Memories of GAMES: Exploring the Long-Term Impacts of After-School Museum Programming on Girls' Attitudes Towards Science

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Memories of GAMES:
Exploring the Long-Term Impacts of After-School Museum Programming on Girls’ Attitudes Towards Science

by

SARAH ELIZABETH SNOW
B.A., Boston University, 2006

A thesis submitted to the
Faculty of the Graduate School of the
University of Colorado in partial fulfillment
of the requirement for the degree of
Master of Science
Department of Museum and Field Studies
2013
This thesis entitled:
Memories of GAMES: Exploring the Long-Term Impacts of After-School Museum Programming on Girls’ Attitudes Towards Science
written by Sarah Elizabeth Snow
has been approved for the Department of Museum and Field Studies

_________________________________________________________   ________________
Dr. Cathy Regan, Committee Chair
Date

_________________________________________________________   ________________
Dr. Deane Bowers
Date

_________________________________________________________   ________________
Dr. Sandra Laursen
Date

The final copy of this thesis has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

IRB protocol # 12-0091
ABSTRACT

The purpose of this study is to investigate any lasting impacts of the University of Colorado Museum of Natural History’s Girls at the Museum Exploring Science (GAMES) Program. Using assessment document analysis, student focus groups, and adult interviews, this study examined whether students’ positive associations with science continue after completion of the program and whether the program affects the academic and career choices of past participants. Results from the analysis suggest that GAMES has a generally positive impact on participant attitudes towards science in both the short- and long-term. These results also support existing research in identifying key factors in the success of the program including hands-on activities, exposure to diverse careers and female role models, and the incorporation of authentic objects and experiences. These factors of success can contribute to the evidence base about the role of informal education programs in increasing science participation among women, as well as ways in which schools and universities can collaborate to effectively serve populations that are traditionally underrepresented in the sciences.
ACKNOWLEDGEMENTS

I would like to express my gratitude to my advisor, Dr. Cathy Regan, for the guidance that she provided, without which this thesis would not have been possible. As the founder of the Girls at the Museum Exploring Science (GAMES) program, she proved to be a rich source of information about the history of the program and its goals. In addition, her desire to hear both the good and bad news about the impacts of GAMES inspired the thoroughness of the study.

I would also like to thank fellow committee members Dr. Sandra Laursen and Dr. Deane Bowers. As the co-director of the University of Colorado’s Ethnography & Evaluation Research unit, Sandra was instrumental in the conceptualization of this project as well as a valuable resource when it came to completing IRB protocols and analyzing data. Likewise, Deane’s feedback and support throughout the process helped shape the final work into what it is today.

Funding for this project was generously provided by the University of Colorado’s Museum and Field Studies Program. Basic support came from the programs’ Education Office, while a William H. Burt Award allowed me to cover the cost of survey mailings, translation services, and incentives for focus group participants. I also give my thanks to Olimpia Mejia Corliss for translating recruitment documents and consent forms into Spanish on a moment’s notice.

One of the major challenges of the study came in the form of completing the IRB review process, and so special thanks go to Claire Dunne and Doug Grafel for helping me to navigate the many obstacles along the way.

In addition, thanks are due to many members of the Boulder Valley School District (BVSD) for their help in facilitating the surveys, interviews, and group discussions. I owe my deepest gratitude to Brigitte Mutter, Lucy Repaci, and the entire BVSD Office of Planning and Assessment team for pulling together targeted recruitment lists and completing the initial mailings. I would also like to thank the principals of BVSD’s middle and high schools as well as their support staffs for helping to organize student meetings during busy times of the year. And, of course, I am grateful for the teachers and students themselves, who took the time to provide such valuable feedback about the GAMES program.

And finally, I would like to extend a heartfelt thanks to my wonderful family for their unconditional love, support, and countless hours of licking envelopes.
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CHAPTER I
INTRODUCTION

Education in science, technology, engineering, and mathematics (STEM) is vitally important because it forms the basis of analytical thinking and serves as a major focus of modern industry and the global job market. However, students from the United States are not keeping pace with their peers in other industrialized nations (Robelen, 2012b). Museums and other informal learning environments have risen to the challenge of promoting STEM education by offering a variety of programs and experiences to audiences of all ages. After-school programming for youth is an area of particular interest as educators scramble to produce enough future STEM professionals to meet the needs of current advancement, while securing a position of leadership within the global community. These types of programs often aim to cultivate and sustain an interest in STEM that may influence future experiences and aspirations.

The University of Colorado Museum of Natural History’s Girls at the Museum Exploring Science (GAMES) is one such program. Now in its tenth year, GAMES aims to expose elementary-aged students to museum-based careers in science with the hopes of improving attitudes towards STEM disciplines. The purpose of this study is to investigate any lasting impacts of the GAMES program. Using assessment document analysis, student focus groups, and adult interviews, this study attempts to determine whether students’ positive associations with science continue after completion of the program and whether the program affects the academic and career choices of past participants. More broadly, the study aims to contribute to the evidence base about the role of informal education programs in increasing science participation among women, as well as ways in which schools and universities can collaborate to effectively serve populations that are traditionally underrepresented in the sciences.
Program Logistics

GAMES is a seven-week after-school program for fourth and fifth grade girls from schools within the Boulder Valley School District (BVSD) that serve high percentages of students from low socioeconomic backgrounds. Within each target school, teachers select individual students to participate in the program. Transportation to and from the museum, snacks, and tools for follow up activities are provided to all participants free of charge through grant support by the CU-Boulder Outreach Committee as well as Impact on Education and the Millennium Trust for Boulder County.

While at the museum, the girls explore the sciences of archaeology, botany, entomology, paleontology, and zoology through hands-on activities and direct interactions with scientists and museum professionals. Each week they meet with museum scientists in their working environments, tour museum collections, and build scientific toolkits to take home upon completion of the program. During the final meeting of each session, the girls have the opportunity to bring their families to the museum and act as tour guides, as they show their parents what they have learned.

GAMES can accommodate 15 girls and two chaperones each session. This allows individual attention, and ensures that the entire group can fit into the research and collections areas that they visit. The participants in each session of GAMES attend a single elementary school, and are accompanied by an adult chaperone with whom they are familiar. This is designed to create an environment of confidence, familiarity, and cooperative learning that can be used back at school to reinforce what they have learned at the museum. Chaperones are charged with providing supervision on the buses to and from the museum as well as during each of the two-hour museum visits. Chaperones come from a variety of backgrounds and have
included fourth and fifth grade teachers, principals, ESL (English as a Second Language) teachers, parents, a TAG (Talented and Gifted) coordinator, and AmeriCorps volunteers.

Conceptual Framework

GAMES began in 2003 as a way of encouraging participation in STEM-related fields. In response to documented discrepancies in science attitudes and achievement, the program sought to engage girls—and to a lesser extent, minority girls—in authentic museum experiences on the University of Colorado campus. In order to establish a program that would address the hurdles of increasing science participation among underrepresented populations, GAMES was designed to incorporate several distinct elements from the educational literature. These include strategies for promoting science, employing after-school learning time, catering specifically to girls and minority students, engaging young audiences, and benefiting from meaningful collaborations.

Promoting Science

Science is a dynamic enterprise which necessitates increasing advocacy among the general population in order to keep up with rapid advancements and changes in understanding (Paris, Yambor, & Packard, 1998). With declines in the number of doctorates received in STEM-related fields over the last decade, there has been recent concern about the stability of the U.S.’s scientific leadership within the global community (cited in Tai, Liu, Maltese, & Fan, 2006). Studies suggest that even in the face of this increased urgency, science is not effectively engaging students when compared to other subject areas (Archer et al., 2010). In fact, many stereotypes continue to persist and there is an ongoing debate about whether science should be viewed and taught as knowledge or as process (Fenichel & Schweingruber, 2010; Martin, 2007).
There is a wide variety of literature focused on identifying effective techniques for promoting science both in and out of the classroom. The National Research Council recommends increased instructional time, putting a science focus on par with reading, writing, and math (cited in Paris et al., 1998). More recently, inquiry-based learning and hands-on experiences have been advocated as a means of producing greater positive outcomes in development, achievement, and attitudes when compared to more traditional approaches (Gibson & Chase, 2002). Rather than focusing on memorization, concepts, and facts, the inquiry approach to learning incorporates critical thinking skills within a “culture of science”—which includes norms, practices, language, and tools—to emphasize the dynamic nature of the discipline (Fenichel & Schweingruber, 2010). Others recommend a combination of the two approaches. In order to meet the growing need for science professionals in this country, the American Association for the Advancement of Science has set goals that advocate for both knowledge and process, as well as specific career preparation for the future (cited in Paris et al., 1998).

By design, GAMES presents science in a way that is aligned with these goals. Participants are introduced to specific information about the scientific disciplines of archaeology, botany, entomology, paleontology, and zoology—including what each discipline encompasses—but they are also invited to take part in the process of science. Students see first-hand how scientific work is done, and they participate in hands-on activities that illustrate authentic science experiences. As this learning is taking place, students are exposed to the “culture of science,” navigating professional work spaces, collaborating with scientific role models, and employing critical thinking skills to problem solve and explore their own personal interests and aspirations.
Learning Outside of School

One method for increasing science instructional time is to promote out-of-school learning. It has been estimated that youth spend only about 20% of their time in school, leaving plenty of room for extracurricular opportunities (Luke, Stein, Kessler, & Dierking, 2007). These types of opportunities have been shown to positively reinforce academic achievement in the form of increased grades, test scores, and graduation rates (Fenichel & Schweingruber, 2010). This is especially evident among certain at-risk populations. Among children of lower socioeconomic status, seasonal learning patterns directly reflect school-year instructional time (Alexander, Entwisle, & Olson, 2001). This suggests that the differences in achievement between these students and their more privileged counterparts stem not from what they are learning in the classroom, but rather what they are not learning once they leave its walls. For this reason, both after-school and summer instruction can help to decrease the achievement gap in all areas of learning, particularly when provided at little or no cost (Laureau, 2003).

However, academic achievement in STEM fields is not a reliable indicator for promoting future participation in the sciences. Even students who make good grades in their science classes do not necessarily translate this success into future career choices (Robelen, 2012a). Fortunately, out-of-school learning opportunities can have positive effects on attitudes as well. Because many of these differences in attitude stem from perceived abilities rather than actual performance, it has been suggested that appropriate after-school interventions may help to prevent or even reverse these negative associations with science and to promote interest in STEM-related careers (Campbell, Acerbo, & Hoey, 1999; DeHaven & Wiest, 2003; Fadigan & Hammrich, 2004; Francsali, 2002; Gibson & Chase, 2002; Hansen, Walker, & Flom, 1995; Pariset al., 1998).

Cultivating and sustaining an interest in science is no easy task. A number of factors play
into the formation of an initial spark of interest which must then be nurtured through a variety of supporting experiences. In one framework for sparking a student’s interest, Deborah L. Perry suggests that there are six elements which together can make for transformational scientific experiences (Fenichel & Schweingruber, 2010). These include curiosity, confidence, challenge, control, play, and communication—all of which fit nicely within the parameters of informal education. Without the presence of mandated curricula and time constraints, after-school programs like GAMES find themselves at an advantage when it comes to employing these elements to create interest.

GAMES, in particular, attempts play on the natural curiosity of students by introducing them to the diverse scientific fields encompassed in the CU Museum. It aspires to build confidence by providing opportunities to ask questions of scientists as well as authentic experiences for the participants to try their hand at what they are learning. It presents challenges in the form real-world problems—whether it be investigating the uses of ancient cultural objects, extracting fossils, or preserving botanical specimens—as well as a sense of control over the way in which they go about solving them. In addition, the activities are designed to be fun and social, relying on meaningful interactions with both mentors and peers.

**Girls and Minority Students**

Although all students can benefit from science interventions, it has long been noted that girls are less likely than boys to pursue advanced scientific education and careers in the sciences (Franscali, 2002; NSF, 2000; Robelen, 2012a). However, studies suggest that this is not a result of innate abilities, but rather of complex cultural factors. On a global scale, girls’ science scores are equal to or greater than those of boys; and in the 34 countries examined by the Organization
for Economic Cooperation & Development (OECD), boys were found to outperform girls in math but not science (Robelen, 2012b). In the US, however, we see surprisingly different trends. In fact, the US science gender gap is among one of the largest in the world with even greater discrepancies among low-income, black, and Hispanic students (Robelen, 2012b).

Based on the National Assessment of Educational Progress (NAEP) exams, the achievement gap for 13 year-old Hispanic students is quite large, especially in math and science (Ginorio & Huston, 2001). And although Latinas often outperform their male counterparts, both subsets fall well below the standard of White student achievement (Ginorio & Huston, 2001). This is especially troubling in light of the ever-changing American demographic. Since a Latino ethnicity distinction was incorporated into the 2000 census, this group has displayed the most dramatic population growth of any minority group in the US (Farrell & Medvedeva, 2010). Outnumbering both African Americans and Asians, the Latino population has earned the designation of the "minority majority", and many argue that discussions of increasing diversity refer specifically to the incorporation of Latinos (Nunn, 2007).

Why should we care whether girls and minorities are involved in science? Because the practice of science is dictated by complex “personal knowledge”—including experiences, learning, and cultural perspective—diversity among scientists actually benefits the entire scientific enterprise (Selby, 2006a; Selby, 2006b). Based on this “personal knowledge,” different scientists may be inspired to ask different questions or employ unique methodologies that serve to enrich our understandings of the world.

In order to increase diversity, underrepresented populations must first see themselves as welcomed members of the scientific community. Early stereotypes concerning scientists as characters must be broken down in order to expand a student’s list of what Angela Ginorio and
Michelle Huston (2001) call “possible selves”. Contributing factors to limited perceived potential may include acculturation, gender roles, values, expectations, and norms manifested within the self, the family, or the greater community (Ginorio & Huston, 2001). Many of the same methods can be employed to increase participation in the sciences among several underrepresented groups. For example, avoiding the promotion of stereotyped careers and providing leadership that reflects the student’s own diversity can be powerful tools for engaging both girls and racial minorities (Fancsali, 2002; Ginorio & Huston, 2001; Liston, Peterson, & Ragan, 2007; Rodríquez, 2010). In addition, reviews of the literature aimed at targeting girls and minority students have found repeated recommendations for adult support, single-sex groupings, and the incorporation of cooperative social learning and hands-on experiences (Augustine, 2007; Fancsali, 2002; Halpern et al., 2007; Hansen et al., 1995; Liston et al., 2007).

Both girls and minorities traditionally have fewer out-of-school experiences than boys and culturally dominant groups (Fancsali, 2002; Laureau, 2003). But aside from simply inviting girls from local schools with high percentages of students qualifying for free and reduced lunch to participate in the program, GAMES also actively attempts to eliminate the barriers of accessibility that created discrepancies in participation in the first place. In order to combat obstacles to participation, GAMES was designed to limit issues of accessibility by providing a free-of-cost, single-sex learning opportunity complete with transportation to and from the students’ home school (Fancsali, 2002). In addition, GAMES provides opportunities to explore and discuss common stereotypes of scientists, while incorporating hands-on learning experiences, female role models, and family support that have been shown to have a positive impact on gender learning in science (Augustine, 2007; Burkam, Lee, & Smerdon, 1997; Hansen et al., 1995).
Additional research indicates that the aforementioned differences in attitudes towards science develop as early as elementary school (Andre, Whigham, Hendrickson, & Chambers, 1999). It has been suggested that at age 10, most students have positive attitudes towards science which then fall off sharply by age 14 (Archer et al. 2010; DeHaven & Wiest, 2003). This is also the time when the gender gap begins to widen. According to 2009 National Assessment & Educational Progress (NAEP) data, girls trail boys by only a small margin in the 4th grade, but the difference doubles by 8th grade and continues to grow throughout high school (Robelen, 2012b).

In addition, early interests play a key role in childhood career aspirations, which may carry weight in later years. In a survey by the Office for Public Management targeted at people working in STEM-related endeavors, more than a quarter of the respondents reported science aspirations by age 11 with an additional 35% claiming aspirations by 12-14 years of age (Archer et al., 2010). In another study, students who reported scientific aspirations by the 8th grade were found to be more than three times as likely to graduate with a degree in science than non-science motivated students, regardless of academic achievement (Tai et al., 2006).

These declines in attitudes towards science are especially important to note because of the difficulty with which negative associations are reversed. Several studies have found that interventions at the middle or high school level can be successful in maintaining interest, but that in order to significantly improve attitudes, students must be reached much earlier—before they have a chance to embark on the slope of scientific decline (Campbell et al., 1999; DeHaven & Wiest, 2003; Fadigan & Hammrich, 2004).

Because a student’s interest in science is essentially a product of his or her experiences
by the preteen years, attitudes may be positively impacted through early intervention (Archer et al., 2010). By catering to 4th and 5th grade girls, GAMES attempts to preempt the decline in attitudes towards science that typically occurs in the final year of elementary school (Archer et al., 2010). In doing so, the program may be better equipped to employ the previously mentioned framework for sparking interest with the hopes of not only improving current attitudes, but also setting the participants on a course towards continued development of scientific interest and aspiration.

Meaningful Collaboration

Contrary to many popular stereotypes, science is an inherently social activity rife with collaboration, communication, and large professional associations (Fenichel & Schweingruber, 2010). Informal educators may use this social aspect to their advantage when attempting to encourage young girls in the sciences. Although it is difficult to reverse negative perceptions of science once they are established, one method that has proved successful in changing views is collaboration with real, working scientists (Laursen & Brickley, 2011). By introducing students to diverse professionals, educators can help to shake off misconceptions regarding scientific identity, allowing for young people to relate and potentially envision a scientific career for one of their own “possible selves” (Archer et al., 2010; Ginorio & Huston, 2001; Selby, 2006a).

Aside from correcting misconceptions, this type of collaboration can present additional benefits as well. Collaborative learning is often mentioned as a recommended practice for engaging girls in science, as is the presence of positive female role models (Fancsali, 2002; Halpern et al., 2007; Liston et al., 2007). Collaborations with working scientists seem especially successful at producing positive outcomes when several factors are met. These include the use of
scientific tools that enable authentic experiences, presenting interesting information with which students can make connections to past and future learning, audience appropriate hands-on activities, and providing a “break from routine” (Laursen, Liston, Thiry, & Graf, 2007). And when done correctly, the experience of collaboration and mentorship can be rewarding for all parties involved (Horvath, 2007).

