
<td>Science teacher</td>
</tr>
<tr>
<td>H</td>
<td>White</td>
<td>25</td>
<td>West</td>
<td>Leader, trainer</td>
<td>yes</td>
<td>Linguist</td>
</tr>
<tr>
<td>I</td>
<td>White</td>
<td>52</td>
<td>Midwest</td>
<td>Leader, trainer</td>
<td>yes</td>
<td>Science teacher</td>
</tr>
</tbody>
</table>
The Girl Scout volunteers in this study were trainers in their home councils and
held other positions such as camp staff, council staff members, or troop leaders. Although
all of the women were white, they came from a variety of backgrounds: 1. 66% of the
participants have a college degree of a bachelor or higher; 2. 34% of the women were
educators; 3. 22% worked at some level for their local council, and 44% the remaining
have other careers or were not in the work force.

The Girl Scout national paid staff members who participated in this study were a
small group of two. Table 7 displays the demographic data for the Girl Scout paid staff
members.

Table 7: Girl Scout national paid staff members

<table>
<thead>
<tr>
<th>Participant</th>
<th>Position</th>
<th>Age</th>
<th>Ethnicity</th>
<th>Years in position</th>
<th>Involvement with project</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>Oversees all STEM funded initiatives</td>
<td>55</td>
<td>White</td>
<td>5</td>
<td>National liaison with NASA</td>
</tr>
<tr>
<td>K</td>
<td>Researcher</td>
<td>40</td>
<td>White</td>
<td>8</td>
<td>Evaluator of Girl Scout programs</td>
</tr>
</tbody>
</table>

GSUSA national staff members who have directly worked with the NASA partnership and have had responsibility over budget, evaluation, and program were
interviewed to gain their perspective of the relationship between NASA and GSUSA.
The national staff members met with the NASA personnel on several occasions, has
assisted with the implementation of the science materials, and have sought out some
funding to provide training to Girl Scout volunteers. National staff members have been
active participants in the trainings provided for the volunteer trainers. The presence of
the national staff members at trainings created a communication path between GSUSA,
NASA, and the volunteer group. GSUSA staff worked in tandem with NASA to evaluate
the effectiveness of the trainings provided to the adults.

The third group interviewed was the NASA staff members who worked directly
with the partnership. Three of the interviewees were scientists while the others worked in
providing NASA educational materials to a variety of formal and informal educational
groups. Table 8 provides demographic data on the NASA staff that were interviewed and
who had the most involvement with this partnership.

<table>
<thead>
<tr>
<th>Participant</th>
<th>NASA position</th>
<th>Ethnicity</th>
<th>How involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>Geologist</td>
<td>White</td>
<td>Lead trainer for adult trainings, was a Girl Scout as girl and adult volunteer, helps write grants for funding</td>
</tr>
<tr>
<td>M</td>
<td>Education specialist</td>
<td>Hispanic</td>
<td>Takes care of logistics for training, helps write reports, works closely with NASA trainers and with GSUSA national staff</td>
</tr>
<tr>
<td>N</td>
<td>Education specialist</td>
<td>White</td>
<td>Writes funding grants and evaluation reports. Works closely with GSUSA national staff</td>
</tr>
<tr>
<td>O</td>
<td>Planetary scientist</td>
<td>White</td>
<td>Provided training on cosmic events, and has been a Girl Scout leader</td>
</tr>
<tr>
<td>P</td>
<td>Planetary scientist</td>
<td>White</td>
<td>Provided training during Universe workshop</td>
</tr>
</tbody>
</table>

The semi-structured interview style was used with the participants. This method
provided open-ended questions that led to a richer discussion of the participant’s
experiences, thoughts, and interpretation of their situation while engaging in the learning of NASA activities, as well as previous experiences in science. Triadic contrast questions (Spradley, 1979) allowed participants to reflect upon the similarities and differences within the two organizations of Girl Scouts and NASA. Matrixes were defined by the outcomes of the interviews as related to the research questions of how the relationship between NASA and GSUSA developed and has evolved. All interview notes were transcribed and sorted, and as new categories emerged from data, existing categories were modified.

Triangulation and Reliability

The triangulation of data included the use of interviews, the evidence of artifacts and programs, and the observations of the participant researcher. The use of multiple sources established validity (Denzin & Lincoln, 1988). The interviews were held with volunteers and staff members who were participants in the NASA/GSUSA partnership. Interviews were also held with personnel from NASA who integrated with the Girl Scout organization. Tentative interpretations of the data shared with people interviewed lent to the validity of the study (Carspecken, 1996; Merriam, 1998). These data were shared from interviews with the GSUSA/NASA volunteer cadre as a member check.

Lincoln and Guba's (1985) criteria of credibility, transferability, dependability, and conformability for establishing trustworthiness was used in this study. Triangulation of the data allowed for a deeper contextual understanding of the data sources, which ensured that the researcher did not develop limited analysis (Goetz & LeCompte, 1984).
Reliability is the extent to which a study can be duplicated. This study with actual GSUSA/NASA artifacts and interviews was reliable in that the scripted notes can be reviewed by other researchers. Participants brought their own knowledge, beliefs of science, experiences, and personalities to the settings; however human variables would not allow for exact replication of this portion of the study. However, the study of the relationship between NASA and GSUSA could be replicated as well as learning why and how a Memorandum of Understanding between the two organizations evolved.

Ethical Issues

The ethical issues of this study were the potential bias of the researcher who has been a girl scout for the past 40 years. The researcher was a knowledgeable participant, and has been involved with the Girl Scouts at a national level for the past 18 years. During this time, the researcher has been involved with several Girl Scout initiatives including those that are related to science. Besides the researcher’s bias, the interviewed volunteers, the national staff members, and members of the NASA community, had a stake in ensuring that the Girl Scout science programs succeeded. The desire for the success of the programs may have biased the feelings and reactions of the participants as they were interviewed. The national staff members have been long-term members of the organization, believe in its values and mission, and stated that they want girls to have high quality experiences. Two of the NASA staff interviewed were also Girl Scout leaders for their daughters’ troops. The Girl Scout volunteers have been members of the organization for a long period of time as leaders, trainers, and several were also girl members. One method utilized to relieve the potential bias, was to ensure that each
participant knew that their true identity was masked in the study. By the assurance of anonymity, participants were free to answer questions such as "What would you tell your organization, and what would you tell the other organization?" These questions were crucial to uncover barriers that either organization needed to cross in order to make the partnership more productive.

Assumptions and Limitations of this Study

An assumption of this study was that every girl in Girl Scouting has access to the NASA science programs. Access to the NASA science activities is dependent upon a number of factors including the council's ability to provide the NASA activities, funding to sustain the program, and a Girl Scout leader’s comfort level of science. A council may not be able to provide the NASA activities because they do not have a trainer who has received the NASA training. Thirty GSUSA volunteer trainers represent 30 of the 315 councils across the United States. Not all councils have access to one of the 30 trainers.

There have been many NASA and local council Girl Scout partnerships for several years prior to the formalized national partnership. Prior to 1999, local councils who were near to NASA centers often received support for activities and programs, and continue to do so. However, this research only focuses on the national endeavors between NASA and GSUSA.

Every one of the Girl Scout volunteers and NASA staff who has worked on this partnership had a story to tell. Not everyone was interviewed in this study and therefore it is possible that not all voices were heard.
This study was conducted over a short range of time, and one large limitation is that an extended study would demonstrate how the partnership has impacted girls and women over the course of time. Longitudinal studies need to be conducted to determine if the money, time, and other resources were appropriately spent and if there was a lasting impression of the experiences on the girls and women who participated. Studies such as these are costly, but the funding should be sought after to really determine the effectiveness of the partnership.

Summary

This chapter highlighted the conceptual framework using an ethnographic lens of a feminist epistemology. The three distinct groups of participants; NASA staff, National Girl Scout staff, and Girl Scout volunteers provided insight into the culture created by the formation of the partnership, as well as belief systems held by the Girl scout volunteers in regards to science. Studying the culture of the Girl Scouts and the culture of NASA revealed patterns of behaviors, actions, and artifacts that defined the nature of the partnership. The experiences of the volunteer Girl Scouts while learning the science content provided the feminist epistemology. Their previous encounters with science as compared to the NASA experience provided a clear voice of the positive science experiences girls could have beyond the classroom.
CHAPTER FOUR

FINDINGS OF THE STUDY

Chapter four presents the findings on the evolving relationship between NASA and GSUSA. Three research questions that guided data collection were:

1. What are the key components of GSUSA and NASA’s support for science programs for girls, and how has this support evolved over the past five years?

2. What are the values and belief systems held by GSUSA and NASA that underpin the development of a successful science education program for girls?

3. What evaluation components exist and how do these support the relationship between GSUSA and NASA in providing science education programs for girls?

Each of the research questions was addressed individually. As the data were collected from interviews, artifacts, and notes they were sorted into different tables, domains, and timelines. After analysis of domains, additional domains were constructed to glean common patterns across the data fields.
Question One

1. What are the key components of GSUSA and NASA’s support for science programs for girls, and how has this support evolved over the past five years?

For the past twenty-five years, the Girl Scouts have established partnerships with local science museums, created science kits, and have sought out opportunities for girls to become more engaged with science and technology. NASA had a history of seeking women who wanted to pursue a career in science. In 1983, Sally Ride (also a Girl Scout) was the first United States woman to go into space. However, since Dr. Ride’s venture into space, NASA as well as other science employers has not received as many women applicants as men. NASA began to look beyond the schools to ignite an interest in space science in America’s youth. In 1999, NASA invited several different youth serving organizations to meet and discuss how NASA could interface with them. One NASA staff member explained how the partnership began with the Girl Scouts, “In the beginning, we wanted to know what different youth organizations wanted from us. We invited key staff from different organizations and we liked the response from the Girl Scouts.”

Both NASA and the Girl Scouts wanted to begin this partnership on a small scale and so the partnership began as a pilot program at a Girl Scout summer camp. A local council’s Chief Operating Officer (CEO) knew a NASA staff member and had requested NASA provide space education activities for the summer camp. NASA saw this as an opportunity to pilot workshop materials for both girls and adults. NASA went to the council’s camp in 2001 and provided a week long workshop for camp staff members and girls on the topic of the solar system.
After the success of the pilot, the Girl Scouts and NASA collaborated on what their next steps should be in this young national partnership. The group decided that they wanted to provide the solar system workshop for trainers and/or leaders from various councils who represented different regions of the United States. NASA and Girl Scout staff members wrote a NASA grant to train the first group of volunteer women who attended a five-day workshop. This workshop was followed by two more multi-day trainings that were held 12 and 18 months apart respectfully. The first two of the trainings were held at the Girl Scout Macy Conference Center in New York. The third training was held at the Jet Propulsion Lab (JPL) in California.

As the relationship evolved, the Girl Scout volunteer group, NASA, and the national Girl Scout staff wanted to expand beyond the original group to provide more opportunities for girls and adults. The partnership evolved to be more than just the three trainings for the original thirty volunteers, and has included more adult trainings with the inclusion of additional volunteers. Large scale Girl Scout events have taken place with more in the planning stages, and additional partnerships with local councils were established. Table 9 identifies the key implementation phases of the partnership between NASA and GSUSA.
Table 9: Timeline of implementation phases of the partnership between GSUSA and NASA

<table>
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<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>NASA contacts various youth groups to search for ways to connect to informal education groups.</td>
<td>Summer camp program is piloted.</td>
<td>First training is held at Macy Conference center. Topic is the solar system.</td>
<td>Second training is provided at Macy Conference Center for 30 Girl Scout volunteers. Topic is the Universe.</td>
<td>Girl Scout volunteers are brought to JPL in Pasadena California. Topic is missions. Volunteers interviewed scientists.</td>
<td>Older Girl event Destination is held in Hawaii.</td>
<td>January 7 of the Girl Scout trainers attend the Stardust Return event at Johnston Space Center.</td>
</tr>
<tr>
<td>The Girl Scouts send a national staff member to speak to the NASA educators.</td>
<td>Application screened to see which volunteers should be included.</td>
<td>Trainers plan destination for older girls, training for second group of volunteer trainers.</td>
<td>Trainers plan destination for older girls, training for second group of volunteer trainers.</td>
<td>Trainers plan destination for older girls, training for second group of volunteer trainers.</td>
<td>Trainers plan destination for older girls, training for second group of volunteer trainers.</td>
<td>Trainers plan destination for older girls, training for second group of volunteer trainers.</td>
</tr>
<tr>
<td>A plan is developed and funding is sought for by NASA.</td>
<td>Volunteers spend 5 days with NASA trainers learning about the Solar System.</td>
<td>December group of volunteers are trained in solar system, missions and universe.</td>
<td>December group of volunteers are trained in solar system, missions and universe.</td>
<td>December group of volunteers are trained in solar system, missions and universe.</td>
<td>December group of volunteers are trained in solar system, missions and universe.</td>
<td>December group of volunteers are trained in solar system, missions and universe.</td>
</tr>
</tbody>
</table>
One focal aspect of the partnership that was revealed in the course of the data analysis was the importance of the same group of volunteers attending more than just one training event. Instead of receiving the typical one training at the Girl Scout training center, the 30 volunteers traveled to New York and received additional space science training. This allowed for the 30 volunteers to use their previously learned schema about the solar system to learn more about the universe, cosmic events and STEM careers. This also began a new culture of learning and sharing science experiences between the Girl Scout volunteers and the NASA staff.

The first of these trainings were held in April 2002 at the Girl Scout Macy Conference Center in New York. Thirty volunteers were selected from a pool of 300 applicants. The 30 volunteers came from all different regions in the United States plus one trainer lived in Germany and worked with Girl Scouts who attend Department of Defense schools. The volunteers ranged from little or no experience with science to science educators to those who work in a science field. The training focus was on the solar system which included several hands-on activities using familiar materials commonly found in a kitchen.

