An Evaluation of the Effectiveness of Science Field Trips and Hands-On Classroom Activities at the Maria Mitchell Association, Nantucket, MA

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Abstract

This report presents an evaluation of the effectiveness of science field trips and hands-on classroom activities offered and coordinated by the Maria Mitchell Association (MMA). Through our analysis of focus groups, interviews, observations, and surveys, we conclude that the programs are effective in meeting the goals of local teachers. Nevertheless, we make several recommendations, including the implementation of a teacher-provider summit and other professional development activities. We developed a quick and easy evaluation tool for the MMA to gauge the relative success of future field trips and to identify how to improve them.

Acknowledgements

Our team would like to thank our sponsor, the Maria Mitchell Association, along with our liaison Dr. Janet Schulte for supporting our project and also housing our team. We would also like to thank Andrew McKenna-Foster for contributing greatly to our project by attending our weekly meetings and leading the field trips we observed. We greatly appreciate the help and input we received from Jenny Mayberry, Cheryl Beaton, Leslie Bresette, Emily MacKinnon, Marjan Shirzad, Michael Varbalow, Harry Payne, John Bartlett, and Amy Cabre. Our group would like to thank all of the teachers from the Nantucket Elementary School for being so excited and willing to help us, especially the fourth grade teachers who let us observe the field trips they went on and also filled out our online evaluation form. Also from the Nantucket Elementary School, we would like to thank the secretaries for helping us distribute and collect the surveys. In addition, we would like to thank Dr. Dominic Golding for helping us produce this project and report. Lastly, we thank the other teams from Worcester Polytechnic Institute that also did their projects on Nantucket for being supportive throughout the past seven weeks.

Executive Summary

Careers in Science, Technology, Engineering, and Mathematics (STEM) fields are becoming increasingly important in the modern world. Unfortunately, the number of professionals entering these fields in the United States has stagnated, while it continues to rise in other countries. Research shows that collaboration between formal and informal learning experiences can promote increased engagement in science learning. So, many informal education institutions including science museums have created outreach programs in a joint effort with schools to bolster an interest and enthusiasm for STEM careers from an early age. On Nantucket Island, the Maria Mitchell Association (MMA) offers many programs of this nature to the general public and to the schools.

In the fall of 2009, the MMA received a grant from the Nantucket Golf Club Foundation to develop a Nantucket-themed K-5 Science Curriculum at the Nantucket Elementary School (NES), involving field trips and other hands-on classroom activities. The scope of the programs includes field trips directed by MMA staff that take place on the MMA campus, off-site on the island, and in the classrooms, as well as field trips directed by other third-party professionals after MMA facilitated contact between these individuals and the teachers. The overall goal of this project was to evaluate the science programs provided by the MMA, and those facilitated by the MMA for other program providers, for grades K-5 of the Nantucket Elementary School. The five crucial objectives involved in the pursuit of this goal were to characterize the K-5 programs offered by MMA, evaluate whether these programs meet the needs and expectations of the teachers, acquire perspectives of field trip providers, obtain alternative perspectives on field trips from other interested parties, and finally develop an evaluation tool for future use by the MMA.

Through focus group sessions with the teachers of each grade level team at NES, the project team assessed their opinions on the MMA's current programs and on the importance of field trip experiences in general. The feedback was almost entirely positive, and all teachers agreed that field trips provide valuable hands-on learning opportunities that enable students to make stronger connections and understand "real world" applications of the classroom concepts, but the content of the field trip must be closely tied to curriculum content for teachers and administration to approve. Funding the field trips poses a serious challenge for the school system, especially during a time of budgetary cutbacks. Some teachers expressed a willingness

to participate in field trips regardless of the provider's ability to fund transportation due to the educational value they deliver, while others simply explained that if the field trips were not funded elsewhere, the school could not afford to participate.

A series of interviews with field trip providers gave insight into their goals and motives for delivering these programs, their thoughts on the effectiveness, and their background and experience in the field. The field trip providers we interviewed included both MMA staff and outside professionals who host field trip programs. Since no provider had formal training in education in general, or delivering field trips in particular, they tended to rely on personal enjoyment and self-motivation to strive to improve the educational value and effectiveness of their own programs. Several providers mentioned that they enjoy working with the students, they want to share their expertise and passion for their respective fields, and that they used parenting experience as a guideline for how to act with children. A common finding between all the providers was the lack of communication with the teachers before a field trip about specific goals and recent lesson plans in the classroom. More knowledge in these areas would enable the field trip providers to better understand the context of the field trip within the curriculum and lesson plan schedule of the class, as well as tailor the program to fit each class as desired.

In addition to teachers and field trip providers, we gathered the perspectives of other relevant parties and community members, including NES parents, funding entities, and other museum education professionals. A survey distributed to all NES parents yielded 73 responses, a 12% response rate. Every respondent valued field trips and felt that they were important to their children's education. The responses explaining why field trips are valuable had four main emphases: (1) education value in general, (2) community involvement, (3) learning science, and (4) having fun. In addition to the survey, we conducted interviews with professionals involved in the field but not in the MMA program, as well as the chair of and MMA's current funding source. The MMA received a grant from the Nantucket Golf Club Foundation to initiate the Nantucket-based Science Curriculum program with NES, so we interviewed the chair of the Grants Committee for her opinion on the program. The Grants chair fully supports field trips and considers them a valuable supplement to classroom learning, but explained that she could not make any further comment on the success of the program without "proof" of its value, and its positive effect on the students' learning. Other interviews with the Director of Outreach and

Special Programs at the Nantucket Historical Association (NHA) and the Education Director at the Cape Cod Museum of Natural History provided examples for us to inspire recommendations for the MMA. The NHA held a Diversity Festival in October, 2010 in an attempt to embrace the minority populations of Nantucket, by offering free admission and running their regular tours at the Whaling Museum in Spanish, Portuguese, and Bulgarian. The festival was well attended, and was made possible by volunteers acquired by the NHA's Diversity Committee. These volunteers translated and delivered the hourly tours in the three languages. Similarly, the Cape Cod Museum of Natural History (CCMNH) relies on volunteers to lead their daily programs and field trips. The CCMNH hosts 43 schools per year for their standard field trip program, which can be tailored specifically to certain teachers upon request. This communication happens between the teacher and the Education Director, who then relays the requests to the host for that day. The CCMNH continually evaluates its programs through visitor surveys and teacher surveys.

The Grade Four classes from NES visited Sankaty Bluff for a field trip with Andrew McKenna-Foster of the MMA. The field trip involved walking the beach, identifying sites of erosion on the cliff, observing rocks and sand with magnifying glasses, and finding a rock to use for future analysis in class, all as a part of the Geology unit. We observed three of the four field trips, focusing our attention on how engaged the students were, whether they asked questions about the curriculum content and the activities, and when they became distracted. After the first day, new rules were instated so that the students would stay more under control, and stricter boundaries were set during the rock-hunting activities so there were fewer wanderers. Over all three days, students were energetic, and excited to be outside and have the experience of being geologists for the day. Depending on the teacher's input, some students made more connections with pre-trip activities than others. One teacher in particular reminded her students about a book they had read before the field trip and about their goals for afterward. This class was the most focused of the three, and the least distracted by off-task behaviors and conversations. But overall during the three field trips, students were engaged in the activities and seemed to enjoy searching for and identifying sites of erosion, as well as using the geological vocabulary from the classroom.

Through interviews with field trip providers and teachers alike, preparation and communication are consistently mentioned as important steps toward a more beneficial field trip experience. In fact, the field trip providers who visited the classrooms before the field trip for an introduction to the topic were well received by both the teachers and the students. Andrew McKenna-Foster did just this before the Sankaty Bluff field trips, and got the students interested and excited to find rocks like the one he brought into the class during a pre-trip visit. Typically, there is minimal communication of goals between the teacher and the field trip provider, aside from scheduling and the general curriculum topics. We found that 80% of field trip providers involved with NES would prefer more specific details regarding the pre-trip activities and lesson plans of each individual class. In the focus groups, some teachers mentioned a desire for more information about available field trips. Several mentioned that they appreciate and value field trips, and would like their classes to participate in more of them, but are unaware of the opportunities that exist on the island and through the MMA. These conclusions all related to the general lack of communication between teachers and field trip providers.

Ultimately, we recommended that:

- **The school administration and field trip providers continue their efforts to offer field trips to the students, and maintain their programs even through economically challenging times;**
- **The field trip providers and teachers communicate more often with each other before field trips;**
- **The MMA and other providers work with the schools to make the field trips as inclusive as possible for the ELL students;**
- **The field trip providers visit the classrooms before the field trips whenever possible;**
- **Field trip providers and teachers pursue professional development opportunities that focus on how to facilitate learning during field trips;**
- **The MMA and teachers, in a joint effort, create a procedural checklist outlining the necessary steps in the field trip process; and,**
- **The MMA host a regular summit to bring together the teachers and field trip providers of Nantucket.**

Authorship

The writing of our report was shared equally by all three members of the group. Allison Roche contributed heavily to editing the report. For the interviews, Jetta Garrity, Kellen Pastore, and Allison Roche took turns leading the interview and taking notes. All three group members took notes on observations of the field trips and contributed equally to the design and questions of the parent survey. Allison Roche translated the Spanish surveys and Kellen logged the survey data. Jetta Garrity designed the SurveyMonkey evaluation tool and did a majority of the scheduling and planning of interviews and focus groups.

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Introduction

Careers in Science, Technology, Engineering, and Mathematics (STEM) fields are becoming increasingly important in the United States today, and around the world. Unfortunately, the number of professionals entering STEM fields has stagnated over time in the United States while it continues to rise in other countries. In attempts to address this dilemma, many science and natural history museums are reaching out and collaborating with schools to promote greater public interest in STEM fields starting from an early age. Research suggests that such collaborations between the formal and informal sectors can be very effective in promoting engagement and learning, since "no single institution, such as schools, afterschool or youth organizations, or science-rich cultural institutions, can achieve this vision acting alone. It will take a combination of resources, expertise, timeframes, and learning designs to support and expand science literacy in today's world" (Bevan, Dillon, Hein, Macdonald, Michalchik, Miller, Root, Rudder, Xanthoudaki, and Yoon, 2010, p. 12).

It is in this context that the Maria Mitchell Association (MMA) collaborates with and offers informal science education programs to the Nantucket community and schools. The MMA is named after Maria Mitchell, a prominent 19th century female astronomer and educator. Following her philosophy, the MMA promotes "learning by doing" and hosts a variety of family activities, summer programs, and school field trips involving their aquarium, natural science museum, observatories, and the environment of Nantucket. The MMA works with the Nantucket Elementary School by providing science programs hosted at MMA facilities, off-site throughout Nantucket, and in the classroom, as well as serving as a coordinator between the school and other third-party field trip providers on the island. A grant provided by the Nantucket Golf Club Foundation recently enabled the MMA to partner with the Nantucket Public Schools in revising the field trip programs to ensure their alignment with the Massachusetts Science and Technology Curriculum Frameworks, and evaluation of this revised program is now necessary. Like many other museums, the MMA wants to know how well their programs meet the goals of teachers and students, and such evaluations are also needed in order to receive continued funding. These evaluations address both the programs run by MMA staff and those facilitated by MMA with other providers.

The goal of this project was to evaluate the MMA's science programs and provide an evaluation tool for future use. In order to achieve this goal, the project objectives were to: characterize the MMA K-5 programs, evaluate whether the programs offered meet teacher goals, acquire the perspectives of the MMA and other field trip providers, obtain alternative perspectives on field trips held by parents and other interested parties, and develop an evaluation tool for future use by the MMA.

Literature Review

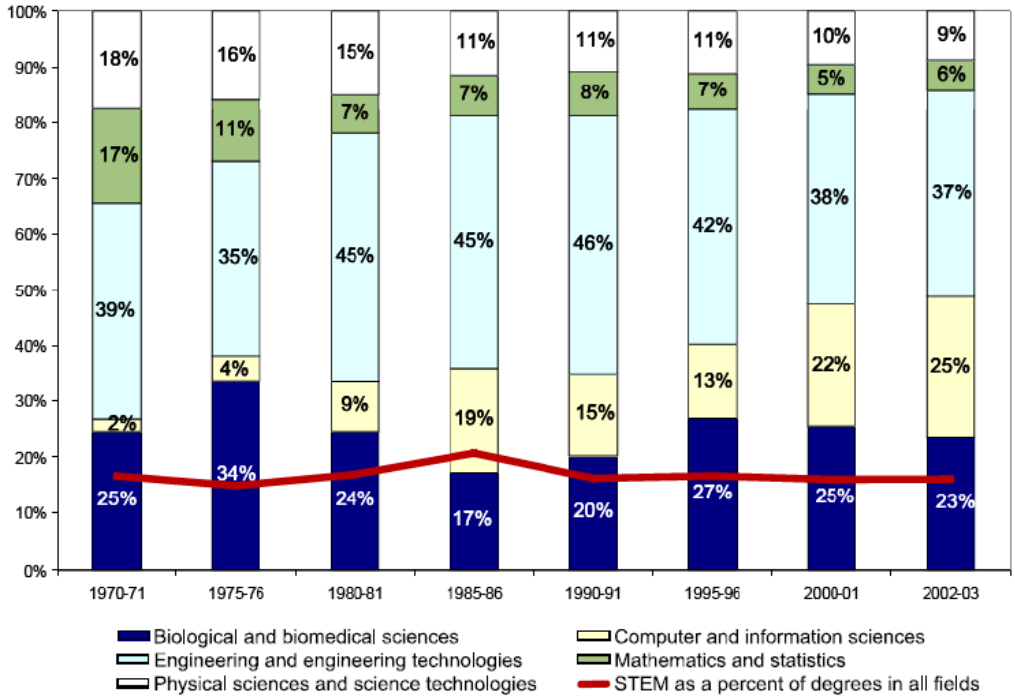
Introduction

The United States of America is competing in an increasingly global economy. In order to maintain its status within this changing world, the U.S. needs to uphold a strong infrastructure of educated professionals leading the economy. The U.S. Government and other agencies support numerous programs that facilitate education in the fields of Science, Technology, Engineering, and Mathematics (STEM), with efforts affecting all levels of schooling. Even elementary school programs are being designed in order to help encourage future interest in STEM fields. One way these programs hope to succeed is through the use of informal learning. For the schools on the island of Nantucket, an important organization that provides informal education opportunities is the Maria Mitchell Association (MMA). The MMA runs several museums on the island and is dedicated to education. This literature review discusses the importance of STEM education, the differences between formal and informal learning, how informal learning is incorporated in science programs, how museums are used in the educational process, and the process of evaluating museum-based informal learning programs.

Science, Technology, Engineering, and Mathematics (STEM)

Science, Technology, Engineering, and Mathematics, or STEM, education is considered important in modern America. As the nation's economy has evolved from industrial to a service based one, the need for highly trained professionals in STEM fields has increased. Ideally, there should be an increase in the number of students pursuing STEM educations as the demand for them in the business world increases, but in recent years this has not been the case. Instead, STEM education has been slow to progress, for reasons including declining math and science standardized test scores, a lack of teachers educated in those fields, and a lack of college students entering into STEM degree programs. Figure 1 shows that the proportion of degrees in STEM subjects (red line) has remained relatively constant over the past twenty years, although there has been some variation in the relative proportion awarded in different STEM subjects, with a notable increase in computer sciences (Kuenzi, 2008).

Figure 1: STEM Degrees Awarded, 1970-2003



(Kuenzi, 2010)

Government agencies at the federal, state, and local levels are concerned about this weakness and are directing focus on improving the state of STEM education. One approach to encourage STEM learning is through the use of informal education channels (Kuenzi, 2008). Considerable research has been conducted to explore the relationship between interest in STEM fields and informal science learning. The general conclusion has been that students who have been exposed to informal science educational approaches tend to be more engaged and interested in the material they are learning. The level of engagement is important in helping foster an interest in STEM fields as the students' progress through high school, college, and then the professional world. Research involving the Summer Science Camp run by the University of Texas Medical Branch found that informal science experience influenced decisions about college majors among 80% of participants (Ricks, 2006). This effect is attributed to the fact that informal learning often focuses more on problem solving and real world applications than formal learning does. In response to the growing evidence that shows the importance of informal education for increasing STEM interest, many organizations have created informal education opportunities for children (Ricks, 2006). It is important to remember, however, that informal science education efforts alone cannot hope to rectify the imbalance in STEM learning and

education. The efforts of informal science education are most effective when partnered with formal education activities and organizations (DeWitt and Hohenstein, 2009).

Programs such as the Maryland's Harford County Public Library's LEAP (Learn, Explore, And Play!), Shreveport, Louisiana's Sci-Port's Minds-On-Math, and NASA's Explorer Institutes, as well as many others, all strive to increase the availability of informal science opportunities in their communities and throughout the nation. Evaluations of both the LEAP and Minds-On-Math programs have shown increases in the knowledge base of their participants and their eagerness to explore the material (Pollock, 2010). Efforts of programs like these around the country are an essential part of increasing interest in the STEM fields (Pollock, 2010, NASA, 2005).

Formal and Informal Learning

Formal learning alone cannot address the problem of STEM decline, since the sometimes unexciting nature of a classroom setting may not be stimulating enough for students to truly learn and understand the entirety of their science curriculum. Students need experiences outside of the classroom to inspire a more active learning process and a love for science. Formal-informal collaboration is necessary so that students are provided with different ways of learning and getting excited about science.

