

THESIS

ENGAGING UNDERSERVED AUDIENCES IN INFORMAL SCIENCE EDUCATION
THROUGH COMMUNITY-BASED PARTNERSHIPS

Submitted by

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ABSTRACT

ENGAGING UNDERSERVED AUDIENCES IN INFORMAL SCIENCE EDUCATION THROUGH COMMUNITY-BASED PARTNERSHIPS

This thesis explores the impact of the Science Education and Engagement of Denver (SEED) Partnership on three of its participant families. The partnership, consisting of large informal science organizations, as well as small community-based organizations, created its programming based on prior research identifying barriers to minority participation in informal science education programs. SEED aims to engage youth and families of emerging populations in science and nature. Three families were examined as a case study to have an in depth investigation about their involvement in the programs sponsored by the partnership. Findings suggest a positive impact on participant feelings and engagement in science and nature. Future recommendations are made for furthering programming as well as conducting a larger scale, more comprehensive program evaluation. This research addresses prior studies that have identified several barriers toward participation of underserved audiences in informal science education programs and how the SEED partnership has addressed specific identified barriers.

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Chapter 1 - ENGAGING UNDERSERVED AUDIENCES IN INFORMAL SCIENCE EDUCATION THROUGH COMMUNITY-BASED PARTNERSHIPS

With current environmental concerns such as climate change, clean energy, water quality, sustainable agriculture, conservation of ecosystems, and endangered species, the science, technology, engineering, and mathematics (STEM) fields require qualified people to tackle these issues by means of scientific research, environmental communication, and education. Yet, the quickly growing minority populations, particularly Latinos here in the U.S., are underrepresented in these important fields. The U.S. census (n.d.) stated that as of 2010, 27.6 % of U.S. residents are minorities. In the fields of science and engineering, minority scientists are reported as having a higher rate of unemployment than Whites (NSF, 2011). The same report states that one antecedent to the higher rate of unemployment for specific ethnic groups is the relatively low percentage of these minorities receiving degrees in science and engineering fields compared to Whites, indicating that if there was an increase in minority pursuit of STEM careers, this could aid in a potential solution for unemployed, emerging populations. With the high percentage of minorities in the population, the paucity of minority representation in the STEM fields is unacceptable. These fields benefit from a diverse display of perspectives in a profession aimed at finding solutions for environmental issues that affect people of all ethnicities living in the United States. Therefore, the array of professionals in the STEM fields in the U.S. should mirror the overall demographics of the population in order to allow for a broad, cross-cultural perspective. This cross-cultural perspective provides insight on how to best reach out to people worldwide who are affected by global environmental issues.

This research is guided by the concept that minority engagement in science can be positively influenced by Informal Science Education (ISE) programs and, even further, through ISE programs that are supported by community-based partnerships (Rahm & Ash, 2008; Bosma,

2010; & Grant, 2010). Having a positive experience with science is one way to raise awareness of STEM careers and self efficacy in school-aged children of emerging populations who might consider pursuing a career in this field. Engaging youth in science can be challenging in a traditional classroom setting. However, many researchers have found that programs offered outside of the typical school day can provide enriching experiences that cultivate a fascination with science and nature (Allison & Hibbler, 2004; Basu & Barton, 2005; Bruyere & Gobbs, n.d.; Rahm & Ash, 2008). ISE is playing an instrumental role in addressing the matter of engaging youth in science and igniting a curiosity in the pursuit of STEM careers. This study explores the underrepresentation of minority populations in the STEM field and the current U.S. achievement gap, as well as minority interest in science. Identified barriers to participation in ISE programs, as well as the role of collaborative partnerships in supporting ISE as a means of engaging underserved audiences in science and nature, are also examined. Recommendations for successful partnerships and ISE programs are offered in the context of future research endeavors that may be undertaken.

Underrepresentation in STEM

Given the well documented achievement gap between majority White students and minorities in the U.S. (NCES, 2003), there is a need to raise the interest and engagement levels of underrepresented student populations to increase the academic achievement of minorities in science. Today, more urban Americans have been born abroad than since the influx of immigrants during the early 1900s (Walker & Manjarrez, 2003). The underrepresentation of minorities in the STEM fields lends to the perspective of these emerging populations being lost in the undertaking of current environmental issues. Educators must be concerned with all children, but the education of minority students merits particular consideration (Wenner, 2003).

U.S. Achievement Gap in Science

Currently the U.S. faces an achievement gap in science between White students and minority students. The NCES (2003) reported that White students had a higher average performance in science than Hispanic and Black students. In the 2003 report by NCES, students were separated into categories according to parental educational attainment. The performance results showed that students whose parents had completed high school (mostly White) had a higher level of science knowledge than students whose parents who had not completed high school (mostly Hispanic). Lack of parents' secondary educational accomplishment was directly correlated with the students' achievement in science.

If parents are a contributing factor to a child's attitude toward science, then science-specific conversations within a family may directly affect a child's self-efficacy in the sciences, which would lead to overall interest and in turn, achievement. Siegel et al. (2007) analyzed the conversations regarding science in families of Mexican-descent. The study found that parents with a higher educational background were more verbose and explanatory in various science-related topics than those parents who had a more basic educational background. The authors noted that it is especially important to be aware of the style of conversations had at home for children from groups who are underrepresented in the sciences in order to foster scientific literacy (Siegel et al., 2007).

Parent-child relationships and science conversations within a family, thus, appear to be important considerations regarding a student's likelihood of attending college, and additionally (for those students that do attend college) to pursue a STEM career. The achievement gap of minorities in science needs to be addressed in order to motivate those populations underrepresented in STEM to pursue those fields in college. According to Cole and Espinoza

(2008), the number of college-age Latinos will increase from 3 million to more than 8 million by 2040. Yet Latino college enrollment will only increase from the current 1 million (approximately) to about 2 million in that time period. This study also illustrated the correlation between Latino students choosing STEM majors in college and their achievement and preparation in high school. One implication is that Latino students who are not academically prepared in science are lacking the interest level to go after a career in a STEM field. In addition, Quimby et al. (2007) found that minorities perceive many educational and career-related barriers toward pursuing a career in an environmental or science field.

Minority Interest in Science

It is essential to investigate the interest level of minority populations when considering how to engage this audience in science. Wenner (2003) compared two schools (one inner city school with minority Black and Latino students, and one private school with White, upper class students) in order to measure student interest level in science education based on race and social economic status. He addressed five areas: perception of scientists, level of knowledge, personal sources of science information, voluntary participation in science activities, and desired level of science instruction. The findings indicated that while the students in the inner-city school did show less overall science knowledge compared to the students in the private school, they also showed a stronger desire for more science education.