In November 2003, another training event was held for the same group of volunteers. This time the content was on other aspects of the universe and included understanding the life cycles of stars and galaxies, light emissions, the electromagnetic spectrum, and the sun-earth connection. During the interviews, five of the nine volunteers mentioned that the content was more complicated during the Universe training. However, the trainers stated that they were willingly to try to understand the more complex information because they felt successful with the solar system session, and
their level of self efficacy in science was higher. A Memorandum of Understanding was signed between GSUSA and JPL in 2003. This MOU later was superseded by the MOU signed by NASA and GSUSA in 2005.

In October 2004, the trainers were invited to their third opportunity at which they visited the Jet Propulsion Lab (JPL) in Pasadena, California. The sessions included planning a mission, touring the facilities to understand how missions are planned, and building a mock rover with a team. During the rover activity, participants had to use their background knowledge of math, what they had learned about Mars, the universe, and what instrumentation would net the results to their science questions.

At the event at JPL in October 2004, the Girl Scout trainers were asked to plan national future events for girls and adults using NASA materials and resources. The group planned a national destination for girls to go to Hawaii in July of 2005 to study comets, Deep Impact and sky lore of the Hawaiian cultures. The high school girl participants were from all over the country and joined five of the Girl Scout volunteers as they toured Hawaii, learned about the Deep Impact mission and how comets were formed.

A training was planned for a second group of Girl Scout leaders and trainers at the New York Girl Scout Macy Conference Center in December 2004. Two of the original Girl Scout volunteer trainers were part of the training team. This event included most of the content that the original group received in the first two trainings in New York with a taste of the training that was held at JPL. This second group of volunteers have not provided as many back-home events as the original group and this may be in part to the fact that the second group of trainers has not received three different opportunities.
The trainers also planned other ways that the NASA materials could be shared with councils that did not have a trainer representative. Ideas included sharing information on the Girl Scout website, and providing regional trainings. As of this writing neither one of the ideas have come to fruition. Although not all ideas have been developed, a significant number of opportunities for adults have been created as a result of the collaboration between NASA and the Girl Scouts.

Table 10 demonstrates who benefited from the NASA/GSUSA opportunities from the inception to 2006.

Table 10: National opportunities as an outcome from the partnership

<table>
<thead>
<tr>
<th>Type of event</th>
<th>Science content</th>
<th>Who provided</th>
<th>Date</th>
<th>Who benefited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camp</td>
<td>Solar System</td>
<td>NASA and a local council</td>
<td>Summer 2001</td>
<td>Camp staff, girls</td>
</tr>
<tr>
<td>Training for adults</td>
<td>Solar System</td>
<td>NASA/GSUSA</td>
<td>April 2002</td>
<td>Trainers I</td>
</tr>
<tr>
<td>Training for adults</td>
<td>Universe</td>
<td>NASA/GSUSA</td>
<td>November 2003</td>
<td>Trainers I</td>
</tr>
<tr>
<td>Training for adults</td>
<td>Missions and Careers</td>
<td>NASA/GSUSA</td>
<td>October 2004</td>
<td>Trainers I</td>
</tr>
<tr>
<td>Training for adults</td>
<td>Universe</td>
<td>NASA/GSUSA</td>
<td>December 2004</td>
<td>Trainers II</td>
</tr>
<tr>
<td>Training for adults</td>
<td>Missions and Careers</td>
<td>NASA/GSUSA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>National “Destination” Event</td>
<td>Comets, Cultures, Missions</td>
<td>NASA/ Trainers</td>
<td>July 2005</td>
<td>High School girls from around the country</td>
</tr>
<tr>
<td>Stardust Return</td>
<td>Artifact return from moon, sun, and comets</td>
<td>NASA</td>
<td>January 2006</td>
<td>Trainers who are also teachers</td>
</tr>
<tr>
<td>NEI NASA Centers and local councils</td>
<td>Planning sessions for future collaborations</td>
<td>NASA/GSUSA</td>
<td>January 2006</td>
<td>Councils who are geographically close to NASA centers</td>
</tr>
</tbody>
</table>
Beyond the opportunities provided at a national level, the 30 Girl Scout trainers have provided over 370 events for girls and adults in their local councils with 36,862 girls and adults in attendance at events, camps, or troop meetings using the NASA activities. If one is to count numbers alone, an argument can easily be made that the partnership has made an impact by ensuring that girls have exposure to science. Within the ethnographic context, girls have received that exposure through the culture of Girl Scouting and in an all female setting. One volunteer noted, “When girls were working with just other girls their femininity was not challenged”. The Girl Scout volunteers shared their experiences bringing the NASA activities back to their home councils. One volunteer stated, “I had to ‘trick’ the leaders at a meeting, and did not tell the leaders that they were doing a science activity until the leaders were really into the activity. Once the leaders discovered that the science was fun, they relaxed and enjoyed it.” Another trainer said that the leaders at her training “giggled” and enjoyed making asteroids from materials from a typical household kitchen and not materials from a science lab. The Girl Scout trainers said that they often encountered fear and apprehension about the space activities prior to events due to the Girl Scout leaders’ previous science experiences in school. One trainer noted, “I had to help the leaders in my area discover that the science was okay, that they could do it too. It helps when we use materials that they are familiar with such as craft items, and food items.” Another comment was, “Leaders are willing to expose their girls to science but they feel insecure doing the science themselves.” The actions, language patterns, and connections with everyday items provided the feminist epistemology frame around the culture of experiences that the Girl Scout volunteer trainers witnessed as they provided opportunities in their own councils.
Several layers of impact occurred because of the collaboration between NASA and GSUSA, and a componential analysis demonstrated a ripple effect of the partnership as demonstrated in Figure 2. This diagram illustrates that once the partnership was established, and the Girl Scout volunteers were trained, the outreach to girls across the nation began in earnest. The numbers listed was a snapshot in time, as trainers continued to hold events and provide NASA activities to girls and adults.

Figure 2: Componential Analysis of impact of national partnership

Over the years, NASA has worked with other youth organizations including 4-H and the Boy Scouts. According to the NASA staff, the relationship with the Girl Scouts is the most developed. This process has occurred over five years and continues to grow.
when funding is available. When asked why this relationship is the most developed, the commitment and enthusiasm from the all the parties was given as an answer.

In 2003, a Memorandum of Understanding (MOU) was written between NASA's Jet Propulsion Lab (JPL), and the Girl Scouts of the USA. However, this MOU was not signed by the top administration of either organization. Both organizations determined that a formal MOU signed by the top executives should formalize the relationship between the Girl Scouts of the USA and NASA. The Girl Scouts have other MOUs signed with other organizations as well does NASA. A formalized understanding between organizations allows for the partnership to set priorities and goals. Since JPL is a NASA center and not the entire NASA organization, it was determined that the MOU needed to include the whole NASA organization as well as include the signatures from the National Chief Executives for NASA and for GSUSA. The formal MOU between the national entities provides for a stronger bond and should be given a higher priority within both organizations. The relationship then would have leverage in both organizations for funding opportunities and marketing strategies.

Riding on the success of three adult trainings, and the positive reactions from members of both organizations, a Memorandum of Understanding between the two organizations was signed in January 2005. This document acknowledged in writing the commitment that both organizations share to provide girls and leaders from across the United States space science educational opportunities. The MOU (Appendix D) gives a background of both organizations, and what is written in the MOU is important to note as it sets the tone for the sustainability of the relationship.
A desire to enter into a long-term sustainable relationship based on a strong foundation aimed at meeting mutual goals of both programs begins the MOU and it states:

"An MOU between NASA and GSUSA will afford NASA an opportunity to offer engaging STEM experiences to the Nation’s girls and women. GSUSA has over 2.8 million girl members, and 962,000 adult members. GSUSA has an aggressive path to attract a diverse membership and is looking to advance women in leadership and supports a new generation of forward-thinking women."

This statement underpins the mutual goals of providing more STEM opportunities to girls and women through this partnership. The MOU recognizes the strengths of both organizations and what each organization has to offer. Mutual goals of the collaboration are that it: 1. raises the comprehension and interest of science-related topics among girls, leaders, and trainers, and 2. encourages girls and women to pursue careers in science, technology, engineering, and mathematics. Each party has obligations and responsibilities to each other as part of the MOU. Figure 3 is a taxonomy which illustrates the written responsibilities of each of the parties and the jointly appointed responsibilities.
Figure 3: Taxonomy chart of responsibilities

Memorandum of Understanding between Girl Scouts and NASA

Responsibilities of GSUSA
- Conduct activities designed to improve the ability of adult members to understand and communicate NASA related STEM concepts
- Provide national and regional workshops for Girl Scout trainers, leaders, and Senior Girls Scouts to mentor younger girls

Responsibilities of NASA
- Support GSUSA training related to NASA content to enhance the understanding of NASA STEM topics and careers

Joint Responsibilities
- Establish appropriate linkages to each organization's programs, products, and resources
- Identify NASA content, experiences (internships) and information that can be used to enhance program goals and objectives
- Develop new models and implement strategies for onsite training and special events
- Identify appropriate mechanisms for NASA to recognize GSUSA accomplishments
- Support joint events recognizing this agreement and other national STEM indicatives
- Jointly develop an implementation plan to identify measurable goals, and evaluation plans for program effectiveness
- Highlight opportunities, programs, and successes in the relationship through press releases, newsletters, and Leader magazine

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The MOU addressed funding, legalities of using corporate images and trademarks and waivers of the liability of each organization. Materials were allowed to be reproduced if the purpose was to provide STEM activities to girls and adult women. The MOU is in effect for five years from the signature date which was in January of 2005. Both NASA and GSUSA will need to eventually decide if this partnership has been successful and if they want to extend their formal collaboration with each other. The evaluation of the partnership is already underway as discussed in the results of the final research question of this study.

In summation of the first research question, the key components of the NASA and GSUSA support for science lies in both organizations' cultural beliefs that girls should have exposure to STEM careers. The timeframe for girls to have initial experiences in science begins in the elementary school years when girls are Brownies or Juniors and must continue through the middle school and high school years. The support for the national partnership has evolved from a local camp setting to on-going training for volunteers and has expanded to training for other sets of volunteers. Large scale older girl events were conducted at the national level while close to 370 events were conducted at the local council level for all ages of girls.

The beliefs and values of the Girl Scout volunteers and staff coupled with the beliefs and values of the NASA staff provided a more in-depth analysis of this partnership. The second research question delves into those beliefs and values and determines if both organizations share a culture that truly contributes to the same goals, if the goals of the two individual organizations were met, and how some Girl Scout
volunteers' beliefs, language, and attitudes about science changed as a result of this partnership.

Question Two

2. What are the values and belief systems held by GSUSA and NASA that underpin the development of a successful science education program for girls?

This research question addressed the relationship of the goals of both organizations. In order to answer the question, both organizations' goals were examined individually and then compared. NASA and the Girl Scouts had written joint goals of raising the comprehension and interest of girls and women in science-related topics, and to encouraging girls and women to pursue careers in science, technology, engineering, and mathematics. Beyond the joint goals each organization had its own program goals. The Girl Scout website (www.girlscouts.org) program goals are stated as: “The Girl Scout program can change the way girls see the world and their place in it. Girls learn the importance of personal responsibility, the value of goal setting, the spirit of teamwork, and the thrill of accomplishment.” The Girl Scout program was based on the Girl Scout promise and Law and four fundamental goals that encourage girls to:

1. Develop to their full potential.
2. Relate to others with increasing understanding, skill, and respect.
3. Develop a meaningful set of values to guide their actions and to provide for sound decision making.
4. Contribute to the improvement of society.
The NASA/Science Mission Directorate has the goals of: (1) Inspiring and motivating students to pursue careers in science, technology, engineering and mathematics and (2) Engage the public in shaping and sharing the experience of exploration and discovery. The NASA Fiscal year 2006 Budget Request summary page for education states, “NASA’s mission to understand and explore depends upon educated, motivated people with the ingenuity to invent tools and solve problems and with the courage to always ask the next question.” Both organizations have the goal of bringing STEM careers to young people. The MOU states:

“The mutual goals of the is collaborations are to 1) raise the comprehension and interest of science related topics among girls, leaders, and leader-trainers and 2) encourage girls and women to pursue careers in science, technology, engineering, and mathematics.”

All participants in this study were asked if they believe if the goals of the two organizations and the joint goals were being met as a result of this partnership. An in-depth analysis provided an insight to how the goals are being met. In Table 11 responses were sorted into different types of statements of how the common goal of encouraging girls and women to seek STEM careers was met.
Table 11: Participant's responses to joint NASA and Girl Scout goal of influencing girls and women to pursue STEM careers

<table>
<thead>
<tr>
<th>Participant</th>
<th>Never knew there were so many different kinds of positions in STEM. Concept of “I could work for NASA too.”</th>
<th>Partnership provides NASA content to Girl Scout audience</th>
<th>Girls and adults need more exposure to STEM—this partnership provides that opportunity</th>
<th>No Response or did not directly address the question in relation to this specific goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>B</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>D</td>
<td>X</td>
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<td>E</td>
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<tr>
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Six out of nine responses from the Girl Scout volunteers indicated that they did not have previous knowledge of the various types of careers one could pursue in space science. The trip to the JPL site and the background tour of JPL provided many of the trainers (participants A-I) with a new insight. One trainer reminisced about that experience, “When we were in the room where they were sewing the space blankets for the crafts, I knew I could do that! But what really caught my eye was the machinist shop because of the attention to detail. I am really good at detail! I never thought about that type of career!” Many of the trainers were astounded to discover who the women were that worked for NASA. One trainer had this to say, “I always thought someone had to have a PhD in physics or astronomy. There were women who had bachelors, and some were so young! I guess I expected to see just older white men.” Women’s perceptions of scientists, their perceptions of who works for NASA, and the education required, was indicative of a feminist perception.