Scientists working on the University campus are a key component of the GAMES program. On the first day of the program, students are led on a guided discussion regarding their perceptions of who and what a scientist is. Each week, these preconceptions are then contrasted with actual scientists as participants visit predominantly female professionals from the Museum’s distinct disciplines. Girls are permitted to get a behind-the-scenes peek at their workspaces and collections and ask the scientists direct questions about their training and daily routines. This is aimed at reinforcing science not as a collection of facts, but rather a dynamic process and potential career path that comes in many varieties and can appeal to many different types of people. This collaborative presentation along with the program’s physical presence on the University campus aligns GAMES with many recommendations for ways to promote sustained interest in the sciences (Archer et al, 2010; Fadigan & Hammrich, 2004; Ginorio & Huston, 2001; Liston et al., 2007; Selby, 2006a).

Scope

With this framework in mind, GAMES strives to promote female and minority participation in the sciences through hands-on, collaborative, outside-of-school experiences. Since its inception, GAMES has served over 350 girls in this endeavor. These students have
come from 12 elementary schools within the Boulder Valley School District, including Columbine, Community Montessori, Creekside, Crestview, Eisenhower, Emerald, Lafayette, Pioneer, Ryan, Sanchez, University Hill, and Whittier, most of which have been involved during multiple school years (table 1).

<table>
<thead>
<tr>
<th>SCHOOL YEAR</th>
<th>Schools that Participated</th>
<th>Cohort 1</th>
<th>Cohort 2</th>
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<td>2008-2009</td>
<td>Ryan, Community Montessori, Columbine, Whittier, Lafayette</td>
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<td>7th, 8th</td>
<td>6th, 7th</td>
<td>5th, 6th</td>
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Table 1. Cohort matrix showing GAMES participation and current grade

This study focuses on the first eight GAMES cohorts, beginning with the 2003-2004 school year. During this time, no significant changes to program format, topics, or activities took
place, and each cohort included both 4th and 5th grade students from multiple schools. The final row of the table indicates the grade in which participants from each cohort were enrolled during the 2012-2013 school year. The blank spaces in the cohort 1 and cohort 2 columns indicate that some or all of the past participants may have completed their secondary education.

Purpose of the Study

The unique combination of strategies for promoting science, employing after-school learning time, catering specifically to girls and minority students, engaging young audiences, and benefiting from meaningful collaborations makes GAMES stand alone among similar programs highlighted in literary studies and reviews. For example, EUREKA! a summer and school-year program for middle school girls takes place on a college campus and incorporates hands-on science activities and career-related field trips, but is focused on sports and aimed at slightly older students (Fancsali, 2002). Similarly, Hands on Science Outreach (HOSO) is a once-a-week after-school program for elementary students in Michigan that features a local museum-university partnership (Paris et al., 1998). Like GAMES, HOSO is six weeks in length and includes hands-on activities based on weekly themes led by university student docents. However, it is not gender-specific (though greater attitude and competence gains were made by girls), lacks scientist mentors, and is less career-focused. The Women in Natural Sciences Program (WINS) is a free-of-charge, museum-based science enrichment program offered to high school girls in the hopes of inspiring them to pursue scientific careers (Fadigan & Hammrich, 2004). Like GAMES, the WINS program meets at the museum once a week, though it targets older participants selected based on academic merit, interests, and attitudes, and takes place over the course of a year.
All of these programs and several others are built upon similar conceptual frameworks and demonstrate positive gains in attitudes towards science, but none shares the exact combination of traits demonstrated by GAMES. The unique conceptualization and execution of GAMES warrants study of immediate effects for both comparison and program improvement purposes. However, longitudinal surveys of past participants may offer even more insight into the long-term impacts of GAMES and its ability to achieve its goals.

Relatively little is known about the longevity of the effects of these types of interventions. A few attempts have been made to formalize knowledge about the long-term impacts of informal education programs (Fadigan & Hammrich, 2004; Gibson & Chase, 2002; Luke et al., 2007), but the difficulty in translating intuitive and anecdotal accounts into viable data sets leaves plenty of room for contributions to this area of investigation.

This study aims to contribute to a general understanding of these kinds of impacts, particularly through the measurement of changes in attitudes towards science and any long-term effects that GAMES may have on the scientific interest, success, and aspirations of past participants. With the first GAMES cohort graduating and moving on from the local educational system, the timeliness of this type of longitudinal study is even more pressing. This important milestone for the program offers the perfect opportunity to engage with past GAMES participants and launch an investigation into the lasting impacts of the program.
CHAPTER II
PREEXISTING ASSESSMENT

The specific goals of GAMES include showing girls that there is a place for them in the sciences, encouraging them to continue their scientific education, and having fun. To determine whether these goals are being met, it is important to answer the following questions: (1) Do GAMES participants believe themselves capable of participating in and contributing to scientific work? (2) Do they continue their academic coursework in science and/or pursue science opportunities outside of the classroom? (3) Do they maintain a positive attitude towards science? Do they like science as much as (or more) than they did when they participated in GAMES?

Some assessment of GAMES outcomes has already been completed in the form of pre- and post-program instruments employed for program improvement purposes. These include the Draw-A-Scientist-Test (DAST) developed by Chambers (1983) to measure preconceived notions of who scientists are and what they do, as well as a six-question survey created by the program staff and administered on the final meeting of each session to gauge knowledge retention, attitudes, and aspirations of participants. A copy of this survey may be found in Appendix A. In addition, pre- and post-program interviews with one group of participants were conducted as part of an unpublished study by Steven Guberman in the early years of the program. Anonymous data from these instruments exist as field notes from verbal descriptions of DAST illustrations, paper-copy survey responses, and coded interview reports. However, little cumulative analysis has been completed and the lasting impacts of the program had not yet been examined.
Draw-A-Scientist

The DAST is an open-ended diagnostic tool designed to study perceptions and prevailing stereotypes of scientists. In the original test designed by Chambers (1983), children were asked simply to draw a scientist and their resulting images were analyzed for the presence or absence of several distinguishing characteristics. From this analysis, it was determined that stereotypes about scientists emerge at an early age and continue to develop as students grow (Chambers, 1983).

Since its creation, the DAST has become a popular tool among researchers interested in the development of attitudes towards science, and over the years the test has seen numerous iterations. For example, some studies have investigated changes to the simple prompt as well as asked for additional written annotations to facilitate interpretation (Rennie & Jarvis, 1995; Symington & Spurling, 1990). Both of these slight variations have been incorporated into the DAST for use during the GAMES program. On the first meeting of a session, even before the general introduction, students are asked to create their own drawing of a scientist in their lab notebooks. Following a brief drawing period, the girls are then asked to share descriptions of their scientists in a group setting. Once a particular characteristic is mentioned, a show of hands is used to determine how prevalent the particular characteristic is among the group.

In this regard, the administration of the DAST during GAMES elicits the inclusion of annotations, though they come in the form of oral descriptors rather than written words. The prompt is not standardized within an established protocol, but rather aims to have students conjure an image in their minds of a scientist and then put it down on paper. Because the drawings themselves are done in the students’ lab notebooks which are taken home at the end of the program, test results are retained in the form of recorded tallies from group discussions.
along with a handful of sample images. It should also be noted that students are not required to share their images and so only the information that is reported gets included in the session notes.

Because of the slim nature of available data and a lack of post intervention comparisons, the DAST is not given thorough treatment in this study. In order to extract more valuable information from future DAST administration, it may be useful to establish set protocols, obtain copies of student illustrations, and develop a complimentary method of assessing changes to perception throughout the program. This could come in the form of an end-of-session group brainstorming of scientist descriptors from which the girls could then be asked to select terms that described themselves as well. In this way it may be possible to gauge whether participants were better able to envision themselves in the realm of science. Despite its present limitations, however, the DAST remains a useful tool for dissecting and discussing stereotypes during the GAMES program.

Post-Program Questionnaire

Although it does not allow for comparison to the DAST administered at the start of the program, a post-program questionnaire offers some insight into the short-term impacts of GAMES. This questionnaire is typically administered on the final meeting of the session and contains questions which aim to measure changes in attitudes towards science, knowledge of the five scientific disciplines explored in GAMES, favorite and least favorite program components, tools perceived as useful, and future career aspirations. The questionnaire has gone through a couple of iterations since the program’s inception, and one question was changed entirely from an earlier version of the questionnaire. The question, “What would you tell a friend about GAMES?” was changed to “What would you like to be when you grow up?” In addition, the
question measuring knowledge of the scientific disciplines underwent slight modifications to the wording.

Ninety-three of these completed post-program questionnaires dating from 2005 to 2012 had been maintained in program records. Raw data from these questionnaires was stored in their original paper form at the University of Colorado Museum of Natural History. Occasionally, anecdotal evidence about the benefits of GAMES (particularly with regards to the question about whether students like science more than, less than, or the same as they did before participating in GAMES) had been pulled for inclusion in program summaries and grant applications, however, no formal analysis of student response had ever been completed.

As part of this study, these post-program questionnaires were analyzed in order to establish a baseline of the short-term impacts of GAMES that could then be used to draw comparisons with additional data collected several years after initial participation. The process of analyzing these data as well as a discussion of the short-term impact findings may be found in the following chapter.

Additional Evaluation

In addition to the pre- and post-program assessment tools, Steven Guberman—Associate Professor of Educational Psychology at the University of Colorado—also conducted some preliminary evaluation in the early years of the GAMES program. During the 2004-2005 school year, he met with one group of GAMES girls before and after their participation to look for changes in their perceptions of museums, science, and scientists as well as their career aspirations. Twelve students took part in both pre-program and post-program interviews, and an additional four participated in post-program interviews only. All students were interviewed in
groups of two or three students at a time.

Although no formal report was assembled, data from these interviews suggest that GAMES is able to provide information and combat stereotypes in the short duration of the program. The majority of students entered the program with some interest in science, with two thirds reporting that they would like to pursue a career in the sciences and one half responding to the question “do you think you are good at doing science?” in the affirmative. Among those who responded negatively or with a “maybe”, all but two reported learning something about their abilities to do science throughout the course of the program. In addition, post-program interviews indicated an increase in science career aspirations among the original twelve respondents from 67% to 83% and all participants were able to discuss museums, science, and scientists using more detail and fewer stereotypes. Much like the questionnaire respondents, when asked, “what did you enjoy most about being part of the GAMES program?” the majority of those interviewed reported liking the hands-on activities, meeting scientists, and getting to see new things.
CHAPTER III
ASSESSMENT ANALYSIS

The first portion of this study involved the analysis of data gathered using preexisting assessment tools. Previously collected post-program questionnaires were examined for evidence of short-term program impacts that could be used to inform further investigations.

Methods

As a part of this study, responses from the ninety-three completed post-program questionnaires were coded using quantitative descriptive analysis (Libarkin & Kurdziel, 2002). Word occurrences and frequencies were sorted for evidence of attitudes towards science—both positive and negative—and categories of future career aspirations as noted in the post-program questionnaires. These assessments of immediate program impact were then used as a baseline for comparison with longitudinal data collected through a survey of former participants one to nine years after their GAMES involvement.

Results

In this analysis, it was noted that the majority of students reported liking science more after completing the GAMES program (table 2). This question was asked on all 93 questionnaires with only one response of “less than I did before.” It should be noted that a brief note accompanied this response, indicating that upon further questioning, the student reported that this was a mistake and that she had intended to choose the “more than I did before” option. While the rest of the student’s answers were remarkably positive about the experience and supported this claim, it is difficult to discern whether the report was influenced by perceptions of
power or intimidation that may have been present between the student and the program administrators. Regardless of this fact, nearly 97% of respondents reported liking science the same as or more than they did before participating in GAMES.

<table>
<thead>
<tr>
<th>I LIKE SCIENCE...</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>More</td>
<td>78</td>
<td>84</td>
</tr>
<tr>
<td>The Same</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Less</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Blank</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 2. Responses to the question: *Since coming to GAMES, I like science more than, less than, or the same as I did before.*

The second question asked students to match each of the five scientific disciplines studied in GAMES with a word describing its focus. The sciences included archaeology, botany, entomology, paleontology, and zoology, with corresponding foci on ancient humans, plants, insects, fossils, and animals respectively. Fifty-two students or 56% of respondents correctly identified all five sciences. Among those who missed one or more pairings, archaeology and entomology were the most commonly mismatched terms, while only five students were unable to match zoology with its study (table 3). It should be noted that on twelve of the questionnaires the zoology-animal pairing was given as an example, and so the percentage for this discipline was calculated out of 81 responses as opposed to the 93 responses used for the other types of science.

<table>
<thead>
<tr>
<th>DISCIPLINE</th>
<th># CORRECT</th>
<th>% CORRECT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoology</td>
<td>76</td>
<td>94</td>
</tr>
<tr>
<td>Paleontology</td>
<td>69</td>
<td>74</td>
</tr>
<tr>
<td>Botany</td>
<td>67</td>
<td>72</td>
</tr>
<tr>
<td>Entomology</td>
<td>63</td>
<td>68</td>
</tr>
<tr>
<td>Archaeology</td>
<td>62</td>
<td>67</td>
</tr>
</tbody>
</table>

Table 3. Correct matches by discipline in response to the question: *Please draw a line to connect the type of science with what it studies.*

When asked what they liked best about GAMES, 28% of respondents mentioned that
they liked the hands-on activities (table 4). Responses in this category included both general and specific references to doing activities, projects, or experiments, as well as “touching things”, “using tools”, and “examining objects”. Almost a quarter of respondents listed science in general or one or more specific disciplines as favorites, and references to objects/collections, learning/studying, and visiting/talking with scientists were not far behind. In addition, 11.8% of respondents reported liking “everything” about the program.

<table>
<thead>
<tr>
<th>LIKED BEST</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doing</td>
<td>26</td>
<td>28</td>
</tr>
<tr>
<td>Science/ Science Discipline</td>
<td>23</td>
<td>25</td>
</tr>
<tr>
<td>Objects</td>
<td>22</td>
<td>24</td>
</tr>
<tr>
<td>Learning</td>
<td>21</td>
<td>23</td>
</tr>
<tr>
<td>Scientists</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td>Everything</td>
<td>11</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 4. Most common responses to the question: *What did you like best about GAMES?*

Table 5 (below) illustrates the number of references to each discipline. Of the five types of science studied in GAMES, zoology, botany, and paleontology were mentioned most as favorites, while archaeology and entomology were mentioned least.

<table>
<thead>
<tr>
<th>LIKED BEST (Sciences)</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoology</td>
<td>14</td>
<td>15</td>
</tr>
<tr>
<td>Botany</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td>Paleontology</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td>Entomology</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Archaeology</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 5. Frequency of references to science disciplines in the question: *What did you like best about GAMES?*

One third of all respondents reported that there was “nothing” that they liked least about GAMES, or that they liked everything about the program (table 6). The next most common response was to choose one or more of the covered science disciplines as a least favorite, with
nearly a quarter of participants interpreting the question in this way. Other responses focused on non-hands-on activities (“writing”, “too much talking”, “too many questions”, “standing around and waiting”), missed opportunities (most commonly because they were absent one of the days), and some type of discomfort. Physical discomfort came up as too much walking and standing, while mental discomfort included things that were perceived as “gross” (“to have to stick a needle through a grasshopper,” “the smell of the rooms-yuck,” “bird feathers falling off them,” “seeing snakes,”).

Table 6. Most common responses to the question: What did you like least about GAMES?

<table>
<thead>
<tr>
<th>LIKED LEAST</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nothing</td>
<td>31</td>
<td>33</td>
</tr>
<tr>
<td>Science Discipline</td>
<td>22</td>
<td>24</td>
</tr>
<tr>
<td>Non-Hands-On Activities</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Missed Opportunities</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Physical Discomfort</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Mental Discomfort</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 7 (below) illustrates the number of references to each discipline. Interestingly, zoology was reported as both the favorite and least favorite science with entomology close behind. This is perhaps because of the link with some sort of mental discomfort or “gross factor” mentioned above. No students reported liking paleontology the least.

Table 7. Frequency of references to science disciplines in the question: What did you like least about GAMES?

<table>
<thead>
<tr>
<th>LIKED LEAST (Sciences)</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoology</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Entomology</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Botany</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Archaeology</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Paleontology</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

When asked to pick a tool that they would use in the future, one third of respondents
chose the magnifier, while the measuring tape and goggles were also reported frequently (table 8). This may suggest that familiar tools or tools that were used during multiple activities were more easily translated to outside contexts.

<table>
<thead>
<tr>
<th>TOOL</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnifier</td>
<td>27</td>
<td>33</td>
</tr>
<tr>
<td>Measuring Tape</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Goggles</td>
<td>18</td>
<td>22</td>
</tr>
<tr>
<td>Brush</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Forceps</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>Pins</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Gloves</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 8. Frequency of references to specific tools in the question: *Pick a tool that you were given and tell me how you will use it in the future.*

In 81 of the 93 questionnaires, participants were asked what they would like to be when they grew up. Many provided multiple responses, with more than three quarters of respondents listing a career in the sciences as one of their choices (table 9).

<table>
<thead>
<tr>
<th>CAREER</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>62</td>
<td>77</td>
</tr>
<tr>
<td>Non-Science</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>Unsure/Blank</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 9. General career divisions in response to the question: *What would you like to be when you grow up?*

Of those, Zoologist was the most common type of science mentioned (table 10). It is worth noting that all five disciplines studied in GAMES appeared as future career choices on the post-program questionnaires. However, because the disciplines were listed on the top of the page as part of a previous question, it is difficult to assess whether these choices truly reflected future aspirations or if it was interpreted as a multiple choice question by some respondents. Of those selecting a GAMES discipline, one third recorded the science as it was written on the questionnaire (“archaeology,” “botany,” etc.) rather than in its career form (“archaeologist,” “botanist,” etc.).
“botanist,” etc.). Among non-GAMES science careers, veterinarian and doctor were the most prevalent.

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoologist</td>
<td>16</td>
<td>26</td>
</tr>
<tr>
<td>Paleoentologist</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Veterinarian</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>Botanist</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td>Doctor</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td>Archaeologist</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Unspecified</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>Entomologist</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 10. Most common science careers reported in response to the question: *What would you like to be when you grow up?*

Of those reporting aspirations to non-science careers, teachers made up more than a quarter of responses, with entertainers (singers, dancers, actresses) close behind (table 11). Those non-science careers falling into the “other” category were each reported only once and include responses like “professional baseball player” and “lawyer of immigration”.

<table>
<thead>
<tr>
<th>NON-SCIENCE</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>Entertainer</td>
<td>4</td>
<td>21</td>
</tr>
<tr>
<td>Artist</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Police Officer</td>
<td>2</td>
<td>11</td>
</tr>
</tbody>
</table>

Table 11. Most common non-science careers reported in response to the question: *What would you like to be when you grow up?*

Overall, immediate program feedback indicates that GAMES has positive effects on participants’ attitudes towards science. The majority of girls who complete the program report liking science more than they did before and also express an interest in pursuing science as a career. Key components of the program’s conceptual framework—including hands-on activities,
authentic objects and experiences, and interactions with working scientists—were all referenced as contributing factors to the short-term success of GAMES.