Sorge et al. (2000) also found that minority Hispanic students are just as likely to think that science is interesting as their White classmates. This study focused on the attitudes of Hispanic middle school students toward science in ISE programs stated the importance of positive attitudes towards science for students who may consider a career in a STEM field. Additionally, the value of student exposure to research, role models, and after-school programs

were noted as effective means of increasing interest in science.

Basu et al. (2005) took the idea of minority interest in science even further by interviewing 2,000 urban minority students in order to discover the origins of their interest in science. The research uncovered that students were interested in science after they were able to identify with it, within the context of relevancy to their personal lives. In other words, if students were able to view science as a means to a future life goal, an interest was cultivated. One implication here is that, again, minority students can be just as interested in science as White students, but this audience needs to be reached on a culturally relevant plane.

ISE Influences on Participation of Minorities

For purposes of this paper, ISE is defined as science education that takes place outside of the formal learning environment, while striving to enhance classroom learning. There have been numerous advantages documented regarding student participation in ISE programs. Through an examination of the National Science Foundation (NSF) funded ISE programs, Many ISE programs take place outside of the typical classroom and often a non-formal approach to teaching or learning science. For example, attending events sponsored by a zoo, museum, or botanic garden would be considered ISE activities.

Sladek (1998) described ISE as consisting of activities that “engage [the participant] with science on their own initiative and not as part of a mandated school experience, “students are then able to apply new knowledge more broadly and are also exposed to potential STEM career choices (p. 1). This definition implies an effect on science achievement through ISE.

Participants who benefit from ISE programs become more science literate. This is essential for minority students who, as previously stated, are experiencing an achievement gap in science.

The main implication here is that minority students would benefit educationally as well, if ISE

programs were able to reach this underserved audience and increase participation. A case study conducted by Rahm & Ash (2008) helped to confirm this point by noting that student participation in ISE programs has created progress in science literacy, interest, and the chance that participating students might pursue a STEM career in college.

Constraints to Minority Participation in ISE

Although research has shown that audiences who are currently underrepresented in the STEM field do indeed have an interest in science (Basu et al., 2005; Sorge et al., 2000; & Wenner, 2003), numerous barriers to minority participation in ISE programs have been identified. As a means to understand the disconnect between a student's interest in science but lack of participation in science programs, Bruyere, et al. (n.d.) conducted focus groups and discovered various constraints that ISE programs should consider with regard to minority audiences. The considerations included cost, transportation, time, cultural connection, language, and identity with the level of ethnic representation in STEM fields, messages of empowerment, and trust or familiarity.

Overall, ISE agencies need to provide an environment where people feel safe and supported by the staff (Borden et al., 2006). A theory developed by Bruyere et al. (2009) that addresses factors influencing participation in ISE programs is represented in Figure 1. Using focus groups, the researchers examined the differing barriers to participation in ISE programs for Latino and non-Latino (White and African American) audiences. The most significant constraints identified for Latinos were awareness of programs being offered and language (for non-English speakers). For Whites, time was the strongest restriction to participation. Both groups showed that desirable program characteristics influenced the intent for ISE participation. These findings convey the need for ISE organizations to design programs that address barriers

and increase participation among underrepresented audiences.

Referring back to the safety, trust and, familiarity barriers that have been identified among minority groups, a family setting may be the solution to engaging these underserved audiences in science and nature (Borden, et al., 2006 & Bruyere, et al., n.d.). A family setting does not have to be in an institutional atmosphere, it can be in everyday life and routine activities (NRC, 2009). Creating a link from classroom-style science learning to everyday life could be a bridge to engaging emerging populations in science and nature.

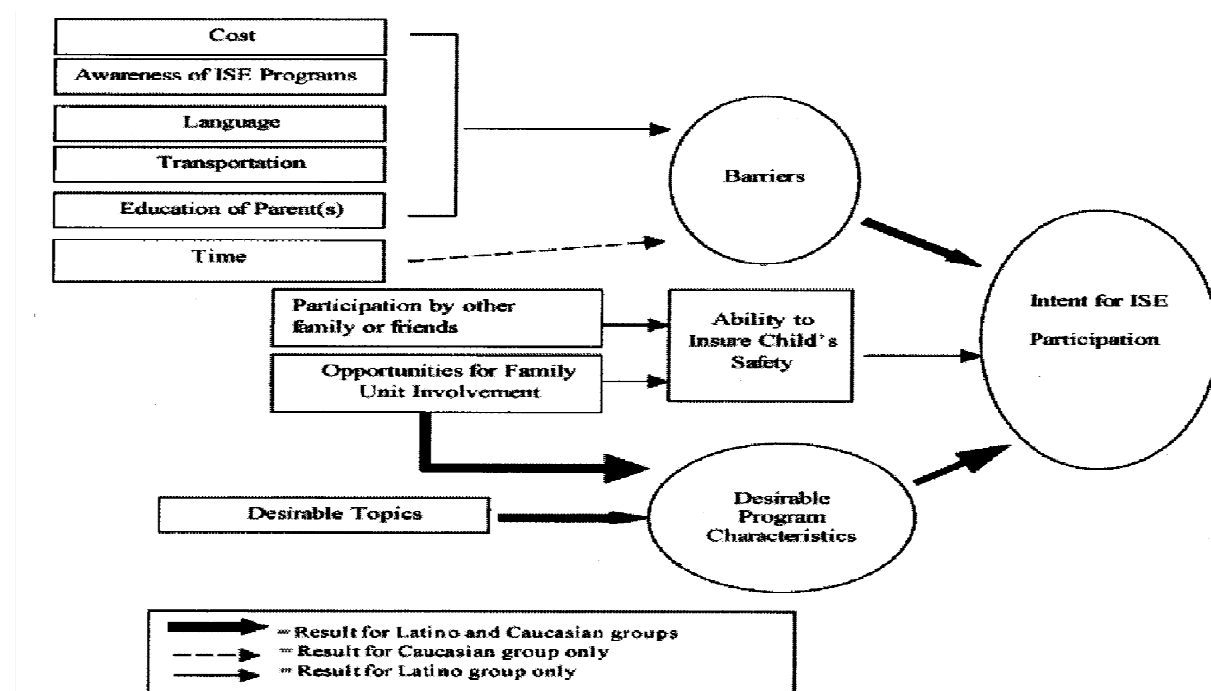


Figure 1.1. Factors that influence ISE participation. This figure demonstrates factors that affect participation in ISE programs for varying ethnic groups (Bruyere et al., p. 3, 2009).

The Role of Community-Based Partnerships in ISE

Creating a partnership among schools, community serving organizations, and larger agencies could lead to bridging the science-engagement gap for minority students, as well as engage families in science and nature, by providing ISE programs designed for a specific audience. Literature has shown what a successful partnership looks like and important components to creating a sustainable community-based partnership. Bosma, et al. (2010) assessed several elements of an existing partnership to determine what a successful partnership exemplifies. Some of the characteristics documented as determinants of a successful partnership were:

(1) communication; (2) shared decision making; (3) shared resources; (4) expertise and credibility; (5) sufficient time to develop and maintain relationships; (6) being present; (7) flexibility; (8) a shared youth development orientation; and (9) recognition of other partners' priorities. (Bosma et al., 2010).