Formal vs. Informal Learning

Typically, educators define the two major styles of learning as informal or formal learning. These two styles differ regarding the ways students learn, and the environments in which most of the learning takes place. Informal learning is generally defined as activities that occur outside of a school setting. It is both voluntary and unstructured. It is generally learner-led, which means it is harder to evaluate what is learned through conventional measures. Different types of informal learning include field trips, student projects, community-based science youth programs, casual visits to informal learning settings, and the press and electronic media (Hofstein and Rosenfeld, 1996). The informal learning setting that our research will focus on is in the museum setting of science field trips, where "Visitors have the opportunity to control their own learning" (Congdon, Tutone, and Valencia, 2008). A study done by DeWitt and Hohenstein found that, "Museum visits may enable pupils to assert more authority temporarily and provide insight into processes by which some experiences may contribute to learning"

(DeWitt and Hohenstein, 2009). This shows that by giving the students control over their own learning, it will provide insight into the best learning style for the student.

Formal science learning is the complement to informal science learning. According to Table 1 from *Bridging the Gap between Formal and Informal Science Learning*, formal science learning is compulsory and structured. This type of learning is also teacher-led and easier to evaluate through written or oral tests. Formal learning is curriculum-based, which means that there are fewer unintended outcomes than there are in informal learning (Hofstein and Rosenfeld, 1996). In a formal learning environment, discussions are usually dominated by the teacher, rather than being "student-led and teacher facilitated" (DeWitt and Hohenstein, 2009).

Table 1: Features of Formal and Informal Science Learning

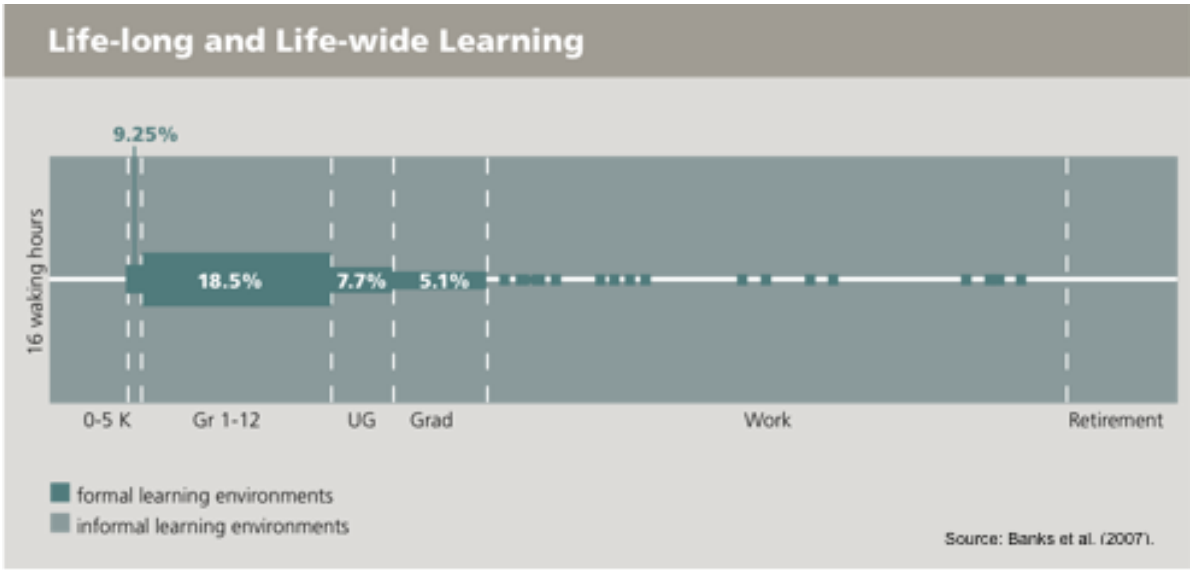
Informal learning- field trips	**Formal learning- School**
Voluntary	Compulsory
Unstructured	Structured
Unsequenced	Sequenced
Nonassessed	Assessed
Unevaluated	Evaluated
Open-ended	Close-ended
Learner-led	Teacher-led
Many unintended outcomes	Fewer unintended outcomes
Less directly measurable outcomes	Empirically measured outcomes
Nondirected or learner directed	Teacher directed

(Modified from *Bridging the Gap between Formal and Informal Science Learning, Hofstein and Rosenfeld, 1996, pg. 89)*

As shown below in Figure 2, assuming the average person is awake for 16 hours a day, formal and informal learning hours are graphed from the time the average person is an infant to the time they reach retirement. Formal learning primarily happens in the grade school years, and sporadically during the adult years, but most time is spent learning in an informal rather than a formal environment. Although accurate measures of the amounts learned in these different environments are not known, it seems necessary to better develop the techniques and skills to

learn effectively in informal environments, based on the amount of time spent in them. Museums and other field trips can help by providing an informal learning environment: an opportunity for students to have real-world experiences and learn in ways that are much different than ways in a classroom.

Figure 2: Compares the amount of time spent in formal learning environments to informal environments from infancy to retirement



(http://www.ed.gov/technology/draft-netp-2010/where-when-people-learn)

Formal and Informal Collaborations

A Caise inquiry report found that the best way to learn and expand a commitment to a certain field is through the use of multiple settings and multiple time frames (Bevan et al. 2010). Some museum programs involve a field trip out of class and then sending a professional into the school for an in-class activity. This type of variation in style and setting incorporates aspects of both informal and formal learning, yielding the positive results of each. Using formal and informal education strategies in complement of each other is a way to reach more students of varying learning types, and to reach each student in a variety of ways. These formal-informal collaborations are considered more effective than either method alone.

Scenarios of formal-informal collaboration often happen naturally or unintentionally. In a certain educational mode, such as formal education in a classroom, characteristics of informal learning also exist during certain activities. For instance, peer group work that happens during the school day could be considered an informal learning activity in a formal learning environment. On the other hand, formal learning characteristics also exist in settings that are considered informal. On a sports team or in a Boy/Girl Scout Troop, the structure of the majority of interactions would be classified as informal. However, completing specified tasks under direct instruction to achieve a certain goal (a badge, or winning record, for example) is a characteristic of formal education. Instances like these of overlap between the educational modes occur daily, both in and out of a school setting (La Belle, 1982, p. 161). Understanding this natural occurrence is the first step in taking full advantage of the benefits of both formal and informal education in any environment. This type of formal-informal overlap can be used intentionally in school to appeal to all types of learners.

Deliberate formal-informal collaborations orchestrated by teachers are especially significant in the field of science. It is important to have these two methods of learning work together because, according to the Caise inquiry report, "The emerging vision of scientific literacy is complex, (and) no single institution can achieve this vision acting alone" (Bevan et al. 2010). This thought is even evident in the WPI motto "theory and practice." One without the other is not a sufficient way to learn science.

Students learn through many different learning styles, and not all students learn best at the same pace, or in the same setting. It is very important for both formal and informal educational instructors to "Provide experiences that leverage prior and future experiences, and help to build coherence and meaning, across settings, around critical ideas and understandings in science" (Bevan et al. 2010). This is done through "Supplementary classroom experiences, integrated core academic curricula, student science learning communities, teacher professional development programs and communities, and distinct infrastructure efforts" (Bevan et al. 2010).

Formal-Informal collaborations are "Designed to contribute towards advancing students' conceptual understanding in science, improving students' school achievement and attainment, strengthening students' positive dispositions towards science, advancing teachers' conceptual

understanding in science, and supporting teachers' integration of inquiry and new materials in the classroom" (Bevan et al. 2010).

Techniques of informal learning

Increasingly, educators are utilizing techniques of informal learning to promote interest and learning in STEM subjects. Some techniques of informal learning include inquiry based learning and using the environment as a learning context.

Informal Science Learning

Informal learning settings can be very effective in motivating a student to learn science on his/her own, but the key challenge is to find a way to "link emotional and sensory responses with science specific phenomena" (Bell and Lewenstein, 2009). Bell and Lewenstein also found that, "Tens of millions of Americans, young and old, choose to learn about science in informal ways- by visiting museums and aquariums, attending after-school programs, pursuing personal hobbies, and watching TV documents, for example. There is abundant evidence that these programs and settings and even everyday experiences such as a walk in the park, contribute to people's knowledge and interest in science" (Bell and Lewenstein, 2009). Field trips involve activities that can normally not be done in a classroom setting, such as visiting a pond and observing the wildlife. This type of field trip provides the student with concrete experiences that have been shown to "Spark curiosity, generate questions, and lead to a depth of understanding and commitment in ways that are often less possible when the same material is encountered in books or screens" (Bevan et al. 2010). DeWitt and Hohenstein (2009) identify many sources that find strong evidence that "School trips to such places can result in both cognitive and affective gains for students" (DeWitt and Hohenstein, 2009). Even though research from Hofstein and Rosenfeld has shown that field trips can help students develop a deeper understanding of science learning and comprehending, they are still sometimes seen as a disruption to the teacher, being both difficult to implement and expensive. Field trips can also be considered unnecessary when administration requires "time on-task" and classes more strictly focused on the curriculum, especially when motivated by standardized tests such as the Massachusetts Comprehensive Assessment System (MCAS). It can be a challenge for the teachers to work outside their natural environment of the classroom, especially if they are unfamiliar with the material the museum staff is presenting to the students. Despite these difficulties, it has been proven that significant

cognitive learning can and usually does occur when students are on science field trips. It has also been proven that information learned on a field trip is not immediately forgotten after leaving the setting, and may be remembered for a long time, showing that museum visits are enjoyable and create long lasting and positive memories (Hofstein and Rosenfeld, 1996). In a comprehensive nationwide study, Falk, Reinhard, Vernon, Bronnenkant, Deans, and Heimlich (2007) found that visits to either a zoo or aquarium had a measurable impact on visitor learning. "Nearly a year after their zoo or aquarium visit, virtually all participants surveyed (87%) could talk about their visit and remember a number of details about the experience. Despite there being no change in short term conversation knowledge, over half of visitors (61%) could talk about what they learned- either prior understandings that were reinforced or new knowledge that was gained" (Falk et al. 2007).

Inquiry Based Learning

Inquiry based learning is applying human sciences through gathering both information and data. This learning style involves observation, experimentation, and rudimentary hypothesis testing and typically involves hands-on activities. This process is more than just asking questions. It is becoming more important for children to learn this way in order to understand and comprehend data instead of just memorizing facts. Children need to gain the ability to generate and transmit knowledge, which inquiry based learning helps with. In this day and age, schools should consider shifting their focus toward how we know information instead of simply what we know. The benefit of learning through inquiry is, "Students who actively make observations, collect, analyze, and synthesize information, and draw conclusions are developing useful problem-solving skills. These skills can be applied to future 'need to know' situations that the students encounter both at school and work" (Concept to Classroom, 2004).

Inquiry based learning happens when students combine scientific knowledge with reasoning and thinking skills to develop their understanding of science. Inquiry based learning can happen in an informal environment since the inquiring process begins when the learner "notices something that intrigues, surprises, or stimulates a question" (Dyasi, 1996). Informal environments are usually a new learning environment, like a museum, which makes for new experiences and explorations in learning. When students experience a new learning environment,

they are more apt to ask questions about what they are experiencing and what is surrounding them (Dyasi, 1996).

Hands-on Learning

Inquiry based learning and hands-on learning are very similar techniques. Hands-on learning is considered to mean "Having students 'manipulate' the things they are studying - plants, rocks, insects, water, magnetic fields - and 'handle' scientific instruments - rulers, balances, test tubes, thermometers, microscopes, telescopes, cameras, meters, calculators. In a more general sense, it seems to mean learning by experience," (Haury and Rillero, 1994). According to James Rutherford (1993) who was the director of the science reform initiative, children are considered to be observers and explorers by nature and therefore the most effective method of learning is hands-on learning where students can experience science to better understand it. The term hands-on was coined in the late 1960s and was used to describe working at a computer by using one's hands on the keyboard. Even though the term was created in the late 1960s, the idea of learning by doing has existed for a longer time in the arts and crafts area (Haury and Rillero 1994).

Recent studies show many benefits to hands-on learning (Stohr-Hunt, 1996; Haury and Rillero, 1994). Hands-on activity is believed to increase learning, motivation to learn, enjoyment of learning, skill proficiency, communication skills, perception, creativity, independent thinking, and decision making based on direct evidence and experience (Haury and Rillero, 1994). Hands-on learning is also fun for both the teacher and student, which is considered to be a worthy goal for choosing instructional approaches in science. "Students in activity-based programs have exhibited increases in creativity, positive attitudes toward science, perception, logic development, communication skills, and reading readiness," proving to be sufficient justification to promote hands-on learning (Haury and Rillero 1994). Stohr-Hunt (1996) found "That significant differences existed across the hands-on frequency variable with respect to science achievement. Specifically, students who engaged in hands-on activities every day or once a week scored significantly higher on a standardized test of science achievement than students who engaged in hands-on activities once a month, less than once a month, or never."

Using the Environment as an Integrating Context for Learning

Another alternative style of education that encompasses the ideas of informal learning is place-based education. This paradigm, based on the important influence of physical settings on learning, relates closely to the MMA since part of their mission is to "use the Island as a laboratory" through their science programs (mmo.org, 2010). Place-based learning is important to consider since field trips utilize the science museum, aquarium facilities, and outdoor settings, each for different designated purposes and subject areas of the curriculum. Place-based education gives the opportunity to "immerse the students in local heritage, culture, and landscapes", essentially using nature as the classroom (promiseofplace.org, 2010).

One way to educate using this place-based style is using the environment as an integrating context for learning, or EIC. This type of education method involves the breaking down of traditional boundaries between course subjects, team teaching, hands-on and project-based learning, and the development of a better understanding of the environment. A nation-wide study involving 40 schools that had implemented EIC-based programs produced results showing improved grades, test scores, attitude and discipline, enthusiasm for learning, and pride and ownership in students' work. In science specifically, teacher evaluations reflected not only improved knowledge and grades, but also a deeper understanding of the significance of science topics and their relation and application to real-world problems. "Ninety eight percent of Domains Survey respondents reported that EIC offered increased opportunities to teach science in a context that students could relate directly to their lives" (Leiberman and Hoody, 1998, p. 61). Student enthusiasm sparks teacher enthusiasm, and team teaching and blending of discipline boundaries result in the students' ability to better synthesize information and think strategically and systematically, relating and making connections between varying learned topics.

Museums as a Solution

As society realizes the importance of informal learning, especially when in collaboration with formal learning, the role of informal learning environments becomes crucial in science education. Science centers and museums can be considered fun and exciting destinations for school field trips or fun family activities but in reality, they also offer legitimate educational opportunities. "A good museum attracts, entertains, arouses curiosity, leads to questioning and

thus promotes learning," according to John Cotton Dana in *The New Museum: Selected Writings of John Cotton Dana* (Hein, 2004). Historically, the design of museum exhibits was based on information that museum faculty deemed most important for viewers to know, with information presented in a didactic manner. However, more recently, museum personnel have come to realize that in order to maintain their business by attracting visitors, and to educate those visitors more effectively, the museum must cater more towards the visitors' needs, especially regarding the ways they actually learn in the museum. Thus a shift has occurred, and is still occurring, towards a refocus on meeting the needs, interests, and agendas of museum visitors, and studying learning theory to revamp the museum education system. "Museum education has been recast as less about facts and information and more about the enabling of personal meaning through narratives and experience," (Hooper-Greenhill, 1998, p. xii) and is thus more conducive to informal learning, and more helpful to promoting STEM learning. To do this, exhibit and program designs and evaluations must now consider how the visitor makes meaning of the information presented. Because of this, many museums are essentially adopting the constructivist view of learning: learners construct their own meanings based on available facts, experiences, and emotions. Contemporary museums strive to be considered legitimate and important learning environments, and can achieve this recognition by educating children in ways that pique interest in STEM careers.

Field Trips and Constructivist Museums

As museums have shifted towards favoring the constructivist ideals of learning and have become better informal learning environments, they have also become more useful to schools for field trips and other programs. Museum programs can offer informal learning experiences to supplement a school's science curriculum, working toward the goal of formal-informal collaboration. Museums are legitimate centers for learning, but they are not exactly schools (Davis and Gardner, 1993, p.99). Most museums incorporate a constructivist educational style in which the viewer (the student, in the case of a field trip) makes his own meaning from the information provided or the experience of the activity provided. As opposed to the "plain, monotonous vault of a school room", museums field trips provide discovery learning through experience and hands-on activities (Hein, 1995, p. 75). The constructivist museum is focused more on the learner than on the subject itself, placing more value on the individual than is possible in the regular classroom. In the field trip or interactive learning scenario, the role of the

teacher or the museum educator is to facilitate the "active learning through the handling and questioning of objects, and through discussions linked to concrete experiences" (Hooper-Greenhill, 2004, p. 68). Eilean Hooper-Greenhill describes learning in the museum as the "conversation" between the viewer and the object. Ultimately, the "critical pedagogy is concerned with the way that students actually construct meaning, what the categories of meaning are, and what beliefs and values students bring to their encounters" (Hooper-Greenhill, 2004, p. 22). This relates to the individualistic aspect of the museum learning experience.