Long-Term Impacts

Short-term assessments of student outcomes based on data from preexisting instruments suggest that GAMES is meeting its goals of showing girls that there is a place for them in the sciences and promoting positive attitudes towards science. However, it is unclear how long these impacts last and whether or not the program has any influence on the future academic and career choices of past participants. In his review of the literature presented in *In Principle, In Practice*, John Falk (2007) concludes:

Recent longitudinal studies have shown that the learning that results from a museum experience does change over time and not always just by declining. What these studies reinforce is that long-term outcomes are often not predictable from short-term outcomes.

(P. 13)

In order to determine whether these short-term outcomes hold true in the long-term, information must be gathered not only about the GAMES program itself, but also about the participants’ pre-GAMES interests and experiences and post-GAMES reinforcements (Falk, 2007). To do this, research must be extended beyond the first and last days of the program to gain some insight into the broader student experience through the past, present, and future.
CHAPTER IV
LONGITUDINAL STUDY METHODS

In order to assess the long-term impacts of the GAMES experience, this study incorporated several methods, including survey assessment data, focus group discussions among past GAMES participants, and interviews with teachers and chaperones who have had continued interactions with program participants. Because contact information for former GAMES participants was not routinely solicited and maintained, creative collaboration with BVSD assessment personnel was used to track down and recruit the target population.

Study Design

Follow-Up Surveys

In a BVSD-led mailing, former GAMES participants were asked to complete a short survey in which they answered questions pertaining to their attitudes towards science, confidence in their own scientific abilities, and participation in science-based activities. These questions were designed to address the goals of the program in an attempt to establish a baseline data set that could be enhanced through focus group sessions. The brief and accessible nature of the survey was selected to allow a greater number of individuals to participate whether or not they chose to continue on in the study.

In the summer of 2012, the BVSD Office of Planning & Assessment compiled a list of females who were enrolled as 4th or 5th grade students at specific BVSD schools during the years that each school participated in GAMES. This list of 919 students received a mailing which included a BVSD cover letter and a notice to parents as well as a student invitation, brief survey, and business reply envelope. In the mailings, students were asked to self-identify as former GAMES participants and complete a short survey. At the end of the survey, participants were
invited to take part in a future focus group. Those who elected to participate were asked to provide contact information to which further instructions and parental permission forms could be sent. In order to ensure the privacy of identified students who chose not to take part in the study, BVSD staff were charged with affixing address labels and conducting the bulk mailing in July of 2012.

An internet link (tinyurl.com/CUGAMESsurvey) containing electronic copies of the survey and invitation was also sent to recent GAMES participants who requested Museum contact via email upon completion of the GAMES program. These addresses were obtained voluntarily during the final program session at which parents were present. At this time, participants and their families were invited to provide an email address in order to receive GAMES updates and information about upcoming museum events. Email addresses were never required of GAMES participants as part of the consent or enrollment process, nor were they solicited at any other time in the duration of the program.

Focus Groups

Those who elected to enroll in the focus group portion of the study were later contacted to join other girls from the same current school to discuss their memories of the program along with current attitudes and aspirations in greater detail. When only one student from a given school elected to enroll, she was invited to share her thoughts individually in a one-on-one interview.

Following principal approval, focus groups were arranged to take place at BVSD middle and high schools identified as "current schools" on the survey forms. These took place in private reserved classrooms during regularly scheduled lunch periods or after school. For those schools
with multiple lunch times, one meeting was held during each period on the same day to enable maximum participation without disturbing the learning day.

Each session represented a one-time visit that lasted approximately 30 minutes. Students enrolled in the focus group portion of the study began by completing an assent form as they ate a catered lunch. With explicit parental consent, audio recordings were used throughout the meetings to enable accurate transcriptions.

To gather participants’ thoughts and ensure that all have something to contribute, note cards were handed out and participants were asked to brainstorm (using pictures or words) a few memories from their experience in GAMES. The memories could be either positive or negative. After a few minutes of individual reflection, subjects were asked to come together for a group discussion where they were given a chance to share these or other memories of the experience.

Focus group protocol was open-ended and semi-structured—using prompts such as: (1) Did you ever talk to people about GAMES? What did you tell them? (2) What would you change about GAMES? What would make GAMES better? (3) Did you ever use any of the tools in your toolkit? (4) Do you go to any other out of school science programs? (5) Do you like science more than, less than, or the same as you did in elementary school? (6) What’s your favorite subject in school? (7) What do you want to be when you grow up? The use of guiding questions ensured coverage of relevant themes and issues, while allowing for spontaneous comments to emerge. Following the discussion, students received a $5 gift card to Target as a token of appreciation.

Adult Interviews

Many teachers and chaperones have been involved in the GAMES program for multiple years, but only those with recent affiliations were recruited for the study. Several of these adults
have had extended contact with GAMES participants both during museum visits and in the school setting as teachers, principals, school program coordinators, and in other professional roles. In the past three years, 12 such adults have been involved in the program in this capacity and they were asked to participate in interviews to discuss their observations of student attitudes and behaviors before, during, and after the program. Interviewees were asked to describe their beliefs or hypotheses about how this program benefits students, what kinds of students benefit most, and how they choose students to participate, as well as any differences observed between participants and non-participants at their school. Additionally, those who directly observed GAMES sessions were asked to provide their observations of girls’ behavior and responses during program activities.

Teachers and chaperones received an electronic invitation to participate in the study based on publicly available contact information. Individual interviews were scheduled for all teachers and chaperones who responded to the study invitation. These semi-structured interviews took place at schools, over the phone, or in other convenient locations as determined by the interviewee and lasted between 30 minutes and one hour. Audio recordings were used throughout the discussions to enable accurate transcriptions.

Questions for teachers and chaperones focused on their observations of students involved in the GAMES program and were guided by prompts such as: (1) Describe your involvement with the GAMES program. (2) What do you think GAMES participants get out of the experience? Why? Can you think of any stories or incidents with students that illustrate this? (3) Did you notice any changes in the students who participated in GAMES either during the program or after its completion? How long did these changes last? (4) Were there any noticeable differences between the program participants and non-participants within your class? (5) What
would you have liked your students to get from GAMES that you feel was lacking? (6) What kinds of students do you think benefit the most from GAMES? Why? How do you select students to participate? (7) How could the GAMES experience be improved for you or your students?

About the Subjects

The subject population included two distinct subsets: former student participants in the GAMES program and adult teachers/chaperones. The population of former student participants consisted of 11-18 year old girls. The only inclusion criterion was that girls attended GAMES sessions when they were in fourth or fifth grade. Focus groups consisted of 2-3 participants per lunchtime meeting.

Teacher/chaperone study subjects were adult females, though recruitment was extended to one male chaperone. Inclusion criteria for this portion of the study included service as a GAMES chaperone within the last 3 years, or as a classroom teacher to actively enrolled GAMES participants within the last 3 years.

Obtaining Consent

A parent permission/student assent form was included in the initial BVSD mailing. Consent forms and other recruitment documents were provided in both English and Spanish for the 203 households which listed Spanish as the home language. The other 716 received English versions only. Because of the minimal risks associated with the study, parental permission was only required from one parent. Students and parents were asked to return the signed consent form along with the completed survey. An electronic copy of this form was also included at the start of the online survey. Respondents using this media were asked to check a box demonstrating their
consent and assent prior to being directed to the survey. Respondents were also asked to provide an email address or phone number that could be used to verify parental consent. This was designed to ensure that the parents had been included in the permission process. This contact information, along with checks next to both the parental permission and student assent statements was required in order to participate in the survey.

Survey respondents who provided contact information for participation in future GAMES discussions received an additional parental consent form prior to the scheduled focus group at their school. These were sent via email and hard copies were delivered to the students at school. Those choosing to enroll in the study were asked to submit their signed consent forms at the time of the focus group meeting.

Student assent forms were distributed at the start of the focus group meeting. The Principal Investigator facilitated the assent process, allowing students to choose to participate or to decline without the influence of a teacher or parent.

Adult interviewees who respond to the invitation to participate in the study were asked to sign a consent form at the time of the interview. For those participating in phone interviews, consent forms were distributed electronically prior to the discussion and were collected by means of mail, email, or in person pick-up according to the participant’s preferences.

Review Process

Because of the nature of the study, Internal Review Board (IRB) approval was required prior to conducting the research. The inclusion of children in the investigation necessitated a full review by the University of Colorado’s IRB and the collaborative efforts with BVSD required a separate review by the district’s own Office of Planning & Assessment. All protocols were
aligned with IRB requirements for working with a sensitive population.

BVSD requires all non-district researchers to apply for project review by submitting a request to do educational research along with a detailed research proposal to demonstrate sufficient benefits to the district and the field of education, compatibility with regular instruction, appropriateness of impact on students, parents and staff, and acceptable technical adequacy. This review process is designed to uphold the specific interests of students and teachers more clearly than other approval process and to serve as additional protection for all involved. Through this process, approval was granted by Planning & Assessment along with appropriate administrators. Following this approval, schools were then given the option to choose their level of participation in the research.

Data Analysis

All data were qualitative in nature and therefore statistical analyses were not performed. Data compilation and analysis took place concurrently to data collection and continued throughout the fall semester of 2012. Survey response frequencies were sorted for evidence of attitudes towards science—both positive and negative—and GAMES memories and career aspirations were coded using quantitative descriptive analysis (Libarkin & Kurdziel, 2002). Word occurrences and frequencies were sorted into categories reflecting both positive and negative associations with science and future goals.

Focus groups were conducted throughout the fall of 2012, with school-based data collection completed in accordance with BVSD district policy and permissions. Teacher/chaperone interviews were completed during the summer and fall of 2012. All focus groups and interviews were recorded, transcribed, and inductively coded using thematic content analysis (Libarkin & Kurdziel, 2002). To address the research questions surrounding the ability
of GAMES to meet its goals on a long-term basis, particular attention was paid to outcome
categories that demonstrated the participants’ confidence or lack there of, attraction to or avoidance of science based programs and coursework, and attitudes towards science—both positive and negative. Recurring themes—both unexpected and those based in theory—were identified from open-ended responses.

Limitations

Recruitment Issues

The method for contacting students that was developed in collaboration with the BVSD Office of Planning & Assessment allowed the recruitment of as many of the 350 former participants as possible in light of the absence of specific records of participation. Because identifying information about past participants is not kept at the Museum, specific students were unable to be targeted except in a few rare cases. Instead, a very wide net was cast with the hopes of capturing the considerably smaller subset of GAMES participants. The final compiled list contained all girls from a given school rather than just the 15 who participated, resulting in a final tally of 919 invitations. Although this was more than two and a half times the actual number of participants, it cannot be assumed that all 350 GAMES girls were included on the list.

Relocation has likely dispersed a number of program participants to schools outside of the district that will not be included in the recruitment plan. In addition, because the program’s target population of low-income, underprivileged youth tend to display higher dropout rates than their peers, some GAMES participants may have left the school system all together.

While as many participants as possible were recruited to participate, responses were not expected to differ dramatically among schools at either the middle or high school level. All
elementary schools were selected for GAMES participation based on their percentages of students qualifying for “free and reduced lunch”, and middle and high schools identified for inclusion in this study serve as receiving schools for one or more of these elementary populations. In addition, initial surveys of existing pre- and post-program assessment data indicate similar responses across cohorts regardless of school affiliation.

For this reason, a large sample size was not necessarily required. Similar assessment studies have produced publishable results with as few as 6 to 24 subjects (Eisenhart & Edwards, 2004; Fadigan & Hammrich, 2004; Gibson & Chase, 2002; Luke et al., 2007; Paris et al., 1998), though some of these studies incorporated quantitative survey results as well. Because of the relatively large pool of existing assessment data and the representative nature of the issues that arose during focus group discussions, meaningful data need not require high participation in order to produce noticeable trends.

However, recruiting students from different schools helped to ensure that participants from multiple cohorts were included in the study. Some differences could be expected between responses of middle- and high-school aged respondents based on the differences in their experiences and the amount of time that had lapsed since their participation in GAMES. While insight into the lasting impacts of the program could be gleaned from either school level, the richest data would incorporate students from both middle and high schools who could reflect on their participation in GAMES from one to nine years after the experience, providing a more complete look at how attitudes towards science are impacted over time.

**Potential Sources of Bias**

Because of a lack of documentation, recruitment strategies relied on self-selecting for
past participation in GAMES, there was potential for bias among survey respondents and focus
group participants. The study was unable to capture data about those for whom GAMES had no
impact and who had not formed lasting memories about their experiences. Similarly, he study
methodologies created a potential for data that were skewed towards strong positive or strong
negative associations. Those with vague recollections of the program or who felt indifferent
about the experience were less likely to value their own contributions and may have elected to
refrain from participating in the research.

In addition, it has been shown that impact studies—particularly those involving in-person
methodologies—may be complicated by social issues of validity. Attempts to please the
researcher or perceptions of power inequality, particularly where young students are involved,
may create discrepancies among reported impacts that are positively skewed (Anderson,
Storkdieck, & Spock, 2007).

Although power inequality was less likely to influence validity of adult interviews, many
of the same potential biases may have influenced these data as well. Teachers/chaperones were
more likely to respond if they had continued and prolonged relationships with the GAMES
program. In order to perpetuate this relationship, some perceived value would need to be
associated with the program that could then manifest as positively skewed interview data.

Absence of Controls

Another problem facing this and many other informal, longitudinal studies was the lack
of a comparative control group (Fancsali, 2002). In order to establish a control group for this
study, a complimentary set of female students from similar backgrounds but who did not
participate in GAMES would need to be assembled. This would help to illustrate the impacts that
were attributed specifically to the GAMES program and more clearly show how the program was able to contribute science attitudes and aspirations.

Alternatively, a more general survey of these attitudes and aspirations among a broader set of students could be used to classify the subset of GAMES participants. This could be used to show whether GAMES girls were more or less likely than the average student to report positive associations with science and to envision a future in STEM-related fields.

Unfortunately, access to control populations is difficult to obtain. Without specific inclusion and exclusion criteria, it is difficult to demonstrate adequate justification of the use of resources. This becomes even more of an issue where children are involved, as there are a number of checks in place to ensure the appropriateness of research interventions. Due to the nature of the BVSD recruitment strategy, a small number of follow-up surveys were completed by students who attended GAMES cohort schools, but were not involved in the program itself. Because all girls from these schools received a study mailing, expanded IRB permissions could have allowed for a more complete control set. However, with the inclusion criteria as they stand, only those who misunderstood or disregarded survey instructions served as controls. Of the forty-three total follow-up responses, thirteen fell into this comparison category. While this is not a large enough sample to draw any definitive conclusions, it was able to offer a few interesting comparisons and shed some light on potential trends.

In a perfect world, all studies would include controls that could be used to verify claims and suggest alternative explanations. Perhaps studies like these can contribute to the growing body of work supporting the value of after-school science interventions that may help to pave the way for future research of even broader scope.
CHAPTER V
RESULTS

In order to determine the long-term impacts of GAMES, study results were examined for two types of patterns. The first pattern included evidence of positive attitudes towards science with respect to the GAMES goal driven questions presented in the Assessment chapter. These questions include: (1) Do GAMES participants believe themselves capable of participating in and contributing to scientific work? (2) Do they continue their academic coursework in science and/or pursue science opportunities outside of the classroom? (3) Do they maintain a positive attitude towards science? Do they like science as much as (or more) than they did when they participated in GAMES?

Whether evidence supported these questions in the affirmative or the negative, a second pattern was then sought that would serve to link the GAMES program to these associations. Without the link to the program itself, it would be difficult to say that GAMES had had any lasting impact on its participants. However, the presence of positive attitudes towards science along with a pattern of attribution to GAMES would indicate that the program was meeting its long-term goals. Similarly, negative attitudes along with a linking pattern would suggest that not only was the program not meeting its goals, but it was actually counterproductive to its most basic framework.

Follow-up Surveys

Of the 919 surveys mailed, 43 completed surveys were received. These included 30 surveys from past GAMES participants, 12 from non-participants, and one from a student who was unsure of her participation. Those who had participated in the program were asked to share
something that they remembered about GAMES. Not surprisingly, the most common responses tended to mirror the things that students reportedly liked best on the final day of the program. In both instances, these include doing hands-on activities, followed by science disciplines and interacting with objects (table 12). Other common memories included exploring the museum, spending time on the university campus, and having fun.

<table>
<thead>
<tr>
<th>Memories</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Doing</td>
<td>9</td>
<td>30</td>
</tr>
<tr>
<td>Paleontology</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Botany</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Entomology</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Museum</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Objects</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>CU Campus</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Zoology</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Fun</td>
<td>3</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 12. Most common responses to the prompt: Please share something that you remember about GAMES.

Although the responses generally aligned with students’ favorite aspects, specific sciences mentioned did not follow this trend. Paleontology was mentioned by 20% of follow-up survey respondents versus only 11% of participants on post-program questionnaires. And Entomology was mentioned by 17% of follow-up survey respondents versus only 4% of participants on post-program questionnaires. In fact, the number of reports of Entomology memories seem more closely aligned with the number of times this science was reported as a least favorite on post-program questionnaires (10%). Though no value judgments were made in the reporting of memories, this suggests students remember both the good and the bad about their experience in GAMES.

When compared to post-program questionnaire results, more students reported liking science less than they did when they were in elementary school as part of the long-term survey
results (table 13). Among GAMES participants, this number went up from 1% immediately following the program to 17% several years after the fact. The comparisons for similarly aged non-participants were less drastic. However, this comparison group was more likely to show no change in how much they liked science, while past GAMES participants tended to skew towards both types of change. Perhaps this is because following the program, some students were able to find reinforcing experiences that cultivated their interest in science, while other participants were not. A lack of reinforcing experiences may have had an adverse effect on attitudes, leaving them with a peak in their scientific interest around the time that they participated in GAMES. Overall however, the majority of respondents reported liking science the same as or more than they did when in elementary school.

<table>
<thead>
<tr>
<th>I like science…</th>
<th>Yes</th>
<th>No</th>
<th>I don’t Know</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>more than when I was in elementary school</td>
<td>14</td>
<td>4</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>less than when I was in elementary school</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>the same as when I was in elementary school</td>
<td>10</td>
<td>7</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>12</td>
<td>1</td>
<td>41</td>
</tr>
</tbody>
</table>

Table 13. Participant vs. non-participant responses to the question: Since coming to GAMES, I like science more than, less than, or the same as I did before.

Although reinforcing activities may have played a role in whether a student’s positive attitudes towards science continued after GAMES, participation in the program did not seem to have an impact on whether students pursued other science programs outside of school (table 14). Both GAMES participants and non-participants were fairly evenly split between those who had participated in other programs and those who had not.
When you were in 4th or 5th grade, did you participate in GAMES?

