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An Exploration of Object and Scientific Skills-Based Strategies for Teaching Archaeology in a Museum Setting

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AN EXPLORATION OF OBJECT AND SCIENTIFIC SKILLS-BASED STRATEGIES FOR TEACHING ARCHAEOLOGY IN A MUSEUM SETTING

by

Candice L. Cravins

A thesis submitted in partial fulfillment
of the requirements for the degree

of

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ABSTRACT

An Exploration of Object and Scientific Skills-Based Strategies for Teaching Archaeology in a Museum Setting

by

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Archaeologists are increasingly asked to justify the meaning and importance of their work to the public through the development of outreach and education programs. As repositories of culture, museums provide a perfect medium to assist in the promotion of an archaeology that is both relevant and engaging. Many archaeology education programs advocate "doing" or "learning about" archaeology, placing strict emphasis upon stewardship messages and the dangers associated with looting and site destruction. While this approach to teaching makes excellent sense from a modern cultural resource management perspective, it fails to portray archaeology education in any other light.

Archaeology exhibits particular relevance within public schools, whose population holds one of the discipline's largest, most inclusive captive audiences. This paper explores the most effective strategies for teaching archaeology to third and fourth grade students in the museum. I assess student level of engagement with object- and scientific skills-based activities, and results of a pilot study conducted at the Utah State

University Museum of Anthropology indicate a need for more object-based curricula within archaeology education programs. Detailed consideration of archaeology's relevance to skills developed within the social, physical, and life sciences highlights areas of focus and improvement in current and future programs.

(86 pages)

PUBLIC ABSTRACT

An Exploration of Object and Scientific Skills-Based Strategies for Teaching Archaeology in a Museum Setting

A pilot study conducted at the Utah State University Museum of Anthropology explores the most engaging strategies for teaching archaeology to children in a museum setting. During a week- long summer workshop event in June 2013, two styles or modes of teaching archaeology were contrasted and evaluated: object-based teaching and scientific-skills based teaching. The teaching styles are evaluated based on third and fourth grade students' level of excitement and engagement with various archaeology activities – which activities are the most interesting and engaging to children while they are in the museum? The first mode of teaching archaeology focuses on object-based learning. This mode of teaching, traditionally used in the museum environment, emphasizes the use of primary resources (for example, artifacts, unpublished photographs, or maps) in learning about past people, events, and everyday life. The second mode of teaching focuses on scientific-skills development, particularly skills related to math and measurement and the application of the scientific method in answering research questions.

Four, fourth-grade-level appropriate lesson plans were developed and administered to 58 third and fourth grade students between the ages of eight and ten. Two lesson plans utilize object-based teaching strategies, and two lesson plans focus on scientific skills development. The lesson plans engage students with hands-on learning activities, such as creating their own Fremont pottery, participating in a mock archaeological excavation, creating their own split twig figurines, and learning about tree-ring dating. Prior to participation in any activities, students were given a pre-teaching questionnaire to assess their previous knowledge of and experience with archaeology. To assess which activities students found most exciting, students were asked to complete a post-teaching questionnaire.

When in the museum, children generally prefer object-based archaeology activities. The information gleaned from this pilot study may assist archaeologists, museum professionals, and education specialists in creating more relevant and exciting archaeology education programs. Through identification of the most engaging archaeology activities, museums and other informal learning institutions (for example, those that are part of the National Park Service, Bureau of Land Management, and other cultural and scientific learning centers) can focus on implementing those types of activities into their programs to better communicate with their audiences.

Candice L. Cravins

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INTRODUCTION

Public outreach and education comprise essential components of contemporary cultural resource management (CRM). Archaeologists hold both legal and ethical obligations to report their findings to the public, present knowledge in a way that promotes understanding and appreciation of a shared heritage, and serve as good stewards of the archaeological record. Archaeologists have only recently, however, more fully realized the importance of making archaeology relevant to the public (Fedorak 1994; Jameson 2004; Malloy 2011; McManamon 1991; Merriman 2004; Smardz 1989; Stone 1997). Most archaeology education programs advocate "doing" or "learning about" archaeology (Fedorak 1994), placing strict emphasis upon stewardship messages (Smardz Frost 2004) and the dangers associated with looting and site destruction. While this approach makes excellent sense from a management perspective, it fails to portray archaeology education in any other light.

While archaeology education programs boast a solid foundation in Canada and the United Kingdom (Fedorak 1994; MacDonald and Shaw 2004; Thomas 2004), less attention has been given to comprehensive examinations of such programs in the United States (Jeppson and Brauer 2007; Smardz and Smith 2000) – with the exception of programs meant to simply enhance popular interest in archaeological matters (Smardz Frost 2004). Relatively few archaeologists have sought to replace the romanticized images of their discipline's goals with a more accurate picture of archaeology's social relevance. Historically, the discipline has also presented very few opportunities for people other than archaeologists to participate in research activities (Fedorak 1994), and public consultation is not often a top priority in archaeological museum development and

management (Merriman 2004). This lack of public access to and involvement in archaeology, perhaps driven by the fact that archaeologists are generally unfamiliar with the best ways to approach educating members of a diverse public (Smardz and Smith 2000:39), presents an environment rich in opportunities for new research avenues. These research avenues focus on creative ways to meet the professional needs of both archaeologists and museum education specialists in promoting an archaeology that is relevant and engaging (Fedorak 1994; Jeppson 2007; Smardz and Smith 2000; Smardz Frost 2004; Whiting 1997).

As an applied branch of archaeology, educational archaeology encourages the use of archaeology as a tool for teaching and learning about the past and involves the production of educational materials and public programs (Fedorak 1994; Smardz 1989). Jameson (2004:21) notes that educational archaeology often refers to formal K-12 classroom situations but that it can also apply to less formal education settings, such as those found in museums or in National Park interpretive centers. Paris and Hapgood (2002) note two defining features of informal learning environments (ILEs) that distinguish them from formal classroom settings. First, ILEs foster enculturation of visitors into social practices through engagement with valued cultural objects. Second, ILEs promote individualized, self-guided knowledge seeking and exploration. The following focuses on educational archaeology as it applies to such an informal education setting, specifically, the anthropology museum. As repositories of culture, museums embody a unique environment in which *anyone* can learn something new about the world around them in imaginative ways (Lasky 2009). The general public thus regards museums as reliable and important information sources (Falk and Dierking 2000, 2002),

and given that elementary school students constitute one of archaeology's largest audiences (Jeppson and Brauer 2007:236), it is essential to better understand how we can effectively engage with this age group.

As noted above, most educational archaeology programs have emphasized "doing" or "learning about" archaeology (Fedorak 1994). However, if archaeologists wish to effectively communicate the importance of archaeology to the public and reach out to a greater number of people, they must switch their emphasis from teaching *about* archaeology to teaching *with* archaeology (Higgins and Holm 1985) – by using the discipline to teach key social science, math, and science skills within our existing educational frameworks in ways that are relevant to our daily lives. An effective communication strategy involves opening the discipline to increased public dialogue and reaching beyond traditional limits set by academic and CRM archaeology (Mayer-Oakes 1989). In this way, archaeologists can explore new outlets by recognizing others' needs as well as secure the public's continued interest and support (Jeppson and Brauer 2007).