Most importantly, all partners involved had an equal role in the development and implementation of programming that was offered. In addition, Grant (2010) noted similar elements for a successful partnership such as clear and shared goals; real and shared risks and rewards; defined time; and a written agreement. Both Bosma et al. (2010) and Grant (2010) made references to an effective partnership being mutually beneficial to all partners. Tett et al. (2003) noted reasons why public sector organizations should collaborate; these aims include, but are not limited to; sharing resources; broadening the scale and scope of intervention (i.e., developing a wider curriculum); and tackling complex social issues, such as engaging minorities in science.

Sladek (1998), in an evaluation of NSF-funded versus non NSF-funded ISE programs, made linkages between certain factors of ISE programs that are bridging the gap to minority

participation in ISE (see Figure 2). In order to increase the number of underrepresented youth in science, parents need to become advocates and involved in science as well. This can occur by hosting programs that engage the whole family, at central locations within a community to minimize the barrier of transportation costs. While small community-based organizations often lack the necessary funds to implement enriching ISE programs, collaboration with other ISE organizations can aid in realizing such programs within a community of underrepresented youth and families. A long term impact can result in a successfully implemented program, ultimately increasing children’s pursuit of science outside the classroom.

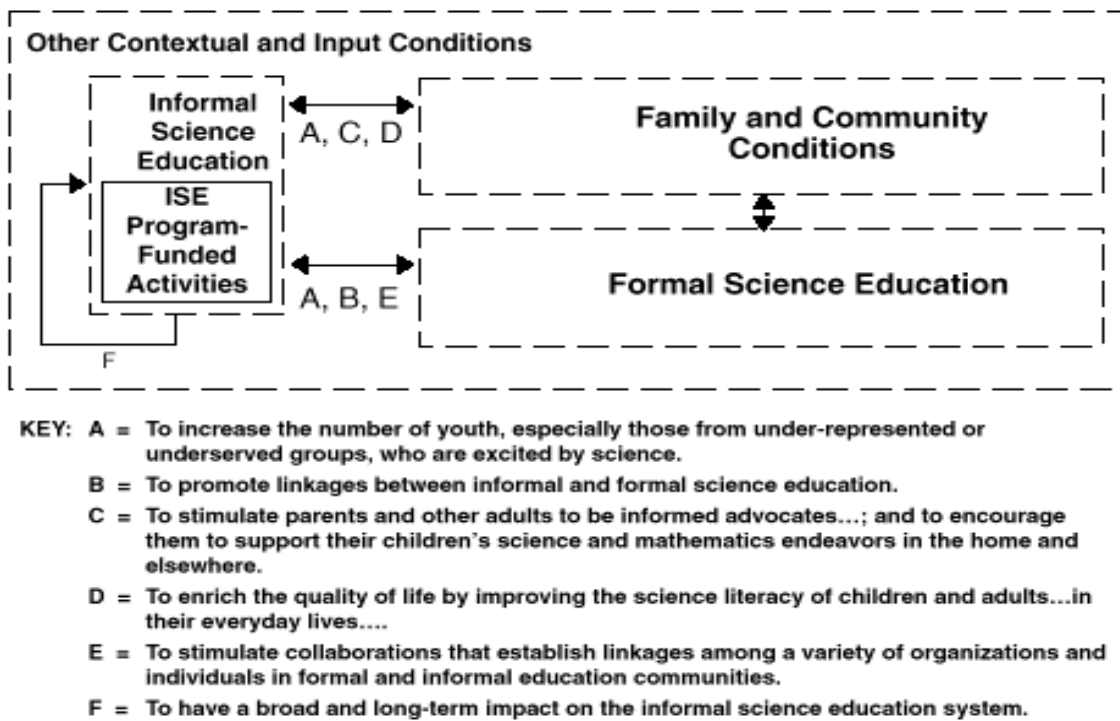


Figure 1.2. Contextual conditions and the evaluation goals of NSF’s informal science education program. This figure illustrates the evaluation framework used to compare ISE program activities and outcomes with those not funded by NSF (Sladek, p. 9, 1998).

The SEED Partnership

The SEED partnership is a collaboration consisting of five large Informal Science Education (ISE) organizations and three small community-based organizations (CBOs) and seeks to provide science engagement and education opportunities for children and families in Denver that are of populations that have been identified as underserved and underrepresented in the STEM fields. All participating organizations have a shared goal of reaching out to underserved audiences in order to engage community members in science and nature.

Each organization is mutually benefiting and sharing resources within the partnership. The ISE organizations possess resources that include funding, manpower, program materials, and expertise that are offered to the CBOs for community engagement in science and nature related programs. The CBOs have resources they leverage for the ISE organizations such as the recruitment of community members, as well as organizational and event marketing capacity within the communities, in order to reach out to the identified audience.

The partnership has a board committee where representatives from each organization meet regularly to discuss existing barriers, goals, objectives, and plans for outreach. A series of workshops were conducted by the ISE organizations initially to offer support to the CBOs in the form of expertise and resources (I.e., general science knowledge, program ideas, etc.). After the workshops were completed, future programs and events were devised. The partnership currently hosts a variety of events within each of the three communities represented by the participating CBOs. The events and programs being offered in the communities are collaboratively planned and executed by the ISE organizations, as well as the CBOs.

The central purpose of the partnership is to engage underserved communities in science and nature by bringing together resources from organizations in the Denver Metro Area. The

stakeholders of the SEED partnership are comprised of the SEED research team involved in coordination, development, and research, within the Human Dimensions of Natural Resources (HDNR) Department at Colorado State University (CSU); the Denver County Extension / 4H, which is the current source of funding for the partnership; five large Informal Science Education (ISE) organizations; and three smaller Community Based Organizations (CBO), which additionally represent the community members that are receiving outreach.

An examination of this current partnership in Denver County provides a unique contribution in this context, adding to existing literature on minority participation in informal science education (ISE) programs. While there is much literature recognizing the barriers to minority participation in ISE, including the need for engaging this audience in these types of programs, there is a gap in research-based literature that discusses steps being made toward addressing the constraints. An evaluation of a partnership aimed at bridging the barriers to minority participation, as the SEED partnership strives to do, would be beneficial in documenting the successes, as well as areas requiring of further development, of recent efforts towards engaging minorities in science and nature. Ultimately, the effectiveness of any partnership relies on consistent evaluations of its objectives and continual modifications based on the outcomes (Kruger et al., 2010).