<table>
<thead>
<tr>
<th>Have you participated in other science programs outside of school?</th>
<th>Yes</th>
<th>No</th>
<th>I don’t Know</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>12</td>
<td>5</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>[41%]</td>
<td>[42%]</td>
<td>[100%]</td>
<td>[43%]</td>
</tr>
<tr>
<td>No</td>
<td>14</td>
<td>6</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>[48%]</td>
<td>[50%]</td>
<td>[0%]</td>
<td>[48%]</td>
</tr>
<tr>
<td>I don’t know</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>[10%]</td>
<td>[8%]</td>
<td>[0%]</td>
<td>[10%]</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>12</td>
<td>1</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>[100%]</td>
<td>[100%]</td>
<td>[100%]</td>
<td>[100%]</td>
</tr>
</tbody>
</table>

Table 14. Participant vs. non-participant responses to the question: *Have you participated in other science programs outside of school?*

When asked to indicate their current favorite and least favorite subjects in school, former GAMES participants reported Language Arts, Science, and Art as their favorites (figure 1). This further indicates continued positive attitudes towards science with one third of follow-up survey respondents reporting that they not only like science, but that it is among their favorite subjects in school. Interestingly, Math led the group as a least favorite subject, suggesting room for growth in the promotion of positive attitudes towards other STEM disciplines.

[Figure 1. Favorite and least favorite subjects among past GAMES participants.]
Among non-participants, Science was even more popular with nearly half of these respondents listing it as a favorite (figure 2). This discrepancy points to potential biases among the small comparison sample. Perhaps those who completed the survey despite having no connection to GAMES were drawn to a study about science attitudes because of their previous interest in the subject. This is pure conjecture, though it does point to potential imperfections in the comparison group and how these responses were obtained. Although no subjects stood out clearly as least favorites among this group, other reported favorites included Music and Art.

![Non-Participant Comparison](image)

Figure 2. Favorite and least favorite subjects among non-participant respondents.

In addition to liking science, more than two thirds of GAMES participants reported that they were “good at” the subject (figure 3). In fact, Science was the most commonly reported strength among this group with other favorites of Language Arts and Art falling close behind. This indicates that GAMES participants feel confident in their abilities to perform science.
Non-participants also reported Science as a strength along with Music and Math (figure 4). Unlike the participant group, comparison group strengths did not mirror their reported favorite subjects, and demonstrated greater general confidence in their academic abilities. More than half of the comparison group reported being “good at” the majority (62%) of listed subjects, while similar numbers of GAMES participants reported strengths in less than one third (31%) of the same subjects. Again, this points to potential comparison bias as this group may also display uncharacteristically high academic achievement when compared to the general population.
These potential biases also came through when asked about academic plans for the future. Three quarters of non-participants reported planning to attend additional school after college compared to slightly less than half of GAMES participants (table 15). This may also reflect differences in socio-economic status among the two groups, with more well-off students able to afford more schooling. Despite these potential differences, the vast majority of all follow-up survey respondents reported a desire to attend college.

![Non-Participant Comparison](chart.jpg)

Figure 4. Academic strengths and weaknesses among non-participant respondents.

<table>
<thead>
<tr>
<th>In the future I plan to (check all that apply)…</th>
<th>Yes</th>
<th>No</th>
<th>I don’t Know</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>graduate from high school</td>
<td>21</td>
<td>9</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>[72%]</td>
<td>[75%]</td>
<td>[100%]</td>
<td>[74%]</td>
</tr>
<tr>
<td>complete a GED</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>[14%]</td>
<td>[8%]</td>
<td>[0%]</td>
<td>[12%]</td>
</tr>
<tr>
<td>go to college</td>
<td>26</td>
<td>11</td>
<td>1</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>[90%]</td>
<td>[92%]</td>
<td>[100%]</td>
<td>[91%]</td>
</tr>
<tr>
<td>continue school after college</td>
<td>13</td>
<td>9</td>
<td>1</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>[45%]</td>
<td>[75%]</td>
<td>[100%]</td>
<td>[55%]</td>
</tr>
<tr>
<td>I am not sure</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>[3%]</td>
<td>[0%]</td>
<td>[0%]</td>
<td>[2%]</td>
</tr>
<tr>
<td>Total</td>
<td>29</td>
<td>12</td>
<td>1</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>[100%]</td>
<td>[100%]</td>
<td>[100%]</td>
<td>[100%]</td>
</tr>
</tbody>
</table>

Table 15. Participant vs. non-participants responses to the question: *In the future I plan to...*
When prompted to describe their career aspirations, GAMES participants were evenly split between science-related and non-science related careers (table 16).

<table>
<thead>
<tr>
<th>CAREER</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Non-Science</td>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>Unsure/blank</td>
<td>4</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 16. General career divisions among GAMES participants in response to the prompt: I would like to have a career as a(n)...

The numbers of science-related careers were down considerably from those reported on the post-program questionnaire which showed 77% of respondents had scientific aspirations. This change was less dramatic among non-participants with 69% of the group reporting a desire for science-related careers (table 17). Several of these respondents however, listed multiple career choices from both scientific and non-scientific categories.

<table>
<thead>
<tr>
<th>CAREER</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>9</td>
<td>69</td>
</tr>
<tr>
<td>Non-Science</td>
<td>6</td>
<td>46</td>
</tr>
<tr>
<td>Unsure/blank</td>
<td>2</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 17. General career divisions among non-participants in response to the prompt: I would like to have a career as a(n)...

Although the long-term aspirations of GAMES participants showed a decline with respect to science-related careers, the diversity of science disciplines increased. Medical professions remained popular among past participants, but only one respondent specifically reported a GAMES discipline (Zoology) as her future career choice (table 18). Perhaps this is because a continued interest in science exposed the students to additional career options after the conclusion of the program.
Medical professions were also popular among the non-participant comparison group (table 19). One respondent from this group also listed a GAMES discipline (Archaeology) as her selection, suggesting that the specific sciences studied during the program did not generally have lasting impacts on future aspirations.

Non-science related careers remained fairly similar to those mentioned on post program questionnaires. Artists overtook teachers as the most common response in the follow-up surveys, and entertainment professions (actress, singer, dancer), remained popular choices as well (table 20).
<table>
<thead>
<tr>
<th>NON-SCIENCE</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artist</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Teacher</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Entertainer</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Media</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Lawyer</td>
<td>2</td>
<td>7</td>
</tr>
</tbody>
</table>

Table 20. Most common non-science careers reported by GAMES participants in response to the prompt: *I would like to have a career as a(n)*...

Interestingly, no comparison group respondents listed artistic professions among their career selections, although teachers were also common responses among these students (table 21).

<table>
<thead>
<tr>
<th>NON-SCIENCE</th>
<th>#</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher</td>
<td>4</td>
<td>31</td>
</tr>
<tr>
<td>Entertainer</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Military</td>
<td>1</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 21. Most common non-science careers reported by non-participants in response to the prompt: *I would like to have a career as a(n)*...

Overall, follow-up survey responses provided evidence that past GAMES participants (1) demonstrate confidence in their scientific abilities and believe themselves capable of participating in science, and (2) maintain fairly positive attitudes towards science—though not as overwhelmingly positive as immediately after the program. However, these data did not provide conclusive evidence that past participants were continuing their academic coursework in science or pursuing other opportunities outside of school. Additionally, comparisons to a small set of non-participants did not demonstrate a pattern of linkages between these findings and a respondents’ participation in GAMES.

Focus Groups

Of the 30 past participants who completed follow-up surveys, 22 reported an interest in
participating in future focus group discussions to generate more detailed information about the long-term impacts of GAMES. These students provided some form of contact information and were sent additional information about the meetings several months later. Eight of these students participated in one of four focus group discussions held at Angevine Middle School and Centaurus High School during the fall of 2012. Reasons for low participation rates are discussed in the following chapter. Although seven of the eight students were interviewed in group settings, their cases are treated individually below.

*Abby (7th grade)*

**Confidence.** Abby finds her current advanced science class to be somewhat difficult, but reports that “it’s a good challenge.” Before advanced science classes were offered, she found science too easy and so is enjoying the higher level of difficulty. Her confidence in her ability to participate in the sciences even extends into the future. She reports that she is not nervous for high school. If the classes are considerably harder, she will seek out additional attention. As she states, “I’m not afraid to ask teachers if I need help.”

**Pursuit of Science.** Abby will likely pursue advanced science in high school, though her interests lie elsewhere. She has not participated in any other science programs, and prefers cheerleading and karate. Once, Abby wanted to be an actress or a writer, but now she would like to go to college for radio or television broadcasting.

**Positive Attitudes.** Abby currently likes science less than she did when she was in elementary school. She preferred the hands-on activities and more frequent labs in elementary school. She reports that she does not dislike science, but her current classes involve lots of not taking and power point presentations which sometimes leave her bored.
Memories of GAMES. Abby has both positive and negative associations with GAMES. She remembers enjoying the plant unit, touching fossils, dissecting dead birds, and perusing the traveling museum exhibit about human consumption. She did not like spending so much time on the bus and had to forgo the entomology unit because of her fear of spiders.

Ties to GAMES. Although she is confident in her own abilities, Abby does not demonstrate strong positive attitudes towards science. However, she does not attribute this lack of interest to her participation in GAMES. When asked what could be done to improve the program, Abby responded, “I wouldn’t change it because some people liked bugs but I was uncomfortable.”

Addy (7th grade)

Confidence. Addy believes that science classes might be more difficult in high school, but she is confident in her own potential as a scientist and knows that she would like to pursue zoology or botany in college.

Pursuit of Science. She is currently studying life science in school and is looking forward to more classes like this. She has even used her safety goggles from GAMES in one of her labs.

Positive Attitudes. Addy is generally quite enthusiastic about science and reports liking it even more after GAMES “because we learned so much about a bunch of different sciences.” Science is one of her favorite classes.

Memories of GAMES. Addy has almost all positive memories of GAMES. She has a very detailed memory of being stuck on the bus in a snowstorm, but does not seem particularly negative about the experience. She also remembers dissecting flowers, using microscopes and
pinning bugs. She was particularly impressed by getting to see extinct animals—including a passenger pigeon and a parrot—and the delicious smelling eucalyptus in the botany collection.

**Ties to GAMES.** Addy has very positive attitudes towards science and even directly attributes her career aspirations to her participation in the program. She states, “for a while before that I wanted to be a zoologist but after that I was really more sure that I wanted to be a zoologist.“ And also, “when we went to GAMES club I really liked botany and zoology and I finally decided I'd rather do zoology cause I’m more interested in animals than plants. But I’m thinking maybe botany.” She also reports an interest in attending the University of Colorado because of the museum. As a zoologist, she thinks it would be cool to work at the school that she attends.

*Kami (7th grade)*

**Confidence.** Kami likes science, but is worried that math and science may get harder in high school. Her confidence appears to wane at times as she goes back and forth between interests. With regards to her future aspirations she states, “I wanted to be an entomologist. And then I wanted to be an architect. And then I wanted to be an interior designer and now I want to be an interior designer or an architect. I mean, or an engineer.”

**Pursuit of Science.** Kami describes her current interest in CU’s Engineering program by reporting, “last trimester I did the engineering class here and it was really fun and I decided I wanted to be an engineer.” However, she admits to using her GAMES toolkit mostly for non-science related activities like working with clay and other art projects.

**Positive Attitudes.** Kami likes her engineering class and reports liking science in general more after GAMES. She was often bored in elementary school due to a lack of new material. She
states, “I knew what that stuff was because I had this little *my first science kit* and I’d done all of this in preschool that we were learning in 2nd grade.”

**Memories of GAMES.** Like Addy, Kami also remembers being stuck on the bus in a blizzard, however most of her other memories center around the entomology unit. She remembers visiting the collection, interacting with the entomologist, and pinning insects.

**Ties to GAMES.** Although Kami’s career choices have not remained constant, at one time she reports aspiring to be an entomologist because of her experience in GAMES. It is difficult to assess the longevity of the impact, but the program seems to have inspired at least a temporary change in Kami’s attitudes towards science.

*Mia (7th grade)*

**Confidence.** Mia is much less assertive than the other students in her focus group, but she sees herself as a marine biologist studying at the University of Hawaii in order to “have an ocean right there instead of being in Colorado where there's no water basically.”

**Pursuit of Science.** Aside from her career aspirations, Mia did not offer much evidence for her continued academic coursework in science or outside opportunities. She reports liking computer class and photography.

**Positive Attitudes.** Mia likes science more now than she did when she was in elementary school. She states, “science was kind of not that fun when I was at Lafayette but now it’s more [fun].”

**Memories of GAMES.** Mia’s memories of GAMES are predominantly focused around the botany unit. She remembers pressing flowers and visiting the botany collection. She recalls, “She
had like this huge area where she kept all her flowers and it had so many secret things that would like come out of the wall. That was really cool. I liked it.” Mia also remembers keeping a journal and taking home her toolkit.

**Ties to GAMES.** Although she reports still having all of the tools, there is little evidence of a pattern of attribution between Mia’s participation in GAMES and her current interests in marine biology.

*Abby (9th grade)*

**Confidence.** Abby likes science and has competed in Science Olympiad events, but it is unclear whether or not she believes herself capable of pursuing science as a career. She expresses no worries about feeling prepared to go to college and would like to obtain a PhD, although she is not yet sure which major she would like to pursue.

**Pursuit of Science.** Abby is currently enrolled in advanced physical science and is thinking about beginning IB next year. She participated in Science Olympiad during middle school and reports that “it was really fun.” If the program was offered at Centaurus, she would participate during high school as well.

**Positive Attitudes.** Abby was not explicit about her current attitudes towards science, though she did mention that her involvement with the Science Olympiad began because of an interest in science and wanting to do more.

**Memories of GAMES.** Abby remembers visiting the different museum collections and seeing the fossils, birds, and taxidermy animals. She also provided a very thorough account of all of the instruments that she took home in her “schwag bag” toolkit.
Ties to GAMES. Abby reports that she still has all of her tools and uses them frequently. She describes all of her program experiences as “positive memories” and even expressed an interest in participating in other GAMES-related programs. It seems likely that these positive experiences have had an impact on her attitudes towards science, though the patterns of attribution are less clear than with some of the other students.

Meghan (9th grade)

Confidence. When it comes to science, Meghan lacks a little bit of confidence. She reports that her current science classes are especially difficult because “there’s just things that I didn’t learn that I was supposed to at Angevine. Or just didn’t pick up on. But yeah. It’s hard but it’s good.” She also admits that science is the only class in which she is currently receiving a B. About her current interest in engineering, Meghan states, “I didn’t think I’d go onto that path because I’m not good as an engineer I guess. Like I thought I wasn’t. But my brother said to just take it anyways and it ended up being one of my favorite classes.” However, she has left herself with an escape route. Meghan also reports taking choir in case engineering gets too hard and she chooses to drop it.

Pursuit of Science. Meghan reports that she has not participated in any other science programs besides GAMES. For a little while after GAMES, she collected rocks and would use her toolkit to break them open. And although she no longer maintains this collection, her enrollment in the engineering class has renewed her interest in science. With regards to her future aspirations she indicates, “I kind of had this plan since I was like 10 where I would go to school for 4 years and get a degree in education and then start teaching and go back and get my masters in English. But since I’m now doing engineering it’s like open to a lot more computer
science. So I’m kind of weighing both of those.”

**Positive Attitudes.** Meghan is not sure if she likes science more now than she did when she was in elementary school. She reports, “they both have different good things and bad things. Like middle school was hands-on more. This is more like theoretical. What would happen if you did this? Because you can’t really drop an egg off a building and measure the velocity of it. So we do a lot of work and then in middle school I guess we didn’t do as hard of concepts and they made it kind of easier. But I’m definitely learning a lot more here. So that’s always good.” She also indicates that, “I really like engineering right now.”

**Memories of GAMES.** Meghan’s memories of GAMES are fairly vague in comparison to some of the other students. She remembers dinosaurs, stuffed animals, “cool exhibits”, the tools, having fun, and “doing things with friends.”

**Ties to GAMES.** Meghan admitted that the GAMES experience did not drastically change her views. However, she refers to the overall program as a positive experience. She also reports that she still has her notebook, bag, and pick, and that she would be interested in participating further with GAMES. About her future involvement, she states, “you guys are pretty creative there and you came up with GAMES and I had a lot of fun during that so I think it’d be pretty cool. I’d go either way. I don’t think that would really stop me unless I’d say like a writing workshop where you just go and write. I don’t think I’d do that.” Much like Abby, Meghan’s positive experiences with GAMES may have helped to maintain her interest in science it is difficult to draw definitive connections.

*Camille (10th grade)*

**Confidence.** Camille likes her current biology class even though it is difficult and
requires a fair amount of memorization. She is completing the IB program at Centaurus and feels confident that she will be prepared for higher education—potentially with a full year’s worth of college credits.

**Pursuit of Science.** Camille is pursuing advanced science and is currently on course to take IB physics during her upperclassman years. In addition, she participated in the Science Olympiad during middle school, which she thoroughly enjoyed. Although her team did not perform very well, Camille has detailed positive memories about the experience and would continue her participation if the program was offered at Centaurus. She has aspirations of attending the Air Force Academy to study flying and psychology.

**Positive Attitudes.** Camille reports liking her current biology class and she has enjoyed other scientific coursework and activities.

**Memories of GAMES.** Most of Camille’s memories of GAMES are negative in nature. She found the first day boring, stating “we sat at this table forever and they were telling us that stuff and it was really boring. They were like telling us about CU and I didn’t really care.” She also complained that the students were only allowed to ask questions, but not to converse among their peers.

**Ties to GAMES.** Fortunately, these negative experiences do not seem to have adversely impacted Camille’s attitudes towards science. She continues to demonstrate confidence in her scientific abilities, to pursue additional opportunities and coursework in the sciences, and to enjoy the majority of her scientific endeavors. And although the GAMES program did not seem to impact her personally, Camille did report recommending it to her younger sister.
Julia (10th grade)

**Confidence.** Julia is pursuing IB chemistry and finds it difficult but enjoyable. She feels confident that her coursework will prepare her for college, although she is less sure about her future in science. Although she is still undecided about what she would like to study, she is leaning toward something more artistic like fashion design.

**Pursuit of Science.** Julia is currently taking IB chemistry so that she can pursue biology in her later high school years. Outside of school, however, Julia has very different interests. She prefers dance over science programs, although she reports “my mother’s dragged me to a lot of things outside of school that probably did have science included.”

**Positive Attitudes.** Julia likes science more now than she did when she was in elementary school. She describes elementary science as “really hands-on but basic.” She goes on to describe the shift by stating, “I had older siblings and my parents are pretty smart and they’re always telling me all this stuff about science so I pretty much knew all that stuff already. But now we’re getting more into the scientific part of it and what actually makes the things do whatever. I don’t know. I like it much better now just because even though we don’t do as many fun things it just makes so much more sense.”