Objectives and Relevance of the Study

The primary objectives of this thesis project are to expand on the research conducted in educational archaeology (Fedorak 1994; Higgins and Holm 1985; Jeppson and Brauer 2007; Owen and Steele 2005; Smardz and Smith 2000; Smardz Frost 2004; Whiting 1997), examine two relevant teaching frameworks, and apply that information in a pilot study focusing on effective strategies for teaching archaeology within the museum. More specifically, the overall objective is to develop and administer four, fourth-grade-level lesson plans focusing on Utah archaeology (two object-driven and two scientific skills development-driven) to third-and fourth-grade students at a summer day

camp at the Utah State University Museum of Anthropology, and evaluate through questionnaires their levels of engagement in the various activities. Are students more engaged with and excited about object-driven archaeology activities or scientific skills-driven activities? What kinds of activities make children more willing to participate in archaeological programs or events? Where are students learning about archaeology? This information can assist archaeologists and museum professionals in drawing more students into the museum through effective education programs.

One of the primary aims of this project is to provide quantitative measures of the effects third and fourth grade students' perceptions of archaeology have on interest and engagement with archaeology-based learning activities. A second primary aim of this project is to assess some of the most effective strategies for teaching archaeology by evaluating levels of excitement with object-based or scientific skills-based activities. The project thus provides a model for further development and monitoring of archaeology programs within anthropology museums.

The working hypothesis for the first aim is that students with previous experience in archaeology will show a greater level of excitement in the various activities (Owen and Steele 2005). The working hypothesis for the second aim is that students will be more engaged with and excited about object-based learning activities. Given that public school curricula increasingly focus on the development of science, math, and language arts skills at the expense of the arts (Utah Education Network 2013; Winner and Hetland 2009), children will likely find object-based, fine and visual arts-centered activities more enjoyable in informal settings. However, this is not to say that children will be entirely

uninterested in or reject science-based activities more generally or outside the classroom setting.

This research is unique in its approach to understanding the most effective strategies to teach archaeology in museums. Strategies for teaching archaeology have often only been explored in formal classroom situations (Fedorak 1994), and student evaluations of object or scientific skills-driven activities have never been explored. It is anticipated that this approach will result in the following outcomes: a better understanding of how to effectively engage our audiences, particularly elementary school-aged children; a better understanding of how to accurately portray the importance of archaeology to the public; and a better understanding of the creative ways in which archaeologists can meet their professional outreach and education objectives. This research thus holds important implications for archaeology education within a museum setting.

Scope of the Study

This research examines several pertinent questions regarding the most engaging ways to teach archaeology to children within a museum setting. These questions focus on students' individual perceptions and experiences related to archaeology-based learning activities and are not intended to provide an assessment of student achievement or retention of learning materials. Additionally, this research is not intended to provide a comprehensive overview of *all* different types of teaching strategies that can be used in a museum, nor is it intended to represent the effectiveness of strategies for teaching archaeology in formal K-12 classroom settings. The choice to include object and science-based strategies was founded upon an examination of the overall success of two

traditional teaching strategies *within the museum*. Both approaches are appropriate for teaching archaeology to children in a museum setting, and both approaches yield positive results. The goal of this research is simply to identify which of these two approaches is most engaging to children while in a museum.

Object-based teaching, one of the most common strategies used in the museum, emphasizes the links between physical objects and critical and historical analysis. Through the exploration of material culture, such as artifacts or documents, students can learn about an object and its relationship to other objects, people, and ideas in an individualized context (Falk and Dierking 2000, 2002; Merriman 2004). In this case, an object is used to initiate discussion and learning with little mediation from a formal educator (Paris 2002; Shuh 1982) and provides an additional dimension to learning not typically available to students in formal classroom settings (Dewey 1934, 1963; Lasky 2009). This object-centered framework of learning in the museum is largely founded upon basic cognitive-developmental, contextual, experiential, and inquiry-based educational theories (Dewey 1933, 1934, 1963; Falk and Dierking 2002; Gardner 1983, 2006; Piaget 1983; Vygotsky 1978).

Alternatively, science-based teaching strategies focus on the refinement of skills in science (biological and physical, as well as social and other natural sciences), technology, engineering, and mathematics – the STEM disciplines. STEM education emphasizes the use of an interdisciplinary and applied curriculum and holds important implications for workforce and technology development in the United States (The National Center for STEM Elementary Education 2014). Archaeology has shown to be well suited to the reinforcement of key principles in STEM education (Cooper 2003;

Davis 2000; Geiger 2004; Jeppson and Brauer 2007; Mamola and Bloodgood 2002; Owen and Steele 2005). Given that an ever-increasing number of United States public schools are emphasizing STEM education to prepare students for future STEM careers, archaeology's connection to science and technology is timely. Through archaeological inquiry, students can refine skills and understanding of concepts in mathematics, social studies, and the basic principles of the scientific method such as observation and inference. Informal learning institutions like the museum can assist in providing access to science-based resources outside the constraints of a traditional school day.

The following questions form the basis of the current research project in addressing the issues detailed here:

1. Overall, what is the most engaging strategy for teaching archaeology to children in a museum: an object-driven strategy or a scientific skills-driven strategy?

2. Do children with previous experience in archaeology show greater interest in archaeology activities at the museum?

3. Is there an association between a child's age and gender and their degree of interest in archaeology activities? For example, do girls and boys prefer different kinds of activities? Do eight-year olds enjoy different activities than ten-year olds?

4. The success of an education program, especially within a museum setting, is often measured in terms of whether or not patrons are likely to return to the museum or tell others about what they experienced (Falk and Dierking 2000, 2002). Are children likely to tell their friends and family about the activities they

participate in at the museum? Does an object- and scientific-skills centered program encourage children to learn more or participate in future activities?

By exploring these research questions through the administration of lesson plans and evaluation of student questionnaires as guiding tools, this project highlights some of the most engaging and effective ways to teach archaeology to children in museums. It illustrates the importance of collaborative efforts made between archaeologists and museum professionals in meeting the common goal of commitment to education (Bonner 1985; Paris and Hapgood 2002). Finally, the project underscores the importance of understanding public needs and interests in developing more relevant educational programming. The information collected in this study provides a basic foundation on which museums can create new or modify existing programs.

Overall, the data acquired through this research project provide a well-rounded representation of third and fourth grade students' experiences with archaeology activities. Although the sample is small, the students' observations present a reliable judgment of the effectiveness of the developed and tested archaeology activities. The learning environment context is important, and the data show that third and fourth grade students enjoy object-based activities more than science-based activities *when in the anthropology museum*. Education programs featuring both object and science-based activities promote positive discussion with friends and family members as well as encourage return trips to the museum.

Previous Research

Responsibility cannot be left only to school educators to create access to archaeology for their students (Owen and Steele 2005; Smardz 1997). Powered by an

obligation to public outreach and education, archaeologists and museum professionals can assist in providing that access. Archaeology is a potent teaching tool for many reasons, most commonly used to instill in the public messages of stewardship and the dangers associated with looting and site destruction (Smardz Frost 2004; Smith et al. 1993). Less apparent, however, is archaeology's employment of social, communication, problem solving, and mathematical applications (Owen and Steele 2005; Smith et al. 1993) – all key components of social science and humanities curricula, as well as the science, technology, engineering, and math (STEM) disciplines that comprise the core of precollegiate education in the United States today. As noted above, archaeology is well suited to the reinforcement of principles taught within these disciplines (Cooper 2003; Davis 2000; Geiger 2004; Jeppson and Brauer 2007; Mamola and Bloodgood 2002; National Council for the Social Studies 2012; Owen and Steele 2005; Smith et al. 1993). Cooper (2003), in particular, demonstrates archaeology's effectiveness in promoting the development of critical and historical thinking skills in a fourth grade classroom. Through the use of an innovative four-day program he called "Dr. Gesundheit and the Mysteries of Snake Valley," students learn to interpret archaeological diagrams at a fictional site, work together to examine relationships between the materials found at that site, and draw conclusions based on their observations using the scientific method. Alternatively from a service-learning perspective, Geiger's (2004) work also highlights the important role archaeology can play in teaching about history and science. Connecting state content standards in science and social studies for middle and high school students in Alabama with experiential learning in archaeology, Geiger (2004) discusses the skills developed through participation in the USDA Forest Service

"Passport in Time" program. Students learn to apply the scientific method to archaeological fieldwork, fine-tuning their understanding and applying the method in real-world situations. At the same time, students learn how to interpret the past – building upon key themes in social studies such as culture, time, and the relationships between humans and their environment (Geiger 2004:167).