Educational Benefits in Museums

While some may consider elementary school field trips, such as those in science museums with interactive exhibits, nothing but fun and games or "edutainment" at best, much research does show that there lies a real potential in informal learning (Eshach, 2007, p. 172). Students, especially at the elementary school age, have limited attention spans and can be prone to behavioral problems when put in a new and exciting situation like a field trip. Eshach refers to this "novelty phenomenon" which includes environment-related distractions and off-task behavior. But, in some cases, this phenomenon is avoided. In a 2003 study conducted by Griffin, Meehan, and Jay, conversations amongst students walking between museum exhibits were found to be "learning talk" 80% of the time. The majority of the time that the students spent travelling the museum was also spent collaborating and discussing the museum exhibit content, making connections, and learning, showing that on-task and effective museum trips do exist (Griffin, 2004, p. S61). Preparation before a field trip is also an important factor. Students who had worked on a topic in school before their museum visit learned the most from the experience, and were the least distracted by the change in setting (Griffin and Symington, 1997, p. 764).

Another way to explain the educational benefits of museums is through Davis and Gardner's theory of multiple intelligences. They list seven different types of intelligence: linguistic, logical-mathematical, musical, spatial, bodily-kinesthetic, interpersonal, and intrapersonal. While schools in general focus on the linguistic and the logical-mathematical aspects of intelligence, museums can address much more than that. With the less structured, more individualized style of learning, students have the opportunity to explore and utilize the rest of the intelligences (Davis and Gardner, 1993, p. 100). For example, interactive exhibits that

include physical tasks and problem-solving through teamwork would involve at least the bodily-kinesthetic and interpersonal intelligences, in addition to any others depending on the nature of the specific activity. Perhaps this type of learning that encompasses the range of intelligence would result in a more "well-rounded" thinker.

As in almost any qualitative area of study, some results vary regarding student opinion on field trips and museum experiences. But for the most part, students report that their favorite activities were handling the objects and other participatory events such as role-playing or dressing up. These may seem like obvious answers, since they were likely the most fun parts of the day, but pupils consistently were able to explain the reasons for the doing the activities, and relevance to their school learning. These results were especially positive when the students had intrinsic motivation to learn along with curiosity in the exhibits. The most effective results from field trips were found when the students were made aware of the purpose of the visit before going (Ingle, 1990, p. 312).

In an attempt to address this highly debated topic of informal learning in science, and to coordinate research in a specified direction, an Ad Hoc Committee on Informal Science Education was formed by the National Association for Research in Science Teaching (Rennie et al., 2003). The committee describes six major "avenues for research into science learning in out-of-school, free-choice environments" which are: examining the precursors to the actual engagement in learning, taking into account the physical settings where learning takes place, exploring the social and cultural mediating factors in the learning experience, promoting longitudinal research designs that recognize learning is cumulative, investigating the process of learning, and expanding the variety of methods used to carry out our research (Rennie, et al., 2003, p. 112). The last avenue, expanding the variety of methods used for research, is an important idea and a common theme in this somewhat "uncharted territory" of research.

Aspects of an Effective Museum Experience

The debate is still active regarding the real long-term benefits of science field trips for elementary school students, and experts in the field may not reach agreement for some time. Nevertheless, several studies report consistent and significant findings. Among the vast research and differing opinions on the subject, there are several frequently-mentioned attributes of a well-run, effective field trip that tend to result in longer-lasting knowledge. According to both Hein

and Eshach, teachers must decide their purpose and goals of the field trip, share these expectations with the trip hosts and/or facilitators and with the students, provide tasks for students to work on during the field trip, and bring activities back to the classroom in order to tie in the topics more strongly. Griffin describes similar ideas by citing Lebeau et al., from 2001 stating that positive elements of museum field trips include: "(a) alignment with accepted science curriculum standards and benchmarks; (b) extension of all contacts through pre- and post-activity connections; (c) integration with other subjects and disciplines; (d) connection of classroom experience to science center experience; and (e) insistence on student production through problem solving, construction, collaboration, and use of creativity (Lebeau et al., 2001, p. 134)". In a museum excursion study, Griffin and Symington also found that task-oriented worksheets were not effective because they were constraining and "stopped them [the students] from having any choice about the exhibits they looked at" (Griffin and Symington, 1997, p. 773).

The role of the teacher is important during a field trip, but in different ways than in the classroom. In a museum, the teacher must take on a facilitative role rather than a directive role, guiding the students to pose their own questions and find the answers through the available materials provided by the setting (Griffin and Symington, 1997, p.765). Griffin and Symington recommend that teachers avoid lengthy worksheets to be completed during the visit; students gain more from field trips when they are given more control and choice in their activities. Since student perceptions tend to reflect those of their teacher, teachers need to exude positive attitudes, clear purposes, and an understanding of the usefulness of hands-on activities in order to motivate and inspire the students to take advantage of the special learning opportunities offered by museums (Griffin and Symington, 1997, p. 774).

Traditional teachers are not the only ones teaching while in a museum. Many museums have staff called docents who help lead groups of visitors through museum exhibits and are also involved with the museum learning process. These docents are trained to engage visitors in stimulating conversations that help educate the visitors. They do this with the help of several important skills, including learning how to effectively communicate with large groups of people. If a docent is inaudible or unable to clearly explain ideas, then they will have failed to help the visitors learn. In addition, a docent needs to be well versed in the exhibits they are presenting. Visitors will ask questions and a docent needs to be able to answer these questions in an

intelligent manner. Finally, docents need to know how to ask questions in a manner that stimulates the group's attention. These include knowing how to appropriately handle different age groups, and knowing what kinds of questions foster meaningful discussion about the exhibit. If a docent does their job properly they can make the experience of students on a field trip more rewarding (Museum on Main Street, 2005).

In addition to the proper training of docents, the design of a museum's exhibits and programs greatly affect how well visitors learn. If students come to a museum field trip prepared and motivated, the rest of the responsibility for educational results lies in the design and execution of the museum exhibits and activities. The goal is to achieve the total educational "flow," meaning that the learner is fully engaged, and engrossed in the activity (Csikszentmihalyi and Hermanson, 1994, p. 150). The first crucial step in achieving this flow is the "hook". The exhibit or program has to grab attention and spark curiosity so that the visitor will initiate an interaction. Flow involves some intrinsic motivation for learning, and an overall positive state of mind. "When goals are clear, feedback unambiguous, challenges and skills well matched, then all of one's mind and body becomes completely involved in the activity" and thus flow is achieved (Csikszentmihalyi and Hermanson, 1994, p. 151). This is a sensory, emotional, and intellectual sensation and the epitome of museum interaction. Experiences like flow are expected to result in longer-lasting positive memories of the field trip experience.

Evaluation and Assessment

For years, museums have relied on evaluation as a way to monitor their success in terms of visitor opinions and perceptions of exhibits. As the nature of museum programs has evolved toward adopting more interactive approaches, their evaluations have also evolved accordingly. A museum's desire to become a more viable learning environment by boosting STEM interest adds an additional incentive for evaluation. The Academic Competitiveness Council (ACC) reports that "education programs designed to improve STEM education outcomes should not increase unless a plan for rigorous, independent evaluation is in place, appropriate to the types of activities funded" (U.S. Department of Education, 2007, p. 26). In fact, evaluation plans are a required part of any Informal Science Education project proposal submitted to the National Science Foundation. Evaluations of each project, whether the project was considered successful or not, will help to "advance the entire field of informal science education" (Friedman, 2008, p.

14). Providing evaluation results also permits the sharing of best practices between different institutions and thus advancement in the field.

Consistent evaluation of informal science education projects is undoubtedly important, but such a procedure is a challenge due to the nature of the field.

> *The nature of these programs makes it difficult to conduct rigorous evaluation because, among other reasons: (1) the audience for these programs is diffuse and difficult to identify; (2) the multiple factors affecting and affected by these activities cannot be isolated for assessment; and (3) the modest scale of these efforts does not warrant a costly assessment approach. There are examples of pre- and post- quasi-experimental evaluations of these programs, but it is extremely challenging to carry out rigorous studies to identify causality in these programs* (U.S. Department of Education, 2007).

Given the somewhat "unconventional" or active nature of these education projects, there is a need for a more "active assessment", according to George Hein. Proposed methods to more adequately assess science learning include (a) observation: the use of control groups, and assessing how students "do science"; (b) verbal responses: "staged conversations" one-on-one with students probing for their understanding of the concepts; (c) written records: open-response questions and notes on science processes; (d) drawings; and (e) products: the results of science laboratory projects and if the final product is correct or works properly (Hein, 1991, p. 109). Variety in methods is another suggestion by many experts as they "more adequately reflects the multifaceted nature of science" (Hein, 1991, p. 122).

Common practice for the evaluation process includes front-end, formative, and summative evaluation. The front-end evaluation takes place in the pre-planning and planning stages of exhibition or program development. The goal of this step is to identify problems before production. The formative evaluation occurs during implementation of the plans. This is also known as developmental testing, which includes the pilot and second stage of the exhibit or program. Lastly, summative evaluation occurs after the program has occurred and no more alteration can be made (Bull, 1989, p. 296). Details for each step are required by the NSF for approval of an evaluation plan. A main focus of the evaluation plans is on the intended impact categories for the programs which are knowledge, engagement, attitude, behavior, and skills.

Proposed programs must consider the desired results of the program on its target audience. Some intended impacts of many programs include knowledge of STEM concepts or careers, and attitude toward STEM fields.

Conclusion

The current inadequate state of STEM education in the United States is an issue that needs to be addressed. It has been shown that the combination of formal and informal learning techniques provides different and more effective ways of teaching science material and getting students excited about science. Thus, teachers should use the many informal education opportunities offered by museums, including field trips and other programs, to supplement formal educational activities. On Nantucket, the MMA provides such informal science education opportunities to various educational institutions, including Nantucket Elementary School, and has recently engaged in a substantial effort to ensure its programs match the curriculum needs of the schools. The MMA has not yet conducted a formal evaluation of these programs, however. The next section describes how we conducted such an evaluation.

Methodology

The overall goal of this project was to evaluate the science programs provided by the Maria Mitchell Association (MMA), and those facilitated by the MMA for other program providers, for grades K-5 of the Nantucket Elementary School (NES). To achieve this goal, the project team identified five objectives (as seen in Table 2 below). These objectives were:

- Characterize the K-5 programs offered by MMA
- Evaluate whether these programs meet the teachers' needs and expectations
- Acquire perspectives of field trip providers
- Obtain alternative perspectives on field trips
- Develop an evaluation tool for future use by MMA

The project team held focus groups with teachers of the each grade level, interviewed MMA staff and field trip providers, surveyed the parents of Nantucket Elementary School students, and observed field trips in the pursuit of these objectives.

Table 2: The Relationship between Project Tasks and Objectives

Objectives → **Tasks** ↓	Characterize the K-5 programs offered by the MMA	Evaluate whether these programs meet teachers' needs and expectations	Acquire perspectives of field trip providers	Obtain alternative perspectives on field trips	Develop evaluation tool for future use by the MMA
Review MMA files	**X**	**X**	**X**		**X**
Review curriculum frameworks	**X**	**X**			**X**
Conduct focus groups		**X**			**X**
Observe field trip		**X**	X		**X**
Interview MMA staff and field trip providers			**X**		**X**
Interview Museum Professionals				**X**	**X**
Interview Funding Source				**X**	**X**
Survey Parents				**X**	**X**

Objective 1: Characterize MMA K-5 Programs

Our first objective was to characterize the MMA science programs. The importance and purpose of this objective was to understand the programs at a deeper level before proceeding with the rest of the evaluation process. The crucial task associated with this was to review the MMA's files on all the current and past programs. This task began before our arrival on Nantucket with a review of a binder containing lesson plans for the upcoming year, based on the science curriculum frameworks for each grade. Acquiring the rest of this information was essentially a continuation of the Literature Review. Characterizing and grouping the programs was important since different types of programs have different goals and thus different evaluation criteria. The results of this activity are presented in Table 3 and discussed in the next section. The main defining factor in our organization of the different programs was whether the field trip was led by MMA staff or led by outside professionals and facilitated by the MMA. Other differing characteristics include what grade level the programs were intended for, what curriculum topics were covered, years the program has been run, the level of communication between the provider and the teachers, pre and post trip activities, and the locale they were presented in. The location is worth noting because MMA leads programs on-site at their facilities, off-site throughout the Nantucket environment, and in the classrooms. In addition to the areas mentioned, we were also interested in knowing about the underlying need for these programs along with the philosophy behind them. The reviewing of MMA's files on these programs provided us with important information on the purpose and methods of each program, as well as any previous evaluations that may have been conducted on their programs.

Objective 2: Evaluate Whether Programs Meet Teacher Goals

Another of our objectives was to determine whether the programs offered by or orchestrated through the MMA met the teachers' needs and expectations. Accordingly, we conducted several focus groups with teachers and observed teachers and students during field trips to Sankaty Bluff.

Focus Groups

The project team conducted a series of six focus group discussions with teachers from the Nantucket Elementary School. Each grade level team was asked to participate in a focus group and three to five teachers from each grade took part. Focus groups were organized by grade

level since that ensured that the teachers in each group had the same curriculum and thus were likely have similar expectations with regards to student skills, knowledge, attitudes, and interests. Also, most MMA field trips involved all classes of the grade in the same program, so each teacher likely had similar experiences. Organizing the focus groups by grade level provided scheduling convenience as well, since most of the focus groups were planned for when the teachers normally held their grade level meetings. The meetings were held at the Nantucket Elementary School which was a comfortable and convenient environment for the teachers. The focus groups lasted between thirty and forty-five minutes each. Handwritten notes were taken by one or two group members, and an audio recording device was used after getting verbal consent from all interviewees. To get permission and to schedule these teacher focus groups, we acquired the contact information from Dr. Schulte and emailed the teachers requesting their participation in a focus group to help us evaluate if the science field trips are effectively meeting their needs and expectations. Some teachers that were interviewed preferred that their comments be anonymous, so all teachers that were quoted, or whose comments were paraphrased in our report were given pseudonyms such as "Teacher 1" to ensure confidentiality. The topics of discussion were developed based on conversations with Dr. Janet Schulte and other staff from the MMA. Some of the main topics of discussion included the role field trips have in supplementing formal classroom learning, how well the programs offered met their overall field trip goals, what the MMA and other providers could do to improve the experience, the highlights of the field trips they attended, what preparation and follow-up activities they completed, if there was a language gap during science activities and if it was an issue, and funding for the programs along with program support. Our goal in holding these focus groups was to obtain opinions about how the current programs are run, information on the communication between and among the teachers, the MMA and other providers, expectations that are being placed on the MMA by teachers and other professionals in terms of coordinating and delivering a larger set of programs, and ideas about how to improve the programs. A complete list of interview questions can be found in Appendix II.

Observations of Field Trip Programs

The MMA scheduled some science programs to occur during our time on Nantucket, so observing the preparation and execution of the programs was an important element in developing the final recommendations and evaluation tool. The design of a museum exhibit or program

involves thought regarding desired impact categories. These impact categories include knowledge, engagement, attitude, behavior, and skills. The vision of the program can be demonstrated with a Logic Model (Friedman, 2008, p. 27) which involves describing the focus or topic, planned activities, anticipated outcomes, and measures of those outcomes. The MMA programs we have evaluated had been put into practice previously, so the development of this vision had already been completed. The desired outcomes of each program and the related curriculum topics are already known, but all the programs evolve continually with successive implementation as the personal styles of those delivering the programs create some variance in both the content and mode of delivery.

Field trip evaluations focus on several different aspects including curriculum content, the quality of the presentation and preparation of the trip leader, issues of safety, and the age-appropriateness of the materials and activities. Each of these categories plays an important part in determining the success of the field trip. Different parties will define a field trip's success in different ways, though. For example, a key measure of success to a teacher might be that the students were actively engaged in learning the significant curriculum topics. When observing a field trip, a decision needs to be made in terms of what categories should be observed. For the MMA field trip with the Grade Four classes to Sankaty Bluff, we decided to focus on observing how well the content matched the curriculum, and the overall presentation techniques used. We observed how well the techniques worked based on how well the students seemed to understand the concepts, how engaged they were in the activities, and how often they were attentive as opposed to distracted with off-task behaviors or conversations. Based on our observations of preschool activities in the Natural Science Museum along with additional outside research, we developed an observation sheet that included write-in sections for several categories to be used during the programs for recording notes. Categories on the observation sheets included when students were on task or distracted, if students were discussing the subject matter and asking questions on the topic, if teachers and staff were engaging and interacting with students, and how students responded to different parts of the programs. After the first of the three field trips we observed (out of four total), the observation sheets were substituted with blank paper for the sake of convenience while taking notes in real time without having to organize them. Observations that were recorded on the blank paper during the second and third field trip remained focused on the same categories as before and included quoted examples of students' "learning talk". The

hand-written notes from all three observers were compiled into one document for each field trip. One of the most important observations made was when the students asked questions regarding the material, since it relates to inquiry based learning, which was discussed in the Literature Review as an important method for learning science. In addition to observing the three field trips to Sankaty Bluff, we held post-field trip interviews with the teachers involved. During the field trips, we only spoke very minimally to the teachers, since they were busy monitoring the students and we were busy observing and taking notes. One teacher did explain a pre-trip reading assignment to us after reminding the students of it and piquing our interest. Other than that, there was minimal interaction between the teachers and the observers. After the field trips, the Grade Four teachers were contacted for a focus group in a similar fashion to the other grade level teams. This particular meeting incorporated an added focus on the very recent field trip.