**Memories of GAMES.** Julia admits that she does not remember much about the program, but she does have memories of bugs, taxidermy animals, “bad smelling rooms”, and dinosaurs. She also recalls the friendly staff and scientists.

**Ties to GAMES.** Julia got a lot of use out of her toolkit over the years. She still has the measuring tape, but reports that the other tools all got broken or lost. Although her positive experiences in GAMES did seem to help maintain an academic interest in science, her long-term career goals were not impacted by the program. Perhaps because of her non-science aspirations,
Julia expressed an interest in having been exposed to a more general introduction to higher education. She suggested, “it’d be cool to learn more about college and going and living on campus and stuff. You know meeting professors and figuring out how it works and class at college and what not. That would be kind of cool.”

Teacher Interviews

Five of the 12 teachers invited to take part in the study participated in individual interviews during the summer and fall of 2012. All five had served as chaperones for the GAMES program at least once, with three of the teachers participating three or more times. They represented Sanchez Elementary, Lafayette Elementary, University Hill, Ryan Elementary, and Emerald Elementary. Because of overlap in responses and common themes, the five separate interviews are divided into questions and addressed collectively below.

What do you think GAMES participants get out of the experience?

All five teachers referenced that participants gained broader perspectives of science, the different types of science, of the kinds of people who participate in them. Especially important to these new perspectives was the presence of female role models—also mentioned in each of the five separate interviews. Other common responses included exposure to higher education and the university campus, increased feelings of empowerment and confidence, and the awareness of diversity among potential careers.

All of these aspects form key components of the program’s conceptual framework and provide evidence that GAMES participants are provided with opportunities to relate personally
to science, and to view themselves as capable of contributing to scientific work.

*Did you notice any changes in the students who participated in GAMES?*

Several teachers mentioned that they had noticed changes in their students’ perspectives regarding their academic future and potential career selections. One teacher noted more interesting GAMES-focused science fair projects in the year following participation in the program. She also described a student who had gone on to attend the University of Colorado Engineering program and continued to return to the elementary school to talk to current students about how GAMES had influenced her own career choices. Another reported an increase in excitement and a desire to continue scientific explorations with their take-away toolkits. And yet another mentioned a student whose academic career path had been expanded after her career aspirations shifted from being a waitress to an entomologist.

These types of examples provide evidence that GAMES participants maintain positive attitudes towards science while continuing academic coursework and pursuing outside opportunities in the sciences. In addition, specific ties to GAMES are present in each example, ranging from interests in particular topics covered in the program, to continued use of toolkits, and strong connections to the university campus. These ties point to a pattern of influence and a linkage between positive outcomes and participation in GAMES.

*Were there any differences between program participants and non-participants?*

In addition to these changes, two teachers mentioned that GAMES participants were
more interested in science and excited about learning than non-participants in their classes. Another reported that they showed more confidence in class, while the final two noted that there was some envy among students who did not have the opportunity to participate in the program.

While feelings of envy could be seen as a negative impact of the program, they also suggest that GAMES was seen in a positive light by both participants and non-participants alike. In order to foster a sense of jealousy, participating students likely demonstrated positive effects of the program in a way that was perceptible to others outside of the experience.

*What kind of students do you think benefit the most from GAMES?*

The presence of envy often made it hard for teachers to choose students to participate in GAMES. Without guidelines from the museum to facilitate the selection process, teachers reported a variety of techniques for filling their 15 vacant spots. Four of the five teachers interviewed thought that students without similar opportunities benefited the most. These included girls who had not visited a museum or experienced a college campus, as well as girls from economically disadvantaged backgrounds, less supportive family situations, and diverse cultural perspectives. In addition all five teachers reported looking for some form of interest in science among potential participants. These students were selected through application processes, teacher recommendations, or on a first-come first-served basis.

The GAMES program was designed to promote accessibility among these types of low-income and minority students, and so it is encouraging to hear that they are indeed benefiting from the experience. However, the GAMES approach also offers a powerful combination of strategies for sparking an interest in science. As mentioned in the conceptual framework section
of the introductory chapter, elements of curiosity, confidence, challenge, control, play, and communication all work together to create this initial interest. As noted throughout questionnaire responses and anecdotal accounts, students who participated in GAMES developed an interest in a variety of scientific topics and disciplines to which many of them had not previously been exposed. In addition, previously completed short-term evaluation in the form of pre- and post-program interviews suggests that greater impacts were seen in students who expressed less interest science and confidence in their own abilities prior to participation.

How could the GAMES experience be improved?

All five teachers responded that the program could be improved by allowing more students to participate. Suggestions for increasing participation included offering the program more often, incorporating additional schools that do not currently qualify to participate, providing more advance notice, adjusting meeting times to ease transportation woes, and addressing language barriers and general accessibility issues. In addition, two teachers suggested putting more emphasis on the college lifestyle and attainability of higher education. One veteran teacher who had chaperoned an estimated five or six different groups of girls also requested bringing back activities to do at home and cloth gloves for the toolkits.
CHAPTER VI
DISCUSSION

The results from the follow-up surveys, student focus groups, and teacher interviews raise several points worthy of discussion. These include implications for the long-term impacts of GAMES, as well as effective program components and suggestions for improvement. Based on comparisons to post-program questionnaires, follow-up survey data suggest that in accordance with Falk’s (2007) observations, perceptions of the GAMES experience do in fact change with time. Several years after completing the program, former participants maintained positive attitudes towards science and confidence in their abilities, but reported fewer science-related career aspirations and less overall positivity towards science than was present immediately following the program. Although patterns of attribution between these data and participation in GAMES are hard to identify from the surveys alone, other study components and methodologies offer some helpful insight.

Summary

All three longitudinal study methods were examined for evidence that GAMES was meeting its goals of (1) inspiring confidence, (2) encouraging the continuation their scientific education, and (3) promoting positive attitudes towards science. With regards to confidence, many former GAMES participants reported science as one of their strengths in school. In addition, of the eight students who participated in group discussions, five demonstrated high levels of confidence, two medium, and only one slightly lower. One teacher also noted that GAMES participants showed more confidence in class than non-participants.

When it comes to encouraging the pursuit of science, GAMES was able to demonstrate
immediate influences on scientific career aspirations on the post-program questionnaire. Years after the fact, this interest appears to wane somewhat based on accumulated experiences. However, all eight of the students who participated in group discussions reported a desire to continue their scientific educations. Of these, five expressed an interest in pursuing a career in the sciences while two remained undecided. Likewise, among notable changes witnessed in their students, teachers reported more GAMES-related science fair projects as well as GAMES-inspired career aspirations.

Finally, although some decline is seen between the immediate post-program questionnaire and the later survey, the majority of GAMES participants reported long-lasting, positive attitudes towards science. Only one of the eight students who participated in group discussions indicated that she liked science less than when she was in GAMES. Two teachers also noted that GAMES participants appeared more interested in science and more excited about learning than non-participants.

Based on these measures, along with previously conducted evaluation, GAMES appears to have a generally positive impact on participant attitudes towards science in both the short-term and for several years after. These results also support existing research in identifying key factors in the success of the program. Program elements that were reported as being enjoyable, memorable, and impactful included hands-on activities, exposure to diverse careers and female role models, and the incorporation of authentic objects and experiences. All of these factors were included in the conceptual framework of GAMES and served to help the program achieve its goals.
Recommendations

While the results did not illuminate any major flaws in the program, a few slight modifications to participant recruitment strategies, curriculum, and evaluation tools may help to make GAMES even better. First, it may be useful for program administrators to reexamine participant demographics and make more concrete guidelines for whom they would like to target. It seems that teachers generally have a sense of what types of students benefit from the program, but additional selection criteria may help to alleviate some of the stress of assembling such a small group of participants from potentially very large pools of students. These criteria could include students who do not already demonstrate a major interest in science so that others may experience the program’s ability to create that interest. Or perhaps the criteria could include students who exude less confidence and could use a boost in self-esteem. Although GAMES can have lasting impacts on all types of students, participants falling into categories like these may shine even more light on the strengths of the program.

Second, several students and teachers mentioned a desire to have the university itself play a larger role within the program curriculum. By placing more emphasis on the basics of campus life and the accessibility of higher education, more participants may see scientific careers within their reach and gain a greater hold on how to work toward achieving their academic goals. This could also serve to strengthen the partnerships between BVSD, the museum, and the university as a whole in order to reach the full potential of the collaboration.

Finally, current practices in program evaluation could be tightened up in order to provide feedback for continual improvements and additional research. While the Draw-A-Scientist-Test provides an effective icebreaker on the initial day of the program, set protocols for administration, data documentation, and complementary post-program evaluation strategies
could turn it into something even more useful. Instead of simply providing a starting off point for addressing scientific stereotypes, the DAST could help to shed light students’ abilities to see themselves within the scientific realm. Similarly, post-program questionnaires could be adjusted slightly in order to clarify results. By altering the competency question to avoid providing a list of GAMES disciplines at the top of the page, subsequent responses (particularly those reporting career aspirations) may see less skew towards these five sciences and ultimately more accurate results.

Future Directions for Research

This study was able to reinforce existing research regarding best practices for promoting science among girls while illuminating potential patterns of attribution between participation in GAMES and prolonged positive attitudes towards science. However, much work remains to be done before more general statements can be made about the long-term impacts of these types of science interventions. One reason for the lack of current research is the difficulty in conducting these types of studies. Longitudinal research requires a lot of time, planning, and creativity. Evaluation methodologies can meet all kinds of obstacles and roadblocks that require creative problem solving and plenty of patience to navigate through.

This is especially true of longitudinal studies involving sensitive populations like children. One of the main hurdles encountered during the course of this study was the challenge of working through two, often competing, Internal Review Boards. For example, the start of the project was significantly delayed when the initial proposal was approved by one board but rejected by the other. After completely changing the focus group recruitment strategies and adding the follow-up survey portion of the study, the research was allowed to move forward.
However, in satisfying the requirements of both boards, the final recruitment packets for some students ended up including fourteen pages.

This daunting collection of information was one of the factors that may have influenced the low survey return rate. It also likely contributed to the number of surveys that were received, but omitted from the study because of missing or incomplete documentation of consent. With the inclusion of so many different letters and forms, it could have been confusing as to which forms needed to be returned in order to participate in the study.

Another factor that may have played a part in the low return rate was the timing of the mailing. Because of the sensitive nature of unsolicited student contact information, IRB approval required that the pre-stuffed envelopes be addressed and mailed by BVSD personnel. However, because the bulk mailings were being combined with those of another study which was running behind schedule, the entire mailing was delayed by more than three weeks. By the time the surveys were sent, the arbitrary return-by date that the IRB suggested including was less than 10 days away. A few responses trickled in following this deadline, but many more likely ignored the request thinking that the deadline had already passed.

Additional timing delays may have been partly responsibly for poor focus group turn-out as well. An unexpected second review was conducted prior to beginning the focus group portion of the study, putting a few months between the students’ election to participate further and the their direct contact with the researcher. During this time, some interest in participating may have waned as about half of those who expressed an interest in focus group participation remained unreachable after several attempts at contact. Of those who were contacted, participation was further diminished by conflicts in scheduling, forgotten permission forms, and unexpected absences.
In order to facilitate this type of study in the future, a few steps can be taken that would drastically reduce these types of challenges. First, participant documentation should be kept among program records. Simply retaining copies of permission forms would allow students to be easily identified and contacted through schools rather than casting out a wide net and hoping for a decent return. Even better, the permission forms could be adjusted to include a simple sentence granting the museum permission to contact students and their families directly. By obtaining this permission and contact information up front, the school system could be cut out from the research process entirely. Though it could possibly raise more issues of study accessibility, this would drastically reduce the amount of time and effort required to satisfy the needs of a second review board.

Second, once this contact information was obtained and properly stored, it would be useful to establish a method of maintaining regular contact with past participants. Because emails, addresses, and even phone numbers are prone to change relatively frequently, it would be important to keep this information as up-to-date as possible. This could be done by maintaining a regular newsletter, a special website, or providing incentives for past participants to keep in touch. During the personal interviews, one teacher suggested the idea of starting a small scholarship fund for GAMES participants who would like to continue their education. After introducing the fund at the final family session of the program, students would be asked to perform regular check-ins in order to maintain eligibility for the award. Alternatively, periodic reunion events could be scheduled to foster a lasting relationship between former GAMES participants and the University Museum. Not only would this serve to keep in touch, but it could also aid in furthering the GAMES mission promoting lasting interests in the sciences.

However these challenges are approached, it is important to keep future evaluation goals
in mind when developing new programming or refining existing endeavors. Because of the challenges inherent to this type of research, this particular study is unlikely to be replicated in the foreseeable future. Other studies within the field will likely also encounter a similar fate. With this reality looming above the heads of future researchers, it is encouraging that these types of longitudinal studies continue to be undertaken and shared. Though long-term studies of after-school programming remain fairly rare among the ever-growing body of museum research, this rarity only adds to their potential value. The value of this study lies in demonstrating the positive impacts of the GAMES program and identifying factors that can be used to develop successful programming in the future.
BIBLIOGRAPHY


1. Since coming to the museum for GAMES, I like science:
   More than I did before: 
   Less than I did before: 
   The same as I did before:

2. Please draw a line to connect the type of science with what it studies:

   Archeology        Fossils
   Botany            Animals
   Entomology        Ancient Humans
   Paleontology      Insects
   Zoology           Plants

3. What did you like best about GAMES?

4. Pick one tool that you were given and tell me how you will use it in the future.

5. What did you like least about GAMES?

6. What would you like to be when you grow up?
APPENDIX B

TITLE: Memories of GAMES: Measuring the Long-Term Impacts of After-School Museum Programming on Girls’ Attitudes Towards Science

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OBJECTIVES

The purpose of this study is to investigate any lasting impacts of the University of Colorado Museum of Natural History’s Girls at the Museum Exploring Science (GAMES) Program. Using student focus groups and adult interviews, this study will attempt to determine whether students’ positive associations with science continue after completion of the program and whether the program affects the academic and career choices of past participants. More broadly, the study aims to contribute to the evidence base about the role of informal education programs in increasing science participation among women, as well as ways in which schools and universities can collaborate to effectively serve populations that are traditionally underrepresented in the sciences.

BACKGROUND

GAMES is a seven-week after-school program for fourth and fifth grade girls from local schools with high percentages of students from low socioeconomic backgrounds. Within each target school, teachers select individual students to participate in the program. Transportation to and from the museum, snacks, and tools for follow up activities are provided to all participants free of charge through grant support by the CU-Boulder Outreach Committee as well as Impact on Education and the Millennium Trust for Boulder County.

While at the museum, the girls explore the sciences of archaeology, botany, entomology, paleontology, and zoology through hands-on activities and direct interactions with scientists and museum professionals. Each week they meet with museum scientists in their working environments, tour museum collections, and build scientific toolkits to take home upon completion of the program. During the final meeting of each session, the girls have the opportunity to bring their families to the museum and act as tour guides, as they show their parents what they have learned.

GAMES can accommodate 15 girls and two chaperones each session. This allows individual attention, and ensures that the entire group can fit into the research and collections areas that they visit. The participants in each session of GAMES attend a single elementary school, and are accompanied by an adult chaperone with whom they are familiar. This is designed to create an environment of confidence, familiarity, and cooperative learning that can be used back at school to reinforce what they have learned at the museum. Chaperones are charged with providing supervision on the buses to and from the museum as well as during each of the two-hour museum visits. Chaperones come from a variety of backgrounds and have included fourth and fifth grade teachers, principals, ESL teachers, parents, a TAG coordinator, and AmeriCorps volunteers.
The program began in 2003 in response to documented gender discrepancies in science attitudes and achievement. It has long been noted that girls are less likely than boys to pursue advanced scientific education and careers in the sciences (Francsali 2002; NSF 2000), but additional research indicates that differences in attitudes towards science develop as early as elementary school (Andre et al. 1999). Because many of these differences in attitude stem from perceived abilities rather than actual performances, it has been suggested that appropriate after-school interventions may help to prevent or even reverse these negative associations with science (Campbell et al. 1999; Francsali 2002; Hansen et al. 1995). However, relatively little is known about the longevity of the effects of these types of interventions. A few attempts have been made to formalize knowledge about the long-term impacts of informal education programs (Fadigan and Hammrich 2004; Gibson and Chase 2002; Luke et al. 2007), but the difficulty in translating intuitive and anecdotal accounts into viable data sets leaves plenty of room for contributions to this area of investigation.

The goals of GAMES include showing girls that there is a place for them in the sciences, encouraging them to continue their scientific education, and having fun. To determine whether these goals are being met, it is important to answer the following questions: (1) Do former GAMES participants believe themselves capable of participating in and contributing to scientific work? (2) Do they continue their academic coursework in science and/or pursue science opportunities outside of the classroom? (3) Do they maintain a positive attitude towards science? Do they like science as much as (or more than) they did when they participated in GAMES?

Some evaluation of GAMES has already been completed in the form of pre- and post-program instruments employed for program improvement purposes. These include the Draw-A-Scientist-Test (DAST) developed by Chambers (1983) to measure preconceived notions of who scientists are and what they do, as well as a six-question survey created by the program staff and administered on the final meeting of each session to gauge knowledge retention, attitudes, and aspirations of participants. A copy of this survey is attached. Anonymous data from these instruments exists as field notes from verbal descriptions of DAST illustrations and paper-copy survey responses. However, little cumulative analysis has been completed and the lasting impacts of the program remain as yet unknown.

**STUDY DESIGN**

The study will include a combination of methods, including analysis of pre- and post-program assessment data, focus group discussions among past GAMES participants, and interviews with teachers and chaperones who have had continued interactions with program participants.

Since its inception, GAMES has served over 350 girls from 12 elementary schools within the Boulder Valley School District. Pre- and post-program student work from all past sessions has been saved anonymously for future analysis. As a part of this study, field notes from verbal DAST descriptions and completed student surveys will be coded using quantitative descriptive analysis (Libarkin and Kurdziel 2002). Word occurrences and frequencies will be sorted with relation to science stereotypes and self-identification with science prior to participation in GAMES, as well as for evidence of attitudes towards science—both positive and negative—and categories of future career aspirations as noted in post-program surveys. These assessments of immediate program impact will then be used as a baseline for comparison with longitudinal data collected in focus groups with former participants one to nine years after their GAMES involvement.