All except one participant expressed the need for girls and women to have more exposure to STEM careers. This information coupled with the high response of the partnership providing STEM experiences speaks to the need of sustaining the collaboration between the two organizations. One volunteer had this to say about the NASA experience, “At least for my council, the NASA activities that I have brought back has really pushed the council forward with STEM awareness and activities.” NASA has the science knowledge, and the Girl Scouts can empower girls to pursue opportunities that have had barriers in the past. The Girl Scouts can provide a natural all girl culture in which the girls can learn while NASA can provide the exciting science experiences.
A second goal that many of the participants addressed was the NASA goal of "engaging the public in sharing the exploration of discovery." For many of the Girl Scout volunteer trainers, this goal was met in their personal lives. Table 12 categorizes how the participants' attitudes about space exploration and science have changed as a result of this relationship.

**Table 12: Change of participants' attitudes about space exploration and science**

<table>
<thead>
<tr>
<th>Participant</th>
<th>Excited about missions, follows news on web</th>
<th>Never knew about cosmic events and now watches the evening sky</th>
<th>Want to share the information learned with others</th>
<th>Taken additional science courses or conducted their own research as a direct result of this experience</th>
<th>Educator who altered instruction in classroom as a result of NASA experiences</th>
<th>Previously not confident in science</th>
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An unexpected aspect that developed from Table 12 was the excitement and interest in missions and the night sky as a result of the NASA trainings. As one Girl Scout volunteer trainer commented, "I never knew about these events before, but now I look up and see the sky differently!"
Scout volunteer stated, “I never knew all that stuff was up there! These experiences have made me look up and wonder!” Every Girl Scout volunteer discussed the importance of sharing the NASA content and excitement with girls and other adults. Several of the participants followed the NASA missions either on the news or on the NASA web sites.

The unexpected positive impact on the Girl Scout volunteers became a significant component of this study. NASA and Girl Scout staff both indicated that they had hoped for the Girl Scout volunteers to want to share the science information with girls and adults in their home councils. As evidenced by the table above, that goal was realized. An exceptional finding was that 4 out of 9 of the trainers have taken college level science courses or have conducted their own research about the universe as a result of this collaboration, even though they were not necessarily the educators in the group. One volunteer, who is 55 years old, is planning to return to college and earn a masters degree in physics. When asked why at this age she wanted to go back to college she replied, “I had this epiphany while at the NASA workshops that I was always meant to be in an area of physics. So, it’s now or never, and I don’t want to wonder someday if I should have, or could have. So because of NASA I am going back to school.”

Two of the trainers were educators and felt they needed to enroll in a college class to build up their content knowledge in either chemistry or physics. Of special note, trainers who were educators of students from Pre-K up through high school changed their instruction in their classrooms as a result of this experience. One trainer said, “The benefit I received from these experiences has not only given me great content and activities to do with my Girl Scout council and troops, but I have used several of these materials in my classroom as well”. Another trainer stated, “I rearranged my focus in the
classroom. I still teach all the strand of science—because you know...you have to. But, I am now teaching using space science as a lens. I can incorporate the physical science, geology of course, and even biology in the classroom by using space as a lens to teach what the kids have to learn. And (said emphatically) it's a whole lot more fun for me and the kids."

Using an open-ended interview approach, the researcher asked the Girl Scout volunteer participants how the NASA experience had been different for them as compared to previous science experiences in school. Many of the volunteers indicated that they had not liked science in school, and that it was not a subject that they particularly enjoyed. Comments from the Girl Scout volunteers included, "Girls just didn't take physics." "My High School physics teacher asked why I was in the room, because girls don't take physics."

When the trainers were asked why they had not felt confident about their science abilities in the past, another domain of previous experiences developed. The pattern of this domain was found in experiences and feelings. Table 13 depicts the volunteers’ experiences and feelings about science previous to the NASA relationship. Of note, even the women who felt more comfortable with science, had at some point, negative or ambiguous feelings about science in the past.
Table 13: Girl Scouts Volunteers experiences and feelings about science prior to the NASA relationship

<table>
<thead>
<tr>
<th>Participant</th>
<th>Was ignored in science class</th>
<th>Never felt confident about science</th>
<th>Did not see themselves as a scientist or engineer</th>
<th>Not encouraged to seek STEM career</th>
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As table 13 indicates when the women were more confident in their own abilities in science, they were not encouraged to pursue STEM careers and they did not perceive themselves as scientists or engineers. The teachers in the group did not perceive their science teaching positions as a science career. All but one participant felt ignored in science classes as students. When the volunteers were probed further and asked how the NASA workshops were different, the comments included were, “I could ask any question, and it didn’t matter if the question was dumb.” “I liked doing the activities. The activities helped me understand why it is important to study craters here on earth.
We did not just read about it.” “For me, it was a feeling of freedom. No one was going to laugh at me just because I was still connecting the dots.” “I didn’t have to worry about what others were thinking. It was okay to just be me.” Further exploration of that topic revealed that some of the women had felt intimidated in science class by males at some point in life. These comments have the common language of inadequate feelings in science, and demonstrate that within the culture of the Girl Scout and NASA partnership, women share similar feelings about science. Table 14 outlines a domain analysis of common belief systems regarding science previous to the NASA workshops, and how the all female setting allowed the participants to feel more comfortable in taking risks and asking questions.

Table 14: Common women’s beliefs about science

<table>
<thead>
<tr>
<th>Participant</th>
<th>Felt inadequate around males in science class</th>
<th>Felt comfortable asking questions or taking risks in NASA training</th>
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As Table 14 demonstrated many of the women felt inadequate around males and had negative experiences in a science class. The phrase choices of “freedom” and “okay to ask a question” used by the women indicate that these experiences were inclusive to being feminine. The feeling of freedom, and the confidence to ask questions was the beginning of an excitement that has been generated by the 30 Girl Scout volunteers. The self-efficacy in their own abilities to engage in science activities, understand the concepts, and then share the information with others has been an indicator of the success of the partnership.

A true culture has been created within this group of 30 women. They email ideas to each other on how to make activities better, or how to manage an event for 100 Junior Girl Scouts. An example was an email sent by one trainer who was doing an event in a shopping mall. One of the activities included using magnetic words to write cosmic poetry after learning about cosmic events in the universe. The dilemma was that there was nothing around in the mall to attach the magnetic words. Within 24 hours the volunteer had several suggestions such as bringing metal TV trays for the girls to attach the magnetic words as they created their own poetry. Beyond the scope of the science activities, these women have become like a family. They share and delight in births and weddings and weep for each other when tragedy strikes. They feel empowered as women to support each other, and to share the science with girls. This culture has extended to the NASA staff as well. When tragedy has befallen NASA such as the Columbia accident, or the JPL van accident, the outpouring of support from the group has touched the NASA staff. Likewise, the success of missions were cheered as if the Girl Scout volunteers themselves were instrumental in the achievement.
The excitement and enthusiasm about current NASA missions has been noted by the NASA staff. One of the NASA staff members commented in an interview, "The synergy and enthusiasm the Girl Scout volunteers bring to these events is contagious!" Another staff member commented, "It’s fun to see the excitement! If we could ignite more women and girls with this kind of passion, we would not have a shortage of women in science."

This researcher witnessed the excitement of the Girl Scout volunteers when the Stardust mission returned. Seven of the Girl Scout volunteer trainers were at Houston to observe the first aerogel comet dust samples extracted from the collector. The Girl Scout trainers, who were also educators, asked the scientists for autographs. Many digital pictures were taken of the scientists as they performed the delicate task of removing the aerogel cells from the collector. Three of the attending volunteers were also participants in this study. They were asked to reflect upon their knowledge of the sample return mission and determine if they would have known about the mission had it not been for the experiences with the Girl Scouts. All three participants said they would have not known about the mission, or followed it as closely. The volunteers also stated that having experiences with mock aerogel assisted with their understanding of how the collection of comet dust was trapped in the substance.

The concept of excitement and enthusiasm began a common thread in this research. Not only were the Girl Scout volunteers enthusiastic about space science, but the NASA staff connected to the Girl Scouts because of the enthusiasm and sought out more ways to connect with the Girl Scouts. At the national trainings the NASA staff became just as engaged and excited about the content as the Girl Scout volunteers. This
led to a learning environment which was mutual versus the “sage on the stage” lecture format that the Girl Scout volunteers distained as students in school. NASA employees were asked why they became involved with the Girl Scout partnership, and their answers were sorted into categories. These categories are: positive previous experiences, mutual goal of encouraging girls to seek out STEM careers, and enthusiasm of Girl Scout volunteers. As Table 15 indicates, many of the NASA employees had more than one reason.

Table 15: NASA’s Employees reasons for working with Girl Scouts

<table>
<thead>
<tr>
<th>Participant</th>
<th>Positive previous experiences</th>
<th>Goal of encouraging girls to seek careers in STEM</th>
<th>Enthusiasm of Girl Scout volunteers</th>
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NASA employees who had previous experiences working with Girl Scouts have positive memories. As Table 15 reflects enthusiasm is an important factor to consider in this study. Enthusiasm is not measured but all the NASA staff interviewed used the word
“enthusiasm” when describing their experiences working with the Girl Scouts. For example, one NASA employee stated:

“Because of my schedule, I can’t work directly with every organization that my Center works with, but when it is a Girl Scout event, I’m there. The energy and enthusiasm is contagious. The trainers get so into what they are learning, and I know that they will take the enthusiasm back home to the girls they work with.”

NASA staff were interviewed about their experiences with the partnership and asked about their experiences with Girl Scout events. NASA staff were positive about working with the Girl Scouts, and some had previous experiences working with local councils. Those who had previous experiences working with Girl Scouts stated that this was a motivator to work with the Girl Scouts again. The combined culture of the NASA staff and the Girl Scout volunteer group has empowered not only the Girl Scouts but the NASA group as well as they have sought more opportunities to work with the Girl Scouts.

When the Girl Scout volunteers and staff were asked why they became involved with NASA, their responses were categorized into these groupings: encourage girls to seek STEM careers, already doing some science with the council, personal interest was piqued, someone at the council level encouraged them, not sure why because science is outside of comfort zone. As with the NASA staff, Table 16 indicated the Girl Scout volunteers and staff often had more than one reason for working with NASA.
Table 16: Girl Scout volunteers and staff reasons for working with NASA

<table>
<thead>
<tr>
<th>Participant</th>
<th>Encourage girls to seek STEM careers</th>
<th>Already doing some science with Girl Scouts</th>
<th>Personal interest was piqued</th>
<th>Someone at council level encouraged them</th>
<th>Not sure why and science is outside of personal comfort zone</th>
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As Table 16 indicates even if the women themselves felt uncomfortable with science, they felt a need to encourage girls to seek STEM careers. The Girl Scout volunteers appeared to be keenly aware that girls are not choosing careers in physics and astronomy. One quote from a volunteer provided the insight to the shared feelings of the women, “We have to let our girls know that science is for them. We have to give them opportunities to feel secure about doing science.” Only one participant did not mention encouraging girls to seek STEM careers as one of the reasons for wanting to work with NASA. Also of note was the initial encouragement of someone at the council.
encouraging the volunteers to apply. In some of these cases, but not all, the volunteer was already doing some science activities with Girl Scout troops, events, or camps. Many of the Girl Scout volunteers felt empowered by the Girl Scout organization to seek out the NASA experiences.

A domain was developed from Table 16 of the reasons why the Girl Scouts wanted to encourage girl members to consider STEM careers. Those reasons included: still a gap in not enough women entering STEM careers, personally did not have the opportunities to consider STEM as a career, and fear that girls and women are afraid of science. Table 17 further classifies the category of reasons why the Girl Scouts wants girls to consider STEM careers.

Table 17: Categories of reasons why Girl Scouts want to encourage girls to consider STEM careers

<table>
<thead>
<tr>
<th>Participant</th>
<th>Gap in women not entering STEM careers</th>
<th>Personally did not have opportunities to consider STEM careers</th>
<th>Think women and girls may be afraid of science</th>
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This table included the feminist epistemology perspective of women’s shared language and feelings regarding their perceptions of how other females perceive science. Common phrases used by the volunteers were “older girls become afraid of science,” and “women volunteers in my council are afraid of science activities.” Two of the volunteers had fathers who were in STEM careers but neither discouraged or encouraged their daughters to think about a career in science or math. All of the above participants discussed how they have encountered barriers with women and girls not wanting to sign up for science events due to the fear factor. Often the volunteer trainers have had to be clever with workshop titles or include it in other events such as “cookie sales training.”

Some of the trainers have provided more opportunities in their home councils than other trainers. Trainers who have not had support in their home councils, or who have not had the funding available have not been able to do as many activities. Some trainers have had much more support and have been asked to lead camp sessions, or had major events funded. In one particular case, the trainer went well over budget, but the executive director of the council determined that the activity was so worthwhile, she appropriated more funds to the activity.

When all of the participants (both Girl Scouts and NASA) were asked about each organization’s commitment to support science program for girls a domain analysis evolved that demonstrated which organization(s) were perceived to be committed to the relationship. Table 18 illustrates how all the participants perceived the commitment of both organizations.
Table 18: Participants’ perception of commitment of both organizations

<table>
<thead>
<tr>
<th>Participant</th>
<th>NASA has shown commitment</th>
<th>National GSUSA organization has shown commitment</th>
<th>Both organizations have shown commitment</th>
<th>Council has shown commitment</th>
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</table>
Four of the nine Girl Scout volunteers did not think the Girl Scout national organization was committed to the NASA partnership. They cited the lack of the NASA exposure in Girl Scout publications, and that the partnership is not well-known in all councils. Three of the Girl Scout volunteers have struggled with their local councils in supporting the NASA activities. Local councils have autonomy of how they provide the Girl Scout program to girls, and do not have to provide specific activities. In one case, the council is strapped for funding, and although the NASA activities are fairly inexpensive the council has given priority to other program events. The Girl Scout volunteers, Girl Scout staff, and NASA staff all indicated that NASA had shown commitment as they had received the funding for the workshops and provided the training to the Girl Scout volunteers.