Cole Arts and Science Academy

CASA is a Pre-school through 7th grade school in the Cole neighborhood within School District No. 1, part of the Denver Public School System. There are 550 students at CASA and 39 teachers on staff. The ethnic make-up of the school is 0.5% Asian, 3.8% Native American, 6.2% White, 28% African-American, and 61.5% Latino. Almost all students at CASA are eligible for free and reduced lunch, meaning their parents or families are of a low socioeconomic status, or at or

below the poverty line. CASA is affiliated with Community Resources, Inc. (CRI), whose goals are to utilize the talents of community members to increase students' knowledge; to strengthen the partnership between school, families and businesses; and to provide opportunities for students to learn outside the school environment. Overall their objective is to help students reach their individual potential for academic success. This case study works directly with CASA, not with CRI and for the purposes of this study, CASA will only be referenced, not CRI.

Methodology

Setting and Participants

The evaluation approach utilized for this partnership was a case study. Three families agreed to participate in the study which will aid in the overall evaluation of the partnership. Pseudonyms have been used to protect the identity of the participants. Purposive sampling was used to select the participants of the study. The families were chosen, as comparison groups, by the family liaison at Cole Arts and Science Academy (CASA). The family liaison was asked to select three families from the entire school population that represented varying levels of participation in the SEED partnership-sponsored programs: very participative, somewhat participative, and not very participative. The study lasted for an eight month time period. The families kept a written record of their experiences in “science and nature” and engaged in bi-monthly meetings/interviews that were conducted in person. The case study provides an in-depth collection of data, which was analyzed in order to evaluate if the identified partnership objectives had been attained.

Data Collection

The families consisted of parents and their children whom are students at CASA. Homogenous and criterion sampling were employed in order to keep the focus of a “minority”

audience. All families met the criterion of being of an ethnically diverse demographic. The ethnic make-up of CASA provided that the families would be of Latino and African-American descent, both minorities in the overall demographic of the population of Denver, Colorado (Fitzpatrick et al, 2011).

The study kicked off with a “Welcome Night” where all families participating were given information about the scope of the study and their role in it. Every 4-6 weeks, the in-person meetings (informal, conversational interviews) provided families with an opportunity to talk about their STEM-related activities. The families submitted activity logs (see Appendix A) during these meetings. A closing survey was administered to the families in the final meeting.

Four interviews with each family lasted approximately one hour and were held in the family community room at CASA. One interview was conducted with the families individually, and three interviews were conducted as a large group consisting of all three families and the family liaison from CASA. An informal nature of the interview allowed the researcher to be open and adaptable to the participants’ (parents and children) priorities of what they wanted to share regarding the activities they had been engaging in (Glesne, 2006). Initially, there were not predetermined questions, in order to permit the participants to share their experiences, ask questions, and elaborate on what they have been doing in participation with the study, openly. Over time, the interviews evolved into a semi-structured format, which aided in the collection of more targeted information as themes began to emerge. For example, in one interview parents were asked if their families were doing anything differently now, than before the case study began and then asked to elaborate. Other questions asked included inquiries about the families’ perceptions of science and nature, as well as their feelings about partnership-sponsored events they had attended. This type of open-ended question allowed the parents to describe how their

family's behavior had or had not changed due to their involvement in the study, and to discuss to the extent they wished.

The written activity logs were distributed to the participants with the purpose of compiling information about what activities participants had been engaging in, including other pertinent details that would provide context to subsequent focus group discussions. Furthermore, the questions the participants responded to in the logs provide more insight into their thoughts and feelings about science and nature, which aided in the later analysis of the data.

A closing written survey asked targeted questions in order to assess the families' views of the overall impact of the SEED Partnership programs on their engagement in science and nature. Parents' responses to questions regarding their involvement thus far, as well as future intentions for engaging in science and nature programs were analyzed. The purpose of the survey was to determine participants' attitudes towards science and nature programs after having participated in such programs. Targeted questions regarding future programming topics, as well as potential constraints, and overall impressions of SEED were solicited.

Finally, because two of the families were Spanish speaking, I translated all documents provided in Spanish into English before transcription and coding. Interviews were conducted by me in both English and Spanish with language interpretation conducted at the time of the interview. All data (e.g., interviews & activity logs) were transcribed into electronic format. Multiple data sources were utilized to give triangulation and all parts of the research paper were peer reviewed.

Data Analysis

To direct the analysis, several investigative questions were referenced throughout the process. The questions were developed in order to extract targeted information from the data

that was used to evaluate the SEED Partnership's goal. One point of interest that guided the research was what change occurred within each family as they journey through the programs offered by the SEED Partnership. As the goal of the SEED Partnership is to engage participants in science and nature through ISE programs, the extent of the impact, if any, was evaluated. Furthermore, the types of changes that occurred, in relation to science and nature, were analyzed and described as findings through constructed themes.

At the end of the case study, all data collected was sorted and defined in order to begin the process of coding. The activity logs underwent thematic analysis to synthesize responses (Gibson & Brown, 2009). Specific themes were constructed and cataloged for coding. This paper explores three findings: behavior change, perceptions of science and nature, and the types of activities the families' chose to engage in during the study. Relationships between the coded content was analyzed for patterns through frequency counting and domain analysis (Glesne, 2006). The series of interviews (both structured and unstructured, depending on the need) were coded for themes as well. A code book was created and used for all data sources. Each family's experience is presented as a case study in the form of a vignette, utilizing raw data to describe the findings of the study. The creation of relationship domains and a taxonomy of code words also aided in the analysis process.

Main cover term: science and nature

1. Is a *place for* engaging in science and nature:
 - a. CASA (school)
 - b. Zoo
 - c. Aquarium
 - d. Museum of Nature and Science
 - e. Park
2. Is a *reason to* engage in science and nature:
 - a. A personal invitation ("...we were invited by the school..."-Zoo camp)
 - b. Friends or family attending
 - c. To share time with family

3. Is an *important attribute related to* engaging in science and nature:
 - a. Provided distraction
 - b. Time with family
 - c. Learning experience (“...learn what they eat...”-SEED night at CASA)
 - d. Literacy
 - e. Playtime
 - f. Sharing (“Sharing with our children.”)
 - g. Technology
 - h. Science immersion (“My children saw different types of fish.”- aquarium)
 - i. Hands on/direct interaction (“...the children could touch the animals...” SEED night at CASA)
 - j. Children’s happiness/enjoyment (“...to see me kids happy...”-SEED night at CASA)
4. Is an *emotion experienced while* engaging in science and nature:
 - a. Happy (Zoo Camp)
 - b. Sad (crying)/Fear (Dinosaur exhibit at museum), (“My children were scared.” - visit to aquarium)
 - c. Anger
 - d. Frustration
 - e. Excitement
 - f. Grateful (Dragon Night at CASA)
 - g. Spiritual
 - h. Enjoyment (fun)
 - i. Relaxed/tranquil
 - j. Aversion (“This activity we were outside.” –at the park)
5. Is a *kind of* science/nature:
 - a. “Houses” –Interview with Juan
 - b. “People” –Interview with Juan
 - c. “Computers” –Interview with Juan
 - d. “Something that you study or discover” –Interview with Rosa

Figure 1.3 Relationships & Domains used for data analysis.