Interviewing the students would have been difficult since elementary school age children can sometimes have short attention spans or unpredictable reactions, or they may not have felt comfortable talking to us, all of which might have resulted in poor data. There is also an ethical dilemma that comes with interviewing minors, so our procedures would have likely required parental consent. With these fallbacks considered, we explored the idea of administering a student evaluation in the form of a post-trip activity in lieu of student interviews. This worksheet would have involved the students drawing a picture of something that they learned at the beach, accompanied by a few sentences of explanation. "Chambers (1983) developed the Draw-A-Scientist Test (DAST) in which children's drawings are rated according to particular characteristics present or absent in the drawings, allowing researchers to determine the images of scientists children hold. In order to improve the objectivity and interpreter reliability of this means of assessment, the authors built upon Chambers' study to develop a checklist useful in assessing DAST drawings" (Finson, Beaver, Cramond, 2010). After some discussion, the team decided not to pursue this plan, so as not to overstep any boundaries with the teachers. We made the decision to rely on the teachers' opinions of the post-trip activities they assigned their own classes. As mentioned earlier, the Grade Four focus group session discussed the Sankaty Bluff field trip in detail, including the planned post-trip activities and the teachers' opinions of whether they noticed increased understanding amongst their students.

Objective 3: Acquire Perspectives of Field Trip Providers

Teacher opinions alone would have resulted in an incomplete, one-sided evaluation of the field trip process. So, Objective 3 dealt with the opinions of the field trip providers. The project team conducted a series of semi-structured interviews with individuals who ran the field trips or in-class activities involved in the newly developed MMA program, the same programs we asked the NES teachers about. One program was not run by or facilitated by the MMA, but was still a valuable resource and served as an example for our recommendations. We identified all involved MMA staff and associates and attempted to interview all of them, depending on availability. We got permission from the staff and professionals either in person, by email, or by telephone to interview them about their personal educational philosophies and opinions on the importance of field trip experiences in general. We were also interested in their reasoning and motives for hosting the programs, their educational background and any previous experience in education, as well as specifics about the field trip(s) they were personally involved in regarding communication with teachers and the sharing of goals, and whether the goals seemed to be met. The field trip providers were also questioned about improvements they would like made to the field trip process, and whether or not they would want more involvement with the classes before or after a field trip, such as a pre-trip visit or collaboration for a post-trip activity. The in-person interviews were held at the location of the interviewee's choice, either at the MMA conference room or their own office. One of the interviewees was unable to meet us in person, so we arranged a phone interview and asked the same set of questions. Each interview lasted between 15 and 30 minutes. Our project group recorded the interview if the interviewee found that acceptable, and we took thorough notes to supplement the recording. Team members took turns conducting the interviews. A complete list of interview questions can be found in Appendix I.

Objective 4: Obtain Alternative Perspectives on Field Trips

Another of our objectives was to gain alternative perspectives on field trips, other than only those of the providers and teachers. Accordingly, we conducted several interviews with key stakeholders and surveys of parents to gain these perspectives. It was helpful to gain insight into how field trips are perceived and valued through outside perspectives that are still very important to the process: parents, administration, and funding organizations.

Interviews

The project team conducted a series of semi-structured interviews in working toward this objective. We contacted the Superintendent of Nantucket Public Schools (NPS), the Vice Principals of Nantucket Elementary School (NES), the Instructional Technology Specialist at NES, the History Educator at the Nantucket Historical Association (NHA), the chair of the Grants Committee of the Nantucket Golf Club Foundation (NGCF), and the Education Director at the Cape Cod Museum of Natural History (CCMNH). Since the MMA is currently providing their field trip opportunities through grant money from the NGCF, we interviewed Leslie Bresette, chair of the Grant Committee, for her opinion on the MMA's recent program, and what changes, if any, might be necessary to enhance the possibilities of additional funding to sustain it and start new projects. Funding is an issue for small non-profit organizations like the MMA, and also for public school systems including NPS. Administrative personnel including the Superintendent and Vice Principals were contacted in order to assess how much field trips are encouraged, and to investigate any potential funding if grant money becomes unavailable. Unfortunately, after several attempts to schedule meetings, we were never successful in receiving a final response from the Vice Principals or the Superintendent.

The NHA held a Diversity Festival during which the Whaling Museum offered free admission and gave their regular tours in Spanish, Portuguese, and Bulgarian. Since there are significant amounts of English Language Learners among the population of NES, MMA wanted to acquire ideas for how to accommodate these students. We interviewed Marjan Shirzad, the Director of Outreach and Special Programs at the Nantucket Historical Association at NHA, about how the Diversity Festival was funded, how successful she found it, and how they planned to sustain it in the future. Another museum educator we contacted to learn from was Barbara Knoss, the Education Director at the Cape Cod Museum of Natural History. The CCMNH is a local organization whose mission is to "encourage and advance understanding of our natural environment through discovery and learning" (ccmnh.org, 2010) through the use of its museum facility and nature walks, similar to the MMA. The goals of this phone interview were to learn about the role of the Education Director there, how she coordinates field trips, who actually runs the programs, and if they evaluate their programs. Identifying similarities and learning new strategies from educators at other museums was an important way to work toward developing our final recommendations. Interview questions are in Appendix I.

Surveys

Another method used to gain alternative perspectives on the field trips offered by the MMA and other providers and to gauge what the students liked or disliked about the field trips, we distributed a four-question survey (see Appendix IV) to the parents of each student in Nantucket Elementary School. Since 11% of the student population is Hispanic, we collaborated with the school translator, Eileen Taveras, to translate the survey into Spanish. We then created a double-sided survey with an English version on one side and a Spanish version on the other. The surveys asked for the parent's name, child's grade, and parent's email for award notification, but all survey responses were kept confidential, as stated on the document itself. This survey was not a pilot test, but it was a simple survey and the questions were developed in consultation with our advisor and sponsor. The survey questions asked what field trips the student has attended of the list we provided, if the parent had ever attended one as a chaperone, what the child remembered from the field trips, and if the parent thinks field trips are valuable. The survey was kept brief in order to increase the response rate. The NES Principal approved the content and our method of distribution, and even suggested we add a question to differentiate between parents who had and had not attended field trips as a chaperone. We obtained permission to distribute the survey from the Principal of the Nantucket Elementary School and then had him approve the content. The 481 copies of the survey were distributed to every class by the school's secretary on Wednesday, November 10, 2010 and were marked as being due back to the teachers on Tuesday, November 16, 2010. We received 38 surveys back on the due date but continued to receive more over the next three weeks totaling 73 which is about a12% response rate. The first two questions were logged as simple yes or no responses. The third question was summarized as the major memories of the children. For the fourth question the responses were split into four categories, community, education, science, and fun, and then each response was logged as one or more of those categories. The Spanish responses were translated using prior knowledge of the Spanish language along with an online Spanish to English Dictionary. Courtesy of the MMA, we also offered an incentive for turning in the survey: a raffle for the chance to win a free Family Membership to the Maria Mitchell Association for the year of 2011. One raffle winner was chosen at random using a random number generator from www.random.com and contacted by email by MMA staff subsequent to the survey.

Objective 5: Develop Evaluation Tool

Our final objective was to develop an evaluation tool for MMA to use with future programs. This evaluation tool was developed based on data from our observations, focus groups, surveys and interviews. Data analysis included logging the responses, comments, and observations, then summarizing and categorizing the ways teacher goals and expectations are met or not met. The information was separated based on whether MMA delivered the program or facilitated it, who ran the program, and the nature of the program.

The most successful evaluation tools involve front-end, formative, remedial, and summative evaluations, involving every stage of the program design and implementation. Since the set of programs we evaluated had already been designed and executed in the past, our version of the pre-trip evaluations focused more on teacher-provider communication of program-specific goals, rather than the actual designing of the programs. The remedial and summative evaluations involved observation sheets and surveys, largely based on the particularly strong or weak areas we discovered through our own observations. Our observation procedure and the quantified data from the observations strongly influenced the evaluation tool. Pre- post testing was another viable option for evaluation, but considering the nature of informal science, and in an attempt to avoid "pre-test trauma", the pre-tests were really observational by the teachers, staff, and project team, or simply a few verbal questions asked before starting the activity.

Part of the evaluation tool we developed included a teacher evaluation form to be completed after each field trip. To make an electronic version of this evaluation survey easy to use, we created an online survey using www.surveymonkey.com. This survey was piloted with four of the five Grade Four teachers following their field trips to Sankaty Bluff on November 18th,19th, and December 1, 2010. We mentioned the survey to the teachers at the end of each field trip and emailed them the link to the website. The survey consisted of four pages with ten questions, including some regarding how age-appropriate, engaging, and tied to the curriculum the field trip content was. The survey also included open-ended questions about content areas that may have been missing from the program, pre-trip and post-trip activities the teachers completed or planned to complete, and also allowed for additional suggestions and comments. The purpose this survey was to gather updated information about teacher satisfaction, and to

allow the MMA to continue to do so as field trips continue to happen throughout the year. The results of the fourth grade team's surveys were analyzed and used toward our overall evaluation.

Findings

Objective 1: Characterize MMA K-5 Programs

To categorize the field trips offered by the Maria Mitchell Association, several different aspects of the field trips were recorded. These include location of the field trip, grade field trip was offered to, organization running the field trip (which is not always the MMA, since they also serve a facilitative role), activities on the field trip, content the field trip ties into, pre and post field trip activities, years field trip has been run, and the level of communication between teachers and provider. Table 3 summarizes each of the programs according to these categories.

Table 3: Characterization of Field Trips

Program Provider	Location	Grade	Field Trip Activities	Curriculum Content*	Pre/Post Activities	Years run	Communication
MMA	Creeks	K	Students observe wildlife and water samples with magnifying glasses and handle animals such as horseshoe crabs.	K-2, Life Science, Characteristics of Living Things 1,2, Living Things and their Environment 6,8	Pre, and provider came in	1	Meetings between provider and teachers
MMA	Aquarium	3rd	Students observe the various forms of aquatic life in the aquarium and identify the characteristics that differentiate the species.	3-5, Life Science, Characteristics of Plants and Animals 1	Post	1	None
MMA	Sankaty Bluff	4th	Students identify erosion and examine rocks with magnifying glasses. Rock specimens are collected for further analysis in class.	3-5, Earth and Space Science, Rocks and their properties, 1,2,3, Soil 4, Earth's History 12	Pre and Post, and provider came in	2	Provider and teachers exchanged brief emails
Bartlett Farms	Bartlett Farm's Pumpkin Patch	1st	Students tour the greenhouse and see the stages of the pumpkin life cycle. Students bring home a small pumpkin.	K-2, Life Science Characteristics of Living Things 3, Heredity 4, Living Things and their Environment 7	Pre and Post	10	None
Amy Cabre (spinner)	Classroom	1st	Students watch a wool spinning demonstration and handle samples of wool in different stages.	K-2, Life Science, Structures and Functions 2	Related activities cancelled by provider	1	None
NHA	Old Mill	5th	Students tour the Old Mill and identify simple and complex machines.	3-5, Technology/Engineering, Materials and Tools 1.3	Unclear	3-5	Teachers assigned 5 questions to ask

*Full detail on Curriculum Frameworks can be found in Appendix VI

Objective 2: Evaluate whether these programs meet the teachers' needs and expectations

The project team held six focus groups, one per grade level, with the teachers of the Nantucket Elementary School. The project team also observed three fourth grade field trips to Sankaty Bluff. The Sankaty field trips were run by Andrew McKenna-Foster, Director of Natural Science Education and Programs of the MMA, and were geology based, focusing on finding interesting rocks, the geological history of Nantucket, and determining sites of erosion and the processes and consequences of erosion.

Focus groups with teachers

The table below (Table 4) shows how many teachers participated in the focus groups compared to the number of teachers total in each grade. A total of 26 teachers participated in the focus groups out of a possible 30, meaning 87% of the teachers were involved.

Table 4: Teacher Participation

Grade	**K**	**1**	**2**	**3**	**4**	**5**
Number of teachers that participated	4	3	5	5	5	4
Total number of teachers	5	5	5	5	5	5

Through the focus groups, we found that all of the teachers believe that field trips play an important role in learning, for several different reasons. For example, some students learn best through hands-on activities, and understand concepts better when they can observe and experience phenomena first hand. Also, students need the opportunities presented in field trips, because many students would not have the chance to experience them outside of school. Teacher 1 said, "It is very important to have hands-on experience at such a young age. We just visited the cranberry bog and it was great for them to touch the cranberries. It makes it easier for them to process the material." Teacher 13 stated that "Real world experience is great for them. They are

able to make the connection with something real and have 'being there' experience." It was also said that field trips reinforce concepts that are taught in the classroom and enhance the curriculum. Lastly, the field trips allow for students to become involved in their community. This is a positive experience that allows them to further appreciate the island of Nantucket that they live on.

Our project group also found that all of the teachers that participated in focus groups thought that the field trips run or facilitated by the MMA went well. Teacher 2 said, "The field trip was really nice. The student helpers of MMA just came off training and set everything up for them. We talked to Janet about the different stations. The field trip was great and they had at least two people per center. The kids had a ball." The overwhelming majority of comments were positive. All of the teachers indicated the field trips age-appropriate, and closely related to the curriculum. We did not receive any negative comments about the content or the delivery of the programs. The only issues mentioned by the teachers were related to logistics and scheduling. Teacher 2 said "We did wish it happened earlier in the year though. We went on the field trip the last week of school so there was no time to refer back to the stuff learned." The reason the trip is run on the last week of school is that MMA's staff is not present till then. Before that week there is not enough staff present to run the field trip for the kindergarten. A similar problem happened with another group during an aquarium trip that was scheduled near the beginning of the school year, but at the end of the season for the aquarium. Teacher 12 said and recommended, "We did this field trip the first week of school. We would like it to be pushed back more if possible. It went well, but some of the tanks were empty, like the open tank." After discussing the events of that focus group, we learned that MMA cannot afford to keep the aquarium open any longer into September, and the field trip took place at the latest date possible. Other comments about the field trips run by the MMA remained positive, including that the field trip was successful and tied in nicely with future classes. Other teachers remarked that the content of these programs invariably tied into the classroom lessons, and tersely pointed out that "if it didn't work then we wouldn't ask them back again next year". Regarding a recurring field trip, teachers felt that "the kinks are worked out" by now and that the MMA does a great job overall.

All of the teachers we interviewed incorporate certain activities before a field trip to introduce the topic, and after the field trip to reinforce it, with the exception of the group that had the field trip at the end of the year and the group that had the field trip early in the year. Some examples of the types of pre-trip and post-trip work include reading books, making art projects, playing games, having a professional come into the classroom before the field trip to introduce the topic and answer questions, and writing summaries of what was learned on the field trip.

All of the teams agreed that the school administration supports field trips, although most groups said that they could not continue to take field trips if the MMA's funding ran out, and expected the situation would change drastically if the school had to pay for everything, including bussing and program fees. In a climate when jobs are being cut, it would be a challenge to justify expensive field trips, but several teachers indicated they would do their best to make field trips possible. For example, Teacher 23 said, "I used to use parents to drive. I would do that again. I wouldn't miss out on field trips. I would take some kids in my car. We would walk if we had to."

The prominence of English Language Learner (ELL) students at NES, and the potential issues that could arise due to the language gap during a field trip, was raised as a concern without our prompting during our first focus group. During the focus groups that followed, we began asking the other groups about their opinions on ELL students on field trips and if it was a problem. All teachers of three different grades agreed that it was a problem that needs to be addressed. One suggestion was that a school translator could accompany the students on the field trip to assist them in comprehending the new vocabulary. However, not all teachers thought that ELL students struggled during field trips. In fact, according to Teacher 22, "hands-on and visual [activity] is what [ELL students] need", hands-on and visual activities being two key attributes of all field trips. Other teachers said that even if an ELL student was having difficulties with field trips, it is the responsibility of the teacher to address it. Teacher 17 said, "If they need more support it is not the MMA's job, it's ours." This teacher went on to explain that she would give the student extra vocabulary and help them as needed. Teacher 20 said, "I just had a girl who moved here from Jamaica. She loved the field trip! Now she is looking for rocks in the playground. She really got the big picture from the field trip." Other groups agreed

that ELL students are often more interested and excited on a field trip and that hands-on and visual learning are effective strategies for them.

Every grade level team would "love more field trips" or a classroom visit from a scientist, and most groups preferred that trips be repeated from year to year to ensure consistency and continuity. Programs that have been run multiple times are more refined and effective than when they were first started. In addition, when the teachers have prior experience with the field trip, they are more prepared and capable of incorporating their lesson plans and preexisting work into the content of the field trip. When asked, the teachers of two grade levels collectively said that they would embrace a field trip provider that suggested a pre-trip activity, or supplied a preview packet that would prepare them, and thus better enable them to prepare the students for the field trip. Another issue raised by teachers was that some felt unaware of the field trip opportunities that exist on the island, and specifically through MMA. One grade level team was unsure of how to relate their curriculum to an MMA program, and requested assistance in finding an appropriate field trip. Teachers all seemed willing to participate in field trips, but lacked the time or resources to identify and initiate potential new programs.