When the participants were asked to define how they defined commitment, other categories became apparent. These categories included funding, materials, marketing, and opportunities for volunteers. Table 19 reveals a more in-depth analysis of the ways NASA and GSUSA demonstrate their commitment to the partnership.
Table 19: In-depth analysis of the ways NASA and GSUSA demonstrate their commitment to the partnership. * participant did not have information

<table>
<thead>
<tr>
<th>Participant</th>
<th>Funding by NASA</th>
<th>Funding by GSUSA/Council</th>
<th>Marketing to other Girl Scouts by GSUSA</th>
<th>NASA provided materials</th>
<th>Opportunities provided by GSUSA/Council</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
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</table>
NASA has provided and has been more successful in securing more of the funding needed to provide the opportunities for both girls and adult leaders. The national organization of Girl Scouts has provided some of the funding such as travel scholarships to the Girl Scout volunteers.

Three of the Girl Scout volunteers did not feel supported from their councils and said that the council leadership did not “buy-in” to the science initiative. Other councils saw the potential of the program but lacked the funding for local events in their councils. Over half of the volunteers interviewed said their council was aware of the Memorandum of Understanding between NASA and GSUSA. All participants agreed that both NASA and GSUSA have been successful in providing opportunities for the volunteer trainers which has led to opportunities for girls.

One category was striking in that the Girl Scout volunteers, the GSUSA national staff and a few of the NASA staff felt that the Girl Scouts were not marketing this partnership well to other members in Girl Scouting. National Girl Scout staff did not feel that other entities in the national Girl Scout organization realized the sheer size and potential of this partnership. The Girl Scout volunteers wanted the national Girl Scout staff to help motivate their individual councils. However, this is an issue that the national organization can not address due to the autonomy that the individual Girl Scout councils hold. The national organization can tell a council that they must provide the entire scope of the Girl Scout program but not how they provide it. The marketing issue as well as providing the NASA experiences to other councils comes down to funding. If the funding is not available then the partnership is limited in what it can provide to the volunteers and to the councils.
As part of the marketing data collection both of the web sites for the two organizations were evaluated to determine if the partnership was clear from an outside viewer. In searching the Girl Scout site using the term “NASA” resulted in less information in comparison to the NASA websites. The Girl Scout site recognized the NASA partnership as a government partner, and NASA was mentioned again on the Girls Go Tech part of the site (Appendix E). There is a hot link to the NASA main web page, but the words “Girl Scouts” had to be typed in the search engine which produced a variety of NASA news sites. At the bottom of the screen was a link to the Solar System Girl Scout page. To utilize the Girl Scout webpage to find NASA activities was not girl-friendly or useful. The word “NASA” was typed in on the search engine area of the “Girls Only” part of the Girl Scout web site and it produced no results. The Girl Scouts have not appeared to market the partnership well on their own website.

Conversely, on the NASA website, a girl or adult can type the words “Girl Scouts” into the site search engine and again can be directed to a page for Girl Scouts entitled Solar System Exploration for Girl Scouts (Appendix F). Once a girl has found that page another click on the words “Girl Scouts” allowed one to further drill down into the site. This was easy as the link was listed on the side menu under the heading of “fast lesson finder.” The new page loaded was under the “NASA Space Place” and included the Girl Scout logo and a choice of clicking on either Junior Girl Scouts or Cadette and Senior Girl Scouts. The Junior Girl Scouts hot link loaded the page of Girl Scout badges and NASA activities. At first glance, an assumption was made that these activities were posted just for Girl Scouts. However, when activities were opened it was evident that these activities were written for a variety of student audiences. Several of the activities
were repeated under different badges. Of interesting note were the numbers of boys pictured as compared to the number of girls. Table 20 illustrates this comparison and it was important to consider the images that NASA portrayed to girls under the heading of a Girl Scout badge.

Table 20: Comparison of boys and girls depicted in pictures of activities

<table>
<thead>
<tr>
<th>Number of activities with pictures</th>
<th>Males</th>
<th>Females</th>
<th>No gender pictures</th>
<th>Mixed genders in pictures</th>
<th>Gender of Astronauts Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>10</td>
<td>6</td>
<td>8</td>
<td>3</td>
<td>39</td>
<td>13</td>
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Table 20 signified that the images from NASA to Girl Scouts were more often male images than female images. For example, one of the first activities listed on the Girl Scout badge web page was an activity entitled, “Make Asteroids You Can Eat!” Once the page was loaded, a picture of three teenage boys seated at a table appeared making model asteroids with no girls depicted in the picture. Unfortunately, the subtle message was again that boys do the science. If the Girl Scouts and NASA are truly committed to this partnership more marketing will need to occur from both sides on their web sites and in other joint publications.

Another domain that emerged as a result of the discussion of the commitment to the partnership was that of the instructional materials provided by NASA. Everyone was in agreement that NASA freely and generously provided the materials, but several of the Girl Scout volunteers have either already adapted materials for Girl Scout leaders or they think the materials need to be adapted. Table 21 demonstrates that most of the leaders
think the materials need to be adapted for informal educational groups such as Girl Scouts, 4-H, and Boy Scouts.

Table 21: NASA materials usability for all

<table>
<thead>
<tr>
<th>Participant</th>
<th>Materials are adequate for all leaders and are usable by all</th>
<th>Materials can be adapted to be less formal education in appearance and more usable for after school groups</th>
<th>Tried activities that had not been demonstrated or utilized in NASA trainings</th>
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Although NASA has provided the training and printed materials, some of the Girl Scout volunteers found that adaptations needed to be made to meet the needs of leaders who had not been through the trainings. The printed materials were written for trained educators and some of the materials can be overwhelming to non-educators. Two of the volunteers had adapted the materials to be more Girl Scout leader “friendly” with the
objective of making the science accessible to everyone while maintaining the science content (Appendix G). The Girl Scout volunteers stated that leaders with an educational background such as classroom teachers should have no difficulty with the materials but noted that many leaders are not educators. Sometimes the materials needed to change in format and in appearance to be less intimidating to leaders. The volunteers also expressed that leaders were more likely to use the materials if they received training. Over half of the volunteer group did try other activities that were not demonstrated or utilized at the NASA trainings but stated that their confidence was bolstered by having experience with other activities. All volunteer trainers said that before they tried a new activity with girls or with leaders they tried the activity at home first.

The lack of funding, marketing issues, understanding the way of work and structure of each organization, time constraints of some grants, potential loss of key staff, and the lack of recognition from top management were barriers that were identified by the participants. In order to evaluate the partnership, the barriers were dissected to determine if barriers were overcome or if the barriers were still a potential threat to the partnership. Table 22 is a table of barriers identified by the participants. Not all participants identified the same barriers.
Table 22 Identified barriers to partnership

<table>
<thead>
<tr>
<th>Participant</th>
<th>Funding</th>
<th>Marketing</th>
<th>Time constraints</th>
<th>Change of key staff</th>
<th>Inter-organizational knowledge</th>
<th>Lack of recognition from top management</th>
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Both the Girl Scouts and NASA realize that this partnership has little hope of moving forward without funding. NASA and the Girl Scouts have sought funding from...
within and outside of both organizations. The volunteers were not paid for their time while participating or providing workshops, likewise NASA staff time was not charged into the cost of the workshops. Travel, hotels, and materials did factor as major budget items. Funding for future workshops for volunteers and girl events is dependent on grants or funding corporations such as Intel, IBM, or Microsoft. According to one national Girl Scout staff member, funding endowments such as these want their brand image and name on the project. NASA already has a recognizable name, and funding corporations do not want to necessarily share the credit especially if they are the one providing a majority of the funding. Sometimes the grants within the organizations are short-term grants and the funding window is extremely tight. Table 22 indicated that the NASA staff felt a time crunch working on one particular NASA funded grant as it posed problems in the advertising to councils, selecting participants, and planning the event. Both corporations shared the concern of key staff members leaving due to change of employment, or change of positions within their respective organizations. This barrier will need to be addressed if the partnership is to survive beyond the next three to five years. Girl Scouts and NASA jointly shared the desire for the recognition of the partnership from the top executives of both groups. This acknowledgment could pave the way for more funding as it gathers the support of key administrators.

Table 22 included one domain of knowing how the other organization works. Both NASA and the GSUSA national staff addressed this as a barrier that was one of complexity. The participants were asked, “What you would tell your organization and what would you tell the other organization?” The categories that developed from knowing the organization barrier included: know who the volunteers are and their needs,
learn each other’s hierarchal structures, and create relationships with the key players.

Tables 23 and 24 illustrated the participant responses to the question of: “What would you tell the Girl Scouts and what would you tell NASA?”

Table 23 What would you tell GSUSA?

<table>
<thead>
<tr>
<th>Participant</th>
<th>Get to know the volunteers and their needs</th>
<th>Learn each other’s hierarchal structures</th>
<th>Market the partnership within the Girl Scout organization</th>
<th>Create relationships with key players</th>
<th>Message of gratitude to GSUSA for opportunities</th>
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In Table 23, the Girl Scout volunteer group, the Girl Scout national staff, and the NASA staff indicated that the national Girl Scout organization needs to recognize the
needs of the Girl Scout volunteers and also applaud their achievements. The national staff of the Girl Scouts and NASA both recognized that building a relationship with key players from both sides was critical in the success of the partnership. The low response rate from the volunteer Girl Scouts in this column as well as learning the hierarchal structures of the other organization was because these volunteers are not involved at that level of communication. The Girl Scout volunteers were not involved on a routine basis with the decisions of how work was accomplished prior to any of the volunteer trainings. This work was mainly finished "behind the scenes" and so only two volunteers discussed these issues. One of the volunteers was part of the pilot in 2001, and the other volunteer was a staff member who worked for a council at one point. This volunteer understood the responsibilities of the national Girl Scout staff. One significant column was that everyone felt that the Girl Scout organization as a whole was unaware of the partnership, and that more marketing needed to occur within the organization.

When the tables were turned, and the same question was asked of what NASA should know, not many of the responses changed except within the Girl Scout volunteer group. Table 24 portrayed that most of Girl Scout volunteer group did not include the terms of getting to know the volunteers in their responses. The volunteer group most common responses to NASA and the Girl Scouts were those of gratitude for the opportunities, education, and positive experiences.
Table 24 What would you tell NASA?

<table>
<thead>
<tr>
<th>Participant</th>
<th>Get to know the volunteers and their needs</th>
<th>Learn each other’s hierarchal structures</th>
<th>Market partnership within the NASA organization</th>
<th>Create relationships with key players</th>
<th>Message of gratitude to NASA</th>
</tr>
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As this table demonstrates the NASA staff have more to say to their own organization just as the Girl Scouts had more to say to the national component of Girl
Scouts. The NASA staff who were interviewed had worked with the partnership by writing grants, providing workshops, and offering additional support as needed by either organization. The NASA personnel and the national Girl Scout staff also felt that the collaboration needed to be well-known within the NASA organization. Many of the Girl Scout volunteers did not know if it was well-known or not, and often did not address the issue in their comments. Therefore, the NASA staff as a whole had a better understanding of the workings of the relationship than the Girl Scout volunteers.

A synopsis of the second research question relating to the values and belief systems held by GSUSA and NASA indicated that both organizations provided girls and adult women science activities coupled with exposure to STEM careers in a non-threatening environment. The feminist perspective of shared experiences with science in the past, and now with this experience, provided for common language and understandings among the members of the Girl Scout volunteer group. Because of the NASA and GSUSA relationship and shared cultural values, girls have the opportunity to learn science through the Girl Scout program without the other issues that they may encounter in a formal co-education school setting such as deferment to males, masculine identity to science, having to compete with boys for materials, and vie for the teacher’s attention. Although the organizations have enjoyed success at providing science education to girls, it has not always been a smooth process.

One of the barriers encountered during the course of the partnership has been funding. A significant selling point to potential funders can be the enormous impact by the numbers of girls served as a result of this relationship, and the unexpected outcomes such as volunteers’ self-efficacy in science, returning to college for science courses, or
just the sheer appreciation for what lies beyond our solar system. Lack of on-going funding for this partnership caused a detriment to the partnership as more time was spent seeking available money versus providing a quality science program for girls. One barrier that did not exist was the dedication of staff members of both organizations.

Key players’ commitment in both organizations allowed for a relationship that has common goals, and ironically similar burdens, such as enlightening top administration to acknowledge the benefits of the collaboration. In order to sustain the relationship, make improvements, and apply for funding, the partnership needs evaluation from different perspectives and through a variety of means. Both the Girl Scout organization and NASA are well versed in evaluating programs due to the fact that many projects are funded through grants. Each grant has its own evaluation plan, but beyond the grant requirements, these large organizations need to determine if the time, monies, and energy is yielding an impact that is suitable to both NASA and Girl Scouts. The third research question addresses the evaluation techniques utilized by NASA and GSUSA.

Question Three

3. What evaluation components exist and how do these support the relationship between GSUSA and NASA in providing science education programs for girls?

This research question analyzes the evaluation techniques used by both NASA and the Girl Scouts to determine if girls and women were benefiting from the NASA/GSUSA partnership. Both NASA and GSUSA personnel have vested many hours, energy and funding into this relationship. How will the two giant entities know if the relationship has been successful?
The partnership is evaluated from different perspectives, with various tools, and for numerous reasons. For example, after every council event or at a local adult training, an evaluation is conducted. These are usually held to one sheet of paper and ask questions such as “What was the most meaningful experience you had today?” Other one sheet evaluations are formatted using a Likert scale and often ask if the girls or adults enjoyed the activity, if the activity was age appropriate, and if they would want more activities similar to what they experienced in that particular event. This type of evaluation provides those at the council level immediate feedback about the training or event.