Public school K-12 students constitute archaeology's largest and most inclusive audience (Jeppson and Brauer 2007:236), and it is within this resource base that archaeologists can create lifelong learners and shape well-informed and involved stewards of our nation's cultural resources. Jeppson and Brauer (2007) provide one of the best case studies for exploring the development of successful archaeology-based teaching modules embedded within public school curricula. The Baltimore County Public Schools Program of Archaeology (Jeppson and Brauer 2007) is a great example of how to create a strong archaeology education program, as it falls *within* the existing curricula. Developed by a social studies specialist in collaboration with a professional archaeologist, the program allows students to develop spatial perception and map-making skills, as well as participate in "artifact analysis" and "excavation" type activities to learn how to measure and weigh materials – key STEM skills tested for in state assessments (Jeppson and Brauer 2007:242). In addition to illustrating archaeology's relevance in teaching key skills in science and social studies, Jeppson and Brauer (2007) highlight the importance of collaborative efforts in archaeology curriculum development – a key theme woven throughout the current research project.

Project Archaeology's *Investigating Shelter* program, a supplementary nine-lesson science and social studies curriculum designed to support Common Core

Standards in literacy and mathematics for grades three through five, further demonstrates archaeology's relevance to refinement of STEM skills in the classroom (Common Core State Standards Initiative 2012; Letts and Moe 2009; Project Archaeology 2012). While survey, excavation, and artifact analysis activities can teach students key skills in math and measurement, the *Investigating Shelter* program helps students refine additional skills in the scientific method itself. An entire lesson is dedicated to an understanding of observation, inference, and evidence, and how the archaeological concept of shelter can be tied to the understanding of cultures past and present. Students apply concepts and skills developed through archaeological inquiry to real-world problems encountered throughout their K-12 coursework (Smith et al. 1993).

While these programs and others like *Intrigue of the Past* (Smith et al. 1993) illustrate the many ways that archaeology can be used to refine key social studies and STEM skills in the classroom, archaeologists must also have a general understanding of how education is conceptualized at the national and state levels (Davis 2000), the unique ways children learn and develop (Danes 1989; Johnson 2000; Smardz 1989), and the relevant teaching frameworks most appropriate for archaeology instruction. This knowledge rests hand in hand with the development of effective, collaborative informal education programs. Key to Davis' (2000) discussion, in particular, is an understanding that American education is far from homogenous and requires a flexible teaching approach. Students come from many socioeconomic and ethnic backgrounds and speak numerous primary languages. Additionally, children who come from diverse backgrounds learn in very different ways. My research project requires an understanding of how education is conceptualized in the state of Utah, pulling from basic curriculum

construction and pedagogy. This basic understanding allows archaeologists to better understand their audiences and communicate their messages through relevant education programs.

While topics related to the development of effective archaeology education programs have been addressed individually and on more general levels (Smardz and Smith 2000), they have not been well explored in applications to case studies within the museum. Case studies illustrating successful archaeology education programs *do* point to the many benefits associated with collaborative efforts in meeting learning objectives (Bunderson et al. 1996; Fedorak 1994; Geiger 2004; Jeppson and Brauer 2007). Few studies delve deeper into understanding the basic foundations of student learning, understanding which activities get students most excited about archaeology, or clearly outlining the state or national curriculum standards their programs assist in meeting. Examination of these case studies reveals a number of independently authored publications either by educators (e.g., Cooper 2003; Geiger 2004) or archaeologists (e.g., Owen and Steele 2005; Smardz 1989), which illustrates a lack of collaboration between professionals tasked with developing effective archaeology education programs. Additionally, these studies demonstrate the importance of revisiting original sources related to relevant educational and cognitive development theories and teaching frameworks (Dewey 1933, 1963; Gardner 1983; Piaget 1983; Vygotsky 1978), rather than rely upon other archaeologists' interpretations and summaries.

Archaeology Education in the State of Utah

Archaeology education within the state of Utah exemplifies the discipline's relevance to core subjects in public schools and the power of collaborative efforts in

developing engaging curricula both in and outside the formal classroom. Museums such as the Utah State University Museum of Anthropology, the Natural History Museum of Utah, and the Brigham Young University Museum of Peoples and Cultures successfully incorporate activities and lesson plans that assist in meeting state and national learning objectives into their public outreach programs (Museum of Peoples and Cultures 2014; Natural History Museum of Utah 2014; USU Museum of Anthropology 2014). Archaeology's relevance in reinforcing skills learned in the classroom is demonstrated through the creation of these important ties to state core curricula. Highly specialized or technical archaeological materials, especially if they do not assist in meeting learning objectives already set in place by school boards, are also unlikely to draw student groups and educators into the museum itself.

The state of Utah has identified core learning standards by grade level that are essential for all students (Utah Education Network 2013). While key concepts show potential for integration into any subject at any grade level, archaeology is most appropriate for inclusion in existing grade 3 through 6 social studies and science curricula. Core standards in social studies for these grade levels focus on the relationships between geography and human culture and understanding how ancient civilizations developed (Utah Education Network 2013). Core standards in science for these grade levels focus on learning and using the scientific method, understanding interactions between living and nonliving things, and understanding properties of inheritance of traits in living things (Utah Education Network 2013). While not taught as a stand-alone subject, archaeology is woven throughout lesson plans teaching core standards in the life, physical, and social sciences.

The Utah Education Network provides some excellent examples of how archaeology is incorporated within state curricula through lesson plans developed in collaboration with the Utah Museum of Natural History. These lesson plans focus, for example, on investigating "cultural clutter" through "tales in the trash" (Utah Education Network 2004a). Here, fourth grade students explore the evidence of prehistoric cultures that encouraged archaeologists to investigate the marshes around the Great Salt Lake in the 1980s. The lesson plan utilizes an object-based teaching strategy to paint a picture of what life may have been like in prehistoric Utah. After listening to a short story, students are given artifact picture cards and asked to discuss what the object is, how it may have been used, and who may have used it. Objects (artifacts) are effectively used to initiate and promote discussion and critical thinking about the past. In addition to illustrating how archaeological concepts can be integrated into existing social studies curricula, the lesson plan teaches students the importance of not disturbing archaeological remains. The lesson plan thus successfully meets the goals and needs of both educators *and* archaeologists.

Another example focuses on Shoshone Seasonal Land Use and Culture (Utah Education Network 2011). This particular lesson plan was created in consultation with the University of Utah American West Center, the Utah State Office of Education, and Northwestern Band of Shoshone, Goshute, Ute, and Southern Paiute nations. The plan teaches students how to analyze the relationship between environment and culture and meets multiple standards within the fourth grade social studies curriculum, including Standard 2, Objective 1: "Describe the historical and current impact of various cultural groups on Utah (Utah Education Network 2013)." It encourages students to explore the similarities and differences in the seasonal dietary and activity habits between themselves

and the ancestral Shoshones, and allows them to refine listening and speaking skills through storytelling – an important aspect of Shoshone culture. Instructional procedures utilize Venn diagrams and coloring books to drive home important concepts relating to the interaction of peoples with their environment. Objects are employed to assist students in visualizing cultural similarities and differences on an individualized level.