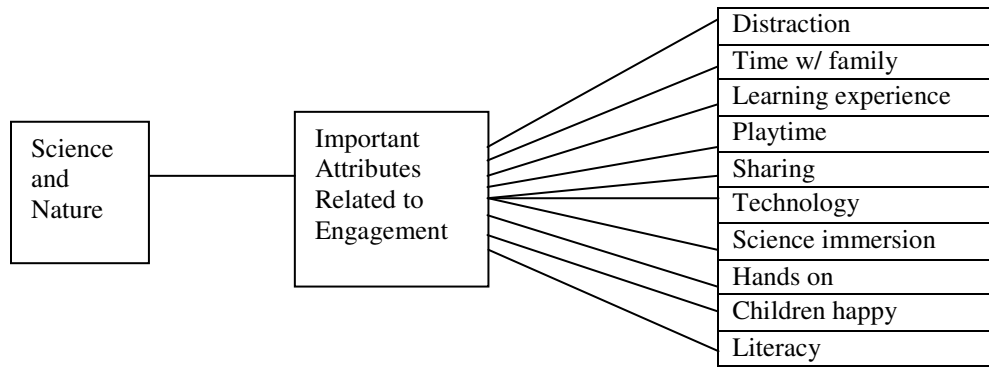


Figure 1.4 Taxonomy of code terms used for data analysis.

Results

The findings exhibited in the following three chapters explore three themes constructed through the analysis of qualitative coding. Through a series of vignettes, the behavior change (*theme 1*) of each family, after having been a part of the case study for six months, is examined. The types of activities that the families engaged in (*theme 2*) since the inception of the study are explored (i.e., science vs. non science activities). A “science activity” is any outing or event the family attends or experiences that is with the purpose of engaging in science (e.g., museum visit, nature observation, etc). A “non science activity” is any outing or event the family attends or experiences that has a purpose other than engaging in science (e.g., family dinner, sports game, etc). An understanding of what each family’s perception is of science and nature (*theme 3*) is also investigated.

Research Questions

Overarching question: What was the impact of the SEED Partnership on participant engagement in science and nature?

Sub questions: What was the level of engagement in science and nature related programs offered through the partnership? What was the level of engagement in science and nature related activities outside of the partnership?

Researcher Perspective

As a returned Peace Corps volunteer who served as an Environmental Educator in Nicaragua, I have both a professional and personal interest in this research. I saw the difference in the way people connected with science and nature in Central America, compared to natives of the U.S., when I returned and worked as a bilingual Natural Science Educator here in the U.S. I have a desire to learn more about barriers that exist and how to address those through research and program evaluation and implementation.

Chapter 2 - THE SMITH FAMILY

The Family

The Smith family identifies as African-American and is comprised of Rhonda (mom), Michael (dad), Lavell (son, 8 years), and Ria (daughter, 6 years). They have lived in Denver for two generations, but their family has been in the United States as far back as they can remember.

The Smiths report having had no prior experiences with science and nature-related activities before the SEED partnership and were identified as not very participative in the partnership sponsored activities. Over a nine month period of time, the Smiths provided one activity log that contained two activities which occurred within the same month. They attended two of four SEED Family Nights (programs hosted by organizations within the SEED Partnership), and participated in three of four interviews. The Smiths reported always engaging in activities as a family and those activities close to home were most appealing due to their lack of transportation.

Findings

Theme 1 –Behavior change. During an interview at month 7 of the case study, the families were asked to describe any change in the family’s behavior that may have occurred since the start of the study, mainly in relation to the types of activities the families’ were engaging in and pursuing. At the end of the study, Rhonda did not identify any behavior change within the family related to science or nature. Rhonda explained that her family was very busy most of the time and did not have much time to leave the house for activities. The Smith family also does not own a vehicle, which Rhonda expressed as a constraint for “getting out” or leaving the house. At the end of the study, through communication with the family liaison at CASA, it was learned that the Smiths had been to two Family Science Nights at CASA during the time period of the

study. Furthermore, when asked to respond to a statement whether the family had spent a significant amount of time in nature over the course of the study, Rhonda reported that she strongly disagreed.

Theme 2 – Types of activities reported.

Looking at the Smiths' activity log and two described activities, the second theme (types of activities reported) can be analyzed to only a small degree. One activity was a description of a Thanksgiving dinner with friends and family, a non science related activity that was not included in this study's analysis. The other activity was a description of the family having a day at the park, which might be loosely considered as related to science. In the recorded activity about the family's park experience, the family chose to spend their time outdoors, which provided an interaction with nature. But, the fact that they were outside was described as a dislike in response to their activity log prompt, stating, "This activity we were out side." This is an interesting point to consider regarding how this family best connects with science and nature. The important part of the activity was not related to science or nature at all, but that the kids were having fun and able to enjoy themselves.

Theme 3 – Perceptions of science and nature. In an interview at month 8 of the study, the families were asked to describe what they associated with the words "science" and "nature." Rhonda and Ria both mention "animals" as the first response to what science and nature makes them think of. There was not much elaboration on thoughts related to science and nature, but Rhonda emphasized the importance of participating in science and nature programs and even relates the experience to other people. Additionally, in the closing survey Rhonda stated that the SEED Partnership had a "good" effect on her family's feelings about science and nature. Though, it is difficult to say whether she was stated that in order to please SEED, or if she in fact

felt a positive effect on her family's feelings towards science and nature.

Excerpt on Perceptions of Science and Nature

Interviewer: Ria, when I say “science” and “nature” to you, what does that make you think of?

Ria: Think of animals

Interviewer: Yeah? Okay. What about you, Rhonda?

Rhonda: Animals. And meetin new people and pretty much you gotta encourage people and their kids to get into stuff like this.

Significance of Data

The Smith family can be described as having very little self-initiating behaviors in science and nature. While they did attend some of the SEED hosted programs at the school, they did not report having made an effort outside the school or SEED to engage in science and nature. In regards to the family's perception of science and nature it is unclear whether Rhonda truly believes that should participate in science and nature programs more, or if she felt pressured to say so because she was directly asked. Moreover, while the family does not provide a lengthy description of what science and nature are, Rhonda does report positive feelings towards science and nature as a result of having participated in the programs hosted by SEED.

Chapter 3 - THE LOPEZ FAMILY

The Family

The Lopez family identifies as Mexican and is comprised of Maria (mom), Miguel (dad), Ramon (5 years), and Chico (4 years). The parents moved to Denver from Mexico before the children were born and they have all been born in Denver since.