Observations of Field Trips

We observed three Grade Four classes on their field trips to Sankaty Bluff with Andrew McKenna-Foster on November 18 and 19, 2010 and December 1, 2010. In all of the field trips, the students seemed to be very involved in learning and very excited to be on the field trip. One of the most important findings included questions that were asked by the students regarding the material. In all of the groups, students would run up to Andrew McKenna-Foster and ask him about the rocks they had found. Questions for Andrew from field trip 2 included, "Have you seen a glacier?", "Are there skeletons here?", "How many minerals are there?", and "How many rocks are there?" Some questions were more directly relevant to the field trip content than others, but all revealed that the students were engaged.

Other important observations we noted were distractions and off-task behaviors. On the first day of the field trip, it seemed as though the students wanted to explore, not walk. The group did not stay together as they travelled the beach; there were some slow walkers and some runners. We also noticed that during longer periods of walking, more of the group tended to have off-topic conversations. In the second field trip, the students stayed together more as a group and

only a couple seemed to be distracted toward the middle of the field trip. In the third field trip, the students seemed very distracted by the cliff, with multiple students climbing it on many occasions. Over the course of the series of field trips, Mr. McKenna-Foster improved in controlling the group's behavior and decreasing the amount of wandering and distractions by implementing a new rule. Whenever he yelled the phrase "Like a rock", the students had to come together in a group like the minerals or particles of a rock. This was very effective when it was used and seemed to get the students excited to hear what he had to say.

Throughout the three field trips, the students appeared to be interested in the activities and in many cases, learning the concepts as the time went on. They exclaimed "whoa cool!" as they identified erosion on the cliff, and were able to answer most of the questions they were asked. The students from all three groups appeared to have fun and enjoy being geologists for the hour. One of the students from Field Trip 2 found a rock and described its shape as a rhombus, excited to tie in a math concept with her rock. The students from Field Trip 1 were having fun trying to find the smallest rock they could. They would look down at the sand with their magnifying glass, pick up a little particle, and run to Mr. McKenna-Foster to show him. He would say "find a smaller one", until one student finally exclaimed "sand is rocks!" Even those less excited about crawling and getting dirty enjoyed themselves and were engaged in the activities. A student from the third field trip said, "I love rocks and being a geologist, but this sand is ridiculous!"

We also noted that the teacher's attitude could change the dynamic of the field trip. During two of the field trips, the teachers had little input in terms of teaching, and just concentrated on keeping the students' behavior under control. Those classes were more distracted overall than the other class, whose teacher added to the instructions given about finding a rock, referencing the book that they had read in class as preparation, as was recommended by Griffin and Symington in *Moving from task-oriented to learning-oriented strategies on school excursions to museums*. She also asked the group questions at the end of the field trip that referenced other pre-trip studies they had done in class. This help in making connections with classroom learning seemed to make the students recall what they had learned and think more about what they were doing. The class was also very well behaved.

Objective 3: Acquire perspectives of field trip providers

Objective 3 was to assess the preparedness of field trip providers. The title "field trip provider" for our purposes means the individual delivering the field trip program. In some cases, MMA staff runs the field trip programs and in other cases, outside professionals run the programs that were facilitated by MMA. The project team conducted interviews with MMA staff members Andrew McKenna-Foster and Jennifer Mayberry. The other field trip providers interviewed were Harry Payne and Michael Varbalow of the Nantucket Historical Association, John Bartlett of Bartlett Farm, and Amy Cabre, a wool spinner. We also interviewed Emily MacKinnon of the Nantucket Land Council. Ms. MacKinnon runs two field trips for NES Grade 5 but is not affiliated with the MMA, and was used as an example for our recommendations.

Providers other than MMA

Field trip providers that we interviewed were unanimously supportive of informal learning experiences for elementary school students. Several providers mentioned that hands-on activities which often occur during field trips can offer students of varying learning styles opportunities to thrive, and also provide a "break from the monotony" of the classroom. Many of the field trips occur in outdoor locations, and providers noted that developing an appreciation for Nantucket's environment such as its beaches, animals, and agriculture, was a goal of theirs. Another common value among the providers was strengthening community ties with the students. Nantucket Island has a rich history, a unique environment, a small population, and many organizations providing opportunities to learn. Michael Varbalow of the NHA would like to "keep tightly knitting the fabric between organizations" on the island, and involve them with the schools.

According to the interviews, the field trip providers have not been through formal training before leading these educational programs for NES. Both Harry Payne and Michael Varbalow were trained as NHA interpreters through a few short sessions, shadowing others while they gave tours, and a mentoring system. None of the field trips providers had a background in education except for Mr. Payne, a former high school math teacher. The rest of the group relies on learning and improving through experience of running field trips, and even experience as parents. "A love of teaching" is Ms. MacKinnon's motivation for actively pursuing field trip opportunities, and the enjoyment of working with children is a common motivation for the other providers as well.

An important part of making field trips as worthwhile and beneficial as possible is integration with classroom learning. We investigated the nature of communication between the providers and the teachers before, during, and after the field trips. The amount of preparation for field trips and teacher involvement in the process tends to vary between the different providers. The first grade has been visiting Bartlett Farm Pumpkin Patch for 10 years, so the important curriculum content is known by Mr. Bartlett, and he has had years of practice delivering the Life Cycles material to students. For that field trip, minimal contact is needed for planning the program content and the teachers contact him simply for scheduling. NHA hosted the fifth grade's trip to the Old Mill during their study of Simple Machines. The teachers submitted a list of five questions they wanted asked to their students during the field trip. Ms. Cabre visited the first grade classes to show samples of different stages of wool and demonstrate the spinning of wool. She was given basic information on the curriculum topic by Dr. Schulte and planned the activity herself without teacher input. Ms. MacKinnon is the only professional who visited the classes for before the field trips to prepare the students, give an overview of the activities and the content, and answer questions. Grade 5 has participated in her Vernal Pool field trip for a few years and Ms. MacKinnon reported that with more experience, the teachers seem more knowledgeable on the subject and able to help facilitate student learning during the activities. Three of four providers would be willing to provide pre-trip or post-trip activities for classes, and would prefer more specific requests from the teachers in order to tailor the material of the field trip program toward the particular lesson plan. In fact, Mr. Payne mentioned that he "would love to have a thirty minute talk with the teacher to get a better idea" of their lesson plans and curriculum, having a larger interest than most as a former teacher himself.

All of the field trip providers had positive feelings overall about their respective field trips, as well as field trips in general. Each provider mentioned that the students were engaged and excited. Ms. Cabre was "pleasantly surprised by some of their questions" that showed real interest in the activity. The most commonly mentioned negative aspect about the field trip process was scheduling and logistical issues. Another issue mentioned was that if the teacher does not act excited about the field trip, it can negatively affect the student attitudes as well. Lastly, attention spans can become an issue depending on the situation, such as when there were too few Monarch Butterflies for the fifth graders to catch and examine. Regardless, the children still enjoyed themselves and learned the information.

MMA Staff as Providers

Andrew McKenna-Foster, the current Director of Natural Science Education and Programs of MMA, runs many field trip programs each year with NES and other youth organizations. We interviewed him about his experiences in general, and about his recent field trips to Sankaty Bluff with the Grade Four classes. We also interviewed Jennifer Mayberry, an MMA summer employee who ran the Kindergarten creeks field trip.

When asked about the importance of informal learning and field trip experience for elementary school students, both Mr. McKenna-Foster and Ms. Mayberry said that they consider it important to give children exposure to outdoor settings and opportunities to be creative, along with it being able to engage multiple learning styles, and have the students excel in something new. According to Mr. McKenna-Foster, "nobody loses in an informal learning setting". Both of these field trip providers enjoy imparting their knowledge and seeing the students enjoy learning. "You feel fulfilled when you see them learning", said Mr. McKenna-Foster. Ms. Mayberry's statements agreed with that sentiment, and "it's great to see them learning and when something clicks- that "aha" moment."

Neither of the two had received any formal training in education. Ms. Mayberry had run a few field trips in the past and worked with children. She was trained through mentoring by more experienced program leaders. Mr. McKenna-Foster has learned his teaching strategies through experience and practice, and also by shadowing more experienced providers. He is always trying to improve his programs with each implementation, and takes the responsibility on himself to practice age-appropriate phrasing of the science information. He considers this to be his weakness in delivering field trips and would like to continue his professional development.

Before the Sankaty Bluff field trip, Mr. McKenna-Foster reviewed the Grade Four curriculum online but did not receive many details from the teachers about what specifically to cover during the activities. He was in contact with the fourth grade team leader via email for scheduling purposes, and was able to get some specifics from her about what her class was currently learning and certain things he should not go over during the field trip. He was also able to visit the classrooms before the field trips for a preparatory lesson during which he showed an example of a rock from the beach, and pointed out the location on a map. When Ms. Mayberry prepared the creeks field trip, there was already a preexisting framework, and she adapted it with

her own ideas. The curriculum had already been considered and incorporated into the program, so she did not have to worry about aligning the content herself. She also emailed the teachers, and held meetings to share their ideas for the field trip.

Both field trips were considered successful in educating the students, as well as fun for the providers. The creeks field trip "went really well" but timing presented some problems. The children took a while to walk to some of the more distant places, and the tide started coming in during the last activity station. Regardless of the loss of a station for each group, the students still seemed to learn a lot, and enjoy the experience of digging in the sand and seeing snails and birds. The Sankaty Bluff field trip was also considered a positive experience. After the first day, Mr. McKenna-Foster realized that more control over the children's behavior was necessary and fortunately, he was able to make adjustments and improvements since he ran the field trip on four different days for the different classes. His goal was to emphasize that Nantucket had formed from a glacier, which seemed to be accomplished judging by the questions he asked at the end of the field trip. The students seemed to like being outside and looking for rocks and erosion to identify. They seemed less interested in the geologic history information. Mr. McKenna-Foster believes that making the field trips exciting is important, and that will make the students remember more.

Mr. McKenna-Foster overall is pleased with the way MMA is running their field trip programs, and with the way he is doing personally. He shows interest in being involved in the classroom lesson plans and desires specific goals from the teachers so he is able to tailor the field trip content to them individually. He also wants to continue with the pre-trip classroom visits because they seem worthwhile and helpful to prepare the students, and give them an idea of what to expect on the field trip. His goal is to develop a stronger relationship with the teachers so that he can continue to collaborate with them and meet their goals with his programs.

Objective 4: Obtain Alternative Perspectives on Field Trips

To accomplish this objective, two separate tasks were completed: interviews with several figures involved with field trip education, but not members of the MMA or the Nantucket Elementary School, and a survey that was submitted to the parents of the students at the Nantucket Elementary School.

Interviews

In order to accomplish this objective, we conducted a series of interviews. The first interview we conducted toward accomplishing this was with Leslie Bresette, chair of the grant committee of the Nantucket Golf Club Foundation, the organization that funded the MMA's recent curriculum alignment project. Leslie Bresette is also a mother of multiple children in the Nantucket Public School system, so we asked her questions to gain an insight into both of her perspectives. As a parent she indicated that the field trips were important to her children's educations, and that they also enjoyed them very much. She also believed that the most effective field trips were aligned with the school curriculum to further benefit learning. As a representative of the Nantucket Golf Club Foundation she made it clear that no opinion on the success of the grant given to the Maria Mitchell Association would be made until an evaluation was made for the field trips. There needs to be "definitive proof" that the Maria Mitchell Association's efforts are having a positive impact on the educations of the students.

Marjan Shirzad is the Director of the Department of Outreach & Special Program for the Nantucket Historical Association (NHA). The NHA ran a recent Diversity Festival program to help provide their resources to the wide variety of people living on Nantucket. Since ELL students and the diversity of the island's population came up in our research, we interviewed her to gain an understanding about how the NHA organized their Diversity Festival, and also to gain her perspectives on field trip education in general. The NHA has a volunteer Diversity Committee, whose events in the past have typically involved sharing the food or music of a certain culture. This year's Diversity Festival was different, and was their first attempt at such an event. The NHA decided to provide their normal services, teaching Nantucket History, in a more accessible manner for the immigrant population on Nantucket. To accomplish this they offered their normal Whaling Museum tours in Spanish, Portuguese, and Bulgarian, led by volunteers who had been provided the tour speeches to translate. Free admission was also offered during the festival, since the $17 admission fee is beyond the means of many families, especially minority and immigrant families. This Diversity Festival allowed for the NHA to focus on what they do best, while reaching out to the community, according to Ms. Shirzad. When asked about the importance of hands on experiences in museum learning, she stressed that different people learn in different ways. She explained that while some people can come into a museum and can get a lot out of it by just looking at and reading the exhibits, others need to be

drawn into the experience with more direct involvement and activity. She added that allowing visitors to participate more in the exhibits is becoming more common in museums everywhere.

Barbara Knoss is the current Education Director at the Cape Cod Museum of Natural History. She was formerly the Principal in an elementary school with a strong foundation in environmental education, before retiring to Cape Cod and volunteering at CCMNH. Part of her job as Education Director is to help organize the field trips offered by the Cape Cod Museum of Natural History for 43 schools and over 2500 students annually. The museum has an administrative hierarchy involving volunteers running the individual field trips and hosts working with teachers to make sure the field trip works for their class, while the education director oversees the whole process. All of the volunteer staff receives training in both the scientific knowledge covered on the field trips and the teaching process, and many of them come with backgrounds in education as well. To help advertise the field trips they offer, the museum sent out flyers to local schools to spread awareness. An important part of their process is evaluation of their field trips to make sure that everything has been running well. The evaluation is conducted by handing out the survey along with a prepaid envelope to be used to return them. They use the responses to identify what is working or not, as well as possible new features for the museum.

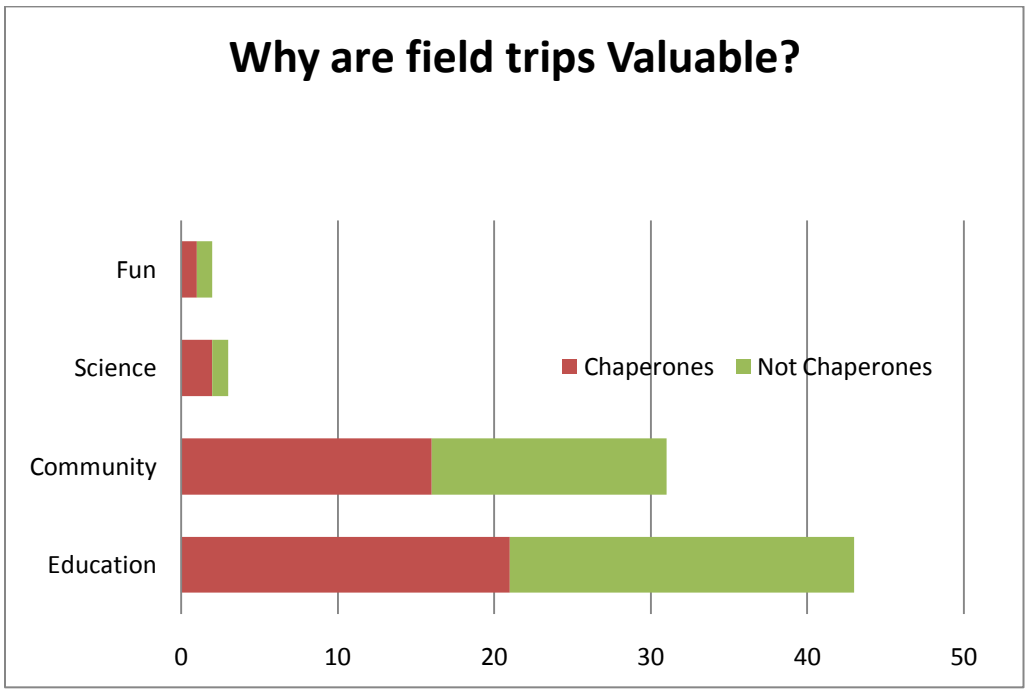
These interviews show how other organizations view the field trip process. It allows for the comments of both the teachers and the field trip providers to be compared to the views of outsiders to see if they are consistent.

Surveys

We received 73 responses to the 481 distributed copies of the survey, approximately 12% of the NES parents surveyed. Seven responses were in Spanish, which is around 10%, very similar to the 11% of Hispanic students at Nantucket Elementary School, which indicates the sample is reasonably representative with regard to ethnicity. Each field trip listed on the survey received at least seven responses of students that had attended, with the smallest number of students going on the Vernal Pools Trip and the most going on the Butterfly tagging trip. Every single respondent felt that field trips were important to their children. Parents indicated several different reasons why they thought field trips were valuable, and we grouped these responses into four different themes or emphases: (1) education value in general, (2) community

involvement, (3) learning science, and (4) having fun. Figure 3 shows that educational value and community involvement were the most common reasons that were cited in support of field trips. Figure 3 also shows that the pattern of responses is similar for parents who served as chaperones and those who did not.

Figure 3: Graph of Responses: Question Four on Survey



A couple of quotations from the surveys illustrate how parents feel about field trips:

Obviously as a parent I believe field trips are a valuable if not critical piece to the academic lessons learned at school. Children must experience life inside and outside the classroom, to involve all their senses and knowledge to fully appreciate the materials they are being presented. Field trips are the crucial piece of "play" needed to "connect the dots".