An examination of these lesson plans illustrates a tendency toward object-based strategies when teaching archaeological concepts in the classroom. This lack of archaeological lesson plans directly tied to more science-based learning objectives presents an environment in which museums can play a crucial role in filling gaps left behind by standard use of object-driven lesson plans. Museums can provide access to science-based archaeology activities through the implementation of outreach programs such as the one piloted at the USU Museum of Anthropology.

METHODS

This section details the methodology used throughout the research project including lesson plan and student questionnaire development; selection of study group sample size and population; the Institutional Review Board approval process; community outreach and marketing; the administration of lesson plans and student evaluation questionnaires (study procedures); and data analysis.

Lesson Plan and Student Questionnaire Development and Selection of Sample Size and Population

To explore the most engaging ways to teach archaeology within the museum, two styles or modes of teaching archaeology were contrasted and evaluated: object-based teaching and scientific, hypothesis-driven teaching. The teaching styles were evaluated based on student level of excitement about the various activities – which activities were the most interesting and engaging? Which activities will draw students back to the museum? As discussed above, object-based teaching is traditionally used in the museum environment and emphasizes the use of primary resources (for example, artifacts) in learning about past people, events, and everyday life (Shuh 1982). The second mode of teaching focuses on scientific skills development, particularly skills related to math and measurement and the application of scientific methods in answering research questions. Key scientific concepts such as observation, inference, and evidence are taught through archaeologically based, real-world problems.

Four, fourth-grade-level appropriate lesson plans were developed and administered to students during daylong events at the USU Museum of Anthropology. Two lessons utilized object-based teaching strategies, and two lessons focused on

scientific skills development. These lesson plans engaged students in hands-on learning activities such as creating their own Fremont pottery, creating their own split twig figurines, participating in a mock archaeological survey and excavation, and learning about tree-ring dating. The Fremont pottery and split twig figurine exercises utilized traditional object-based teaching strategies, while the excavation and tree-ring dating exercises stressed scientific skills development (see Appendices A-D).

One-page evaluation questionnaires were created to assess students' previous knowledge of archaeology and gauge which activities students found most exciting. Pre-teaching questionnaires assessed whether or not students knew what archaeology was, how archaeologists look for and find sites, where they have learned about archaeology, and whether or not this was their first time participating in an archaeology project (see Appendix E). These questions were devised to provide data for analysis of correlations between a student's previous knowledge of archaeology and their level of interest in the various activities, as well as provide an idea of where archaeologists and museum specialists should focus their education programs. Post-teaching questionnaires asked students which activities they found most exciting using a clearly distinguishable, five-point pictorially labeled Likert scale (Likert 1932). The post-teaching questionnaire also asks students whether or not they would like to participate in future activities and whether or not they are likely to communicate what they learned to their friends and family (see Appendix F). These questions were devised to provide quantitative measures of the most engaging ways to teach archaeology, answering the question of whether or not object and science-based learning activities are effective in teaching archaeology to children, as well

as whether or not these activities encourage children to share their knowledge with others.

Lesson plans were developed following a standard template used in Utah public schools (Utah Education Network 2013) and included overall learning objectives, core curriculum ties, required materials, background information, instructional procedures, closing activities, and evaluation components for each of the activities. The Fremont pottery and mock archaeological excavation activities were adapted from lesson plans already approved and used in Utah public schools for fourth grade (Utah Education Network 2004b). The split twig figurine exercise was adapted from the Society for American Archaeology's activity developed by Carol Ellick of the SRI Foundation, tested and approved for children seven years of age and up (Ellick 2012). The tree-ring dating activity was developed using the "Lab-Aids Kit 52: Dendrochronology Tree Ring Dating Kit" approved for use in supervised classroom settings by students nine years of age and older (Lab-Aids, Incorporated 2000). Personal familiarity and over two years of experience working with standard lesson plan templates and grade school curriculum was also used as a guide throughout this process. This format was chosen to ensure that children were familiar and comfortable with how learning activities are executed in the Museum, thus making them more likely to provide honest and accurate feedback on questionnaires. Evaluation questionnaires were developed following survey templates commonly utilized in classroom and museum settings. Aesthetically pleasing color and font schemes, illustrations, and inclusion of short, clearly worded multiple choice and short answer questions allowed for the collection of meaningful data (Bell 2007; Borgers et al. 2000; de Leeuw 2011; Earthman et al. 1999).

The relevance of archaeology to the Utah core curriculum for grades three and four (Utah Education Network 2013) guided the choice to include children ranging from ages eight to ten in this study. Additionally, students of this age group are at an appropriate level of cognitive development in which they can thoughtfully engage with learning material and provide meaningful feedback (Borgers et al. 2000; de Leeuw 2011; Scott 1997). An initial sample size of 125 students (25 students per day) was selected based on an examination of the Museum of Anthropology's past visitation records for school tours and similar events during summer months, an estimate of a third-and fourth-grade classroom ratio of 20 students to one teacher for local schools, and a consideration of space limitations within the Museum itself. Of this sample, 58 students (approximately 10 to 15 students per day), equally split amongst males and females ranging from ages eight to ten, represented the total number of children who voluntarily enrolled in the summer day camp. No students were denied admission to the camp unless they fell outside of the study age group. The hands-on nature of the activities and the skill levels of individual students were also considered; a larger sample size would have had a negative effect on the effective execution of lesson plans and activities, as larger student groups become increasingly more difficult to manage (Quarto 2007).

The Institutional Review Board Approval Process

Utah State University conducts research designed to create new knowledge and promote an improved quality of life for citizens of Utah, the nation, and the world. The Institutional Review Board (IRB) at Utah State University reviews and approves all research involving human participants prior to the initiation of such research, including project advertising and public outreach. The IRB operates according to Title 45 Code of

Federal Regulations (CFR) part 46, Federal and State guidelines, and the Belmont Report.

IRB approval was required since this research project seeks to contribute to general knowledge and obtain data from living individuals through interaction and intervention. IRB General Protocol #5169 was initiated on May 2, 2013 under the direction of Dr. Bonnie Glass-Coffin, who served as the project's Principal Investigator. Approval to conduct research was granted on May 23, 2013 (see Appendix G), and carries an expiration date of May 2, 2014.

The requirement to ensure scientific validity was fulfilled by the submission of a detailed project summary and a scientific validity checklist. Most importantly, the IRB protocol detailed the approved measures put in place to ensure the proper protection of participants' personal information and survey data and in order to minimize any possible risks associated with participation in the project. The approved measures implemented throughout the research project included the following: no personally identifiable information (i.e., names) was collected on student questionnaires; identifiable information found on registration forms and camp permission slips was kept separate from survey data, as student questionnaires were randomly numbered and unable to be linked to individual participants; parents and guardians were given the opportunity to "opt out" of the project's research component and still allow their children to participate in activities; and all activities were conducted under direct museum staff supervision in order to minimize any potential physical risks.

Collaborative Institutional Training Initiative (CITI) certification is also required of any individual conducting human subjects research at Utah State University. The

"Social and Behavioral Research Modules, Basic Course," with optional modules "Research with Children," "Conflicts of Interest in Research Involving Human Subjects," and "Unanticipated Problems and Reporting Requirements in Social and Behavioral Research" were completed on April 24, 2013.