At the national level several methods of evaluation were employed. After each national workshop the volunteer trainers have been asked to complete an evaluation. Three to six months later another evaluation is mailed out to determine if the effect of the training has changed. For example, at the completion of a training the emotions of being “in the moment” may be high with the intention of bringing the information back to the council levels. In order to determine if the plans were completed, post surveys were conducted after six months to determine if the “back home” plans were in planning stages, completed, or had altered. The results of the national studies were utilized to write grants for more funding which led to more opportunities for girls and adults. Grants were usually one year or less and the partnership will need to find long-term funders to avoid writing small grants.

The NASA Explorer Institute (NEI) provided funding for the trainers to attend the training at JPL and for a new group of 30 Girl Scout volunteers to attend training at the Macy Girl Scout Conference Center. A pre-survey was given to the new group of
participants which asked respondents to identify their knowledge level of proficiency in
the areas of science in general, technology, engineering, mathematics, earth science,
space science, training adults, training girls, knowledge of STEM careers, and knowledge
of required education for STEM careers (Appendix H). The post survey (Appendix I)
sent 3 months after the training, asked participants to identify if their content knowledge
of earth and space science concepts increased and if the format was an effective way to
acquire new information about the topics. The same survey inquired if the NASA staff
was knowledgeable about their subject matter, was organized and prepared, used
examples and illustrations, handled questions effectively, was enthusiastic, and presented
the material in an understandable format. The last section of the post survey asked the
respondents to identify if their knowledge and skills were affected in the areas of earth
science, solar system, electromagnetic spectrum, sun-earth connections, universe and
origins, and mission design. The results of these surveys were collected by GSUSA staff
and then shared in a report to the NASA staff. Besides the surveys conducted by
GSUSA, a national GSUSA staff member who is a trained researcher, has taken
substantial field notes and has participated in the workshops. These notes along with the
survey information provided the Girl Scout and NASA organizations critical information
of how the trainings were received by the participants.

The trainers returned home after trainings and began providing workshops in
their local councils. Trainers were encouraged to record those events on a web site
maintained by NASA which has a secure login so that only the trainers can log the
information onto the site. This database was analyzed to determine the impact of the
training provided by NASA to the Girl Scout trainers. If the trainers were returning
home after each training, and providing activities to their council’s girls and adults, it is safe to assume that the impact was high. If the trainers were not returning home and providing the latest training materials to their council members, the impact would be low. A large number of opportunities have been provided to girls, leaders, and trainers prior to and since the inception of this partnership. The Girl Scout web page indicated that over 100,000 girls and adults have participated in activities provided by NASA. This figure included all of the NASA events that occurred prior to the formal partnership for the past 15 years. These activities were sporadic and without a long-lasting or sustainable partnership. Girl Scouts of the USA determined that over 1/3 of all councils have benefited from a NASA experience in the last 15 years. However this study only evaluated the last five years and focused on the events which were outcomes of the national collaboration. Table 25 delineates the type of events and the numbers impacted by this partnership.

<table>
<thead>
<tr>
<th>Girl Scout Events/Activities Total participants: 32,937</th>
<th>Other Community or School Events Total participants: 3,925</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar System Content</td>
<td>Universe Content</td>
</tr>
<tr>
<td>13,538</td>
<td>8,087</td>
</tr>
</tbody>
</table>

The number of activities based on the database was well over 370 Girl Scout events and activities that were provided during informal educational settings. A total of 36,862 people have received some type of space education experience as a direct result of
this partnership. Of the 36,862, the number of Girl Scouts impacted were 32,937. Not all events have been recorded on the data base, and so this number is actually lower than the expected reality of how many girls and adults have been impacted by the NASA experience. The trainers found it easier to incorporate missions and careers into content areas than just doing sessions purely on careers or just on missions. Many of the events had more than one content area addressed. For example, one camp session had activities for younger girls that came from the solar system training, the training on the universe, and also introduced STEM careers to older girls. Another trainer focused her trainings for adults in the council and connected exploring the earth to understand the universe.

Table 25 indicates the type of event, the number of participants impacted at Girl Scout events and the number of non-Girl Scout groups who have also been impacted as a direct result of this partnership. Non-Girl Scout groups included other organizations such as Boy Scouts, school groups, and community events. The data base is monitored by a staff member at JPL, who sent reminder notices to the Girl Scout volunteers to update the information on a periodic basis. This data base can be used by the NASA staff to determine what activities in the national trainings were highly transferable back to the council and troop levels.

In addition to the workshop evaluations conducted by the GSUSA staff on behalf of NASA, and the data base; JPL contracted with a group from Leslie University to evaluate the partnership between the Girl Scouts and NASA. Those results have not been publicized for general review. However, this researcher was able to talk to their lead investigator. The lead investigator noted that interviews were conducted with the Girl Scout volunteers, GSUSA staff, NASA staff, and girls who had been directly affected.
because of the partnership. The work contracted by JPL is synergetic with this research study, and it is expected that this study will add to the triangulation of information that NASA and the Girl Scouts are collecting to demonstrate the effectiveness of the partnership.

As the different evaluation methods were evaluated Table 26 was created with the following domains of: type of evaluation, who collects the data, type of feedback, and who receives the feedback. The combination of data from each of these evaluation sources paints a picture that the partnership is successful at both the national level and usually at the council level when funding is available.
Table 26: Evaluation methods

<table>
<thead>
<tr>
<th>Type of evaluation</th>
<th>Who collects the data</th>
<th>Type of feedback</th>
<th>Who receives the feedback</th>
<th>How data is utilized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Council event evaluations</td>
<td>Troop leaders, workshop presenters</td>
<td>Survey and some short answer to specific questions about particular event</td>
<td>Council staff and trainers</td>
<td>Evaluate effectiveness of event, plan for future events</td>
</tr>
<tr>
<td>Pre survey before national trainings for Girl Scout volunteers</td>
<td>National GSUSA researcher</td>
<td>Survey content and STEM knowledge the participants have before attending the workshops</td>
<td>NASA trainers providing the workshop GSUSA national staff</td>
<td>Needs assessment to plan the workshop. Used as a tool to compare to post surveys.</td>
</tr>
<tr>
<td>Post surveys</td>
<td>National GSUSA researcher</td>
<td>Evaluate information and how it was utilized upon returning to local councils</td>
<td>NASA and GSUSA national staff</td>
<td>Evaluate effectiveness of workshops, implementation of NASA materials. Compare to pretest surveys</td>
</tr>
<tr>
<td>Field observations</td>
<td>GSUSA researcher, or contracted researcher</td>
<td>Coded field notes from observations and interviews</td>
<td>GSUSA and NASA staff, researchers</td>
<td>Analyze Field Notes and compare to other data sources such as data base and survey results</td>
</tr>
<tr>
<td>Data base</td>
<td>NASA staff</td>
<td>Compilation of number, type of events, demographic data of who received trainings.</td>
<td>NASA and GSUSA national staff</td>
<td>Evaluate what trainings were useful, what material is used at council events</td>
</tr>
</tbody>
</table>
According to the national Girl Scout research department, the survey results signified that adult participants increased their science content knowledge, increased their self-efficacy in science, and increased their knowledge of STEM careers. Surveys sent out six months past the workshop date indicated that the motivation to engage girls and adults in science remained high. Most of the councils with trained volunteers supported local events as evidenced by the data base.

Research question number three examined the ways and methods that the GSUSA and NASA partnership was evaluated. A number of methodologies were utilized including both qualitative and quantitative designs. Several different researchers have added to the knowledge base of the benefits of this partnership. Based on the large numbers of girls impacted by the NASA and GSUSA partnership, the relationship is a viable one. However, only a longitudinal study can determine if the impact is long-lasting or merely has a short-term effect.

Summary of findings

The three research questions examined the Girl Scout and NASA partnership to determine if the two organizations truly shared the same goal of encouraging girls and women to seek out STEM careers. The first question delineated the evolution of the partnership from its grass roots beginnings to a mature relationship. Relationships, beliefs, and benefits were common themes considered within the second question. Issues requiring resolution included learning the ways of work within both organizations, involvement of key personnel, funding, and engaging top management. Some of the barriers continued to persist such as funding and the recognition of the relationship by top
management in both organizations. Finally, the third question addressed the evaluation tools that the two organizations utilized to evaluate and perpetuate the partnership. These tools included an active data base that allowed volunteer trainers to input data after the completion of an event in a local council, surveys, and qualitative data collections from different researchers. The significance of the different data collections is important because it signifies that the results of the data is credible.

Discussion of the need for the continuation of this partnership, longitudinal studies, and suggestions for each organization is discussed in Chapter Five. The three research questions as well as the implications was utilized as a framework in the next chapter. Implications were identified for formal school settings, NASA and the Girl Scouts.
CHAPTER FIVE

DISCUSSION, IMPLICATIONS WITH RECOMMENDATIONS,
UNEXPECTED IMPACTS AND SUMMARY

Discussion of Results

A significant undertaking to encourage girls to seek out STEM careers has been through a national partnership between the largest all girl institution in the United States, the Girl Scouts, and the most recognized space agency, NASA. This ethnographic study examined the relationship that evolved and developed between the two large national organizations with both having a similar common goal of introducing more girls into science, technology, engineering and math careers. The culture created within this partnership led to the changing beliefs, emotions, and attitudes toward science by the Girl Scout volunteers. Common and shared values and language about science experiences were examined through a feminist epistemology. The three research questions examined the evolution of the partnership by examining the Girl Scout and NASA culture that contained the beliefs, actions, and goals of the two organizations, and finally how the partnership was evaluated.

As the data results revealed in Question One, the relationship enjoyed a healthy growth pattern over the last five years beginning with a pilot study at a summer camp, and continued to offer national events for both girls and adults. The adults that were trained as the original 30 volunteers continued to provide local events, day camps, and
resident camp sessions based on the information they received at national trainings. Tens of thousands of girls and adults engaged in space science activities as a direct impact of the collaboration. A positive effect of the partnership was the formal Memorandum of Understanding (MOU) between the Girl Scouts of the USA and NASA, which indicated the relationship was recognized and sanctioned by both organizations. This MOU was signed in January 2005 and can be renewed if both organizations are in agreement. The significant positive consequences of a sustained adult development plan for volunteer trainers yielded positive results in that the volunteers increased in their own science knowledge, provided over 370 events to girls and adults in local councils, and sometimes led to the adult volunteers enrolling in science college courses or conducting their own research to learn more about the universe.

Question Two addressed the goals, belief systems, and barriers of the GSUSA and NASA partnership. One continuous thread from Question Two’s data collection was the Girl Scout volunteers’ enthusiasm for science, activities, and the partnership which led the NASA staff to pursue more funding for additional opportunities, and the desire of the NASA staff to work with the Girl Scout volunteers again. As the volunteers’ understanding of the science content grew, so did their self-confidence in their ability to understand science, and their commitment to the success of the program increased. Without the on-going training provided to the adult trainers, it was unlikely that the success rate for this program would have reached the remarkable numbers of girls and adults.
Both the Girl Scouts and the NASA participants indicated their concern about funding in the future. Financial resources were not immediately available in either organization and outside agency funding will most likely need to be tapped. Funding concerns was tied to most all other barriers including that of marketing. The Girl Scouts have not produced a “Studio 2-B” booklet for older girls on space science due to lack of funds. Future trainings for adults in the second cadre of volunteers have not taken place as a result of the lack of monies available. The national organization can not provide mini grants to councils to aid in the implementation of the NASA activities because there are no funds to support the grant money needed. Mutually the two organizations’ staff members indicated that top administrators needed to commit to the partnership publicly in order to market and then fund the program. In a manner of speaking this became a marketing issue for each organization internally and one way to resolve the issue may be to share with the top administration that the organizations’ goals were met because of the partnership.

Participants did indicate that the joint goals and individual goals were met but also indicated that materials may need to be adapted for non-educators’ usage. Some of the Girl Scout volunteers have adapted the materials, and have carefully tried to keep the content the same. Most of the volunteers felt that sometimes the materials could be adapted by simply changing how some of the materials are formatted and presented.

Beyond barriers of funding, marketing, and concerns about the materials; consistently the story of adult women changing their own attitude about science was clear. All of the Girl Scout participants agreed that they had a larger appreciation for space science, NASA, and STEM exposure to girls at an early age. Educators and non-
educators in the group reported a higher self-efficacy in science because of the workshops they had attended. The educators in the group included more space science in their classrooms, and all of the volunteers have provided some type of event, training, or activity to their home councils. Reports on the data base from the trainers indicate that local council events have been successful and an appetite has been whetted for more space science activities, and trainers have included this data as part of the feedback to NASA.

Question Three examined all of the different evaluation tools utilized to determine the effectiveness of the partnership between NASA and GSUSA. The data base was one tool which listed the type of activity, and the numbers of people who attended each event. Other evaluation tools included pre and post surveys sent to the volunteer trainers, qualitative field notes, contracted research to study the partnership, as well as this study. Results of all the data will be utilized for future planning to seek other opportunities for the NASA and Girl Scout collaboration. Due to the massive size of this undertaking, a variety of evaluations were employed to determine the strengths and weaknesses of the partnership and to utilize the findings in future partnerships with other organizations.

As all large endeavors of this magnitude, there were some difficulties that became barriers to the partnership. Both NASA and the Girl Scouts will need to address some of these barriers if the partnership is to grow and become sustainable. These barriers become implications and include funding, marketing, engaging top administration, and ensuring that the collaboration continues even if key staff members leave their respected organizations. At times the organizations may have to address the barriers as a united
front, and other times each organization will need to work within its own association to ensure that the partnership continues and is strengthened.