[Field trips are] not just valuable, but vital. Growing up on Nantucket provides an opportunity for children that is rare. Learning about out islands ecosystems, environment, birds, plants, trees, and history teaches them things about the larger world too. Further, it teaches the respect for nature and man's part in protecting and preserving it.

These quotes are consistent with the sentiment demonstrated by most of the parents who responded to the survey. They not only feel that field trips are valuable, but that they are necessary. These parents want field trips for their children and they truly appreciate what the MMA is doing to help run field trips for the children.

Objective 5: Develop an evaluation tool for future use by MMA

After analyzing the results from observations, focus groups, interviews, and parent surveys, the project group developed a teacher evaluation form in the form of an online survey through SurveyMonkey. A complete copy of this survey can be found in Appendix V. This will be a valuable tool for the MMA since they will be able to use the data to gauge the relative success of their field trips and identify how to improve them. The survey allows for room for the teacher to write in additional suggestions for the MMA to improve their field trips based on content, presentation style, or any other changes the teachers would like. This survey will be convenient for the MMA to send out in the future since it can be emailed as a link to the teachers whom have participated in a field trip run or organized by the MMA. It is also a convenient way to review the results since they can be retrieved online through a login and are then analyzed. The MMA staff would need to process the data. The MMA is expected to get around 50 responses per year from the teachers.

Following the field trips to Sankaty Bluff that were conducted while we were on Nantucket, the five teachers that participated in the field trips were asked to fill out the survey. All of participants strongly agreed that the field trip was age-appropriate. Three quarters of participants felt that their students were engaged all of the time, and the other quarter felt that their students were engaged most of the time. This was probably due to the large area of the Sankaty Bluff location and the freedom for the students to walk at the pace of their choice. All of the participants felt that the field trip was almost always tied into the curriculum. One participant said, "The areas that we had asked Andrew to cover were covered. The entire field trip was based around the science curriculum that we are studying with our students." Another participant requested that rock cycle stages be covered in the future, but later found out at our interview that the team leader told Andrew not to cover the rock cycle stages since not all of the classes were at that level yet. All of the teachers were completely satisfied regarding overall experience on the

field trip. One suggestion for improving the trip was to explain to students how to use the hand lenses.

The survey also questioned whether the teachers did any pre-trip or post-trip activities. This would show if the students were more prepared for the field trips or if the concepts were reinforced after the field trip. All of the teachers did both pre and post-trip activities. Some examples of pre-trip activities were: reading a book called *Everybody Needs a Rock*; studying properties of rocks and minerals using hand lenses and field journals to note observations; and Andrew McKenna-Foster's visit to the class to preview the area of the island with a map of Nantucket and show the class a large rock sample. The pre-trip activities ensured that the students were prepared for the field trip provided by the MMA. Some examples of post-trip activities included observing and describing the rock that was brought back to the classroom, and writing in their science notebooks with what they wanted to remember about the trip, which will "not only pertain to our science units but will also focus on our writing frameworks."

Lastly, our survey asked if the teachers had any additional comments that they would like to make. This allowed for the teachers to make any comments about the field trip on topics that were not addressed in the survey previously. The responses were, "Andrew had a great rapport with the students," "Can't wait to do it again next year!" and "I thought that the field trip went smoothly. It was based on activities and language that based for elementary students. The activities were hands-on and with periodic discussion that were great for students."

During our focus group with the fourth grade teachers, we questioned them about the SurveyMonkey. Teacher 17 felt that it was "Pretty quick and to the point." Teacher 20 added to that saying that that it didn't take too much time. Teachers 18 and 19 agreed that, "We are all big fans of SurveyMonkey!" This showed that the teachers did not mind filling out the survey after they went on a field trip and may be willing to fill it out in the future for the MMA.

Conclusions & Recommendations

Through our evaluation of the field trips offered by and coordinated through the Maria Mitchell Association for the Nantucket Elementary School, we concluded that there is overall approval of the current state of these field trips. Teachers, field trip providers, and parents alike unanimously agreed that field trips are highly valuable to the school climate due to the way they supplement classroom learning by connecting curriculum content with hands-on activity. Hands-on activities can provide any student the opportunity to increase learning, motivation, creativity, independent thinking, and communication skills while tying curriculum concepts into "real world" examples (Haury and Rillero, 1994). Teachers consider the MMA to be doing a "great job" with the field trips that they offer, and the other field trip providers were spoken quite highly of as well. The students enjoy the field trips that they experience, and return with more realistic understandings of curriculum concepts as well as insights into the world around them.

We recommend that the school administration and field trip providers continue their efforts to offer field trips to the students, and maintain their programs even through economically challenging times. Although the MMA's grant may not continue to provide funding to run these programs, it is still important to offer field trip opportunities to students. We have found an abundance of examples showing that the members of the school and community value the field trips as they exist now, and that losing these programs would prove to be detrimental to the education of the students. Informal science programs, such as those that the MMA provides, are considered legitimate and important sources of learning by many organizations including the National Science Foundation, a federal agency that promotes the progress of science and funds many museum programs nationwide. Field trips offer unique experiences for children to connect with their environment, learn through activity, and engage multiple intelligences: linguistic, logical-mathematical, musical, spatial, bodily-kinesthetic, interpersonal, and intrapersonal, as defined by Davis and Gardner (1993). **We recommend that in the event that the MMA can no longer fully fund programs with outside grants, the NES use resources such as volunteers to supplement their limited budget in an effort to maintain existing field trip programs.**

The MMA is not responsible to make major programmatic changes for the sake of English Language Learners (ELL). Our research found that there was a significant population of ELL students at NES. It was brought to our attention that these students may tend to have trouble during field trips, but after further discussions during focus groups, we ultimately concluded that the MMA is not responsible for making major accommodations for these students, and that the teachers must prepare the students by providing the necessary vocabulary before a field trip. A few teachers explained that hands-on activities and visuals are known to be effective strategies to teach students who have difficulty due to a language gap, so field trips are especially beneficial to them.

We recommend that the MMA and other providers work with the schools to make the field trips as inclusive as possible for the ELL students. The primary responsibility for fully preparing the ELL students to have a successful field trip falls with the teachers and the schools to accommodate their language needs, but providers can provide preparatory information that supplies any vocabulary that the students will need.

Teachers consistently agreed that the field trips were successful in addressing science curriculum content. During the focus groups, teachers from each grade level that had participated in a field trip through the MMA felt that the trips were very relevant to the Curriculum Frameworks content. Each field trip addresses different parts of the state science curriculum frameworks, often the same framework that would be currently covered in the classroom. Grade Four teachers explained, through their post-field trip evaluation surveys and their focus group, that the Sankaty Bluff field trip covered the desired topics of the Geology unit. In fact, four out of the four survey responses indicated that the content was "almost always" tied to the curriculum, the highest ranked option for an answer.

We recommend that the MMA continue to evaluate its programs regularly. The evaluation tool that we created for teachers to complete after a field trip involves curriculum content, age-appropriateness of the content, and level of student engagement during the activities. Timely feedback with teacher reactions to field trips will aide in improving the content and execution of each individual field trip. The pilot test of the evaluation tool with the Grade Four team proved successful, yielding positive feedback, and specific comments and suggestions regarding content that was missing from the field trip and what parts of the

presentation the teachers preferred over others. Evaluation is important in regards to informal science programs. Increasingly, funding agencies, such as the National Science Foundation, Institute for Museum and Library Services, and many private foundations, require all project proposals incorporate a thorough plan for evaluation. When MMA evaluates its programs, we also recommend that the MMA continue to designate the specific Curriculum Framework strands that each program relates to, and update them as the curriculum evolves over time.

Many teachers said that scheduling field trips is difficult. Scheduling an acceptable date for a field trip could pose a challenge, and there was a lack of continued communication with providers about specific preferences and also how far the class was into the curriculum. Communication is an important part of preparing successful field trips. Without communication, the provider cannot adapt their field trips to suit an individual teacher's needs. It is imperative that the provider know the material being taught in the classroom so that s/he can more effectively supplement what was learned in the classroom on the field trip. Expert researchers in the field have found that teachers must decide their purpose and goals of the field trip, share these expectations with the trip hosts and/or facilitators and with the students, provide tasks for students to work on during the field trip, and bring activities back to the classroom in order to tie in the topics more strongly (Eshach, 2007, p. 172). Currently, the communication between the field trip providers and the teachers is quite limited, with minimal sharing of goals and specific lesson plans.

We recommend that the field trip providers and teachers communicate more often with each other before field trips. The teachers should supply the field trip providers with their goals for the field trip, along with information on how in-depth they would like the presentations to be, and what the recent classroom lessons have focused on. This information could be given in person, or even via email or phone call, and would be a quick procedure. **We highly recommend that this communication happens before any and all field trips, because if the provider knows exactly what the teacher's lesson plans and schedule entail, they can design the field trip accordingly.**

Between our interviews of the field trip providers and the focus groups with teachers, we discovered that pre-trip visits are very beneficial. Both Andrew McKenna-Foster of the MMA and Emily MacKinnon of the Nantucket Land Council visited classrooms before the students

attended the field trips they ran. The students were able to ask them some initial questions about the nature of the field trip, and they were also able to learn more about the material directly from the source. **We concluded that pre-trip visits added to the success of field trips**, which concurs with the findings in the literature. For example, Griffin and Symington (1997, p. 764) found that students who had previously worked on the topic of focus in school before a museum visit learned the most from the field trip experience, and were the least distracted by the novelty of the setting. In addition, the NES teachers also expressed interest in scientists visiting the classroom whenever possible, since it gets their students excited about science, and about learning from a "real expert". Lastly, we found that some teachers would appreciate receiving a preview packet of the field trip from the provider, as well as suggestions for the pre-trip activity to help them prepare themselves and their students for the field trip.

We recommend that the field trip providers visit the classrooms before the field trips whenever possible. It is beneficial for the students to be introduced to a field trip before it happens, to better prepare them for the experience. Preparation also helps them to be less distracted by off-topic behaviors during the field trip. It is also valuable because the visit excites the students about learning science. If a pre-trip visit is not feasible, then we recommend that the provider give the teacher a pre-trip activity that would help the students to better understand the content for the field trip and also prepare them for it.

Field trip providers typically are well-educated in their respective fields, but not necessarily in education per se. Most learn how to teach through professional development, shadowing, or mentoring, or simply through their own experience. Some providers would appreciate additional assistance to help improve their teaching methods and approaches to student learning. The natural ability to act and speak in a manner that children respond to is not possessed by everyone, and most could benefit from some training. At the same time, many teachers feel that they are less than comfortable when teaching science. Elementary school teachers are required to teach every subject to their class, which inevitably means they will have weaker backgrounds in some of those areas. Several teachers shared with us that science was their weakest area, and the one they were least comfortable teaching. Teaching style has an effect on student learning not only in the classroom, but also during field trips. Through our observations over three different days of the Sankaty Bluff field trip, we noted the differences in

the teacher's attitudes and how it affected the behavior of students. **The most effective way for students to learn is when the teacher facilitates the learning process by reminding students of the pre-trip studies along with their purpose for being there.**

We recommend that providers and teachers pursue professional development opportunities that focus on how to facilitate learning during field trips. For the provider, this would focus on the most effective way to teach students at an elementary school level, and how to explain scientific ideas about which they have immense knowledge, in a manner that is engaging and understandable to children. For the teacher, the professional development would focus on learning through inquiry, hands-on science activities, how to facilitate learning during a field trip, and how to make the field trip experiences effective and memorable for the student. As stated by Griffin and Symington, in a museum, the teacher must take on a facilitative role rather than a directive role, guiding the students to pose their own questions and find the answers through the available materials provided by the setting (Griffin and Symington, 1997, p.765).

Based on conclusions about the key factors to successful field trips, we recommend that the MMA and teachers, in a joint effort, create a procedural checklist outlining the necessary steps in the field trip process. According to Lebeau, positive elements of field trips include: "(a) alignment with accepted science curriculum standards and benchmarks; (b) extension of all contacts through pre- and post-activity connections; (c) integration with other subjects and disciplines; (d) connection of classroom experience to science center experience; and (e) insistence on student production through problem solving, construction, collaboration, and use of creativity (Lebeau et al., 2001, p. 134)". Therefore, we recommend that the checklist include items such as assurance of curriculum correlation, communication between teachers and field trip providers before the field trip, pre-trip visits, appropriate teaching strategies, and use of the post-trip evaluation tool. The project group recommends that this tool should be used in the future to ensure that the field trip is running smoothly and having the desired effect on students.

Two grade level teams that we interviewed specifically mentioned that they were unaware of the field trip opportunities that exist through the MMA and other island organizations. **Most of the teachers are willing to experience new field trips, as long as they fit into the curriculum appropriately.** The teachers also said that they do not have enough time to design and plan their own new field trips, in addition to fulfilling their current responsibilities

and that they wanted the MMA to think of possible field trips and propose the ideas to them. **Teachers also emphasized that they would appreciate continuity in field trips, and consistency from year to year**. With already experiencing a field trip, a teacher would become more comfortable with the content. When the teacher knows what to expect from the field trip, they are more capable of preparing their students, making them ready to learn. More practice in executing field trips also helps smooth out small issues and improves the field trip each year. This idea of repetition was also apparent in the field trips we observed; Mr. McKenna Foster made adjustments for each consecutive field trip, eventually finding a very successful method to control the students and get their attention. After running the same program a few times, the providers also learn which aspects of the program worked best and which parts should not be repeated in the next try.

We ultimately recommend that the MMA host a regular summit to bring together the teachers and field trip providers of Nantucket. This summit would allow for the teachers and providers to consult with each other, and open the flow of communication that has been lacking. This would create the opportunity to form new working relationships, and connect island professionals to teachers with relevant curriculum topics, to create new field trip ideas. Current field trip providers would also be present for discussions with teachers regarding past experiences with the field trip, and to initiate the increased amount of communication necessary to make the field trips as beneficial as possible. The summit could also serve as an opportunity for some of the aforementioned professional development sessions, through focus groups or with an outside education professional. Lastly, the summit would bring together teachers and field trip providers, creating an opportunity to discuss and confirm the contents of the field trip checklist, which requires input from both sides.

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Appendices

Appendix I: Interview and focus group questions

Section 1.1: Leslie Bresette Interview Questions

Preamble: We are students from WPI working at the Maria Mitchell Association to evaluate the effectiveness of science field trips and hands on classroom activities. Your comments will be kept confidential, you may withdraw your consent at any time, and you may refuse to answer a particular question if you wish.

What grades are your kids in?

Do they enjoy the field trips provided by the MMA?

What was their favorite field trip? Why?

What did they learn on that field trip?

Do you believe that science field trips add educational value to the elementary school?

Why do you think that?

Should the school offer more field trips?

Do you feel like there is good quality control during the field trips?

Are the field trips well organized and well run?

Is this program making a difference in the elementary school?

Are the students learning from the field trips?

How do science field trips affect the school climate?

Are the students excited about field trips?

How should this program be sustained by the school and providers after the budget runs out?

Was it a good decision to fund the MMA's programs?

Section 1.2: Emily MacKinnon Interview Questions

Preamble: We are students from WPI working at the Maria Mitchell Association to evaluate the effectiveness of science field trips and hands on classroom activities. We would like to ask you a few questions to understand the role that you see for field trips and how you conduct them. Your comments will be kept confidential and your name will not appear in any of our reports (Unless we have permission to quote you). Please note, you may stop the interview at any time and you may refuse to answer a particular question if you wish.

So, perhaps we can begin by discussing the bigger picture. Can you tell us why you think it is important to offer informal learning opportunities (such as field trips) to students?

What role do you think field trips play?

What role do you think hands-on classroom activities play?

Why does the Land Council offer field trips?

What are your reasons for hosting field trips?

What do you enjoy most about conducting field trips and classroom activities?

What do you find most difficult or frustrating about conducting such activities?

What are some of the most important benefits students get from these kinds of programs/activities?

How long have you been conducting field trips for the Foundation?

Did you run field trips for other organizations before that?

Have you had any training as a teacher?

Did you receive any training about how to conduct field trips and in-class activities?

Would it be helpful to have training for such activities?

Now we could like to ask you some questions about the Monarch Butterfly tagging field trip and vernal pools field trip. *****ask about both field trips for the rest of the interview*****

How many times have you run the Monarch Butterfly tagging field trip/Vernal pool?

Did you develop the content and activities for the trip? Did these build on previous materials or did you develop them from scratch?

How did you go about developing the content and activities?

Did you purposely try to connect the content and activities to the Massachusetts school curriculum frameworks?

How much did you know about the school curriculum before the field trip?

Did you communicate with the teachers before the trip??

Did you discuss their objectives and goals for the field trip?

What did they want to get out of the trip?

Did they have any particular needs or concerns?

What role did the MMA serve in setting up this field trip?

Did they help with logistics?

Setting up field trip

Organization

Did they suggest content or activities?

Did you get help with curriculum and planning of field trip?

Would it be helpful if MMA provided additional support in any way for these activities?

How did the field trips go?

What were the positives and negatives?

What did the students learn?

Both facts and skills

What did the students find most engaging about the trip? Least engaging?

Did you provide pre/post activities for the class?

If YES- how did you develop them?

Did she or the teacher deliver them?

Did the students like them?

If NO- Would you be interested in doing this in the future?

What help if any would you need on this front?