Community Outreach and Marketing

Since this project targeted third-and fourth-grade students ranging from 8 to 10 years of age, community outreach and marketing focused on reaching out to local elementary school teachers in the Logan City and Cache County school districts, the Edith Bowen Laboratory School on the Utah State University campus, and the Thomas Edison charter schools. Emails and fliers (see Appendices H and I) were sent to teachers, with follow-up calls and emails made to administration as necessary. Community outreach and marketing began on May 23, 2013, as soon as approval to conduct research was granted.

Fliers featuring camp activities, dates, location, and registration and contact information were posted in numerous online venues, including the Museum of Anthropology's Facebook page and website; the USU Anthropology Program, the Utah Professional Archaeological Council, Cache Valley Boys and Girls Scouts, and Utah State Antiquities Section (SHPO) Facebook pages; and the Cache Valley Visitor's Bureau, Logan and Hyrum City Public Libraries, Utah State University, and the Now Playing Utah events calendars. Fliers and information were distributed to museum employees conducting school tours and given to friends throughout the community. Fliers were also posted in public venues including libraries, and camp registration and

recruitment took place during regularly scheduled "Saturdays at the Museum" events at the Museum of Anthropology.

This marketing plan was chosen based on an examination of the Museum of Anthropology's current and previously successful marketing strategies. Online venues, weekly emails, and word-of-mouth are the most effective means through which the Museum's visitors learn about various activities and events.

The Administration of Lesson Plans and Student Questionnaires

Lesson plans and student questionnaires were administered to third and fourth grade students at an archaeology day camp at the USU Museum of Anthropology from June 24-28, 2013. Parents had the opportunity to register their children for the day of their choice, and from 9:00 am to 1:00 pm each day, 10 to 15 different students took a pre-teaching questionnaire, participated in two object-based learning and two scientific skills-based learning activities, and filled out a post teaching questionnaire after all activities were completed (see Appendices A-F).

Activities were set up at tables in the Museum one at a time following the schedule detailed below, and each activity was conducted *as an entire group* in order to ensure that all students were completing activities at the same time and pace. Candice Cravins led all activities and administered all evaluation questionnaires while undergraduate museum employees assisted individual students in completing each activity. Children as a group were able to walk around the Museum, engage with exhibits (namely the Great Basin and Fremont pithouse displays) and materials related to lesson plans, and walk outside to participate in mock archaeological survey and excavation

activities (Figure 1). This setup ensured that children were both physically and mentally engaged throughout the various activities.

Lesson plans were strictly adhered to in terms of ensuring that main learning objectives were met; however, small modifications were made depending on individual or group needs. All questions found in the pre- and-post teaching questionnaires were read aloud to the students, with clarifications and explanations made when confusion arose. All students completed each questionnaire at the same time, and students were not allowed to proceed to the next question until directed. No individual answers were shared amongst the group. Each day's student groups spent the same amount of time on each of the activities.

The schedule of daily activities was as follows:

- 8:30 am to 9:00 am: Activity preparation and student drop-off and check-in;
- 9:00 am to 9:15 am: Introduction and completion of pre-teaching questionnaires;
- 9:15 am to 10:00 am: Completion of split-twig figurine activity at tables;
- 10:00 am to 11:00 am: Completion of mock archaeological excavation and survey activity outside;
- 11:00 am to 11:15 am: Short break – Students play a quick game of "Simon Says," stretch, eat a snack, listen to the *You Wouldn't Want to be a Mammoth Hunter* story, etc.
- 11:15 am to 11:45 am: Completion of tree-ring dating activity at tables;
- 11:45 am to 12:30 pm: Completion of Fremont pottery making activity at tables;
- 12:30 pm to 1:00 pm: Completion of post-teaching questionnaire, show and tell, clean up, and wait for parents or guardians;

- 1:00 pm to 2:00 pm: Clean up and prepare for next day's activities.

This activity schedule was developed based on personal experience with time needed to complete similar activities in formal classroom and museum settings.

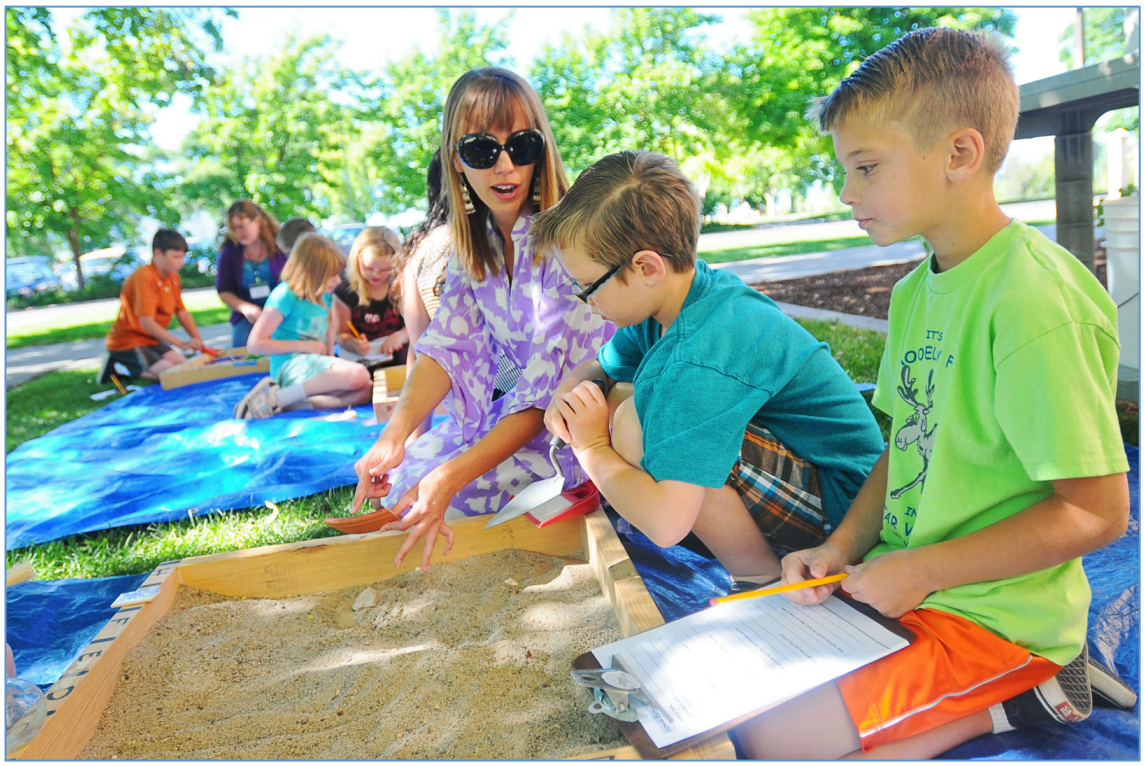

Figure 1. Candice Cravins Instructs Camp Participants in Artifact Identification and Excavation Techniques. Photo courtesy of *The Herald Journal.*

Quantitative Analysis of Student Survey Data

Results from student pre- and post-teaching surveys illustrate the opinions of 58 children between the ages of 8 and 10. The results for each question on each survey form were compiled and allocated into categories using the statistical analysis program Statistical Package for Social Sciences (SPSS). Responses were identified within the program by the hand-written number found on each of the physical copies of the student questionnaires (1-58). This procedure ensured participant anonymity.