Implications Specific to Both GSUSA and NASA

As a true partnership, the two organizations will need to work in tandem to work through their shared challenges. Shared challenges included funding, marketing beyond their individual organizations, and ensuring that they continue to share common goals within the partnership. In order for the partnership to be sustained and to continue to make progress, long-term funding must be found. One of the strengths of the relationship was the change of attitudes and beliefs about science by the Girl Scout volunteers. This positive change occurred because the training did not become a one-time event, but a series of trainings, which led to a strong network between the trainers, and between the trainers and the NASA scientists. The series of trainings also directly resulted in more girls having exposure to different topics within space science. For example, the topic for the first training for the 30 volunteers was the solar system. The following year, the volunteers learned about the universe, electromagnetic spectrums, and about the sun’s energy. Council events after the second training included the first training topic of the solar system, and topics from the second training on the universe. At JPL, the following year, the 30 trainers were introduced to women from a variety of fields and backgrounds working for NASA. This information was then incorporated into the trainings that the volunteers provided in their home councils. The significance of ensuring that the volunteer Girl Scout trainers have a different opportunities is that when they return to their councils and offer events, some girls may participate who attended prior events. In
order to keep girls engaged in science pursuits, they need a variety of instructional materials and not events that keep repeating the same activities.

A second cadre of volunteer trainers received all three topics during five days instead of 15 days spread out over time. This cadre group has not networked together as tightly as the original group, and has not synthesized the same amount of science content. This is not to say that the second group of trainers does not want the trainings, in fact just the opposite. However, funding has not been made available for them to have additional trainings. Without the on-going training for all cadre volunteers, the synergy and enthusiasm will likely wane over time. Volunteers will eventually leave the Girl Scout organization, and without adding to the training and to the numbers of a highly trained cadre, the results of the relationship previously experienced will diminish. Funding and marketing are interrelated in that if the funding organization does not know the importance or significance of the work accomplished by the two organizations, then the higher probability that the requested funds will be denied.

Implications Specific to NASA

Communication within the NASA organization about the significance of this partnership, and similar collaborations, will become critical to obtain the educational dollars attached to missions. If NASA wants to make an impact on today’s youth, their educational funding has to support early science experiences. Waiting until students are in colleges or universities and then just funding internships will not engage or excite young scientists. The top administration that controls the education budget for NASA needs to become aware of the significance of this collaboration. Research indicated that
girls begin to lose their interest and self-confidence in science before they begin the 8th grade (Meece and Jones, 1996). Therefore, it is critical to reach girls prior to and continuing throughout the adolescent years.

If NASA is truly concerned about the quality and quantity of scientists available for employment then perhaps other organizations should be considered for long-term partnerships. The relationship created with the Girl Scouts and the lessons learned can become a national model for not only NASA to follow but other organizations who partner together for the benefit of the people they serve. One key lesson that was learned was that constant communication between the two organizations was critical to ensure that the individual and joint goals were met. Strategies to meet the goals were discussed to understand how each organization works, and it was imperative for the two organizations to understand the structure, hierarchies, and inner working of the opposite organization.

NASA can not take the short road and try to fit all the different organization’s educational needs into one format of materials either printed or on-line. Materials may need to be adapted for the informal education setting in which the leader of the group may not be a trained educator. It will be important to keep the activities engaging without bringing the content information down. Perhaps formatting the materials to look differently so that the content information is in the back of the educational package will not be as overwhelming to the non-educator presenter. Materials may need to be specific to different groups or at least grouped by kind of group. For example, science museums may be able to use similar materials. Girl Scouts, Girls, Inc., and the Sally Ride Science Centers may need materials that are more “girl friendly.” The idea of the badges tied to
NASA activities was productive until the images of boys doing the science was displayed on the web site.

NASA needs to consider their website and the messages that they inadvertently send to girls. When girls click on Girl Scout activities on the Space Page, they should see pictures of other girls engaged in science. Girls need to begin to reprogram the message of the gender of science. Not only is this important for girls but it is important for boys as well. Research indicated that parents, families, and society have a large influence in how girls perceive science (Klein, 1989; Sadker & Sadker, 1994). Future fathers and brothers need to help their daughters and sisters see themselves as scientists. Science needs to become demystified for girls, and the masculine image of science needs to be countered with feminine images of science. One way to create feminine images of science is to provide girls with science experiences in all female settings that includes access to and images of female scientists such as those that can be provided through the Girl Scout audience.

Implications Specific to GSUSA

If enthusiasm is transferable to others, then the Girl Scout volunteers will easily transfer what they have learned to other adults and to girl members. The Girl Scout volunteer group of trainers will need to be kept current on NASA missions and on educational materials through on-going and frequent trainings. For the thirty trainers who have received this training, the experiences have been exceptional. However, these thirty trainers are under-utilized. They are empowered with a wealth of knowledge, with enthusiasm about science, and knowledge of how Girl Scouts operate in different size of
councils. A potential use of the thirty volunteers is to utilize them as regional or national trainers. Working in groups of two, the volunteers could provide workshops for regional training conferences, program conferences, and specific trainings to councils geographically close to the volunteers. The volunteers would require additional training on how to work with a council that is not their own, so that consistent messages are delivered to all Girl Scouts regardless of the council or its size. This of course takes funding, but if the Girl Scouts are serious about promoting and sustaining this partnership the funding needs to be found. Funding will only be made available if funders outside of GSUSA and NASA are aware of this enterprise, and the reasons why this partnership should continue.

As with NASA, the top administration and other entities need to become educated and engaged in the NASA and GSUSA mission. Marketing throughout the Girl Scout organization needs to occur so that all Girl Scout councils are aware of the dynamics behind this unique partnership, and how to access the NASA activities and trainers. Girl Scout councils who have trainers living within their jurisdiction or geographically nearby need to know that a Girl Scout trainer is available to provide quality NASA science activities to girls and adults.

Although there has been STEM initiatives for years within the Girl Scouts, many of the adult women leaders continue to fear science. Girl Scouting has to help women get over the fear, and one way to assist the women is to continuously provide science workshops that uses everyday materials. The adult women members of councils need to feel more confident in their own abilities if they are to engage more girls in STEM activities. Girls and adults need easier access to physical and chemical activities that
have a more feminine slant such as these words advertising a chemistry workshop for
girls: “Feel good about you! Learn about ingredients in various types of make-up, and
then you will make your own designer make-up!”

The Girl Scout website needs to be girl-friendly so that when girls type in the
word “NASA”, they are immediately directed to the NASA Girl Scout web page.
Additionally, on the Girl Scout web site “Just for Girls” there should be some NASA
activities that are easy and engaging to do with links to other activities either on the
NASA site or other Girl Scout websites. Girls need bombardment of female friendly
science so that the masculine image of science, especially in physics, is more gender
neutral.

Implications for Formal Education

As more school districts adopt less inquiry-based science education models, both
girls and boys will have to find their science inquiry elsewhere. The state of Nevada
requires that all students have a textbook for each subject area including science.
Although textbooks provide reference and content information, they do not support
inquiry-based instruction. Student achievement is raised when students are highly
engaged in the learning activities. After school programs that are inquiry-based and
focus on academics such as science have helped raise test scores (AYPF, 2006). After
school programs such as those offered by the Girl Scouts affords organizations such as
NASA a “built-in” audience. In the State of the Union address on January 31, 2006,
President Bush announced an American Competitiveness Initiative, to encourage
innovation throughout the economy, and to give the nation's children a firm grounding in
math and science. He proposed to double the federal commitment to the physical sciences
over the next 10 years. This funding will support the work in areas such as nanotechnology, supercomputing, and alternative energy sources. He stated that children need to be encouraged to take more math and science, and to make sure those courses are rigorous enough to compete with other nations. He went on to say that we’ve made a good start in the early grades with the No Child Left Behind Act, which is raising standards and lifting test scores across our country. Mathematics and reading tests were mandated beginning in 2002 for students in third grade through grade twelve. Each state developed their own standards and assessments to determine if schools were making adequate progress or were in need of improvement. In many states including Nevada, science was not an area that was scored for Adequate Yearly Progress (AYP), and will not use science as an area to determine AYP until 2007.

Since the push was on to increase reading and math scores, science was not been pushed in many schools (Heller, 2002). School districts, especially those in academically disadvantaged communities, felt the pressure to spend all available money on math and reading basic skills. Inadequate schools may only be able to fund reading and math efforts which could lead to a larger science and technology gap among the nation’s poor and groups underrepresented in science. In order to counter the mentality of more reading and math and less science, a multi-year study was launched in Florida. Romance and Vitale (2001) found that elementary students became better readers by studying science. Students were engaged in inquiry-based science instruction for at least two hours a day which included reading informational text, application of math skills, and utilizing “hands-on” materials. This study was significant in that it demonstrated that students can be motivated through content areas such as science, and application of other academic
skills are easily incorporated. Science and reading utilize many of the same thinking processes such as drawing conclusions, making inferences, usage of vocabulary, and making predictions. The use of guided inquiry which allowed students to ask in-depth questions about a particular topic was utilized in the extended science class. The use of inquiry can be used in reading classes as well which allows students to ask questions of each other and of the text that they are reading. However with more scripted programs comes less inquiry and certainly less hand-on science. Students will not have access to the inquiry-based science that motivates them to search for the answers and to become critical thinkers. Schools must see science as a crucial subject that does not take a backseat to reading and math. Schools must also find teachers who want to teach chemistry, biology, and physics. Currently one of the largest school districts only allows for 80 minutes per week for science in the elementary classroom.

Unexpected Impacts

Neither NASA nor the Girl Scouts could predict one major unexpected outcome and that was the influence the multiple trainings would have on the volunteer trainers. When the trainers were asked the question, “How has this project impacted you?” this researcher anticipated hearing that the volunteer presented more science in the council either to girls or to adults. The researcher heard those types of responses but also heard more of a personal impact: one trainer returned to college at the age of 55 to pursue a degree in astronomy, two others went back to college to take more chemistry classes, and another applied to the teacher in space program. Another response included paying more attention to NASA activities, and this dissertation was a result of the impact on this
researcher. Beyond going back to school, writing a dissertation, or taking additional courses other volunteers felt more of an emotional response as noted in quotes such as, “I know I can do science now, I don’t have to be afraid.” Another response was, “I always thought science was set in concrete. But now, I know that science is always changing, just like the universe. That is exciting to me!” From seeking a new career to creating an interest in space and science, the NASA and Girl Scout partnership did more than provide some activities to Girl Scout leaders. This experience sparked a passion in many of the trainers, a passion to know more about the planet they live on, the system it exists in, and what lies beyond it.

Potential Solutions to Close the Science Gap

If girls are not given more opportunities to pursue science in nurturing settings, the gap that has persisted will continue to exist and perhaps even widen. If schools are spending their time and resources on math and reading while ignoring the sciences, the role of NASA and other science education entities becomes paramount. This is true not only for the girls but for the boys as well. Who will be the next scientists? Who will become the next problem-solvers? Most likely, it will be the students who had early positive experiences with science. Those early experiences may be the ones that occur with informal educational groups such as the Girl Scouts, 4-H, and the Boy Scouts. Gender neutral areas in which neither the boys nor girls need to worry about the presence of each other may be appropriate in the upper grades of elementary school, Junior and High School years when the sexual tensions are especially at their strongest. Students also need mentors and engagement with science with those that are passionate about science.
Summary

In Chapter One several issues were raised why girls have not entered STEM careers. The reasons ranged from the teachers' perceptions of how girls learn science in formal education, equitable access to science materials in class, the idea that at least some sciences are masculine in nature, and the role that parents or society play in girls’ perceptions of who can become a scientist. Test scores have been used an indicator to demonstrate girls’ lack of progress in science. Those scores coupled with the fact that males are employed as scientists by three times the number of women indicated that the United States still has a significant gender gap in science. We can not afford another twenty-five years of girls not excelling in science, technology, engineering, and math. The loss of those potential human resources puts the nation at a critical juncture in science.

Potential solutions to the science gender gap include ensuring that girls and boys receive equitable instruction in science. Some schools have begun to implement same-sex classrooms for girls in science, and for boys in literacy. Instruction needs to be varied and include cooperative learning which allows for the socialization of science. Even in co-educational settings, girls could work in cooperative groups that sometimes are all one gender, and other times with mixed genders. Girls need to have access to the science materials in class and feel confident in how to use the materials.

One way to build girls’ efficacy in science is to provide the girls with quality and meaningful science experiences beyond the school day. Girls need to learn that science is not a masculine endeavor, and is accessible to them. This can be accomplished by providing the girls with feminine images of science. Images include not only pictures of
female scientists, but also interaction with female scientists. A crucial component of the NASA and GSUSA partnership was the interaction with the women scientists during the national workshops. NASA and GSUSA will need to help local councils connect to women scientists in their geographical regions. The two organizations are already making progress toward this end with the latest NASA Explorer Institute (NEI) which connected local Girl Scout councils to NASA centers. This work needs to continue and expand beyond the NASA scientists.

Some Girl Scout councils have connected with local chapters of Women in Engineering, some councils have received grants to create science kits, and others are involved with the Lockheed Martin or Intel programs. Regardless of who is providing the science support to the girls, there are critical key factors. The first is that the Chief Operating Officer (CEO) of the local Girl Scout council needs to commit to the partnership, and the volunteers need to embrace the program. The organization providing the science content, materials, and/or personnel also need to commit for a long-term and sustainable relationship. If girls receive quality positive science experiences as a result of their involvement in Girl Scouting, they may decide to enter a STEM career. Men and women often make career choices based upon experiences they had as youth.

Another factor that has prevented women from entering science careers is the societal role that has been placed on women. If parents want to stay at home with a young child, it is more likely the female that stays home. Child care facilities are available at most of the NASA centers, but this is not true for all other science agencies. Some science jobs require field work which may take the parent away from the home for more than a day at a time. Society seems to have more understanding of that situation if
the male is absent from the home, but is not as understanding if the woman is away from
the children.