As many of the 350 former participants as possible will be recruited to take part in focus groups at local middle and high schools, but the actual number of students enrolled in the study will likely be much smaller for several reasons. Because identifying information about past participants is not kept at the Museum, we will be unable to target specific students except in a few rare cases. Girls must self-select themselves as candidates for participation in this study based on generalized recruitment strategies—as described in the Recruitment Methods section below. These recruitment strategies will be aimed at current BVSD students whose enrollment data indicates that they were in the fourth or fifth grade during the year that their school participated in GAMES. Relocation has likely dispersed a number of program participants to schools outside of the district that will not be included in the recruitment plan. In addition, because the program’s target population of low-income, underprivileged youth tend to display higher dropout rates than their peers, some GAMES participants may have left the school system all together.
In a BVSD-led mailing, former GAMES participants will be asked to complete a short survey in which they will answer questions pertaining to their attitudes towards science, confidence in their own scientific abilities, and participation in science-based activities. These questions will address the goals of the program in an attempt to establish a baseline data set that can then be enhanced through additional focus group sessions. The brief and accessible nature of the survey will likely allow a greater number of individuals to participate whether or not they choose to continue on in the study. At the end of the survey, respondents will be invited to participate in future discussions. Those who elect to enroll in the focus group portion of the study will join other girls from the same school to discuss their memories of the program along with current attitudes and aspirations in greater detail. If only one student from a given school has elected to enroll, she will be invited to share her thoughts individually in a one-on-one meeting with the researcher. Overall, we expect to be able to recruit no more than 200 students.

Many teachers and chaperones have been involved in the GAMES program for multiple years, but only those with recent affiliations will be enrolled in the study. Several of these adults have had extended contact with GAMES participants both during museum visits and in the school setting as teachers, principals, school program coordinators, and other professional roles. In the past three years, 12 such adults have been involved in the program in this capacity and they will be asked to participate in interviews to discuss their observations of student attitudes and behaviors before, during, and after the program. Interviewees will also be asked to describe their beliefs or hypotheses about how this program benefits students, what kinds of students benefit most, and how they choose students to participate, as well as any differences observed between participants and non-participants at their school. Additionally, those who directly observed GAMES sessions will be asked to provide their observations of girls’ behavior and responses during program activities.

All data will be qualitative in nature and therefore statistical analyses will not be performed. While as many participants will be recruited as possible, it is not expected that responses will differ dramatically among schools at either the middle or high school level. All elementary schools were selected for GAMES participation based on their percentages of students qualifying for “free and reduced lunch”, and middle and high schools identified for inclusion in this study serve as receiving schools for one or more of these elementary populations. In addition, initial surveys of existing pre- and post-program assessment data indicate similar responses across cohorts regardless of school affiliation. For this reason, a large sample size is not necessarily required. Similar longitudinal studies have produced publishable results with as few as 10 to 24 interviewees (Fadigan and Hammrich 2004; Gibson and Chase 2002; Luke et al. 2007), though some of these studies incorporated quantitative survey results as well. Because of the relatively large pool of existing assessment data and the representative nature of the issues that are likely to arise during focus group discussions, meaningful data could be achieved with a minimum of 24 participants from at least two different schools. Recruiting students from different schools will ensure that participants from multiple cohorts are included in the study. Some differences may be expected between responses of middle- and high-school aged respondents based on the differences in their experiences and the amount of time that has lapsed since their participation in GAMES. While insight into the lasting impacts of the program could be gleaned from either school level, the richest data will incorporate students from both middle and high schools who can reflect on their participation in GAMES from one to nine years after the experience, providing a more complete look at how attitudes towards science are impacted over time.

Focus groups and interviews will be conducted throughout the fall of 2012, with school-based data collection completed in accordance with BVSD district policy and permissions described in the Multi-Site Studies section below. Teacher/chaperone interviews will be completed through August 2012. All focus groups and interviews will be recorded, transcribed, and inductively coded using thematic content analysis (Libarkin and Kurdziel 2002). To address the research questions surrounding the ability of GAMES to meet its goals on a long-term basis, particular attention will be paid to outcome categories that demonstrate the participants’ confidence or lack there of, attraction to or avoidance of science based programs and coursework, and attitudes towards science—both positive and negative. Recurring themes—both unexpected and those based in theory—will be identified from open-ended responses, at which point the Principal Investigator will hold sessions with her faculty advisor in order to share ideas about the these themes and their theoretical explanations in order to limit bias in the analysis process. During the sessions, negative instances will be actively sought that may contradict previous observations and challenge emerging explanations. Data analysis will take place concurrently to data collection and will continue through the fall semester of 2012. A final report will be submitted as a Master’s thesis by November 30th 2012.
ABOUT THE SUBJECTS

The subject population will include two distinct subsets: former student participants in the GAMES program and adult teachers/chaperones. The population of former student participants will consist of 11-18 year old girls. The only inclusion criterion is that girls attended GAMES sessions when they were in fourth or fifth grade. Focus groups will consist of 2-8 participants with no more than 200 total students enrolled in the study. If more than 8 students are recruited to participate from any given school, the group will be split into multiple sessions scheduled for different days.

Teacher/chaperone study subjects may be adults of either gender. Inclusion criteria for this portion of the study include service as a GAMES chaperone within the last 3 years, or as a classroom teacher to actively enrolled GAMES participants within the last 3 years. Classroom teachers will be excluded from the study if they are unaware of the program or unable to identify GAMES participants. Without identifying information, we are unable to supply teachers with lists of students to compare and must therefore rely on their prior participant knowledge to evoke observational responses.

VULNERABLE POPULATIONS

Because of the recruitment target for the program, students enrolled in the focus groups may be considered vulnerable because of their age and because many are also of low socioeconomic status and may speak a language other than English at home. All children participating in the study will be protected through parental consent as well as age-appropriate language in both the student assent forms and the discussion questioning. Consent and assent will be collected as described in the Consent Process section below. In addition, focus group settings will minimize the likelihood of one-on-one interactions between children and adults and to ensure the physical and emotional safety of all participants.

Students will not be offered excessive compensation that would influence their decision to participate. Lunch will be provided to all participants during the meeting whether or not they are actively involved in the discussion or choose to withdraw from the study altogether.

Because many GAMES students are English language learners (ELLs), consent and assent forms will be provided in both English and Spanish, with Spanish forms added as amendments once translation is completed. During focus group discussions, sheltered English techniques (an ELL teaching strategy) will be employed when appropriate to increase comprehension with the help of written words and pictorial clues. Students will be encouraged to work together to provide collaborative responses or draw pictures as needed.

RECRUITMENT METHODS

The BVSD office of Planning & Assessment will compile a list of females who were enrolled as fourth or fifth grade students at specific BVSD schools during the years that each school participated in GAMES. The mailing will include a BVSD cover letter and a notice to parents as well as a student invitation, brief survey, and business reply envelope. Once mailing packets are complete, BVSD staff will affix address labels and conduct a bulk mailing to ensure the privacy of identified students who choose not to take part in the study. In the mailings, students will be asked to self-identify as former GAMES participants and complete a short survey. At the end of the survey, participants will be invited to take part in a future focus group. If they elect to participate, students will be asked to provide contact information to which further information and parental permission forms may be sent.

An internet link (tinyurl.com/CUGAMESsurvey) containing electronic copies of the survey and invitation will be sent to recent GAMES participants who requested Museum contact via email upon completion of the GAMES program. These addresses were all obtained voluntarily during the final program session at which parents were present. At this time, participants and their families were invited to provide an email address in order to receive GAMES updates and information about upcoming museum events. Email addresses were never required of GAMES participants as part of the consent or enrollment process, nor were they solicited at any other time in the duration of
the program.

A copy of the parent notice, student invitation, student survey, and follow-up correspondence may be found in the attachments.

All students enrolled in the focus group portion of the study will be provided with a catered lunch during the discussion as well as a $5 gift card upon completion of the session. Participants will be offered a choice of gift cards to either Target or Glacier Ice Cream. In the event of early withdrawal, students will experience no loss in compensation.

Teachers and chaperones will receive an invitation to participate in the study electronically or through school mail based on publicly available contact information. No compensation will be offered.

CONSENT PROCESS

A parent permission/student assent form will be included in the initial BVSD mailing. All consent forms will be provided in both English and Spanish. Because of the minimal risks associated with the study (see section on Risks to Participants below), parental permission will only be required from one parent. Students and parents will be asked to return the signed consent form along with the completed survey. An electronic copy of this form will be included at the start of the online survey. Respondents using this media will be asked to check a box demonstrating their consent and assent prior to being directed to the survey. Respondents will also be asked to provide an email address or phone number that may be used to verify parental consent. This will help to ensure that the parents have been included in the permission process. This contact information will be required along with checks next to both the parental permission and student assent statements in order to participate in the survey.

Survey respondents who provide contact information for participation in future GAMES discussions will receive an additional parental consent form prior to the scheduled focus group at their school. Those choosing to enroll in the study will submit their signed consent forms to the Primary Investigator at the time of the focus group meeting.

Student assent forms will be distributed at the start of the focus group meeting. The Principal Investigator will facilitate the assent process, allowing students to choose to participate or to decline without the influence of a teacher or parent.

Adult interviewees who respond to the invitation to participate in the study will be asked to sign a consent form at the time of the interview. For those participating in phone interviews, consent forms will be distributed and collected prior to the discussion by means of snail mail, email, or fax according to the participant’s preferences.

PROCESS TO DOCUMENT CONSENT IN WRITING

Parental permission and assent will both be documented in writing using the attached forms. The joint parental permission/student assent form will be used to obtain consent for the survey portion of the study. Because of the nature of the online survey, I am requesting a waiver of documentation of informed consent for these responses. In these cases, before the survey may be completed, both consent and assent will be recorded as checked boxes following an electronic version of the consent form. An email or telephone number will also be required in order to verify parental consent. The separate parental permission and student assent forms will be used for those continuing on with the focus group discussions. Parents will be provided with a copy of the consent form for their own records. One assent form will be used for all minor participants regardless of age, though all forms will be provided in both English and Spanish. Additional verbal assent to record the discussions will be obtained at the start of each focus group or interview.
PROCEDURES

Initial mailings including study invitations and surveys will be sent out in July 2012. Survey data will be collected throughout the summer and contact information from those electing to participate in focus group discussions will be recorded. Based on respondent numbers and fall 2012 enrollment, one to three focus groups will take place at BVSD middle and high schools identified as "current schools" on the survey forms. This will take place in a private reserved classroom during the regularly scheduled lunch period. For those schools with multiple lunch times, one meeting will be held during each period on the same day to enable maximum participation without disturbing the learning day. Each session will represent a one-time visit that will last approximately 30 minutes. Students enrolled in the focus group portion of the study will begin by completing an assent form as they eat a catered lunch. Audio recording will be used throughout the meeting, though it is optional for participation in the research. If recording consent has been obtained from all participants, students will be asked for their verbal recording assent and will be reminded to refer to themselves and each other by their first names only. In sessions where permission to record is not granted for all participants, the Principal Investigator will take detailed meeting notes.

To gather participants’ thoughts and ensure that all have something to contribute, note cards will be handed out and participants will be asked to record (using pictures or words) a memory from their experience in GAMES. The memory could be either positive or negative. After a few minutes of individual reflection, subjects will be asked to come together for a group discussion where they will be given a chance to share these or other memories if they so choose. Focus group protocol will be open-ended and semi-structured—using prompts such as: (1) Did you ever talk to people about GAMES? What did you tell them? (2) What would you change about GAMES? What would make GAMES better? (3) Did you ever use any of the tools in your toolkit? (4) Do you go to any other out of school science programs? (5) Do you like science more than, less than, or the same as you did in elementary school? (6) What’s your favorite subject in school? (7) What do you want to be when you grow up? The use of guiding questions will ensure coverage of relevant themes and issues, but will also allow for spontaneous comments to emerge. Following the discussion, students will receive a $5 gift card to either Target or Glacier Ice Cream as a token of appreciation.

Individual interviews will be scheduled for all teachers and chaperones who enroll in the study. These semi-structured interviews will take place at schools, over the phone, or in other convenient locations as determined by the interviewee and will last between 30 minutes and one hour. Audio recording will be used throughout the discussion, though it is optional for participation in the research. If written consent indicates permission to record, verbal recording permission will be obtained, and interviewees will be reminded to refer to themselves and their students by first name only. If audio recording permission is not granted, interviews will be documented by detailed field notes.

Questions for teachers and chaperones will be focused on their observations of students involved in the GAMES program and will be guided by prompts such as: (1) Describe your involvement with the GAMES program. (2) What do you think GAMES participants get out of the experience? Why? Can you think of any stories or incidents with students that illustrate this? (3) Did you notice any changes in the students who participated in GAMES either during the program or after its completion? How long did these changes last? (4) Were there any noticeable differences between the program participants and non-participants within your class? (5) What would you have liked your students to get from GAMES that you feel was lacking? (6) What kinds of students do you think benefit the most from GAMES? Why? How do you select students to participate? (7) How could the GAMES experience be improved for you or your students?

DATA MANAGEMENT

All study participants will be identified by first name only. Consent forms, surveys, and other hardcopy data including tapes and notes will be stored in a locked filing cabinet within a secure campus office. Electronic data (including transcriptions, coded responses, and final reports) will be stored on a password access-protected, automatic log-off university computer, and saved to the CUB server for remote VPN access from a personal password-protected laptop. All identifiable information will be omitted from electronic sources. Copies of all project data collected within the district will be submitted to BVSD’s office of Planning and Assessment at the conclusion of the project in accordance with district policy. All university held data will be wiped from the server, shredded, or
otherwise destroyed within 12 months from the start of the study.

WITHDRAWAL OF PARTICIPANTS

Subjects may withdraw from the study at any time with no consequences. Participants may be withdrawn from focus group settings without their consent if they are perceived to pose any threat to other research participants. In this case, the subject in question will be removed from the meeting and the group discussion will continue as scheduled. Data collected prior to any such removal will be included in the analysis unless the student or her parents ask to be omitted from the study.

RISKS TO PARTICIPANTS

There is minimal risk associated with participating in this study. All subjects voluntarily participated in the GAMES program and they are being asked to recall their past experiences in the context of normal educational activity (e.g. whether the program did or did not help them in school, or whether it had any influence on their future goals). There may be mild emotional discomfort in recalling the program experience if the girls felt frustrated by the activities or if they experienced any interpersonal conflict during the sessions. However, the probability of this is quite low as current and past facilitators have strived to create an exciting environment in which students are allowed control over their own learning. Classroom mediation and conflict resolution techniques are also employed to minimize social frustrations. Other possible discomfort could stem from a reluctance to speak candidly to the researchers, as perceived authority figures, if students have something negative to say about the program. The likelihood of this scenario is minimized by a lack of previous contact between the researcher and subjects in the context of GAMES or otherwise, as well as the researcher’s status as a University student. All foreseeable discomforts are likely to subside upon the conclusion of the discussions.

For adults involved in teacher/chaperone interviews, the risk is quite minimal. Interview topics focus on observations of students within the classroom and are not likely to be sensitive, though delivering critical feedback could elicit some discomfort in the interviewee. This discomfort would pose only minor risk and would likely subside by the end of the interview.

Loss or theft of data stored on portable devices (including tape recorders and laptops) could pose a risk to participants as well. This risk is mediated by the lack of identifying information included in these types of data that would reveal the identity of research participants. Only first names will be used on tape and in transcriptions and all personal information will be omitted from coded responses.

POTENTIAL BENEFITS TO PARTICIPANTS

There are no direct benefits to focus group participants. Based on the findings of the study, program improvements could be implemented that would create a more enjoyable experience for teachers and chaperones (as well as their students) should they continue their involvement with GAMES.

PROVISIONS TO PROTECT THE PRIVACY INTERESTS OF PARTICIPANTS

The study could potentially impact a student’s privacy interests if she perceives her participation in GAMES as uncool or socially stigmatic. To protect the privacy interests of participants, girls will not be asked to self-identify themselves as GAMES alumni in front of their peers. All focus groups will take place in private classrooms with minimal signage for way-finding purposes.

COST TO PARTICIPANTS

There are no costs associated with participating in the focus group discussions. Most teacher/chaperone interviews will take place at school, at another convenient location, or over the phone with no associated costs. However, upon
interviewee request, some adult interviews may be arranged to take place at alternative locations that may require transportation costs.

MULTI-SITE STUDIES

Focus groups and interviews will be conducted at a number of schools throughout the Boulder Valley School District. Internally identified science teachers will aid in the recruitment and consent collection processes, but the Principal Investigator will be responsible for enrollment and participant interaction at each location and CU Boulder will serve as the sole site for all activities beyond data collection.

BVSD requires all non-district researchers to apply for project review through the office of Planning and Assessment. Researchers must submit a request to do educational research along with a detailed research proposal to demonstrate sufficient benefits to the district and the field of education, compatibility with regular instruction, appropriateness of impact on students, parents and staff, and acceptable technical adequacy. This review process is designed to uphold the specific interests of students and teachers more clearly than other approval process and to serve as additional protection for all involved. Approval is granted by Planning and Assessment along with appropriate administrators. Once approval is granted, the Principal Investigator will provide the district with a one- to two-page description of the project to be mailed to the six middle and three high schools identified in the Study Design section above. Schools will then have the option to choose their level of participation in the research. A research review is being conducted by BVSD concurrently to the CUB IRB approval process and a district letter of approval will be attached as an amendment as soon as it is received. All research activity will remain on hold pending receipt of this approval.

SHARING OF RESULTS WITH PARTICIPANTS

Consent forms will allow parents of participants or adult interviewees to request that a copy of the research results be sent to them electronically or through the mail. A brief summary of results and any associated changes or improvements to the GAMES program will be prepared for this purpose and will be submitted for inclusion in BVSD’s Thrive Newsletter as well as any individual school or teacher newsletters that were used in the recruitment process. In addition, a one-page summary along with a copy of the final report and copies of all project data collected within the district will be submitted to BVSD’s office of Planning and Assessment at the conclusion of the project. The Office of Planning and Assessment will then be charged with disseminating project results to appropriate staff.

REFERENCES


APPENDIX C

Memories of GAMES: Measuring the Long-Term Impacts of After-School Museum Programming on Girls’ Attitudes Towards Science
Principal Investigator: Sarah Snow

PARENTAL PERMISSION FORM

Please read the following material that explains the research study in which your child is being asked to participate. Signing this form will indicate that you have been informed about the study and that you give permission for your child to participate. We want you to understand what your child is being asked to do and what risks and benefits—if any—are associated with the study.

Once you provide your permission, your child will also be asked to provide his or her assent to participate. Your child may not participate in the study unless BOTH you and your child agree.

CONTACT INFORMATION

Your child is being asked to take part in a research project conducted by Sarah Snow, a graduate student in the University of Colorado at Boulder’s Department of Museum and Field Studies, 218 UCB, Boulder, CO 80309. This project is being done under the direction of Dr. Cathy Regan, Education Coordinator, CU Museum of Natural History, 218 UCB. Sarah Snow can be reached at (303) 492-1666. Dr. Regan can be reached at (303) 492-4843.