Multiple choice and yes/no questions were set up within the SPSS program using a nominal scale and coded numerically for each response, with "1" corresponding to multiple choice answer "A," "2" corresponding to multiple choice answer "B," and so on. Questions for which there could be multiple responses, such as "Where have you learned about archaeology?" (Appendix E), were separated into multiple variables within the data view and identified by key words. These questions were set up using a nominal scale, and coded with the number "1" for "They checked this" if the student chose that particular item on the questionnaire.

Respondent gender was coded with "1" representing "male" and "2" representing "female." Respondent age was input within SPSS as a numerical variable. Likert scale questions (Likert 1932; Appendix F) were set up within SPSS using an ordinal or ranked scale and coded numerically for each response, with the number "5" representing the most positive response "Loved it," "4" representing "Liked it," "3" as "Neutral/OK," "2" as "Didn't like it," and finally the least positive response "Hated it" coded as "1." This setup provides a breakdown of percentages detailing how much each student enjoyed each activity.

The only open-ended question, "How do archaeologists look for and find archaeological sites?" (Appendix E), was set up within SPSS using a nominal scale and coded numerically for each response based on key words. Key words such as "dig," "look for fossils," or "use technology" were grouped together under single codes for ease of analysis. This procedure highlights the number of times students mentioned these words in their responses, and helps to further identify participants who have previous knowledge of archaeology.

Since the data are categorical, simple frequency tables, case summaries, and cross- tabulations were constructed to explore the data on a basic level (Bernard 2011; Field 2005). This procedure highlights the most frequently selected answers for each survey question and allows for the exploration of possible relationships between nominal and ordinal variables. The research question of "What is the most effective (engaging) way to teach archaeology to children in the museum setting?" is explored using simple frequency tables. The activities with the highest percentages of "Loved it" or "Liked it" show that those activities are the most exciting to the children. The activities with the highest percentages of "Didn't like it" or "Hated it," indicate the least popular or engaging activities. Success of the activities is also measured in terms of the frequency with which children answered positively to the questions "Do you think you will tell your family or friends about what you did today?" and "Do you think your friends would like to participate in archaeology activities?" (Appendix F).

Simple analyses performed within SPSS were used to examine possible relationships between variables (such as age, gender, previous knowledge, and levels of excitement for the various activities), exploring the research questions related to whether or not boys and girls prefer different kinds of activities or whether or not children with previous archaeology experience are more likely to enjoy certain activities. The Mann-Whitney U-test is used to compare two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed. This test is particularly helpful in understanding whether interest in archaeology activities differs based on previous experience or gender. To compare age and degree of interest in archaeology activities, a Kruskal-Wallis one-way ANOVA test is used, and a Spearman's rank

correlation coefficient indicates whether or not there is any association between these interval and ordinal variables (Field 2005; McCrum-Gardner 2007).

RESULTS

A total of 55 students registered in advance for the day camp, and 4 students registered in person at the camp session of their choosing. Of the final 59 students, 58 attended the day for which they registered; only one student who registered in advance did not attend. Of the 58 students who participated in all camp activities as detailed above, 28 (48 percent) were male and 30 (52 percent) were female. Twenty students (35 percent) were 8 years of age, 22 students (38 percent) were 9 years of age, and 16 students (28 percent) were 10 years of age. The following details the results of preliminary analyses.

Pre-Teaching Questionnaire Results

Camp participants were asked the following four open-ended multiple-choice questions on the pre-teaching questionnaire: What is archaeology (Table 1); how do archaeologists look for and find sites (Table 2); where have you learned about archaeology (Table 3); and is this your first time participating in an archaeology project (Table 4)? Blank or illegible responses were coded within SPSS as "Missing." All questions were coded as detailed above, with the exception of the only open-ended question "How do archaeologists look for and find sites?" Here, student responses were grouped together by keyword and split into three categories (Table 2).

The majority of camp participants (75 percent) understood that archaeology was the study of past human life (Table 1). Although 14 percent of students believed archaeology is "the study of dinosaurs," this is a promising find given that this misconception is not often dispelled in schools and consequently persists into adult life

(Balme and Wilson 2004). Children are receiving accurate information regarding archaeology early in their education – whether it be at school, at a museum, from books, or from family or friends. Indeed, camp participants frequently cited these sources as informing their understanding of archaeology (Table 4).

The question "How do archaeologists look for and find sites?" relates to the methodologies archaeologists employ in locating sites and materials (Table 2). This was one of two questions devised to assess whether or not students could distinguish the methods archaeologists use to learn about the past. It was also devised to provide a further measure of whether or not students could distinguish archaeology from paleontology since the two disciplines are often confused. Because this was an open-ended question, responses were grouped by keyword and condensed into three simplified categories: excavation, survey, and paleontology. Responses such as "dig," "use special technology," and "use special tools" were grouped under the "excavation" category. Participants demonstrated some understanding of survey methodology through responses such as "look for old stuff, old buildings and structures, Indian artifacts, or unusual artifacts" and "travel or explore" – these responses were grouped under the "survey" category. Responses with any mention of "dinosaur bones" or "fossils" were grouped under the "paleontology" category. Most students (90 percent) assumed that sites were discovered through a process of survey or excavation, or both. These responses are reinforced with the data highlighted in Table 3, where 81 percent of students reported archaeologists look for and find "old buildings, arrowheads, pottery, bones." Based on these summary data, most students demonstrated a good understanding of the methods archaeologists use to locate sites, as well as the types of materials they might recover.

However, there is still some confusion between archaeology and paleontology. Five students (9 percent) associated archaeological methods with those used by paleontologists (Table 2), and eight students (14 percent) indicated archaeologists look for and find "dinosaur fossils" (Table 3). A further possible indicator of misunderstanding, the number of "missing" or "blank" responses was highest in Question 2, where 7 students (12 percent) expressed confusion in the form of responses such as "I don't know" or skipped the question altogether (Table 2).

Students cited a variety of sources as informing their understanding of archaeology (Table 4). Thirty-seven students (64 percent) reported learning about archaeology at school, 42 students (72 percent) reported learning about archaeology at a museum, 33 students (57 percent) reported learning about archaeology from a book, and 16 students (28 percent) reported learning about archaeology from family or friends. Interestingly, only 18 students (31 percent) reported learning about archaeology from TV or movies. This is a promising find given the prevalence of inaccurate information perpetuated by popular media outlets.

Seventy percent of students reported this was their first time participating in an archaeology-related project such as a museum summer day camp (Table 5). However, most students also came into the camp with at least *some* knowledge of what archaeology is or had been exposed to it in some other way. While largely positive, these results may support a need for increased access to and availability of archaeology outreach programs in museums, particularly in Cache Valley and northern Utah in general. This information can also assist museums in the identification of appropriate, beginner-level activities for students who have had no previous experience.

Table 1. Participant Responses to "What is Archaeology?"

Response	Frequency	Percent	Cumulative Percent
The study of art	5	8.6	8.8
The study of past human life	43	74.1	84.2
The study of dinosaurs	8	13.8	98.2
The study of plants	1	1.7	100.0
Total	57	98.3	
Missing	1	1.7	
TOTAL	58	100.0	

Table 2. Participant Responses to "How do Archaeologists Look For and Find Sites?"

Response	Frequency	Percent	Cumulative Percent
Excavation	24	41.4	47.1
Survey	22	37.9	90.2
Paleontology	5	8.6	100.0
Total	51	87.9	
Missing	7	12.1	
TOTAL	58	100.0	

Table 3. Participant Responses to "What Kinds of Things do Archaeologists Look for and Find?"