Could MMA help on this front (e.g., hosting a workshop of field trip providers to compare notes and strategies)?

Is anything else that you want to add that you have not discussed, especially with regards to the future role that MMA might play on developing, coordinating, and implementing these kinds of field trips and activities?

Section 1.3: Jenny Mayberry Interview Questions

Preamble: We are students from WPI working at the Maria Mitchell Association to evaluate the effectiveness of science field trips and hands on classroom activities. We would like to ask you a few questions to understand the role that you see for field trips and how you conduct them. Your comments will be kept confidential and your name will not appear in any of our reports (Unless we have permission to quote you). Please note, you may stop the interview at any time and you may refuse to answer a particular question if you wish.

So, perhaps we can begin by discussing the bigger picture. Can you tell us why you think it is important to offer informal learning opportunities (such as field trips) to students?

What role do you think field trips play?

What role do you think hands-on classroom activities play?

What do you enjoy most about conducting field trips?

What do you find most difficult or frustrating about conducting such activities?

What are some of the most important benefits students get from these kinds of programs/activities?

How long have you been conducting field trips for the MMA?

Did you run field trips for other organizations before that?

Have you had any training as a teacher?

Did you receive any training about how to conduct field trips and in-class activities?

Would it be helpful to have training for such activities?

Now we would like to ask you some questions about the Sankaty Head Field Trip

How many times have you run the Sankaty Head Field Trip?

Did you develop the content and activities for the trip? Did these build on previous materials or did you develop them from scratch?

How did you go about developing the content and activities?

Did you purposely try to connect the content and activities to the Massachusetts school curriculum frameworks?

How much did you know about the school curriculum before the field trip?

Did you communicate with the teachers before the trip??

Did you discuss their objectives and goals for the field trip?

What did they want to get out of the trip?

Did they have any particular needs or concerns?

How did the field trip go overall?

What were the positives and negatives?

What did the students learn?

Both facts and skills

What did the students find most engaging about the trip? Least engaging?

Is anything else that you want to add that you have not discussed, especially with regards to the future role that MMA might play on developing, coordinating, and implementing these kinds of field trips and activities?

Section 1.4: Andrew McKenna-Foster Interview Questions

Preamble: We are students from WPI working at the Maria Mitchell Association to evaluate the effectiveness of science field trips and hands on classroom activities. We would like to ask you a few questions to understand the role that you see for field trips and how you conduct them. Your comments will be kept confidential and your name will not appear in any of our reports (Unless we have permission to quote you). Please note, you may stop the interview at any time and you may refuse to answer a particular question if you wish.

So, perhaps we can begin by discussing the bigger picture. Can you tell us why you think it is important to offer informal learning opportunities (such as field trips) to students?

What role do you think field trips play?

What role do you think hands-on classroom activities play?

What do you enjoy most about conducting field trips?

What do you find most difficult or frustrating about conducting such activities?

What are some of the most important benefits students get from these kinds of programs/activities?

How long have you been conducting field trips for the MMA?

Did you run field trips for other organizations before that?

Have you had any training as a teacher?

Did you receive any training about how to conduct field trips and in-class activities?

Would it be helpful to have training for such activities?

Now we would like to ask you some questions about the Sankaty Head Field Trip

How many times have you run the Sankaty Head Field Trip?

Did you develop the content and activities for the trip? Did these build on previous materials or did you develop them from scratch?

How did you go about developing the content and activities?

Did you purposely try to connect the content and activities to the Massachusetts school curriculum frameworks?

How much did you know about the school curriculum before the field trip?

Did you communicate with the teachers before the trip??

Did you discuss their objectives and goals for the field trip?

What did they want to get out of the trip?

Did they have any particular needs or concerns?

How did the field trip go overall?

What were the positives and negatives?

What did the students learn?

Both facts and skills

What did the students find most engaging about the trip? Least engaging?

How do you think the MMA is doing with organizing and holding field trips?

What could be improved?

Is anything else that you want to add that you have not discussed, especially with regards to the future role that MMA might play on developing, coordinating, and implementing these kinds of field trips and activities?

Section 1.5: Harry Payne and Michael Varbalow

Preamble: We are students from WPI working at the Maria Mitchell Association to evaluate the effectiveness of science field trips and hands on classroom activities. We would like to ask you a few questions to understand the role that you see for field trips and how you conduct them. Your comments will be kept confidential and your name will not appear in any of our reports (Unless we have permission to quote you). Please note, you may stop the interview at any time and you may refuse to answer a particular question if you wish.

What are your educational and professional backgrounds?

Just try to find out what kind of people work at the old mill.

Before running the field trip did the Nantucket Historical Association give any training on conducting field trips?

If they did, try to figure out what the training was.

Can you describe a typical trip to the old mill for the 5th grade from Nantucket Elementary?

Clarify any details that were unclear.

How did the field trips go?

What were the positives and negatives?

What did the students learn?

Both facts and skills

What did the students find most engaging about the trip? Least engaging?

Before you went on the trip, did the 5th grade teachers provide you with any materials?

Try to find out what materials they were, what material they covered, etc.

Did you provide the 5th grade teachers with any materials?

If they did, why, how does it help. If not, then move on.

What role did the MMA serve in setting up this field trip?

Did they help with logistics?

Setting up field trip

Organization

Did they suggest content or activities?

Did you get help with curriculum and planning of field trips?

Would it be helpful if MMA provided additional support in any way for these activities?

Do you feel like the field trips to the old mill fit within the curriculum content of the students coursework?

Can be simplified to just say did the students learn relevant information.

Why does the NHA offer field trips?

What are your reasons for hosting field trips?

What do you enjoy most about conducting field trips and classroom activities?

What do you find most difficult or frustrating about conducting such activities?

What are some of the most important benefits students get from these kinds of programs/activities?

Is there a significant language gap between you and ESL children during field trips?

Do you have the capability to teach to ESL children?

Try to find out exactly what they do and don't have.

Would it help ESL students to offer more support to them?

Any other comments you wish to make.

Section 1.6: Amy Cabre Interview Questions

Preamble: We are students from WPI working at the Maria Mitchell Association to evaluate the effectiveness of science field trips and hands on classroom activities. We would like to ask you a few questions to understand the role that you see for field trips and how you conduct them. Your comments will be kept confidential and your name will not appear in any of our reports (Unless we have permission to quote you). Please note, you may stop the interview at any time and you may refuse to answer a particular question if you wish.

So, perhaps we can begin by discussing the bigger picture. Can you tell us why you think it is important to offer informal learning opportunities (such as field trips) to students?

What role do you think field trips play?

What role do you think hands-on classroom activities play?

What are your reasons for doing in-class activities?

What do you enjoy most about conducting classroom activities?

What do you find most difficult or frustrating about conducting such activities?

What are some of the most important benefits students get from these kinds of programs/activities?

How long have you been conducting classroom activities?

Have you had any training as a teacher?

Did you receive any training about how to conduct in-class activities?

Would it be helpful to have training for such activities?

Now we could like to ask you some questions about the Spinning Classroom activity.

How many times have you run the spinning?

Did you develop the content and activities for the trip? Did these build on previous materials or did you develop them from scratch?

How did you go about developing the content and activities?

Did you purposely try to connect the content and activities to the Massachusetts school curriculum frameworks?

How much did you know about the school curriculum before the field trip?

Did you communicate with the teachers before the trip??

Did you discuss their objectives and goals for the field trip?

What did they want to get out of the trip?

Did they have any particular needs or concerns?

What role did the MMA serve in setting up this field trip?

Did they help with logistics?

Setting up field trip

Organization

Did they suggest content or activities?

Did you get help with curriculum and planning of field trip?

Would it be helpful if MMA provided additional support in any way for these activities?

How did the field trip go?

What were the positives and negatives?

What did the students learn?

Both facts and skills

What did the students find most engaging about the trip? Least engaging?

Did you provide pre/post activities for the class?

If YES- how did you develop them?

Did she or the teacher deliver them?

Did the students like them?

If NO- Would you be interested in doing this in the future?

What help if any would you need on this front?

Could MMA help on this front (e.g., hosting a workshop of field trip providers to compare notes and strategies)?

Is anything else that you want to add that you have not discussed, especially with regards to the future role that MMA might play on developing, coordinating, and implementing these kinds of field trips and activities?

Section 1.7: John Bartlett Interview Questions

Preamble: We are students from WPI working at the Maria Mitchell Association to evaluate the effectiveness of science field trips and hands on classroom activities. We would like to ask you a few questions to understand the role that you see for field trips and how you conduct them. Your comments will be kept confidential and your name will not appear in any of our reports (Unless we have permission to quote you). Please note, you may stop the interview at any time and you may refuse to answer a particular question if you wish.

So, perhaps we can begin by discussing the bigger picture. Can you tell us why you think it is important to offer informal learning opportunities (such as field trips) to students?

What role do you think field trips play?

What role do you think hands-on classroom activities play?

Why does Bartlett Farms offer field trips?

What are your reasons for hosting field trips?

What do you enjoy most about conducting field trips and classroom activities?

What do you find most difficult or frustrating about conducting such activities?

What are some of the most important benefits students get from these kinds of programs/activities?

How long have you been conducting field trips for Bartlett Farms?

Did you run field trips for other organizations before that?

Have you had any training as a teacher?

Did you receive any training about how to conduct field trips and in-class activities?

Would it be helpful to have training for such activities?

Now we could like to ask you some questions about the Pumpkin Patch Field Trip.

How many times have you run the Pumpkin Patch field trip?

Did you develop the content and activities for the trip? Did these build on previous materials or did you develop them from scratch?

How did you go about developing the content and activities?

Did you purposely try to connect the content and activities to the Massachusetts school curriculum frameworks?

How much did you know about the school curriculum before the field trip?

Did you communicate with the teachers before the trip??

Did you discuss their objectives and goals for the field trip?

What did they want to get out of the trip?

Did they have any particular needs or concerns?

What role did the MMA serve in setting up this field trip?

Did they help with logistics?

Setting up field trip

Organization

Did they suggest content or activities?

Did you get help with curriculum and planning of field trip?

Would it be helpful if MMA provided additional support in any way for these activities?

How did the field trips go?

What were the positives and negatives?

What did the students learn?

Both facts and skills

What did the students find most engaging about the trip? Least engaging?

Did you provide pre/post activities for the class?

If YES- how did you develop them?

Did she or the teacher deliver them?

Did the students like them?

If NO- Would you be interested in doing this in the future?

What help if any would you need on this front?

Could MMA help on this front (e.g., hosting a workshop of field trip providers to compare notes and strategies)?

Is anything else that you want to add that you have not discussed, especially with regards to the future role that MMA might play on developing, coordinating, and implementing these kinds of field trips and activities?

Section 1.8: Marjan Shirzad Interview Questions

Preamble: We are students from WPI working at the Maria Mitchell Association to evaluate the effectiveness of science field trips and hands on classroom activities. We would like to ask you a few questions to understand the role that you see for field trips and how you conduct them. Your comments will be kept confidential and your name will not appear in any of our reports (Unless we have permission to quote you). Please note, you may stop the interview at any time and you may refuse to answer a particular question if you wish.

So, perhaps we can begin by discussing the bigger picture. Can you tell us why you think it is important to offer informal learning opportunities (such as the Diversity Festival) to students?

What role do you think hands-on activities play?

How did the Diversity Festival go?

Were there as many people there as you were expecting/hoping?

What were the positives and negatives?

What did the students learn?

Both facts and skills

What did the students find most engaging about the Festival? Least engaging?

What activities were most helpful in the learning process?

How were the parents interacting with their kids?

Is this typical of English-speaking families?

Did the environment of the Diversity Festival help with this type of interaction?

How will this Festival be continued in the future?

Annually? Biannually?

Do you have any employees that speak another language?

Are you looking into hiring an employee that speaks a second language?

How do you work with school administration to help organize NHA sponsored field trips?

How do you effectively keep the field trips content centered?

Can you explain the training process for volunteers?

Is anything else that you want to add that you have not discussed, especially with regards to the future role that MMA might play on developing, coordinating, and implementing these kinds of field trips and activities?

Section 1.9: Barbara Knoss Interview Questions

Preamble: We are students from WPI working at the Maria Mitchell Association to evaluate the effectiveness of science field trips and hands on classroom activities. We would like to ask you a few questions to understand the role that you see for field trips and how you conduct them. Your comments will be kept confidential and your name will not appear in any of our reports (Unless we have permission to quote you). Please note, you may stop the interview at any time and you may refuse to answer a particular question if you wish.

To start, we'd like to learn about your personal background.

Degree and Major

How long at the museum

Our project is to evaluate the MMA's elementary school field trips. Does the Cape Cod Museum of Natural History host any field trips for that age group?

What role in general do you think these types of informal learning opportunities play?

Why is it important?

For the field trips that you do host, do the schools seek you out? Or do you seek them out to make them aware of what you offer?

As Education Director, what role do you serve in the field trips?

Is there communication regarding the curriculum, learning standards, or any other specifics with the teachers beforehand?

Do you run the programs and work directly with the kids?

How many people do you have on staff running the field trips?

What districts does the museum serve?

How many schools?

For your staff in the Education Department, how are they trained to run field trips or youth programs?

Are their degrees typically just in science or education as well?

The MMA is a very small non-profit organization, so they require outside funding through grants for much of their projects. The current director is applying for one to fund a type of summit between teachers and some current or potential field trip providers on the island.

The former Education Director who left a few years ago was never exactly replaced, so they kind of split the duties between three people. The current man with the title is just a scientist with the natural ability to work with kids. They lost the education background though, so they were thinking of bringing in someone to give a training session. Have you ever done anything like this? Do you think it would be beneficial?

Anything else you'd like to add regarding any recommendations for us and MMA, or about your field trip experiences in general?

Appendix II: Generic Focus Group Questions

What role do you feel field trips have in supplementing formal classroom learning?

What is the importance of hands on learning?

How well in general would you say the programs that MMA offers and those that it coordinates through other providers meet your overall field trip goals?

Is the content relevant and age-appropriate?

Does the content tie to the curriculum effectively?

Are the programs fun and do they engage the students?

MMA makes an effort to coordinate field trip providers and teachers. What could MMA do to improve the experience?

Do the providers seem well prepared?

How well do they connect with the students?

Would you find it helpful if the field trip providers gave you pre/post materials before the trip?

Turning to a recent fieldtrip to _____, what were the highlights of the trip?

What material did you give to the field trip provider?

Was the content relevant and tied to the curriculum?

What were the most engaging parts of the program?

Did the students have fun?

What aspects of the program might be improved?

For the _____ trip, what preparation and follow-up activities did the class complete?

What did the post activities show?

What changes, if any, did you notice in terms of knowledge, skills, and attitudes?

How might the pre- and post-trip activities be improved?

In your classes, has there been an issue with a language gap during science activities?

Has it been an issue during field trips? If yes--- do you think this is something MMA should try to address in its programs and with the various providers that it coordinates?

What suggestions do you have for how the language gap might be addressed?

Finally, we would like to ask some questions about funding and program support.

Do you feel that the Principal, Assistant Principal, and school administration are supportive of these kinds of activities?

Have attitudes changed with the growing emphasis on MCAS?

What is most important in maintaining this support in the future?

The cost associated with the delivery of these programs has been covered by grants through the MMA. If this support were no longer available, would you still be able to participate in the fieldtrips? Would the school be willing/able to raise funding to cover some nominal costs?

Appendix III: Observation Sheet

Observation Sheet

Field Trip: _____

Field Trip Provider: _____

Date of Field Trip: _____

Number of Questions Asked

Welcome Phase

- ☐ Distractions
  - Ex.

    _____
    _____
    _____
- ☐ Kids are Engaged
  - Ex.

    _____
    _____
    _____
- ☐ Additional Observations
  - Ex.

    _____
    _____
    _____

Program Introduction

- ☐ Distractions
  - Ex.

    _____
    _____
    _____
- ☐ Kids are Engaged
  - Ex.

    _____
    _____
    _____
- ☐ Additional Observations
  - Ex.

_____
_____
_____

Activities

- ☐ Teachers on task
- ☐ Students on task
- ☐ Professionals on task
- ☐ Students and teachers talking about subject matter in a meaningful manner
  - Ex.

    _____
    _____
    _____
- ☐ Distractions
  - Ex.

    _____
    _____
    _____
- ☐ Students responding well to field trip
  - Ex.

    _____
    _____
    _____
- ☐ Teacher is engaged and interacting with students
  - Ex.

    _____
    _____
    _____
- ☐ How the field trip providers engage with students
  - Ex.

    _____
    _____
    _____
- ☐ Additional Observation
  - Ex.

    _____
    _____
    _____

Wrap-up

- ☐ Distractions

- Ex.

  _____
  _____
  _____

- Effective summary of trip by provider
  - Ex.

    _____
    _____
    _____

- Additional Observation
  - Ex.

    _____
    _____
    _____

Appendix IV: Survey

Section 4.1: Survey Template English Version

Your name: _____

Your child's grade: _____

Your Email: _____ (for award notification)

Dear Parent/Guardian,

We are students from Worcester Polytechnic Institute working on a research project that is one of our degree requirements. We are helping the Maria Mitchell Association (MMA) evaluate the effectiveness of science field trips. Your responses to this survey will be kept confidential and your name will not be revealed in any of our reports. The survey results will be used to improve the quality of future field trips.