In order for the societal expectations of women to change, the way women are
perceived will need to change. Girl Scouting empowers girls and women to think beyond
the normed expected role. Juliette Lowe, the founder of Girl Scouts, said over 90 years
ago that she had something for every girl in the United States. She was committed to
providing girls with experiences that they normally would not have, and even the earliest
Girl Scout badges such as Aviation included subject areas that were considered to be
within the male’s dominion. There are currently over 75 Girl Scout badges or insignia
that are themed to STEM. A current goal is to help Girl Scout leaders put aside their
fears and allow the science to get to the girls. Girl Scout volunteers such as the 30
participants in this study are the best prepared and able to meet the needs of the Girl
Scout leaders simply because they have walked in the same shoes as their sister Girl
Scouts. The empowerment of the Girl Scout volunteers was a result of the Girl Scout
organization’s ongoing mission to instill in women and girls the confidence to try new
things. The Girl Scouts have always been resourceful, and they were wise to partner with
NASA which could bring the space science information to girls “as only NASA can.” If
women and girls can create a culture within their Girl Scout groups such as the culture
that has been created by the Girl Scout Volunteers and the NASA scientists, then perhaps
girls can look beyond society’s expectations and truly look toward the stars.
APPENDIX A

INITIAL SEMI-INFORMAL INTERVIEW QUESTIONS

1. How did you become involved with the Girl Scout/NASA partnership?

2. What has been your observations of the collaboration between NASA and GSUSA?

3. What do you think your organization has learned from this experience?

4. How does or has the collaboration benefited the organization’s goals?

5. What has been your experience with this collaboration?

6. If you were involved with the development of the MOU, explain how the process evolved.

7. What methods or ways is this partnership evaluated for success? What types of evaluation or data would you want but are not receiving?
APPENDIX B

REvised SEMI-FORMAL INTERVIEW QUESTIONS

1. How did you become involved with the Girl Scout/NASA partnership?

2. What has been your observations of the collaboration between NASA and GSUSA?

3. How has the partnership impacted you as an individual, your council or other councils in which you volunteer?

4. How does or has the collaboration benefited the organization’s goals?

5. What has been your experience with this collaboration?

6. If you were involved with the development of the MOU, explain how the process evolved.

7. What methods or ways is this partnership evaluated for success? What types of evaluation or data would you want but are not receiving?
**APPENDIX C**

**TRANSCRIPT PORTION OF INTERVIEW WITH GIRL SCOUT VOLUNTEER**

<table>
<thead>
<tr>
<th>Interviewer</th>
<th>Girl Scout Volunteer</th>
</tr>
</thead>
<tbody>
<tr>
<td>If you could say anything to NASA, what would you say?</td>
<td>Oh my gosh. I would say thank you. I would say you have opened my eyes. You have broadened my whole universe, not my world, but my universe. You make me look up. You make me tell other people to look up. You have imparted a great…my faith in God is better. I mean, I thank them. You have enriched my life beyond anything that I could tell you.</td>
</tr>
<tr>
<td>If you could say anything to the National Girl Scouts, what would you say?</td>
<td>If I could say one thing to the National Girl Scouts?</td>
</tr>
<tr>
<td>Yeah, or anything to the National Girls Scouts, what would you say?</td>
<td>If I could say anything to the National Girl Scouts, I would say continue to encourage the council to foster women who want to train in this and who want to bring this back to the council. Pay these people to go on trips with NASA to train with them. And not just staff, but enthusiastic volunteers.</td>
</tr>
</tbody>
</table>
MEMORANDUM OF UNDERSTANDING
BETWEEN THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
AND THE GIRLS SCOUTS OF THE USA

Authority

This Memorandum of Understanding (MOU) is entered into between the National Aeronautics and Space Administration (NASA) and the Girl Scouts of the USA (GSUSA). Both organizations desire to establish a long-term sustainable relationship based on a strong foundation of programs aimed at meeting mutual core goals of both organizations. GSUSA is a corporation incorporated under and existing by virtue of an act of Congress of the United States of America approved March 16, 1950. This corporation is a successor to Girl Scouts of the United States of America, a former District of Columbia corporation which was originally incorporated as Girl Scouts, with the Headquarters office located at 420 Fifth Avenue New York, New York 10018. The legal authority for NASA to enter into this agreement is found in sections 203 (c) (5) and (6) of the Space Act of 1958, 42 U.S.C., section 2473 (c).

This MOU supersedes the MOU dated February 28, 2003, between NASA’s Office of Space Science at the Jet Propulsion Laboratory (JPL) and GSUSA.

Background

NASA’s Office of the Chief Education Officer has the lead role in the Agency to inspire and motivate students to pursue careers in science, technology, engineering, and mathematics and engage the public in shaping and sharing the experience of exploration and discovery.

With its ability to capture the imaginations of educators, students, and the general public, NASA has a unique capacity to help revitalize science, technology, engineering, and mathematics (STEM) education in America. An MOU between NASA and GSUSA will afford NASA an opportunity to offer engaging STEM experiences “as only NASA can” to the Nation’s girls and women. This collaboration will provide a mechanism to inspire pursuit of STEM-related careers and provide a diversified and scientifically literate pool of individuals that will help us meet our Nation’s technical workforce needs in the 21st century.
GSUSA has over 2.8 million girl members, 962,000 adult members, and 315 regional councils. GSUSA has embarked on a bold and aggressive path to approach the Nation's preteen and teen girls and to attract diverse groups. Ultimately, GSUSA is looking to advance women in leadership and citizenship roles and support a new generation of forward-thinking women. Five program levels reach girls in kindergarten through the 12th grade. GSUSA offers a variety of delivery systems for Girl Scout programs that include workshops, day and residential camps, special events, interest groups, mentoring projects, career days, and the more traditional troop groups' programs. GSUSA is already using NASA-related content as the basis for several awards programs including Space Explorer for Brownies, Aerospace, and Sky Search badges for Junior Girl Scouts, and Space Exploration project awards for Cadette and Senior Girl Scouts. GSUSA also has a core STEM initiative, Girls Go Tech, which focuses on helping girls have fun while becoming innovative inventors and problem solvers through STEM-enrichment activities on-line or through hands-on experiences such as astronomy camps, design challenges, and career expos.

The mutual goals of the is collaborations are to 1) raise the comprehension and interest of science related topics among girls, leaders, and leader-trainers and 2) encourage girls and women to pursue careers in science, technology, engineering, and mathematics.

Responsibilities of the Parties

GSUSA will use reasonable efforts to:

- Conduct activities designed to improve the ability of adult members to understand and communicate NASA-related STEM concepts. The primary vehicle will be national and regional workshops for Girl Scout trainers. The training will also be given to leaders and the senior girls who mentor younger girls.

NASA will use reasonable efforts to:

- Support GSUSA training experiences related to NASA content and technical work that is designed to enhance the understanding of NASA-related STEM topics and careers.

NASA and GSUSA will use reasonable efforts to:

- Establish appropriate linkages to each organization's programs, products, and resources.
- Identify NASA-related instructional content, experiences, (existing internships and mentoring opportunities), and information that can be used to enhance the GSUSA program goals and objectives.
• Develop new models and implementation strategies for onsite training and special events.

• Identify appropriate mechanisms and venues for NASA to recognize GSUSA’s outstanding accomplishments.

• Support joint events recognizing this agreement and other national STEM initiatives that it supports.

• Strive to highlight the opportunities, programs, and successes in the relationship through press releases, content for the NASA Portal, the GSUSA online newsletter, and the GSUSA Leader Magazine.

• Jointly develop an implementation plan to identify measurable goals, associated metrics, and evaluation plan of program effectiveness.

Points of Contact

Correspondence concerning this MOU should be directed to the following points of contact:

For GSUSA: For NASA

Michelle Hailey James L. Stofan
Program Membership Research Director, Informal Education Division
Consultant Funded Initiatives NASA Headquarters
GSUSA Headquarters Suite 2Q88
420 Fifth Avenue, 15th Floor 300 E. Street, SW
New York, NY 10018-2798 Washington DC 20546-0001

Funding

This is a nonreimbursable agreement. There will be no transfer of funds between NASA and GSUSA in connection with this MOU. Each party will fully fund it own participation subject to physical, personnel, and budget resource availability.

All activities under or pursuant to this MOU are subject to availability of appropriate funds, and no provision contained in this MOU shall be interpreted to require obligation of payment of funds in violation of the Anti-Deficiency Act, 14 C.F.R.& 1221.110.

A separate instrument, signed by both parties, may provide for transfer of funds or other NASA resources within the scope of this MOU based on NASA program goals and availability of funding.
Liability

With regard to activities undertaken pursuant to this MOU, neither party shall make any claim against the other, employees of the other, the other’s related entities (e.g., contractors, subcontractors, investigators, or their contractors or subcontractors), or employees of the other’s related entities for any injury to, or death of, its own employees or employees of related entities, or for damage to, or loss of, its own property of that of its related entities, whether such injury, death, damage, or loss arises through negligence or otherwise, except in the case of willful misconduct.

The parties further agree to extend this cross-waiver to its related entities by requiring them, by contract or otherwise, to waive all claims against the other party, related entities of the other party, and employees of the other party, or of its related entities for injury, death, damage, or loss arising from, or related to, activities undertaken pursuant to this agreement.

Application Law

U.S. Federal law governs this MOU for all purposes including, but not limited to, determining the validity of the MOU, the meaning of its provisions, and the rights, obligations, and remedies of the parties.

Use of the NASA Name, Initials, Symbols, and Insignia

Use of NASA’s name, initials, and insignia by GSUSA is subject to prior review and written approval by the NASA Assistant Administrator for Public Affairs or designee. GSUSA agrees to submit to the NASA Assistant Administrator for Public Affairs or designee for approval any material that uses the NASA name and insignia, including all promotional and advertising material. Approval by NASA public affairs shall be based on applicable law and policy governing the use of the words “National Aeronautics and Space Administration” and the letters “NASA,” and the NASA insignia. 14 C.F.R. &1221.110.

Use of the GSUSA Name, Service Marks and Trademarks

GSUSA has the sole and exclusive right by virtue of its Congressional Charter, including, inter alia, 36 U.S.C. & 80106 et.seq., to have and use all service marks, trademarks, emblems and badges, descriptive or designating marks, and other words or marks now or heretofore used in carrying out its program. GSUSA is the owner of the GIRL SCOUTS name, service mark, and trademark and the distinctive TREFOIL design mark, and of all other associated names and marks, slogans, insignias, logotypes, and designs including but not limited to, the names and marks “Girl Scouts of the United States of America” and “Scouts.” GSUSA also owns trademarks including, but not limited to, WHERE
Intellectual Property

I. Definitions: The term “participant,” as used herein, means any non-Federal Government entity that is a party to this MOU. The rights in data set forth herein are applicable to any employees, contractors, or subcontractors, or other entities having a fiduciary or contractual relationship with the participant that are assigned, tasked, or contracted with to perform specified participant activities under this agreement.

The term “data,” as used herein, means recorded information, regardless of form, the media on which it is recorded, or the method of recording. The term includes, but is not limited to, data of a scientific nature, computer software, and documentation thereof, and data comprising commercial and financial information.

II. General: Data exchanged between NASA and participation under this MOU will be exchanged without restriction as to its disclosure, use, or duplication, except as otherwise marked or as otherwise provided below in this provision.

III. Confidential Data: It is not contemplated that either participant or NASA will furnish the other party with confidential information under this MOU.

IV. Copyright: In the event data is exchanged with a notice indicating that the data is protected by copyright, such data will be presumed to be published and the following paid-up licenses apply:

(1) If indicated on the data that said data existed prior to or was produced outside of this MOU, the receiving party and others acting on its behalf may reproduce, distribute, and prepare derivative works, for internal use, for the purpose of carrying out the receiving party’s responsibilities under this MOU.

(2) If the furnished data does not contain the indication of (1) above, it will be assumed that the data was first produced under this MOU, and the receiving party and others acting on its behalf, may reproduce, distribute, and prepare derivative works for any of its own purposes. All joint works, as that term is defined under copyright laws, created by the parties under this MOU shall be jointly owned, and neither party shall have to account to the other for profits.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Nonexclusivity

Nothing contained in this MOU, or in any of the activities under or pursuant to this MOU, shall be construed as creating either explicitly or implicitly an exclusive relationship between NASA and GSUSA. Each party shall be free to discuss, contract, or agree with other entities, public, or private, concerning matters of the same or dissimilar topics.

Assignment of Rights

Neither this MOU nor any interest arising under it will be assigned by GSUSA or NASA without the express written consent of the officials executing the MOU.

Release of General Information

Releases may be made by either party for its own portion of the program/cooperation as desired. Insofar as participation of the other party is involved, the parties will seek to consult with each other, as appropriate, prior to any release, consistent with the parties’ respective laws and policies.

Duration and Termination

This MOU shall become effective upon the date of the last signature below and shall remain in effect for a term of 5 years. Any modifications to this MOU shall be executed in writing and signed by the signatories to this MOU or their designees. This MOU may be terminated at any time by either party, at its sole discretion, upon 30 days notice to the other party.

Continuing Obligations

The obligations of the parties set forth in the provisions “Liability” and “Intellectual Property” will continue to apply after the expiration or termination of this MOU.
Signatures

For NASA

Sean O’Keefe
Administrator
NASA

Date: December 21, 2004

For GSUSA

Kathy Cloninger
Chief Executive Officer
GSUSA Headquarters

Date: January 26, 2005
WEB PAGES FROM GSUSA WEB SITES

National Aeronautics and Space Administration (NASA)

Also see:
- Mission Implications
- Space, Arts, and Education
- Great Inventions

Outside Links:
- NASA's Mars Exploration Program
Program Opportunities: Science, Technology, Engineering, and Math

NASA

Girls Scouts of the USA has worked with NASA for more than 15 years to promote interest and engagement in science, technology, engineering and math (STEM) with a shared common goal to enable more youth and adults to embrace the value of STEM. NASA signed a Memorandum of Understanding with GSUSA in January 2005. Strengthening this comprehensive partnership has provided adult development training opportunities, materials development, career exploration, research sharing, mentors, community outreach exhibits, summer workshops for girls, field trips relating to earth and solar exploration.