Response	Frequency	Percent	Cumulative Percent
Dinosaur fossils	8	13.8	14.3
Old buildings, arrowheads, pottery, bones	47	81.0	98.2
Treasure	1	1.7	100.0
Total	56	96.6	
Missing	2	3.4	
TOTAL	58	100.0	

Table 4. Participant Responses to "Where have you Learned About Archaeology?"

Response	Frequency of "Yes" Responses	Percent	Frequency of "No" Responses	Percent
At School	37	63.8	21	36.2
From Family or Friends	16	27.6	42	72.4
At a Museum	42	72.4	16	27.6
From a Book	33	56.9	25	43.1
From TV or Movies	18	31.0	40	69.0

Table 5. Participant Responses to "Is this your First Time Participating in an Archaeology Project?"

Response	Frequency	Percent	Cumulative Percent
Yes	39	67.2	69.6
No	17	29.3	100.0
Total	56	96.6	
Missing	2	3.4	
TOTAL	58	100.0	

Post-Teaching Questionnaire Results

On the post-teaching questionnaire, participants were asked the following: rate each of the four activities using a Likert Scale system; if they wished to participate in more archaeology-related activities, and if yes, what kinds of activities; whether they would tell their friends and family about what they did at the camp; and if they thought their friends would like to participate. For the questions "Do you think you will tell your family and friends about what you did today?" and "Do you think your friends would like to participate in archaeology activities?" originally only two answer choices were possible; however, discussion with participants prompted the addition of a third answer

choice "maybe." Some students expressed that some of their friends might or might not wish to participate, so this addition was necessary in order to cover the wider range of possible responses. This change was made the first day of the workshop and provided as an answer choice on questionnaires to all students throughout the week.

The most popular activity among camp participants overall was the Fremont pottery activity, which received the highest number of students who "loved" the activity – 87 percent of students loved participating in this activity, and 12 percent "liked" the activity (Table 6). The second most popular activity was the split twig figurine activity, with 40 percent of students indicating they "loved" the activity and 35 percent of students indicating they "liked it" (Table 7). Thirty-eight students (66 percent) reported they either "liked" or "loved" the survey and excavation activity, making it the third most popular activity (Table 9). The least popular activity overall was the tree-ring dating activity (Table 8). The majority of students (25 out of 58 or 43 percent) felt only neutral toward this activity. The tree-ring dating activity also had the highest number of students who "hated" it, with nine or 16 percent of students indicating such on their questionnaires. Based on these results, the most engaging strategy for teaching archaeology in the museum is an object-driven strategy.

Students exhibited an overwhelmingly positive response when presented with the possibility to participate in additional archaeology activities. When asked, "Would you like to participate in more archaeology activities?" 95 percent of students indicated that they would, and expressed verbal excitement over the chance of being able to return to the Museum (Table 10). The students responded "yes" to this question were then asked about the kinds of activities they would like to participate in (Table 11). For this

particular question, students were allowed to select as many responses as applicable. The vast majority (95 percent) of students indicated they would like to participate in additional activities, whether they be to attend another summer day camp (71 percent), participate in a dig or visit a real archaeology site (66 percent), participate in archaeology activities at school (48 percent), or visit an archaeology museum (66 percent).

When asked whether or not they would tell their friends or family about what they did at camp, 86 percent of students said "yes" (Table 12). Eighty-three percent of students also felt their friends would like to participate in archaeology activities (Table 13). Based on the results presented here, it appears the summer day camp was successful in teaching students about archaeology, promoting discussion about archaeology with family and friends, and encouraging future visits to archaeology museums and archaeological sites.

Table 6. Participant Responses to "How much did you enjoy the Create Your Own Fremont Pottery Activity?"

Response	Frequency	Percent	Cumulative Percent
Hated It	0	0	0
Didn't Like	1	1.7	1.8
OK/Neutral	1	1.7	3.5
Liked It	5	8.6	12.3
Loved It	50	86.2	100.0
Total	57	98.3	
Missing	1	1.7	
TOTAL	58	100.0	

Table 7. Participant Responses to "How much did you enjoy the Create Your Own Split Twig Figurine Activity?"

Response	Frequency	Percent	Cumulative Percent
Hated It	0	0	0
Didn't Like	1	1.7	1.8
OK/Neutral	13	22.4	24.6
Liked It	20	34.5	59.6
Loved It	23	39.7	100.0
Total	57	98.3	
Missing	1	1.7	
TOTAL	58	100.0	

Table 8. Participant Responses to "How much did you enjoy the Tree-Ring Dating Activity?"

Response	Frequency	Percent	Cumulative Percent
Hated It	9	15.5	15.8
Didn't Like	7	12.1	28.1
OK/Neutral	25	43.1	71.9
Liked It	8	13.8	86.0
Loved It	8	13.8	100.0
Total	57	98.3	
Missing	1	1.7	
TOTAL	58	100.0	

Table 9. Participant Responses to "How much did you enjoy the Excavation and Survey Activity?"

Response	Frequency	Percent	Cumulative Percent
Hated It	2	3.4	3.5
Didn't Like	4	6.9	10.5
OK/Neutral	13	22.4	33.3
Liked It	19	32.8	66.7
Loved It	19	32.8	100.0
Total	57	98.3	
Missing	1	1.7	
TOTAL	58	100.0	

Table 10. Participant Responses to "Would you Like to Participate in More Archaeology Activities?"

Response	Frequency	Percent	Cumulative Percent
Yes	53	91.4	94.6
No	3	5.2	100.0
Total	56	96.6	
Missing	2	3.4	
TOTAL	58	100.0	

Table 11. Archaeology Activities Students are Most Interested in.

Activity	Percentage of Students who Selected Each Activity
Another Summer Day Camp	70.7
Visits or Digs at Real Archaeology Sites	65.5
Archaeology Activities at School	48.3
Visits to Archaeology Museums	65.5
Other	8.6

Table 12. Participant Responses to "Do you think you will tell your Family or Friends about what you did today?"

Response	Frequency	Percent	Cumulative Percent
Yes	47	81.0	85.5
No	7	12.1	98.2
Maybe	1	1.7	100.0
Total	55	94.8	
Missing	3	5.2	
TOTAL	58	100.0	

Table 13. Participant Responses to "Do you think your Friends Would Like to Participate in Archaeology Activities?"

Response	Frequency	Percent	Cumulative Percent
Yes	47	81.0	82.5
No	5	8.6	91.2
Maybe	5	8.6	100.0
Total	57	98.3	
Missing	1	1.7	
TOTAL	58	100.0	

Previous Experience and Interest in Archaeology Activities

Owen and Steele (2005) found that previous experience with archaeology influenced primary school students' understanding of archaeology in the classroom. The current research project complements their findings by asking the important question: Is there a relationship between students' previous experience with archaeology and their degree of interest in archaeology activities? That is, do students with previous experience get more excited about archaeology activities in the museum? To explore this topic, previous experience with archaeology was measured on the pre-teaching questionnaire with "Is this your first time participating in an archaeology project" (Table 4)? Using SPSS, responses to this question were then cross- tabulated with participants' self-evaluative measures of each activity found on the post-teaching questionnaires. This procedure provides a percentage breakdown of students who replied "yes" or "no" and their respective evaluations of each of the activities. A Mann-Whitney U-test was used to understand whether interest in archaeology activities differs based on previous experience. If students with previous archaeology experience express greater interest in activities, we would expect to see a higher percentage of students who responded "no" to

the question “Is this your first time participating in an archaeology project?” represented among those who “loved” or “liked” each of the activities.