The Lopez's claimed to have little experiences with science and nature related activities before the SEED partnership, comprised of mostly playing outside at parks. The Lopez family returned four activity logs, with a total of 12 activities described in the logs. Every activity recorded was as a whole family, sometimes with friends or extended family. Often the activities chosen were close to home, though visits to the aquarium, zoo, museums, and so on were reported. The family participated in three interviews and attended two SEED Family Science nights at CASA, all as a whole family.

Findings

Theme 1 –Behavior change. When asked about what has changed with the family since the beginning of the study, Maria made references toward science and nature related activities in which they had engaged. Maria stated that she strongly agreed that her family had spent a significant amount of time in nature over the course of the study. This statement shows an increase since the beginning of the case study where she said that her family had little experience with science and nature.

The Lopez family had attended two Family Science Nights at CASA. Maria mentioned that they try to go to these (science and nature-related) places now, showing a raised awareness of science and nature engagement opportunities compared to before the study. She talked about a day camp at the zoo that Ramona and Chico attended and how her family enjoyed walking

around the zoo when the camp was over. When asked why she enrolled her sons in the zoo camp, Maria stated that the school invited them to join and helped them to fill out the necessary forms to sign up. The Lopez family had a personal connection with the school and family liaison, who speaks Spanish; this could have been an influence on their desire to participate in SEED programs.

Excerpt on Behavior Change

Interviewer: Again, thinking back to the beginning of the study, is your family doing anything differently now than before the beginning of the study?

Maria: Yes.

Interviewer: And what is that?

Maria: Well, in the first place we have shared more time together and the things that are said, a conversation, and when we go to a place we take notice more of what we are saying and try to go to more places for the kids to get to know them and different things.

Interviewer: So, when you say that you try to go more places, for example...?

Maria: Okay, we, for example, we took him (son) the zoo, to the camp, and after we walked around the zoo. And we have gone to the aquarium and we have gone to parks.

Chico: We went to some beautiful parks, mommy! We went to the zoo mommy because we had three days of vacation and we could go there to see the birds.

Theme 2 – Types of activities reported. In reference to the second theme, the Lopez family showed an increased awareness of science and nature in their daily lives, and reported so in their activity logs. While not all the activities the Lopez family chose to write about were directly related to science or nature, thus showing a clouded perception (theme 3) of what exactly science and nature are, the family did display a raised awareness of science and nature in everyday life.

Maria noted that Ramon “took notice” during a normal daily routine of walking to school that was, in fact, related to science and nature. Ramon made informal scientific observations about trees, and leaf patterns. Maria also stated that discovering new things *with* her children was an important aspect of the activity she chose to write about. Essentially, although the family is not always seeking out experiences at museums or the zoo, they are able to relate “non science” activities back to science and nature. Almost half of the recorded activities were science related (ten out of twenty two), which ranged from visiting SEED-partnered museums or centers or playing outside to attending sporting events or parties. The Lopez family started out by recording many activities unrelated to science and nature such as going to parties or sporting events, but as the study went on they began to visit the science themed areas such as the zoo, museum of nature and SEED-partnered organizations in general.

Excerpt on types of activities reported

What did you do? We walked to school

Where were you? Between home and school

Who joined you? Mom and the boys (Ramon and Chico)

What did you like? It was a cool and tranquil morning

What didn't you like? We didn't have a lot of time to get to school

What do you remember most? Ramon mentioned that the trees had patterns of green and red in the leaves

What else was important? Discovering new things with my children

Theme 3 – Perceptions of Science and Nature. When directly asked what he thought of when he heard the words science or nature, Ramon identified both science and nature with animals.

When Maria was asked to describe her thoughts on science and nature she related it to academics

and as important for the children to learn. In the final survey she stated that it was very interesting to visit natural places. A sense of stewardship for the environment also evoked in Maria's response to the question. In other analyses of activities the family reported, it is evident that the family had a sense of what science and nature were because they wrote about very direct experiences with science or nature such as visiting the local aquarium, although they also often reported attending events unrelated to science and nature.

Excerpt on Perceptions of Science and Nature

Interviewer: When I say science or nature, what do you think of?

Ramon: A puppy

Maria: What about nature?

Ramon: a parakeet

Interviewer: and what about for you Maria?

Maria: Ahhh, okay, well at the best, I'm lacking a lot. But, science, well, it's something that is very interesting for them because they are just starting school and I think it's something, a material, I don't know. But it's something very important for them [the children] in their studies... and nature, I think it's something that we have here that we are here and we have to learn about it, to care for it, our environment.

Significance of Data

The Lopez family showed an apparent change in their level of engagement in science and nature. As the family progressed through the study, they attended more events on their own as a family, including noticing science and nature during their daily routines. As the study went on, the family seemed to do more with regards to science. Looking at the interview data, the mother

described a sense of stewardship for the environment, something that was not expressed at the being of their involvement in the case study. Maria also portrayed that her family held positive feelings towards science and nature.

Chapter 4 - THE GONZALEZ FAMILY

The Family

The Gonzalez family identifies as Mexican and is comprised of Rosa (mom), Pedro (dad), Juan (son, 8 years), Christian (son, 6 years), and Flor (daughter, 3 years). The parents moved to Denver from Mexico before the children were born; all three children were born in Denver.

The Gonzalez's claimed to have minimal experiences with science and nature related activities before the SEED partnership, mostly having played outside at parks. The mothers of the Gonzalez and Lopez families are sisters. The family recorded in nine activity logs for a total of 33 activities, attended two SEED family nights, and participated in three interviews. The Gonzalez family engaged in a variety of activities. Most of the activities did not require much transportation such as family parties and soccer or basketball games, but they also pursued events at the zoo, aquarium, and museums which did require transportation.

Findings

Theme 1 - Behavior change. When asked at the last interview, the Gonzalez's did not identify with any behavior change related to science and nature since the start of the case study.

Although, when asked if the family had spent a significant amount of time in nature over the course of the study, Rosa agreed that her family had. This exhibits an increase in nature engagement since the inception of the study where Rosa had said her family had little experiences with science and nature.

The family attended two of the Family Science Nights at CASA and had reported involvement in many science and nature related activities. Rosa also mentioned enjoying

activities that are low cost, which poses a question of whether or not her family was aware of free activities provided through the SEED Partnership and outside of the school.

Excerpt on Behavior Change

Interviewer: Again, thinking back to the beginning of the study, is your family doing anything differently now, than before the beginning of the study?

Rosa: Well... we have always liked to record ourselves or take pictures. But now we do it more, but sometimes the kids fight over who gets to take the photos.

Interviewer: But, for example, are there activities you are doing now, that you wouldn't have done before?

Rosa: We have always liked to go out and take advantage of places to go out to... and that don't cost a lot of money.