PROJECT DESCRIPTION

This research study is about how effective CU’s Girls at the Museum Exploring Science (GAMES) program is at helping girls enjoy science. Your daughter is being asked to be in this study if she participated in GAMES during elementary school. We would like to ask her some questions so that we can make the program better. Participation in this study is entirely up to you and your child. 200 participants from schools across the district will be invited to participate in this research study.

PROCEDURES

Taking part in this study is completely voluntary. Your child does not have to participate if you or your child don’t want to. Your child may also leave the study at any time. If your child leaves the study before it is finished, there will be no penalty to your child, and your child will not lose any benefits to which he or she is otherwise entitled.

If you and your child agree to take part in this study, your child will be asked questions about her memories of GAMES and her attitude towards science. Here are examples of some of the questions that may be asked:

- Did you ever talk to people about GAMES? What did you tell them?
- What would you change about GAMES? What would make GAMES better?
- Did you ever use any of the tools in your toolkit?
- Do you go to any other out of school science programs?
- Do you like science more than, less than, or the same as you did in elementary school?
What is your favorite subject in school?
What do you want to be when you grow up?

Participation in this research may include audio recording. These recordings will be used to take accurate notes and will be retained for 12 months. Those individuals who will have access to these recordings will be Sarah Snow and Cathy Regan. Being audio recorded is not a requirement for participation. You may still participate in the study should you choose not to be recorded.

Participating should take about 30 minutes. The questions will be asked to groups of girls from the same school or individually if your daughter is the only enrolled student from her school. The meeting will take place at your child’s school during lunchtime on __________________________.

Date

We expect to recruit approximate 200 participants in this research study.

RISKS AND DISCOMFORTS

There are some potential risks if your child takes part in this study. These may include emotional discomfort in recalling frustrating experiences, or in providing negative feedback about the program to the researchers.

BENEFITS

There are no direct benefits to you or your child from taking part in this study.

COST TO PARTICIPANT

There is no cost to you for your child’s participation in this study.

SUBJECT PAYMENT

Your child will receive a free lunch and a $5 gift certificate for participation in this study. At the end of the meeting, she may choose a gift certificate to either Target or Glacier Ice Cream. If you or your child chooses to withdraw before the conclusion of this study, your child will not be penalized.

ENDING YOUR CHILD’S PARTICIPATION

Your child has the right to stop participating at any time, and to refuse to answer any question(s) or participate in any procedure for any reason. Declining to participate will not adversely affect your child’s grades.

CONFIDENTIALITY

We will make every effort to maintain the privacy of your child’s data. All study participants will be identified by first name only. Research data will be stored in a secure location and audio
recordings will be destroyed within 12 months of the study.

Other than the research team, only regulatory agencies such as the Office of Human Research Protections and the University of Colorado Human Research Committee may see your child’s individual data as part of routine audits.

QUESTIONS?

If you or your child has questions about this study, you should ask the researcher before you sign this permission form.

If you have questions regarding your rights as a participant, any concerns regarding this project or any dissatisfaction with any aspect of this study, you may report them confidentially, if you wish to the Institutional Review Board, 3100 Marine Street, Rm A15, 563 UCB, (303) 735-3702.

SHARING RESULTS

☐ Check this box if you would like to receive a copy of the research results. Please include an e-mail or physical address where you would like them to be sent.

___________________________________________________
___________________________________________________
___________________________________________________

AUTHORIZATION

I have read this paper about the study or it was read to me. I know the possible risks and benefits. I know being in this study is voluntary and that my child has the right to decline to participate or to withdraw his or her assent at any time during the study. I give permission for my child to be in this study. I have received, on the date signed, a copy of this document containing 3 pages.

Name of Participant (printed) ______________________________________________

Name of Parent or guardian (printed) ________________________________________

Signature of Parent or guardian _____________________________ Date ___________
(Also initial all previous pages of the permission form.)

AUDIO AUTHORIZATION

I give permission for my child to be audio recorded during this study.

Signature of Parent or guardian _____________________________ Date ___________
Please read the following material that explains the research study in which your child is being asked to participate. Signing this form will indicate that you have been informed about the study and that you give permission for your child to participate. We want you to understand what your child is being asked to do and what risks and benefits—if any—are associated with the study.

Once you provide your permission, your child will also be asked to provide his or her assent to participate. Your child may not participate in the study unless BOTH you and your child agree.

CONTACT INFORMATION

Your child is being asked to take part in a research project conducted by Sarah Snow, a graduate student in the University of Colorado at Boulder’s Department of Museum and Field Studies, 218 UCB, Boulder, CO 80309. This project is being done under the direction of Dr. Cathy Regan, Education Coordinator, CU Museum of Natural History, 218 UCB. Sarah Snow can be reached at (303) 492-1666. Dr. Regan can be reached at (303) 492-4843.

PROJECT DESCRIPTION

This research study is about how effective CU’s Girls at the Museum Exploring Science (GAMES) program is at helping girls enjoy science. Your daughter is being asked to be in this study if she participated in GAMES during elementary school. We would like to ask her some questions so that we can make the program better. Participation in this study is entirely up to you and your child. 200 participants from schools across the district will be invited to participate in this research study.

PROCEDURES

Taking part in this study is completely voluntary. Your child does not have to participate if you or your child don't want to. Your child may also leave the study at any time. If your child leaves the study before it is finished, there will be no penalty to your child, and your child will not lose any benefits to which he or she is otherwise entitled.

If you and your child agree to take part in this study, your child will be asked fill out a short survey about her memories of GAMES and her attitude towards science. Here are examples of the types of questions that will be asked:

- What do you remember about GAMES?
- What is your favorite subject in school?
- What do you want to be when you grow up?

Participating should take about 5 minutes. We expect to recruit approximately 200 participants in this research study.
RISKS AND DISCOMFORTS

There are some potential risks if your child takes part in this study. These may include emotional discomfort in recalling frustrating experiences, or in providing negative feedback about the program to the researchers.

BENEFITS

There are no direct benefits to you or your child from taking part in this study.

COST TO PARTICIPANT

There is no cost to you for your child’s participation in this study.

ENDING YOUR CHILD’S PARTICIPATION

Your child has the right to stop participating at any time, and to refuse to answer any question(s) or participate in any procedure for any reason. Declining to participate will not adversely affect your child’s grades.

CONFIDENTIALITY

We will make every effort to maintain the privacy of your child’s data. All study participants will be identified by first name only. Research data will be stored in a secure location.

Other than the research team, only regulatory agencies such as the Office of Human Research Protections and the University of Colorado Human Research Committee may see your child’s individual data as part of routine audits.

QUESTIONS?

If you or your child has questions about this study, you should ask the researcher before you sign this permission form.

If you have questions regarding your rights as a participant, any concerns regarding this project or any dissatisfaction with any aspect of this study, you may report them confidentially, if you wish to the Institutional Review Board, 3100 Marine Street, Rm A15, 563 UCB, (303) 735-3702.

SHARING RESULTS

☐ Check this box if you would like to receive a copy of the research results. Please include an e-mail or physical address where you would like them to be sent.

___________________________________________________
___________________________________________________
___________________________________________________
PARENT AUTHORIZATION

I have read this paper about the study or it was read to me. I know the possible risks and benefits. I know being in this study is voluntary and that my child has the right to decline to participate or to withdraw his or her assent at any time during the study. I give permission for my child to be in this study.

Name of Parent or guardian (printed) ________________________________________

Signature of Parent or guardian _____________________________ Date ___________

(Also initial all previous pages of the permission form.)

STUDENT ASSENT

I have read this paper about the study or it was read to me. I know the possible risks and benefits. I know being in this study is voluntary and that I have the right to decline to participate or to withdraw my assent at any time during the study. I give my assent to be in this study.

Name of child/adolescent (printed) __________________________________________

Signature of child/adolescent _______________________________________________

Date ___________________________________________________ Age____________
Memorias de GAMES: Analizando los impactos a largo plazo del programa extra-curricular de los programas del Museo en las actitudes de las estudiantes en el área de Ciencias

Investigador principal: Sarah Snow

FORMATO DE PERMISO DE LOS PADRES
Y CONSENTIMIENTO DEL ALUMNO

Por favor lea la siguiente información sobre la investigación en el que su hija se le ha pedido que participe. Firmando esta forma usted indicará que ha leído y comprendido el objetivo de la investigación así como dar permiso en que su hija participe en este. Queremos que usted entienda los beneficios y riesgos -si es que existiera alguno- en los que su hija estará participando para esta investigación.

INFORMACIÓN DE CONTACTO

A su hija se le ha pedido que participe en el proyecto de investigación conducido por Sarah Snow, estudiante de posgrado del Departamento de Museo y Estudios de Campo de la Universidad de Colorado en Boulder, 218 UCB, Boulder, CO 80309. Este proyecto esta bajo la dirección de Dr. Cathy Regan, Coordinador de Educación, en el Museo Nacional de Historia de CU, 218 UCB. Sarah Snow podrá se localizada en el número telefónico (303)492-1666. Dr. Regan podrá ser localizada en el número telefónico (303) 492-4843.

DESCRIPCIÓN DEL PROYECTO

Este estudio de investigación es sobre la eficacia del programa Girls at the Museum Exploring Science (GAMES) para ayudar a las estudiantes a disfrutar de la ciencia. A su hija se le ha pedido que forme parte en este estudio, si participó en GAMES durante la escuela primaria. Nos gustaría hacerle algunas preguntas para que podamos mejorar el programa. La participación en este estudio es totalmente de usted y su hija. 200 participantes de las escuelas de todo el distrito serán invitados a participar en este estudio de investigación.

PROCEDIMIENTO

La participación en el estudio de investigación es completamente voluntaria. Su hija no tiene que participar si usted o su hija no lo desea. Su hija puede retirarse del estudio en cualquier momento. Si su hija deja el estudio antes de que termine, no habrá sanción alguna, y su hija no perderá los beneficios a los que ella tiene derecho.

Si usted o su hija están de acuerdo en participar en este estudio, su hija tendrá que llenar una pequeña encuesta sobre los recuerdos del programa y su actividad a la ciencia. Estos son algunos ejemplos de los tipos de preguntas que se realizarán:

¿Qué recuerda acerca de los juegos?
¿Cuál es tu materia favorita?
¿Qué quieres ser cuando seas grande?
La participación debe tomar alrededor de 5 minutos. Esperamos reclutar aproximadamente 200 estudiantes en este estudio de investigación.

<table>
<thead>
<tr>
<th>RIESGOS Y MOLESTIAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hay algunos riesgos potenciales si su hija forma parte de este estudio. Estos pueden incluir molestar emocional en el recuerdo de experiencias frustrantes, o en el suministro de retroalimentación negativa sobre el programa para los investigaciones.</td>
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<thead>
<tr>
<th>BENEFICIOS</th>
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<tbody>
<tr>
<td>No hay beneficios directos para usted o para su hija al formar parte de este estudio.</td>
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<thead>
<tr>
<th>COSTO DEL PARTICIPANTE</th>
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<tbody>
<tr>
<td>No existe ningún costo en la participación de su hija en este estudio.</td>
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<tr>
<th>TERMINACIÓN DE LA PARTICIPACIÓN DE SU HIJA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Su hija tiene el derecho de terminar su participación en el estudio y a no responder cualquier pregunta(s) por cualquier procedimiento o razón. Al decidir no participar no se verá afectado de ninguna manera el grado de su hija.</td>
</tr>
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<tr>
<th>CONFIDENCIALIDAD</th>
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<tbody>
<tr>
<td>Haremos todo lo posible para mantener la privacidad de los datos de su hija. Todos los participantes en el estudio se identificarán por su nombre solamente. Los datos de la investigación serán almacenados en un lugar seguro.</td>
</tr>
<tr>
<td>Aparte del equipo de investigación, sólo las agencias reguladoras tales como la Oficina de Protecciones de Investigaciones Humanas y el Comité de Investigación Humana de la Universidad de Colorado, puede ver los datos individuales de su hija como parte de las auditorías de rutina.</td>
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<table>
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<tr>
<th>PREGUNTAS</th>
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</thead>
<tbody>
<tr>
<td>Si su hija tiene preguntas sobre la investigación, usted puede contactar al encargado de estudio antes de firmar la forma de autorización.</td>
</tr>
<tr>
<td>Si usted tiene preguntas acerca de sus derechos como participante, cualquier duda respecto a este proyecto o cualquier insatisfacción con cualquier aspecto de este estudio, usted puede reportar de manera confidencial, si así lo desea, a la Junta de Revisión Institucional, 3100 Marine Street, Rm A15, 563 UCB, (303) 735-3702.</td>
</tr>
</tbody>
</table>
• Por favor seleccione esta casilla si le gustaría recibir una copia de los resultados de esta investigación. Por favor incluya un correo electrónico o una dirección física a donde le gustaría que sean enviados.

________________________________________________________
________________________________________________________

AUTORIZACIÓN DEL PADRE O TUTOR

He leído o fue leído a mí, este documento acerca de la investigación. Reconozco los posibles riesgos y beneficios. Tengo conocimiento de que formar parte de esta investigación es de forma voluntaria y mi hija tiene el derecho a declinar su participación o de retirar su consentimiento en cualquier momento de este estudio. Doy mi permiso para que mi hija forme parte de esta investigación.

Nombre completo del padre o tutor ____________________________________________

Firma del padre o tutor ____________________________________________ Fecha __________

(También póngale las iniciales a todas las páginas anteriores)

CONSENTIMIENTO DEL ALUMNO

He leído o fue leído a mí, este documento acerca de la investigación. Reconozco los posibles riesgos y beneficios. Entiendo de mi participación en esta investigación es voluntaria y tengo derecho a declinar mi participación o de retirar mi conocimiento en cualquier momento de este estudio. Doy mi permiso para formar parte de esta investigación.

Nombre completo de la niña/adolescente _______________________________________

Firma del niña/adolescente ___________________________________________________

Fecha ____________________________ Edad ___________
Memories of GAMES: Measuring the Long-Term Impacts of After-School Museum Programming on Girls’ Attitudes Towards Science
Principal Investigator: Sarah Snow

ASSENT FORM
(2012)

Principal Investigator’s phone: (303) 492-1666
Location of the study: BVSD

What is research?

Research studies help us learn new things. We can test new ideas. First, we ask a question. Then we try to find the answer. This can help us learn why people feel a certain way.

This paper talks about our research study. We want you to ask us any questions that you have. You can ask questions anytime.

There are a few things you should know about the study:

- You get to decide if you want to be in the study.
- You can say ‘No’ or you can say ‘Yes’.
- Whatever you decide is OK.
- If you say ‘Yes’, you can always say ‘No’ later.
- No one will be upset if you say ‘No’.

Why are we doing this research study?

We want to talk to you about this study because we want to make GAMES better and we think you can help.

What would happen if I join this study?

If you decide to be in the study:

- We would meet during lunchtime at your school. We would meet in a group with other girls who did GAMES when they were younger.
- The visit would take about 30 minutes
- During the visit, a researcher would ask you and the other girls some questions. You would take turns answering the questions out loud.
- How it would affect their everyday lives

Audiotapes:
We will audiotape the group discussions that are part of this study. This will help us make sure that we hear and understand everything that you say.
Could bad things happen if I join this research?

The researchers would need to ask you some questions. They might be hard to answer. If you do not like a question, you do not have to answer it.

If I join the study would it help me?

We do not think being in this study would help you.

What else should I know about this research?

Being in the study is your choice. You can say ‘Yes’ or ‘No’. Either way is OK.

It is also OK to say yes and change your mind later. You can stop being in the research at any time. If you want to stop, please tell the researchers.

There are also some reasons why we would ask that you stop being in the study:
  • If you are not respectful to other girls in the group.

Your information

We don’t plan to share your information. Or tell anyone if you join this study. But, there are a few reasons we would tell someone:
  • If we found out you were in serious danger.
  • If we found out someone else was in serious danger.

Here are some examples of when we would tell someone:
  • If you told us you were being abused.
  • If you told us you were going to hurt yourself or someone else.

We would tell to protect you or someone else from being hurt.

Would I be paid if I do research?

To thank you for being in the study, we would give you lunch and a $5 gift certificate. You may choose whether you would like a gift certificate to Target or Glacier Ice Cream. You should talk with your parents about how you would like to use this.

If I have questions who do I ask?

You can talk to Sarah Snow. She will be at the discussion or can be called later at (303) 492-1666. Ask us any questions you have. You can ask questions any time. Take the time you need to make your choice.
**Child’s/Adolescent’s Statement**

The researchers have told me about the research. I had a chance to ask questions. I know I can ask questions any time. I want to be in the research.

Remember - being in the research is up to you. No one will be upset if you don’t sign this paper or if you change your mind later.

*Name of Child/Adolescent* ________________________________

*Signature of Child/Adolescent* ________________________________

*Date* ________________________________

*Age* ________________________________
UNIVERSITY OF COLORADO BOULDER
CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Study Title: Memories of GAMES: Measuring the Long-Term Impacts of After-School Museum Programming on Girls’ Attitudes Towards Science

Principal Investigator: Sarah Snow

Key Personnel:

<table>
<thead>
<tr>
<th>Name</th>
<th>Role</th>
<th>Department</th>
<th>Phone Number</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sarah Snow</td>
<td>Principal Investigator</td>
<td>Museum and Field Studies Graduate Program</td>
<td>(303) 492-1666</td>
<td><a href="mailto:Sarah.snow@colorado.edu">Sarah.snow@colorado.edu</a></td>
</tr>
<tr>
<td>Cathy Regan</td>
<td>Faculty Advisor</td>
<td>Museum</td>
<td>(303) 492-4843</td>
<td><a href="mailto:Cathy.regan@colorado.edu">Cathy.regan@colorado.edu</a></td>
</tr>
</tbody>
</table>

Your participation in this research study is voluntary. Please think about the information below carefully. Feel free to ask questions before making your decision whether or not to participate. If you decide to participate, you will be asked to sign this form and will receive a copy of the form.

Purpose and Background

The purpose of this study is to investigate any lasting impacts of the University of Colorado Museum of Natural History’s Girls at the Museum Exploring Science (GAMES) Program.

The goals of the program include showing girls that there is a place for them in the sciences, encouraging them to continue their scientific education, and having fun. Interviews with teachers and chaperones who have had continued interactions with program participants will help determine if these goals are being met.

From these interviews, we hope to find out whether students’ positive attitudes towards science continue after the end of GAMES and whether the program affects the academic and career choices of past participants. More broadly, the study aims to find ways to increase science participation among women, and create stronger partnerships between schools and universities.

Study Tasks and Procedures

Twelve teachers and former GAMES chaperones will be asked to participate in this study.