Currently, more than one-fifth of Girl Scout councils have attended one or more trainings by NASA science experts. These councils have engaged over 100,000 girls in NASA missions, research and centers across the United States and international locations.

Nature and Science

Fun and Easy Activities: Nature and Science (bilingual) and Fun and Easy Nature- and Science-Investigations (available in English and Spanish) features fun and easy indoor and outdoor activities that leaders can use to help girls conduct their own science and nature investigations using local resources and inexpensive materials.

JOIN US! SUPPORT US! VOLUNTEER! CAREERS! FIND A COUNCIL! GIRL SCOUT CENTRAL
Girlsgotech  Webpage  www.girlsgotech.org/resources.html

The Girl Difference: Short-Circuiting the Myth of the Technophobic Girl, a review of current research on girls and technology, is available as a research review or executive summary. Call (800) 221-6707 to purchase or visit www.girlscouts.org/research for more information. (New York, N.Y.: Girl Scouts of the USA, 2001)


The Cool Careers for Girls series by Ceel Pasternak and Linda Thornburg. Targets middle-school-age girls and focuses on career paths and mentoring. (Manassas Park, Va.: Impact Publications)


Online

Girl Scouts of the USA: www.girlscouts.org
The Girl Scouts Web site has a portal for girls called Girls Only (www.gogirlsonly.org) and for teens called STUDIO 2B (www.studio2b.org).

Girls are I.T.: www.girlsareit.org
A Web site from Girl Scouts, Hornets' Nest Council of Charlotte, N.C., where girls can explore the history of technology through an interactive timeline, read about empowering technology careers from women across the country, and post their ideas on how technology can improve our lives in the future.

NASA: www.nasa.gov
The National Aeronautics and Space Administration is behind the USA's space program. Find out all things spacey at their Web site.

Public Broadcasting Stations: www.pbs.org and www.pbskids.org
The local and national PBS stations have tons of cool science stuff for kids—both online and on screen. Check out the national Web site, the national kids' Web site, and links to your local stations.
Help with Junior Girl Scout Badges at The Space Place

Important note

Please see your Girl Scout books for complete descriptions of badge requirements.

<table>
<thead>
<tr>
<th>Junior Girl Scout Handbook...</th>
<th>Space Place Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 7: Let's Get Outdoors</td>
<td>Become a Weather Wizard and learn weather map symbols.</td>
</tr>
<tr>
<td>Symbol Hunt</td>
<td></td>
</tr>
<tr>
<td>Chapter 9: Explore and Discover</td>
<td>Make yummy Moon Cookies, Star Cookies, or Asteroid Potatoes</td>
</tr>
<tr>
<td>Mix it up as a Cook</td>
<td></td>
</tr>
<tr>
<td>Computer Fun and Games</td>
<td>For lots of opportunities for fun and games, try Spacey things to make, Spacey things</td>
</tr>
</tbody>
</table>
Make Asteroids You Can Eat!

Create your own odd-shaped asteroids out of plain old mashed potatoes. Bake them in the oven to turn them (more or less) asteroid color. Then eat your asteroids for dessert!

Click here for how to make Asteroid Potatoes.

The Big Deal About Asteroids

Asteroids are chunks of rock that never quite made it to full-fledged planet-sized when our solar system formed. Most of them orbit the sun in a "belt" between Mars (the fourth
APPENDIX G

EXAMPLE OF GIRL SCOUT VOLUNTEER ADAPTATION OF NASA ACTIVITY FOR YOUNG GIRLS

Adapted from NASA materials: Destination to Mars-Looking for Life

MARS: Other World Soil Samples

This activity will help younger girls observe and look for evidence of life in soil. It is best if someone other than the girls makes up the soil sample. That way the contents will be a total surprise and the search will be more interesting.

Supplies
3 small jars with lids clean sand or soil per group
instant active dry yeast 1 teaspoon per jar
Magnifying lenses
tiny bits of plant debris (bit of pine needle, stick, dried leaf, etc.)
tiny bits of animal debris (hairs, tiny sea shells, bits of bone, dried insect parts, etc.)
Make sure the sand/soil has no man-made objects in it.
Mix into 4 tablespoons of sand/soil a couple of teaspoons of yeast and an assortment of plant and animal debris.
Make several jars of “other world soil samples” varying the contents from jar to jar. Be sure to put yeast into every jar.

Keep a small amount of yeast in a separate jar.
After the girls have looked through their “other world soil” sample for life let them have a look at the yeast with a magnifying glass.
How many girls spotted the yeast as a life form?
APPENDIX H

EXAMPLE OF NASA MARS ACTIVITY: LOOKING FOR LIFE

Activity 2 —

Looking for Life

About This Activity
In Activity A students will use research to develop their criteria for life. The class will combine their ideas in a teacher-guided discussion. In Activity B they will then use those criteria for life to determine whether there is anything alive in three different soil samples. They will make observations and draw pictures as they collect data from the samples and experiment.

Objectives
Students will:
• form an operational definition of life,
• conduct a simulated experiment with soil samples similar to the experiments on the Mars Viking, Landers,
• state relationships between the soil samples using their operational definition of life,
• make an inference about the possibility of life on Mars based on data obtained.

Background
We usually recognize something as being alive or not alive. But when scientists study very small samples or very old fossilized materials, the signs of life or previous life are not easy to determine. Scientists must establish criteria to work with in their research. The tests for life used by the Viking Mars mission were based on the idea that life would cause changes in the air or soil in the same way that Earth life does. The Viking tests did not detect the presence of life on Mars. The Viking tests would not have detected fossil evidence of past Mars life or a life form that is very different from Earth life.

Vocabulary
criteria, characteristics, organism, replication, metabolic

Part B: It’s Alive!

About This Part
Students will take three different soil samples and look for signs of life based on the criteria from Part A.

Materials
• sand or sandy soil sample
• three glass vials, baby food jars, or beakers for soil per group
• sugar—5 ml sugar will be added to all soil samples
• instant active dry yeast—5 ml added to 50 ml of soil
• Alka-Seltzer tablets—crushed-1 tablet added to 50 ml of soil
• hot water—enough to cover the top of the soil in all jars (not hot enough to kill the yeast!)
• cups for distributing the water
• magnifying lens—1 per group or individual
• Student Sheets Data Chart I and Data Chart II (pgs. 45-44)

Procedure
Advanced Preparation
1. Fill all jars 1/3 full of soil. You will need 3 jars per team.
2. Add just sugar to 1/3rd of the jars. Label these jars “A.”
3. Add instant active dry yeast and sugar to 1/3rd of the jars. Label these jars “B.”
4. Add the powdered Alka-Seltzer and sugar to the remaining jars. Label these jars “C.”
5. Give each group a set of three jars, magnifying lens, and the chart from previous activity.

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**Classroom Procedure**

1. Explain to the students that each team has been given a set of soil samples. No one knows if there is anything alive in them. The assignment is to make careful observations and check for indications of living material in them—based on their criteria.

2. Ask students to observe all three samples. They can smell and touch the samples but not taste them. Encourage students to put a few grains on a flat white surface and observe them with a hand lens. Students should then record their data.

3. Give each group a cup of water. (Use hot tap water (~50°C) for the best results, do not kill the yeast.) Ask students to pour the water so that each sample is covered with the water.

4. Repeat step 2 and record data on a second sheet or in a separate area of the first sheet. Students should look for and record differences caused by adding water. After recording the first observations have students go back and observe again. (After about ten minutes Sample B will show even more activity.)

5. Discuss which samples showed indication of activity (B and C).

6. Discuss which samples contained life by applying the fundamental criteria for indicating life developed in Activity 2.

7. Tell students that Sample B contained yeast and Sample C contained Alka Seltzer. Discuss how scientists could tell the difference between a non-living chemical change (Alka Seltzer) and a life process (yeast) which is also a chemical change.

8. Discuss which of their criteria would identify yeast as living and Alka Seltzer as non-living.

Does that activity mean there is life in both B and C and no life in Sample A? Are there other explanations for the activity in either B or C?

- Both B and C are chemical reactions
- Sample C reaction stops
- Sample B sustains long-term activity
- Sample A is a simple physical change where sugar dissolves

Students should realize that there could be other tests that would detect life in Sample B. There might be microbes in the soil that would grow on a culture medium.
APPENDIX I

PRE-SURVEY INSTRUMENT TOOL FOR EVALUATION

GSUSA NASA Experiences: A Vision for Girls in Earth and Space Science
Macy Trainee Workshop Pre-survey – December 8, 2004

We request your opinion on these questions relevant to your background and to this week’s training. Your voluntary responses will be held in complete confidence. All the data will be summarized and only de-identified published as part of the entire group; no one will be identified. In order to successfully relate your responses today with those on future surveys, it is essential that you include your name on the bottom of the survey. Under James Redd, the GSRI coordinator, will read your surveys with the identifying information on them.

Circle the number indicating your own level of proficiency in each of the following categories using the scale from "1" to "5," where "1" is novice and "5" is advanced.

<table>
<thead>
<tr>
<th>Category</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Knowledge of science in general</td>
<td></td>
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</tr>
<tr>
<td>2. Knowledge of technology</td>
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<tr>
<td>3. Knowledge of engineering</td>
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<tr>
<td>4. Knowledge of mathematics</td>
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<td></td>
<td></td>
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<tr>
<td>5. Knowledge of earth science</td>
<td></td>
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<tr>
<td>6. Knowledge of space science</td>
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<td>7. Training adult trainers (any topic)</td>
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<tr>
<td>8. Teaching girls (any topic)</td>
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<tr>
<td>9. Knowledge of careers in STEM fields in general</td>
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<tr>
<td>10. Knowledge of required education for STEM careers</td>
<td></td>
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<tr>
<td>11. If you have specific expectations of this week’s training, what are they?</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Please indicate your primary position in Girl Scouting (check only one):

- Council board board committee member
- Council executive staff
- Special service adult
- Troop group leader assistant leader
- Troop leader
- Other (specify: ____________________________)

Please print your first and last name: ____________________________

What council do you work in? ____________________________

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APPENDIX J

POST SURVEY INSTRUMENT FOR EVALUATION

GSU SA NASA Experiences: A Vision for Girls in Earth and Space Science
Macy Trainer Workshop December 7-12, 2004 Post-training Survey

In our effort to further the NASA-GSU collaboration and to provide the trainers with useful feedback we request your frank responses on this voluntary post-training survey. The data will be summarized and disseminated as part of the entire group. In order to protect your identity, your responses will be confidential. This survey has two main sections: one about the overall NASA training and the other about you. Please carefully respond at each item.

For items 1 through 8, circle the number indicating your level of agreement with the statement. Circle 1 for "strongly disagree," 2 for "disagree," 3 for "neither agree nor disagree," 4 for "agree," and 5 for "strongly agree."

<table>
<thead>
<tr>
<th>Overall, the NEI training:</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. content increased my knowledge of earth and space science concepts</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. formal was an effective way to acquire understanding of the concepts and skills needed to teach them to others</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overall, the NASA staff:</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neither Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. was knowledgeable of their subject matter</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. was organized and prepared</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. made good use of examples and illustrations</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. handled questions well</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. was enthusiastic and interesting</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. presented the material in a way that I could understand</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

9. Rate each of the following six segments of the NEI training on each segment's design, the degree to which it changed your knowledge, and the extent to which it may affect your training skills. Write "1" for "little," "2" for "somewhat," "3" for "much," and "NA" for "not applicable." Refer to Activities and Topics for Workshop Segments to stimulate your recall of the segments.

<table>
<thead>
<tr>
<th>Segment Design</th>
<th>Changed your Knowledge</th>
<th>Affect your Skills</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Earth Science</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Solar System</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Electromagnetic Spectrum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Sun-Earth Connection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Universe and Origins</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Mission Design</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

10. Were the connections and thematic threads evident and clearly articulated? No Yes
11. Was the time provided for any of the seven segments too much or too little? ____ No  ____ Yes

If "yes," explain. ____________________________________________________________

12. Thinking specifically about the presentation and the flow (not the specific content) of the training,
   a. What worked well? _______________________________________________________

   b. What might work better? ________________________________________________

13. What were the most valuable aspects of the entire NEI training? __________________________________________________________________________

14. If you have a recommendation for improving this training, what is it? __________________________________________________________________________

15. Rate your own level of proficiency following this week's training in each of the following categories using the scale from '1' to '5,' where '1' is novice and '5' is expert.

<table>
<thead>
<tr>
<th>Knowledge of:</th>
<th>Novice</th>
<th>Intermediate</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. earth science</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>b. solar system</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>c. sun-earth connections</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>d. universe and origins</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>e. space mission planning and design</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>f. why we explore our solar system and beyond</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>g. how we explore our solar system and beyond</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>h. careers in space science</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

16. In the space provided, write a brief summary of your "back home" plan. Include the audience (and numbers) that you intend to affect directly and indirectly within one year; over how many sessions and the length of each will your training take place; what content you will present; your expected method of training; what resources you will require from your council; etc.
17. Briefly sketch in what way you have grown from and/or how you can use the following experiences with your future audiences.

Journaling

Interviewing

Future planning

18. Finally, please provide the following demographic information.

Please print your first and last name: ________________________________

Number of years as adult in Girl Scouts: ____________________________

List Girl Scout positions held and number of years in each: ____________________________

Number of years as a girl in Girl Scouts, and until what age: ____________________________

Educational background (check highest degree achieved)

High School or less  Associate  Bachelor  Master

Doctorate  Professional (e.g., MD, DDS, JD)  Other

If beyond high school, what was your major field of study? ____________________________

What is your current employment outside of Girl Scouting? ____________________________

Aside from Girl Scouting, what is your current volunteer work? ____________________________

Use these lines to write any comments: ____________________________________________

Thank you much for your participation.
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