Theme 2 – Type of activities reported. The Gonzalez Family wrote quite a bit about activities they engaged in that were both related as well as unrelated to science and nature. The Gonzalez's reported thirty activities in their log, nine of which were science related. In this excerpt, the family took a trip to the Museum of Nature and Science, specifically to see the dinosaur exhibit, which shows pursuit of a science activity. The only negative experience was due to the three year old being scared of the life sized dinosaur models. Learning was one aspect of the activity deemed as important.

Excerpt on types of activities reported (from the perspective of Juan)

What did you do? Visit the dinosaurs

Where were you? Science Museum

Who joined you? Whole family, plus friends

What did you like? I liked all the dinosaurs

What didn't you like? We couldn't record videos or take pictures

What do you remember most? They looked real and shouted a lot, my little sister was scared

What else was important? There were different dinosaurs, the whole visit was fun and I learned a lot

Theme 3 – Perceptions of science and nature. In general, Rosa stated in the final survey that the family is feeling more interested in science and nature as a result of the SEED programs. She said that they want to learn more and continue discovering about all the things they have learned about.

Christian connected the words science and nature to technology, as well as humans. Rosa was more vague and described science and nature as more academic. No one in the family linked science or nature to the environment.

Excerpt on Perceptions of Science and Nature

Interviewer: When I say science or nature, what do you think of?

Juan: animals

Rosa: Christian, for you?

Interviewer: Christian, if I say nature, what do you think?

Christian: that it's not real?

Interviewer: How about science? Do you know that word?

Christian: (laughs) science? Houses? People? Computers?

Interviewer: Yes, technology is science.

Interviewer: and you, Rosa, what do you think when I say science or nature?

Rosa: that it's something that you study or discover.

Significance of Data

The Gonzalez family engaged in more science related activities throughout the case study; although they may not have realized that they were doing anything differently since it was not self-reported. The case study provided an opportunity for them to get out as a family and spend time together, according to Rosa. They did not seem aware of their behavior change, but they are more involved with science and nature, as reported by their activity logs. Additionally, in the closing survey, Rosa wrote that the family had participated quite a bit in programs and had spent a significant amount of time in nature.

Chapter 5 - CONCLUSION

Discussion

This research began with the question of what impact the SEED Partnership had on participating families within partnership-related activities, as well as outside of the partnership (self-initiated activities). While the answer to this question varies for each family to a different degree, it is positive overall. The Smith family had the lowest level of engagement in science and nature and also reported the lowest level of behavior change stemming from their involvement in the SEED programs. The Lopez family engaged in the most science and nature related activities, but the Gonzalez family, was not far behind the Lopez family's level of participation. One interesting discovery was that the family that was most participative with science related activities also exhibited the highest sense of environmental stewardship. It cannot be determined through this research whether the stewardship inspired the active participation or vice versa. But it is certain that the majority of the science activities the family recorded were either SEED events or days spent at a partner organization within SEED. Although there were occasional negative comments regarding certain aspects of science activities, none of the families reported negative experiences to an extent that would prevent them from participating in future science and nature related programs under the right circumstances for them

Commonalities

Within the context of the SEED Partnership-sponsored activities, specifically the Family Science Nights at CASA, all three families have attended and reported positive experiences. They all enjoyed the Family Science Nights and all three families participated in every activity as a family, and often with extended family and friends. It was seen as an important component

for the families to be able to engage in activities together, showing that family oriented activities makes science more accessible to these families (NRC, 2009). All of the families attended the same number of Family Science Nights and expressed that the close proximity to home made it easy to attend.

In activities that the families reported outside of partnership, there was more of a difference. The Smith family did visit the zoo once, whereas the Lopez and Gonzalez families visited the zoo, aquarium, museum of nature and science, and the botanic gardens many times over the course of six months. One constraint to the Smith family's participation in science and nature related activities outside of the community could be related to the fact that they do not own a car. The Lopez and Gonzalez families do own a car, and also have more opportunities to carpool because they are related to each other. Lack of transportation is a constraint in science and nature activities that has been documented in current literature (Borden et al, 2006 & Bruyere et al, 2009).

Essentially, all the barriers that were stated by the families were practical. Among the families time, cost, and transportation were mentioned as issues, known barriers to ISE (Borden, et al., 2006 & Bruyere, et al., n.d.). When these particular barriers were less of a factor, especially when programs were offered at the children's school, all families were interested and motivated in participating; thus showing a bridge to the previously documented gap of minority interest in science (Basu et al., 2005; Sorge et al., 2000; & Wenner, 2003). All families stated that they felt comfortable participating in the ISE programs offered through the partnership. The cultural barrier, or ability to identify with those providing programs, was nonexistent.

The absence of a cultural barrier within the SEED partnership is a significant finding in this study. As previous research has shown (Borden et al., 2006; Bruyere et al., 2009; Quimby et

al., 2007 & Sorge et al., 2000), a main constraint to emerging populations' participation in ISE programs has been cultural. Families have expressed a lack of familiarity with the staff, and therefore a low level of trust when leaving their children with strangers to participate in programs. SEED is providing programs that integrate whole families and include staff within families' communities, which offers a higher level of comfort for families and opens the pathway for them to program participation.

Significance of Research

This case study has identified that the SEED Partnership is engaging these families in science and nature. They are participating in Family Science Night at CASA, a partnership-sponsored program, and having positive experiences. Regarding the extent to which the partnership is making an impact on the families and their self-initiating behaviors in science and nature, it differs from family to family, and also seems to be connected to each family's perception of what science and nature are. The Smith family described no change, yet they have reported positive experiences at the Family Science Nights. The Lopez family stated that they are now visiting more science and nature related places outside of their community, due to a raised awareness via the partnership. The Gonzalez family, while they also describe not having any change in behavior to report, is engaging in many science and nature related activities.

The SEED Partnership is on track to engaging underserved audiences in science and nature. The families within this study have shown interest in programs that the partnership is providing and are attending. In addition, other than general engagement, the partnership would benefit from defining further what take away message they want to families to have after having engaged in their programs. When family perceptions of science and nature have been identified, the partnership can better design their programs to specifically target information they want the

families to leave with at the end of a program.

Limitations & Future Research

Considering that the partnership is relatively new and this was the first evaluation of the program, the evaluation was a starting point for further growth of the partnership. A more comprehensive evaluation on a larger scale that involves all served communities would be beneficial for acquiring broader representation of the overall impact the partnership has had across communities. Although a case study evaluation design allowed for an in-depth look at participants of the partnership programs, it did not allow for a bigger picture of the larger participant population. Since the evaluation approach being utilized was objectives-oriented, a main constraint to keep in mind was that it had the potential to focus so intently on the evaluation of the objectives that final conclusions can sometimes be incomplete in regards to other extraneous components as the program is being evaluated (Fitzpatrick et al., 2011). Additionally, my point of entry into the partnership was after its inception. There was also a lack of data from the previous year, as the partnership had not yet been evaluated.