Please return this form to your child's teacher by **Tuesday, November 16, 2010** to enter to win a 2011 Family Membership* provided by the MMA. You will be notified by e-mail should you win.

Thank you for completing this survey. Please contact mariamitchell@wpi.edu for more information.

1. To your knowledge, what field trips did your child attend in elementary school? Please circle all that apply.

Kindergarten
Trip to Creek

Grade 1
Pumpkin Patch
Natural Science Museum
Sheep Shearing and Spinner Visit to NES

Grade 2
Fossils

Grade 3
Aquarium

Grade 4
Sankaty Cliffs Geology Tour
MMA Astronomy Open Nights
Bird Adaptations at MMA

Grade 5
Monarch Butterfly Tagging
Vernal Pools
Old Mill

2. Have you ever attended a field trip as a chaperone? Yes ___ No___

3. What does your child remember about the field trip(s) s/he participated in?

4. As a parent, do you think such field trips are valuable? Why?

Natural Science Museum Fall Hours: Saturday and Sunday 12-5
Visit www.mmo.org for more information on the Maria Mitchell Association
**Family Membership includes unlimited free admission to MMA's museums and aquarium, free admission to Open Nights, select nature walks, and more!, online newsletter, the E-Comet; copy of Annual Report, discounts on field trips, workshops, lectures, and other programs, and 10% Discount at MMA Museum Shop.*

Section 4.2: Survey Template Spanish Version

Su nombre: _____

Grado de su hijo/a: _____

Email: _____ (para la notificación)

Estimado padre o tutor,

Somos estudiantes del Instituto Politécnico de Worcester trabajando en un proyecto de investigación que es uno de los requisitos de nuestro grado. Estamos ayudando a la Asociación Maria Mitchell (MMA) a evaluar la eficacia de los viajes de estudios de ciencia. Sus respuestas a esta encuesta es confidencial y su nombre no será revelado en cualquiera de nuestros informes. Los resultados del estudio se utilizarán para mejorar la calidad de los viajes de estudio futuro.

Por favor devuelva este formulario al maestro de su hijo por el **16 de Noviembre, 2010** para inscribirse para ganar una Membresía para el año 2011 *Proveída por el MMA. Se le notificará por correo electrónico en caso de que gane.

Gracias por completar esta encuesta. Póngase en contacto con mariamitchell@wpi.edu para más información.

1. Para su conocimiento, ¿qué excursiones asistió su hijo en la escuela primaria? Por favor, marque lo que corresponda.

Kinder
Viaje a Creek

Grado 1
Pumpkin Patch
Museo de Ciencia Natural Esquila
y hilandero de Ovejas Visita NES

Grado 2
Fossils

Grado 3
Aquario

Grado 4
Sankaty Cliffs Tour de Geologia
MMA Noches de Astronomia
Las adaptaciones de la aves MMA

Grado 5
Estudiando las mariposas Monarch
Piscinas Vernales
Old Mill

2. ¿Has ido alguna vez a un viaje estudiantil como acompañante? Sí ___ No___

3. ¿Qué recuerda su hijo/a sobre el/los viaje/s de estudios que ha participado?

4. Como padre, ¿cree que estos viajes de estudios son valiosos? ¿Por qué?

Natural Science Museum Fall Hours: Saturday and Sunday 12-5
Visit www.mmo.org for more information on the Maria Mitchell Association
**Family Membership includes unlimited free admission to MMA's museums and aquarium, free admission to Open Nights, select nature walks, and more!, online newsletter, the E-Comet; copy of Annual Report, discounts on field trips, workshops, lectures, and other programs, and 10% Discount at MMA Museum Shop*

Appendix V: SurveyMonkey

1. Name (optional)

2. Grade

3. Field Trip Title and Date of Field Trip

4. Would you agree that the field trip was age-appropriate for the students?

- Strongly agree
- Inclined to agree
- Neither
- Inclined to disagree
- Strongly disagree

5. How engaged were the majority of your students during the field trip?

- All of the time
- Most of the time
- Some of the time
- Seldom
- Never

6. How consistently was the field trip tied to the curriculum?

- Almost always
- Often
- Sometimes
- Seldom
- Never

What areas of the curriculum, if any, were not covered?

7. How satisfied were you regarding your overall experience on the field trip?

- Completely satisfied
- Very satisfied
- Fairly well satisfied
- Somewhat dissatisfied
- Very dissatisfied

What can you suggest to help improve the field trip for future classes?

8. Did you complete any pre-field trip activities?

- Yes

- No

Please describe these activities.

9. Do you plan on doing any post-field trip activities?

- Yes
- No

Please describe these activities.

10. Do you have any other comments on the field trip you wish to make?

Life Science (Biology), Grades PreK–2

Learning Standard	**Ideas for Developing Investigations and Learning Experiences**	**Suggested Extensions to Learning in Technology/Engineering** (Technology/Engineering standards for grades PreK–2 are on page 85.)
Characteristics of Living Things		
Recognize that animals (including humans) and plants are living things that grow, reproduce, and need food, air, and water.	Draw and record the growth of a plant grown from seeds with different light exposures (vary the duration and intensity of light exposure).	Design and construct a habitat for a living organism that meets its needs for food, air, and water. (T/E 1.1, 1.2, 1.3)
Differentiate between living and nonliving things. Group both living and nonliving things according to the characteristics that they share.	Compare and contrast groups of animals (e.g., insects, birds, fish, mammals) and look at how animals in these groups are more similar to one another than to animals in other groups.	
Recognize that plants and animals have life cycles, and that life cycles vary for different living things.	Using either live organisms or pictures/models, observe the changes in form that occur during the life cycle of a butterfly or frog. Discuss the life cycle of a tree.	Design and build a habitat for a living organism that can be modified to meet the changing needs of the organism during its life cycle. (T/E 1.1, 1.2)
Heredity		
Describe ways in which many plants and animals closely resemble their parents in observed appearance.	Look at and discuss pictures of animals from the same species. Observe and discuss how they are alike and how they are different.	
Living Things and Their Environment		
Recognize that people and	Observe small animals in the	Design and build an ant farm.

Learning Standard	**Ideas for Developing Investigations and Learning Experiences**	**Suggested Extensions to Learning in Technology/Engineering** (Technology/Engineering standards for grades PreK–2 are on page 85.)
other animals interact with the environment through their senses of sight, hearing, touch, smell, and taste.	classroom while they find food, water, shelter, etc. Talk about how people use their senses every day.	Observe how ants use their senses and how they communicate to each other the location of a food source. (T/E 1.1, 1.2, 1.3)
Recognize changes in appearance that animals and plants go through as the seasons change.	Observe and record changes in plants (e.g., trees, flowers, grass) on the playground and around the school during fall, winter, and spring.	Visit a maple syrup manufacturing facility. Discuss the sap-to-maple syrup process and the seasonal life cycle of a tree. (T/E 1.1, 1.2)
Identify the ways in which an organism's habitat provides for its basic needs (plants require air, water, nutrients, and light; animals require food, water, air, and shelter).	Create a garden habitat that will attract and provide shelter for birds and butterflies. Research and plant appropriate flowers.	Have students draw pictures of their houses and an animal's habitat. Discuss differences and similarities (e.g., type of materials used to build each shelter). (T/E 1.3)

Life Science (Biology), Grades 3–5

Learning Standard	**Ideas for Developing Investigations and Learning Experiences**	**Suggested Extensions to Learning in Technology/Engineering** (Technology/Engineering standards for grades 3–5 are on page 86.)
Characteristics of Plants and Animals		
Classify plants and animals according to the physical characteristics that they share.	Sort plant and animal pictures based on physical characteristics. Use a dichotomous key to	Create a simple chart to classify plants and animals that are common to the school's geographical area. (T/E 2.2)

Learning Standard	**Ideas for Developing Investigations and Learning Experiences**	**Suggested Extensions to Learning in Technology/Engineering** (Technology/Engineering standards for grades 3–5 are on page 86.)
	identify plants.	

Learning Standard	**Ideas for Developing Investigations and Learning Experiences**	**Suggested Extensions to Learning in Technology/Engineering** (Technology/Engineering standards for grades 3–5 are on page 86.)
Rocks and Their Properties		
Give a simple explanation of what a mineral is and some examples, e.g., quartz, mica.	Observe and describe the characteristics of ore minerals such as magnetite and hematite (two sources of iron).	Design a flowchart to demonstrate how silica from sand is used to make glass. (T/E 2.2)
Identify the physical properties of minerals (hardness, color, luster, cleavage, and streak), and explain how minerals can be tested for these different physical properties.	Acquire a collection of minerals that includes (a) duplicates of the same mineral, somewhat different in appearance (size, shape, exact color) and (b) samples of minerals that look similar but are actually different. Examine minerals using a hand lens. Look for and record similarities and differences such as heaviness, color, texture, crystal shapes, luster, surface patterns, etc. Sort as accurately as possible. Report total number of different minerals present, and how many duplicates, if any, of each type.	Use simple tools to test for hardness, e.g., Moh's Scale of Hardness. (T/E 1.1)

Learning Standard	**Ideas for Developing Investigations and Learning Experiences**	**Suggested Extensions to Learning in Technology/Engineering** (Technology/Engineering standards for grades 3–5 are on page 86.)
Identify the three categories of rocks (metamorphic, igneous, and sedimentary) based on how they are formed, and explain the natural and physical processes that create these rocks.	Examine rocks collected from the schoolyard or a field trip location, or brought in from home. Sort rocks into igneous, metamorphic, or sedimentary based on their physical properties.	Discuss the use of rocks in construction based on their physical properties. Test the hardness of various types of rocks used in construction. (T/E 1.1)
Soil		
Explain and give examples of the ways in which soil is formed (the weathering of rock by water and wind and from the decomposition of plant and animal remains).	Observe sand with a hand lens. Note how particles resemble minerals. Observe topsoil with a hand lens. Look for fragments of organisms. Note differences in color, texture, odor, and clumping due to organic components vs. pure sand. Mix topsoil and sand together in various proportions to represent samples of types of soils.	Design and construct a composting bin being sure to keep design considerations in mind, e.g., aeration, resistance to rot, etc. (T/E 1.2, 2.1–2.3)
Earth's History		
Give examples of how the surface of the earth changes due to slow processes such as erosion and weathering, and rapid processes such as landslides, volcanic eruptions, and earthquakes.	To demonstrate the influence of vegetation on erosion, put soil in two shallow rectangular baking pans. Cover one pan with a layer of sod. Elevate one end of each pan. Compare and discuss the erosion caused by equal amounts of water running down each slope.	Identify one manmade attribute that slows the erosion process (e.g., hay bales used at a construction site, silt fence protecting sand dunes) and one attribute that accelerates it (e.g., paving a parking lot, cutting trees). Relate these to natural systems. (T/E 2.1, 2.4)

Technology/Engineering, Grades 3–5

Learning Standards

1. Materials and Tools

Central Concept: Appropriate materials, tools, and machines extend our ability to solve problems and invent.

1.1 Identify materials used to accomplish a design task based on a specific property, e.g., strength, hardness, and flexibility.

1.2 Identify and explain the appropriate materials and tools (e.g., hammer, screwdriver, pliers, tape measure, screws, nails, and other mechanical fasteners) to construct a given prototype safely.

1.3 Identify and explain the difference between simple and complex machines, e.g., hand can opener that includes multiple gears, wheel, wedge, gear, and lever.

Appendix VII: Survey Results

Survey Number	Trip to Creek	Pumpkin Patch	Natural Science Museum	Sheep	Fossils	Old Mill - 2	Aquarium	Sankaty	Astronomy	Bird	Monarch	Vernal	Old Mill - 5	Chaperone	Remember	Valuable
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	Blue Lobsters, puffer fish, huge lobster	1
4	1	1	0	0	0	1	0	0	0	0	0	0	0	0	Hermit crabs, pumpkins	1
5	0	0	0	0	0	0	1	0	0	0	1	1	0	0	Likes	4
6	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	1	Listening, going back as a family	1
8	0	1	0	0	0	0	0	0	0	0	0	0	0	1	Spiders	1
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
10	0	1	1	0	0	1	1	0	0	0	1	1	0	0	See things for real	2
11	0	0	0	0	1	0	1	0	0	1	1	0	1	0	Blue lobster, catch butterfly, raise sails, dead birds	3
12	1	1	1	1	1	1	1	1	1	1	1	0	0	1	Horseshoe crab	1
13	0	0	0	0	1	0	0	0	0	0	1	0	1	1	Missions to learn, imagination adventures, applying learned knowledge to the larger world.	1
15	0	1	0	0	1	0	0	1	0	0	0	0	0	1	Little	2
16	0	1	1	0	0	0	1	0	0	1	1	1	0	1	Birds	2
17	0	0	0	0	0	1	1	0	0	1	1	0	1	1	Grind corn, hard to reach butterflies, how birds kill	7
18	0	0	0	0	0	0	0	0	0	0	0	0	0	1	Mayflower	2
19	0	1	0	0	0	0	0	0	0	0	1	0	1	1	Touch butterfly, grind corn, learn about pumpkin	9
20	0	0	0	0	0	0	0	0	0	0	1	0	1	1	Team, search for butterfly, how the mill worked, touch, olden days	3
21	1	1	1	1	1	1	1	1	1	0	1	1	1	1	Sheep shearing, astronomy	7
22	1	1	0	0	1	1	0	1	1	1	1	0	1	1	Dead fish, dead birds, no	2

															pumpkin, moons of jupiter…	
23	0	1	0	1	1	1	0	1	0	1	1	0	1	0	Likes	1
24	1	1	1	1	0	0	0	0	0	0	0	0	0	0	Talks about learning	1
25	0	1	1	0	0	0	1	0	0	0	0	0	0	1	Blue lobster, pumpkins	1
26	0	0	0	0	0	0	1	0	0	0	0	0	0	0	Blue lobster, tropical fish	2
27	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1
28	1	1	0	0	0	0	0	0	0	0	0	0	0	0	Exploring nature, friends with learning, being able to talk about learning with family	1
29	1	0	0	0	0	0	0	0	0	0	0	0	0	1	Water search, sand whale	2
30	0	0	0	0	0	0	1	0	0	0	0	0	0	0	Touch tank, Blue lobster, pufferfish	2
31	0	0	0	0	0	0	1	0	0	0	0	0	0	0	Touch, Skate, Jellyfish	2
32	1	1	1	1	1	1	1	0	0	0	0	0	0	1	Likes	2
33	0	1	1	0	1	0	1	0	0	0	0	0	0	0	Likes	1
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
35	1	0	1	1	1	0	0	0	0	0	0	0	0	0	Little	1
36	1	0	0	0	0	0	0	0	0	0	0	0	0	1	Cleaning, Vacuum the Cranberries, bogs, grapes	1
37	1	1	0	0	0	0	0	0	0	0	0	0	0	0	Likes	1
38	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Learn, talk about	1
40	0	0	0	0	0	1	1	0	0	0	0	0	0	0	Mayflower, aquarium	2
41	0	1	0	0	1	0	0	0	1	0	1	0	1	0	Pumpkins, butterfly	9
42	0	0	0	0	0	0	0	0	1	1	1	0	1	1	Birds, old mill, butterfly, saturn	3
43	0	0	0	0	0	0	0	0	0	0	1	0	0	0	Butterflies	2
44	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Life cycle of pumpkin, saw plants and cows	2
45	0	0	0	0	0	0	0	0	0	0	0	0	0	1	Activities	1
46	1	0	0	0	0	0	0	0	0	0	0	0	0	0	Stations, jellyfish, crabs, sand whale	3
47	1	1	0	0	0	0	0	0	0	0	0	0	0	0	Crabs, sharks, minnows, squash, birds, pumpkins	0

48	1	0	0	0	0	0	0	0	0	0	0	0	0	1	Fun, crabs, raced	1
49	0	0	0	0	0	0	0	0	0	0	1	0	1	0	Butterflies, pulling sheet, gears	1
50	1	1	0	0	0	0	0	0	0	1	1	0	1	0	Birds dieing, butterfly catching	3
51	0	0	0	0	0	0	0	0	0	1	1	0	1	0	Birds, no butterfly just fun, pulling rope at mill	2
52	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Very interesting, birds, pulleys	1
53	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	1
54	1	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0
55	1	1	0	0	1	0	0	0	0	0	1	0	0	0	Butterflies	2
56	1	0	0	0	0	1	0	0	0	1	1	0	1	1	Birds dieing, field trips are great	2
57	0	0	0	0	0	0	0	0	0	0	1	0	1	0	Butterfly pouch, sails in old mill, levers	2
58	0	0	0	0	0	0	0	0	0	0	1	1	1	0	Butterfly, grinding corns	1
59	0	0	0	0	1	1	1	0	1	1	1	0	1	1	Aquarium	1
60	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	1
	20	23	10	7	14	12	18	7	8	14	27	6	20	26		

In the survey results, the name of locations are possible responses to question 1. 1 for attended, 0 for not. Same system for chaperones. Remember has some key words from responses to questions number three. Valuable is coded in binary converted to decimal. 1 is education, 10 or 2 is community, 100 or 4 is science, 1000 or 8 is fun. This allowed multiple responses to be coded into one response.

Reasons for Value	Chaperone	Not	Sum
Education	18	17	35
Community	12	13	25
Science	2	1	3
Fun	1	1	2