If you agree to take part in this study, you will be asked to schedule a one-time individual interview to take place in person at a location of your choice, or over the phone. During the interview, you will be asked questions about your involvement with GAMES and your observations about student participants. Some of these questions may include:

- What do you think GAMES participants get out of the experience? Can you think of any stories or incidents with students that illustrate this?
- Did you notice any changes in the students who participated in GAMES either during the program or after its completion? How long did these changes last?
- Were there any noticeable differences between the program participants and non-participants within your class?
- What would you have liked your students to get from GAMES that you feel was lacking?
• What kinds of students do you think benefit the most from GAMES? Why? How do you select students to participate?
• How could the GAMES experience be improved for you or your students?

Participation in this research may include audio recording. These recordings will be used to take accurate notes and will be retained for 12 months. Those individuals who will have access to these recordings will be Sarah Snow and Cathy Regan. Being audio recorded is not a requirement for participation. You may still participate in the study should you choose not be recorded.

Duration

Interviews are expected to last between 30 minutes and one hour.

Study Withdrawal

You may withdraw from the study at any time with no consequences.

Risks and Discomforts

There are some risks associated with participating in this study. Interview topics focus on observations of students within the classroom and are not likely to be sensitive, though delivering critical feedback could elicit some discomfort. This discomfort would likely subside by the end of the interview.

Benefits

Based on the findings of the study, program improvements could be implemented that would create a more enjoyable experience for you (as well as your students) should you continue your involvement with GAMES. These improvements could also help to increase the program’s impact on attitudes towards science and better reinforce learning in the classroom environment.

Confidentiality

These are some reasons that we may need to share the information you give us with others:
• If it is required by law.
• If we think you or someone else could be harmed.
• Sponsors, government agencies or research staff sometimes look at forms like this and other study records. They do this to make sure the research is done safely and legally. Organizations that may look at study records include:
  i. Office for Human Research Protections or other federal, state, or international regulatory agencies
  ii. The University of Colorado Boulder Institutional Review Board

Incentives

There is no monetary compensation for participation in this study.
Participant Rights

Taking part in this study is your choice. You may choose either to take part or not take part in the study. If you decide to take part in this study, you may leave the study at any time. No matter what decision you make, there will be no penalty to you in any way. You will not lose any of your regular benefits. We will tell you if we learn any new information that could change your mind about being in this research study. For example, we will tell you about information that could affect your health or well-being.

Contacts and Questions

For questions, concerns, or complaints about this study, call (303) 492-1666

If you have questions about your rights as a research study participant, you can call the Institutional Review Board (IRB). The IRB is independent from the research team. You can contact the IRB if you have concerns or complaints that you do not want to talk to the study team about. The IRB phone number is (303) 735-3702.

Sharing Results

☐ Check this box if you would like to receive a copy of the research results. Please include an e-mail or physical address where you would like them to be sent.

______________________________
______________________________
______________________________

Signing the Consent Form

I have read (or someone has read to me) this form. I am aware that I am being asked to be in a research study. I have had a chance to ask all the questions I have at this time. I have had my questions answered in a way that is clear. I voluntarily agree to be in this study.

I am not giving up any legal rights by signing this form. I will be given a copy of this form.

Name of Participant (printed) __________________________________________

Signature of Participant __________________________ Date ______________

Name of Person Obtaining Consent (printed) ______________________________________

Signature of Person Obtaining Consent __________________ Date ______________
Audio Recording Consent

I give permission to be audio recorded during this study.

Name of Participant (printed) __________________________________________________________

Signature of Participant ____________________________________________ Date ______________
APPENDIX D

RECRUITMENT DOCUMENTS

Student Invitation (to be mailed to students identified by BVSD)

Dear Student,
Hello! My name is Sarah and I am a graduate student at the University of Colorado. I am trying to learn about girls and science.
I am looking for students who went to the Girls at the Museum Exploring Science (GAMES) program when they were in 4th or 5th grade. Because of the elementary school you went to, the Boulder Valley School District identified you as someone who may have been in GAMES. Do you remember going to the University after school to meet with scientists, look at museum objects, and do hands-on activities like pinning bugs and digging for fossils? If so, I’d love to talk to you.
I will be collecting surveys and talking with groups of girls about what they remember and how to make the program better. During group discussions, lunch will be provided and those who attend will receive a $5 gift card for their help.
If you were in GAMES and you’d like to help, please begin by filling out the enclosed consent form and survey and returning them in the pre-paid envelope.
It is OK if you don’t want to participate. If you have any questions or would like more information, you can call me at (303) 492-1666 or email me at sarah.snow@colorado.edu.
Thanks for your help!

Sincerely,
Sarah Snow

Invitación para estudiantes
Estimado estudiante,
¡Hola! Mi nombre es Sarah, y soy una estudiante de posgrado en la Universidad de Colorado. Estoy aprendiendo acerca de las niñas y las ciencias.
Estoy buscando a las estudiantes que se encontraban en el programa de Girls at the Museum Exploring Science (GAMES) cuando estaban en el 4to o 5to año de primaria, y así realizar una encuesta.
Con respecto a la escuela primaria que asististe, el Distrito Escolar del Valle de Boulder te ha identificado como una persona que pudo haber estado en GAMES. ¿Te acuerdas de ir a la Universidad después de la escuela para reunirte con científicos, mirar los objetos del museo, hacer actividades prácticas como pinchar insectos y/o excavar fósiles? Si es así, me encantaría platicar contigo.
Estaré realizando encuestas para saber que opinas del programa, que recuerdas de este y así encontrar maneras de poder mejorarlo. Se realizará una reunión donde se podrá discutir ideas, y a quienes asistan se le dará almuerzo y una tarjeta de regalo por valor de $5 por su ayuda.
Si estuviste en GAMES y te gustaría participar, por favor completa la encuesta adjunta y devuélvela en el sobre pre-pagado.
No tienes que participar si no lo desees. O bien, si tienes alguna pregunta o deseas obtener más información, puedes llamarme al (303) 492-1666 o enviarme un email a sarah.snow@colorado.edu
¡Gracias por tu ayuda!

Atentamente,
Sarah Snow
Student Invitation (to be e-mailed to students who provided post-GAMES contact info)
Dear Student,
Hello! My name is Sarah and I am a graduate student at the University of Colorado. I am trying to learn about girls and science.
I am looking for students who went to the Girls at the Museum Exploring Science (GAMES) program when they were in 4th or 5th grade and this e-mail address was given to the museum by a GAMES participant who wanted to keep in touch. Do you remember going to the University after school to meet with scientists, look at museum objects, and do hands-on activities like pinning bugs and digging for fossils? If so, I’d love to talk to you.
I will be collecting surveys and talking with groups of girls about what they remember and how to make the program better. During group discussions, lunch will be provided and those who attend will receive a $5 gift card for their help.
If you were in GAMES and you’d like to help, please begin by filling out the online consent form and survey at http://tinyurl.com/CUGAMESsurvey. Also, if you know other girls who went to GAMES, please invite them to join by sharing the survey website or telling them to contact me directly.
If you don’t want to participate, if you have any questions or would like more information, you can call me at (303) 492-1666 or email me at sarah.snow@colorado.edu.
Thanks for your help!
Sincerely,
Sarah Snow

Student Invitation (to be sent to students who elected to participate in focus groups)
Dear [Name],
Thank you for answering our questions about Girls at the Museum Exploring Science (GAMES) and agreeing to participate in a group discussion at your school.
I will be at [school name] during lunchtime on [date], talking with a group of girls about what they remember and how to make the program better. Lunch will be provided and those who attend will receive a $5 gift card for their help.
If you are still able to help, please RSVP by [date] so that I can make sure to have enough food. Also, please print out the attached permission form and bring a signed copy to our lunch meeting. If you would like me to send you a paper copy, please let me know when you RSVP.
It is OK if you don’t want to participate. If you have any questions or would like more information, you can call me at (303) 492-1666 or email me at sarah.snow@colorado.edu.
Thanks for your help!
Sincerely,
Sarah Snow

Student Invitation (to be sent to students who elected to participate in focus groups, but are the solo respondents from their schools)
Dear [Name],
Thank you for answering our questions about Girls at the Museum Exploring Science (GAMES) and agreeing to participate in a group discussion at your school.
You are currently the only student enrolled from your school, but I would still like to meet with you at [school name] during lunchtime on [date], to find out what you remember and how to make the program better. Lunch will be provided and you will receive a $5 gift card for your help.
If you are still able to help, please let me know by [date]. Also, please print out the attached permission form and bring a signed copy to our lunch meeting. If you would like me to send you a paper copy, please let me know when you RSVP.
It is OK if you don’t want to participate. If you have any questions or would like more information, you can call me at (303) 492-1666 or email me at sarah.snow@colorado.edu.
Thanks for your help!
Sincerely,
Sarah Snow
form and bring a signed copy to our lunch meeting. If you would like me to send you a paper copy, please let me know when you RSVP.
It is OK if you don’t want to participate. If you have any questions or would like more information, you can call me at (303) 492-1666 or email me at sarah.snow@colorado.edu.
Thanks for your help!

Sincerely,
Sarah Snow

Parent Notice (To be mailed to student households identified by BVSD)
Dear Parents/Guardians,
Hello! My name is Sarah and I am a graduate student at the University of Colorado. I am working with the CU Museum to evaluate an after-school program called Girls at the Museum Exploring Science (GAMES). To do this, I am looking for students who participated in the program when they were in 4th or 5th grade.
As part of the evaluation, the district identified girls within Boulder Valley who attended schools that participated in GAMES between 2003 and 2011. Your daughter’s name on the label affixed to the envelope was selected because her enrollment history in the district indicated that she attended one of these elementary schools as a 4th or 5th grader.
Did your daughter participate in GAMES? Did she travel to the university campus after school to meet with scientists, explore museum collections, and complete hands-on activities like pinning bugs and excavating fossils? If so, I’d love to talk to her.
I will be collecting surveys and talking with groups of girls about what they remember and how to make the program better. During group discussions, lunch will be provided and those who attend will receive a $5 gift card for their help.
If your daughter was in GAMES and would like to help, please have her complete the enclosed survey and return it along with the signed consent form using the pre-paid envelope.
For more information or if you have any questions, you can call me at (303) 492-1666 or email me at sarah.snow@colorado.edu.
Thanks for your help! I look forward to hearing from you!

Sincerely,
Sarah Snow

Aviso para los Padres de Familia
Estimados padres o tutores,
¡Hola! Mi nombre es Sarah y soy una estudiante de posgrado en la Universidad de Colorado. Estoy trabajando con el Museo de CU para evaluar el programa extra-curricular Girls at the Museum Exploring Science (GAMES). Para poder realizar esto, estoy buscando a los estudiantes que participaron en el programa cuando estaban en 4to o 5to año de primaria.
Como parte de la evaluación, el Distrito Escolar del Valle de Boulder ha identificado a las niñas de las escuelas que participaron entre 2003 y 2011. El nombre de su hija en la etiqueta del sobre fue seleccionado por el distrito debido a que, de acuerdo con el historial de su hija, ella asistió a una de estas escuelas en 4to o 5to año de primaria.
¿Sabe si su hija participó en GAMES? ¿Sabe si ella visitó la cuidad universitaria después de la escuela para reunirse con los científicos, explorar colecciones de los museos, y completar actividades prácticas, como pinchar insectos y/o excavar fósiles? Si es así, me encantaría hablar con ella.
Estaré realizando encuestas para saber que opinan del programa, que recuerdan de este y así encontrar maneras de poder mejorarlo. Se realizará una reunión donde se podrá discutir ideas, y quienes asistan se le dará almuerzo y una tarjeta de regalo por valor de $5 por su ayuda.
Si su hija estaba en GAMES y le gustaría ayudar, por favor, pídale que complete la encuesta adjunta y devuélvala en el sobre pre-pagado.
Para obtener más información o si tiene alguna pregunta, puede llamarme al (303)492-1666 o envíe un email a sarah.snow@colorado.edu.
¡Gracias por su ayuda! ¡Espero con interés escuchar de usted!

Atentamente,
Sarah Snow

Adult Invitation (to be sent to selected teachers and chaperones)
Dear [Name],
Thank you so much for your continued support of the Girls at the Museum Exploring Science (GAMES) program. Since 2003, GAMES has been bringing elementary-aged girls from BVSD schools with high percentages of low income students to the CU Museum of Natural History to meet with scientists, explore museum collections, and complete hands-on science activities. It’s hard to believe that the first groups to complete the program are now preparing to graduate from high school.
We hope that former GAMES participants have continued on their path towards success. Before they begin the transition to the next phase of their lives, we at the CU Museum of Natural History would like to implement a longitudinal study to investigate any lasting impacts that may be associated with the GAMES program. Using student focus groups and interviews with teachers and chaperones, this study will attempt to determine whether students’ positive associations with science continue after completion of the program and whether the program affects the academic and career choices of past participants. Because you had interactions with girls while they were participating in GAMES, your participation would be an important contribution to the study. We would appreciate your insight and any observations of student attitudes and behaviors before, during, and after the program that you may have. We will be scheduling interviews either in person or over the phone to take place in June, July, and August 2012. This is a one-time commitment with interviews expected to last between 30 minutes and one hour and participation is entirely voluntary.
If you are able to help or have further questions, please contact me through any of the information provided below. Also, please let me know if there is anything else that I can do to make your participation possible.
Thank you,
Sarah Snow
CU Museum of Natural History
Education Graduate Assistant
(303) 492-1666
sarah.snow@colorado.edu
Thank you for answering our questions about girls and science. It should only take about 5 minutes. There are no right or wrong answers and if you do not like a question, you do not need to answer it.

When you were in 4th or 5th grade, did you participate in the Girls at the Museum Exploring Science (GAMES) program?
- Yes
- No
- I don't know

If yes, please share something that you remember about GAMES.

____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Have you participated in other science programs outside of school?
- Yes
- No
- I don't know

If yes, please list the programs you have participated in.

____________________________________________________________________________________
____________________________________________________________________________________

I like science...
- more than when I was in elementary school
- less than when I was in elementary school
- the same as when I was in elementary school

<table>
<thead>
<tr>
<th>Language Arts</th>
<th>Secondary World Languages</th>
<th>Math</th>
<th>Science</th>
<th>Music</th>
<th>Art</th>
<th>Social Studies</th>
<th>History</th>
<th>Physical Education</th>
<th>Health</th>
<th>Technology</th>
<th>Theater</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>My favorite subject in school is...</td>
<td>☐</td>
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<td>My least favorite subject in school is...</td>
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</table>
For the following questions, please check all that apply.

<table>
<thead>
<tr>
<th>Subject Category</th>
<th>Language Arts</th>
<th>Secondary World Languages</th>
<th>Math</th>
<th>Science</th>
<th>Music</th>
<th>Art</th>
<th>Social Studies</th>
<th>History</th>
<th>Physical Education</th>
<th>Health</th>
<th>Technology</th>
<th>Theater</th>
<th>Other</th>
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<tbody>
<tr>
<td>Some subjects that I am good at</td>
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<td>Some subjects that are hard for</td>
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</table>

In the future, I plan to (check all that apply)...
- graduate from high school
- complete a GED
- go to college
- continue school after college
- I am not sure

I would like to have a career as a(n)...  ________________________________________________________________

In addition to these surveys, we will be talking with groups of GAMES girls to learn more about their experiences with the program. If you participated in GAMES, please consider participating in a group discussion. To thank you for helping in these discussions, we will provide you with lunch and a $5 gift certificate.

May we contact you about participating in a group discussion?
- Yes
- No

If yes, please provide a name and current school as well as your preferred contact information.
Name ____________________________________________
Current School (Fall 2012) ____________________________
E-mail ____________________________________________
Telephone _________________________________________
Address __________________________________________

Thank you for your help! Please use the enclosed pre-paid envelope to return this survey along with the signed "Parental Permission & Student Assent" form by August 10th.
**Encuesta Girls at the Museum Exploring Science (GAMES)**

*Gracias por responder a nuestras preguntas. Esta encuesta sólo te tomará 5 minutos. No hay respuestas correctas o incorrectas, y si no te gusta una pregunta, no es necesario responderla.*

¿Cuándo estabas en 4to o 5to de primaria, participaste en el programa de Girls at the Museum Exploring Science (GAMES)?
- Sí
- No
- No me acuerdo
  
  Si tu respuesta fue Sí, por favor comparte algo que recuerdes sobre tu experiencia.

¿Habías participado en otros programas fuera de la escuela?
- Sí
- No
- No sé
  
  Si tu respuesta fue Sí, por favor enlista los programas en los que has participado.

Me gusta la ciencia...
- Más que cuando estaba en la escuela primaria.
- Menos que cuando estaba en la escuela primaria.
- Igual que cuando estaba en la escuela primaria.

<table>
<thead>
<tr>
<th>Lenguaje</th>
<th>Artes</th>
<th>Lenguajes del Mundo</th>
<th>Matemáticas</th>
<th>Ciencias</th>
<th>Música</th>
<th>Artes Sociales</th>
<th>Ciencias Sociales</th>
<th>Historia</th>
<th>Educación Física</th>
<th>Salud</th>
<th>Tecnología</th>
<th>Teatro</th>
<th>Otra</th>
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<tr>
<td>Mi clase favorita en la escuela es...</td>
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</table>
Para las siguientes preguntas, por favor checa la(s) casilla(s) que te aplique.

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<tr>
<td>Las clases en las que me va bien son...</td>
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<td>Las clases que se me hacen difíciles son...</td>
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En el futuro, planeo, (por favor checa las casillas que te apliquen)...  
☐ graduarme de la preparatoria  
☐ completar GED  
☐ ir a la universidad  
☐ continuar estudiando después de la universidad  
☐ no estoy seguro(a)

Me gustaría estudiar una carrera en...  
________________________________________________________

En adición a esta encuesta, estaremos platicando en grupos con los estudiantes de GAMES para aprender más sobre sus experiencias en el programa. Si tu participaste en GAMES, por favor considera participar en nuestro grupo de discusión. Y en agradecimiento por ayudarnos con tus comentarios, si asistes al grupo de discusión te proveeremos el almuerzo y una tarjeta de regalo con valor de $5.

¿Podemos contactarte para saber si quieres participar con nosotros en el grupo de discusión?  
☐ Sí  
☐ No  
Si tu respuesta es Sí, por favor provee de la siguiente información:  
Nombre ____________________________________________________________  
Escuela a la que estudias actualmente (Otoño 2012) ________________________  
Correo electrónico ______________________________________________________  
Teléfono ___________________________  
Dirección _____________________________________________________________

¡Muchísimas gracias por tu ayuda! Por favor utiliza el sobre pre-pagado para regresar tu encuesta, así como el formato firmado de “Permiso de los padres y consentimiento del alumno” antes del 10 de Agosto de 2012.