The study was designed in order to evaluate to what extent the SEED Partnership is reaching its goal of engaging underserved audiences in science and nature. As organizations such as SEED, aimed at raising science literacy continue to grow and gain support, a model needs to be set for future implementation and further promotion of ISE for minority and majority audiences alike. EE organizations must rise to meet the new challenges of the 21st Century, but, while most outdoor leisure organizations assume a level of goodness in their organization and therefore reach a level of complacency with program design for marginalized populations and thus fail to recognize the institutional discrimination that may exist in programs, SEED is attempting to design programs that resonate with its target audience (Allison & Hibbler, 2004).

The solution for capturing the attention of underrepresented minorities within STEM starts at the community level, by providing minority youth and families with experiences in science and nature. Community education takes place outside of institutions and responds to the notion of ‘community’, and the SEED Partnership is doing just that (Tett, et al., 2003). This aids in connecting people to the world around them and sparking an interest in the conservation of natural resources.

Some organizational barriers such as the inability of certain agencies to recognize and respond appropriately to the changing nature of the communities served, reluctance to modify programming, and language barriers can be significant obstacles (Allison & Hibbler, 2004). A collaborative and community-oriented partnership can be effective in creating science and nature opportunities for underserved populations within their specific communities, while also keeping specific cultural needs in mind. Large ISE organizations have the resources and funding (Sladek, 1998) to reach out to the minority audiences that many smaller community-based organizations (CBOs) represent. A collaborative partnership between these types of organizations, such as the SEED Partnership, serves in reaching the goal of engaging minority populations in science and nature, bridging the gap to existing barriers for participation in science and nature related activities, and driving youth toward creating a richly and ethnically diverse representation within the STEM field.

SEED Program Recommendations

A consideration should be made on adding another program that nurtures young scientists and naturalists within the communities served, in order for SEED to make a bigger leap into encouraging youth to pursue STEM careers. Additionally, while one family did increase their sense of stewardship, the other two families mostly expressed enjoyment in having the

family experience the programs together. For families that are busy and cannot get out of the house much, an at-home extension activity could be created to include those who cannot always attend events. In order to further the program goal past just general engagement, SEED will need to make a link for participants between the program topics and the importance of learning about them and applying those topics in their everyday lives. The partnership does have a solid beginning in getting these underserved populations experiencing science and nature, in an educational and family-oriented atmosphere. There is much room for growth as the partnership leads ISE and CBO organizations in this new direction of addressing participation barriers through a community-based partnership.

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Appendix A: Data Collection Instrument

Family Activity Log Sheet

Today's Date: _____

Today's Date: _____

Today's Date: _____

<p>The Activity</p> <ul style="list-style-type: none"> • What was the activity? • Where was the location? 			
<p>Who was there?</p> <ul style="list-style-type: none"> • Who from your immediate family attended? • Was anyone else present? 			
<p>When did it occur?</p> <ul style="list-style-type: none"> • What day of the week? • What time did you start? • How much time did you spend doing the activity? 			
<p>What did you like about the activity?</p>			
<p>What didn't you like about the activity?</p>			
<p>What do you remember most?</p>			
<p>What else was important about the activity?</p>			

Appendix B: Survey Instrument



Science and Nature Survey for CASA families and students

The Science Education and Engagement of Denver (SEED) Partnership, in collaboration with the Colorado State University, is interested in your thoughts about your family's interest in programs designed to get kids and families learning about science and better connected with nature. The information in this survey is used to help shape the direction of programs with the SEED Partnership. Please answer the following questions to the best of your ability.

1. To what extent do you think your child / children are interested in nature? (Circle the number)

<i>Not interested</i>							<i>Very interested</i>
1	2	3	4	5	6	7	

2. How interested are you, as a parent, in having your child / children learn about nature? (Circle the number)

<i>Not interested</i>							<i>Very interested</i>
1	2	3	4	5	6	7	

3. Please indicate your level of agreement with the following statements about children who spend time outdoors in nature (Circle one number per statement)

	<i>Totally disagree</i>			<i>Neutral</i>			<i>Totally agree</i>
Spending time in nature is important for the physical health of children.	1	2	3	4	5	6	7
Spending time in nature is important for the academic performance of children.	1	2	3	4	5	6	7
Spending time in nature is important for the mental health of children.	1	2	3	4	5	6	7
Spending time in nature is important for the creativity of children.	1	2	3	4	5	6	7
Spending time in nature is important for children for raising awareness of the need to conserve our natural resources.	1	2	3	4	5	6	7

4. While your answers to the following questions may be different depending on the specific circumstances, please answer based on your opinion. Note that this survey relates to community programs, such as those that occur in parks, zoos, schools and science centers or the nature of education. (Circle one number per statement)

	<i>Totally disagree</i>			<i>Neutral</i>			<i>Totally agree</i>
In the last 9 months, my family has spent a significant amount of time in nature.	1	2	3	4	5	6	7
In the last 9 months, my family participated in one or more community programs about nature.	1	2	3	4	5	6	7
My family is too busy to participate in the programs of science or nature.	1	2	3	4	5	6	7
The cost of nature programs is usually not a problem for my family.	1	2	3	4	5	6	7
Transportation to programs about nature is difficult for my family.	1	2	3	4	5	6	7
Participation in nature programs is safe.	1	2	3	4	5	6	7

I do not feel comfortable with my child in a program that does not know the staff.	1	2	3	4	5	6	7
I have no knowledge about nature programs in my community.	1	2	3	4	5	6	7
I'm comfortable with my child in a program about nature without me there.	1	2	3	4	5	6	7
CASA programs and SEED are reliable sources for nature programs.	1	2	3	4	5	6	7
My intention is for my family to attend a nature program about the next 6 months.	1	2	3	4	5	6	7

5. Please answer based on how often the following influence the likelihood that your child / children or family participate in a community program about nature. (Circle one number per statement)

	<i>Much less likely to attend</i>			<i>No effect</i>	<i>Much more likely to attend</i>		
Programs that occur on weekends.	1	2	3	4	5	6	7
Programs in which the family attends.	1	2	3	4	5	6	7
Programs designed for preschoolers.	1	2	3	4	5	6	7
After school.	1	2	3	4	5	6	7
Programs that occur close to my neighborhood.	1	2	3	4	5	6	7
Programs that expose my children to future career opportunities.	1	2	3	4	5	6	7
Programs that occur when school is in session during the school year (for example, on weekdays colleges).	1	2	3	4	5	6	7
Programs that occur during the summer (eg., summer camp).	1	2	3	4	5	6	7

For questions 6-9, please provide a brief answer in the space provided.

6. What affect did the SEED Partnership have on your feelings about science and nature?
7. What is the best way to inform you of the nature programs for children and families in your community?
8. What is the best benefit you can think of for your children to participate in nature programs?
9. What is the biggest concern you have about your children participating in nature programs?

Thank you for participating in this study!