The Mann-Whitney U-test performed for the Fremont pottery activity shows that there is no statistically significant difference between previous experience and degree of interest in the activity ($U = 316.5$, $p = .838$). The analysis performed for the split twig figurine activity also shows that there is no statistically significant difference between previous experience and degree of interest in the activity ($U = 287.5$, $p = .491$). The Mann-Whitney U-test performed for the tree-ring dating and excavation and survey activities produced similar results, with U values of 276.5 and 308.5 and p values of .374 and .783, respectively.

Overall, these preliminary results indicate that students *with* previous experience enjoy archaeology activities just as much as students *without* previous experience. Previous experience likely informs student understanding of archaeology and its uses, but is not necessarily a prerequisite for increased engagement with archaeology activities in the museum.

Gender and Interest in Archaeology Activities

A secondary aim of this project is to explore whether or not girls and boys prefer different kinds of archaeology activities while in the museum. Is there a relationship between gender and degree of interest in archaeology activities? Using SPSS, gender was cross-tabulated with participants’ self-evaluative measures of each activity found on the post-teaching questionnaires. A Mann-Whitney U-test was again used to explore whether interest in archaeology activities differs based on gender.

The Mann-Whitney U-test performed for the Fremont pottery activity shows that there is no statistically significant difference between gender and degree of interest in the activity (U = 382.5, p = .528). Eighty-five percent of boys "loved" the activity, while 90 percent of girls "loved" it. The analysis performed for the split twig figurine activity also shows no statistically significant difference between gender and degree of interest in the activity (U = 376.0, p = .621). Thirty-seven percent of boys "loved" the activity, while 43 percent of girls "loved" it. The percentages of boys and girls who "liked" or felt "neutral" toward the activity were also quite similar. For example, 10 boys (37 percent) and 10 girls (33 percent) responded that they "liked" the split twig figurine activity. Seven girls (23 percent) and six boys (22 percent) indicated they felt "neutral" toward the activity.

The results of the analyses performed for the scientific skills-based tree-ring dating and excavation and survey activities largely mirror the results of those performed for the object-based activities. The Mann-Whitney U-test performed for the tree-ring dating activity shows that there is no statistically significant difference between gender and degree of interest in the activity (U = 384.5, p = .730). Forty-four percent of boys and 43 percent of girls felt only "neutral" toward this activity. The analysis performed for the excavation and survey activity shows that there is also no statistically significant difference between gender and degree of interest (U = 383.0, p = .713).

Based on these results, there is no significant difference between boys and girls in the types of activities they prefer while in the museum. Boys and girls equally enjoy object- and scientific skills-based activities.

Age and Interest in Archaeology Activities

One of the aims of this project is also to explore on a basic level the possible relationship between age and level of interest in archaeology activities. Do 8-year-olds prefer different activities than 10-year-olds? Cross-tabulations performed within SPSS provide a percentage breakdown of children within each age group who "loved" or "liked" each activity. Participant age was then split into three categories or groups, and a Kruskal-Wallis one-way ANOVA test was used to compare these age groups with responses provided on the Likert scale questions. A Spearman's rank correlation coefficient was calculated for each age group and respective activity to investigate the association between the variables. Overall, the results from these analyses show that there is no significant relationship between age and degree of interest in the Fremont pottery, tree-ring dating, and excavation and survey activities. Children of all ages enjoyed the Fremont pottery activity ($H = .923$, $p = .630$). Ninety percent of 8-year-olds, 91 percent of 9-year-olds, and 80 percent of 10-year-olds reported that they "loved" this particular activity. Results indicate 8-year-olds enjoyed the split twig figurine activity more than nine or ten-year olds, with fifty-five percent of students indicating they "loved" the activity, while 32 percent of 9-year-olds and 33 percent of 10-year-olds reported the same ($H = 5.391$, $p = .068$). The Spearman's rank-order correlation coefficient ($r_s=-.281$, $p = .034$) indicates there is a negative correlation between age and degree of interest in the split-twig figurine activity, which was statistically significant. As age increases, degree of interest in split-twig figurines decreases. This result holds implications for the types of object-based teaching strategies used within various age groups at the museum.

Children of all ages reported similar levels in interest in the tree-ring dating activity, with 45 percent of 8-year-olds, 46 percent of 9-year-olds, and 40 percent of 10-year-olds indicating they felt "neutral" toward the activity ($H = 2.766$, $p = .251$). Seventy percent of 8-year-olds, 64 percent of 9-year-olds, and 67 percent of 10-year-olds indicated they "liked" or "loved" the excavation and survey activities ($H = 3.589$, $p = .166$).

Summary

Previous knowledge of archaeology varied among children of all ages, but most came into the camp with a generally accurate understanding of archaeology. It is clear that some basic archaeological concepts are in fact being taught within Utah public schools, likely within preexisting social studies curricula as discussed above. Students are enthusiastic about and interested in learning about archaeology, and boys and girls alike enjoy object-based activities over science-based activities while in the anthropology museum. Children are highly likely to discuss their experience with friends and family, and most feel their friends would also enjoy participating in similar activities. While in its early stages, this research indicates an object- and scientific skills-centered museum program is effective in getting students excited about archaeology, promoting discussion about archaeology with family and friends, and encouraging future visits to archaeology museums and archaeological sites.

DISCUSSION

This study has examined the effectiveness of object- and scientific skills-based strategies for teaching archaeology to children in a museum setting. The following discussion reviews the summer workshop activities, identifies areas for improvement, and acknowledges sources of error in the current study. Additionally, it provides recommendations for future directions and research in archaeology education programs in museums.

Overall, the well-planned strategies employed in recruiting student participants, executing activities, and collecting student survey data for the summer day camp were effective in teaching students about archaeology, promoting discussion with friends and family, and encouraging future visits to the museum. No major issues were encountered, and all aspects of the summer workshop – from the development of lesson plans and organization of learning materials to the pacing of activities – ran smoothly and efficiently. Archaeologists and museum professionals who wish to develop and implement similar programs, however, should plan for a marketing period of *at least* two months in advance of the event in order to reach the most members of their target audience. While a marketing period of one month for the current study proved to be sufficient in gathering a well-rounded sample of third and fourth grade students interested in archaeology, the implementation of more intensive outreach strategies would boost the statistical and predictive power of study results with a larger sample size. Personal visits to classrooms and distribution of pamphlets and materials to teachers and parents are also excellent ways to reach more students *if project funding permits*. Additionally, the implementation of *multiple* weeklong workshops spread throughout the summer or

classroom field trips made to a museum during the school year would ensure that a larger sample of students across the spectrum of ability and interest in archaeology are represented.

While short questionnaires are an excellent, cost-effective way to assess the most engaging archaeology activities to children in the museum, other qualitative methods can be incorporated in future projects to enhance understanding and strengthen findings – especially when dealing with small sample sizes (Bernard 2011). Informal conversations with students during activities, follow-up focus groups and paper surveys or phone interviews with parents can provide archaeologists and museum professionals with additional information regarding the effectiveness of their education programs. One of the measures used to determine the success of the summer workshop activities in the current project was the question, "Do you think you will tell your family or friends about what you did today?" Follow-up surveys or interviews with parents or guardians can help determine whether or not students *actually* went home and told them about the day's activities, what kinds of activities were most memorable to them, and if those are the same activities children identified as the most exciting on their questionnaires. Formal parent interviews can also assess what drew them to enroll their children in archaeology-related camps and activities in the first place. In the case of the current study, informal conversations with parents did not reveal a strong tendency toward interest in archaeology as a topic in and of itself, but rather an interest in no-cost, interactive, daylong learning activities that would keep their children entertained. Focus groups conducted shortly after programs end could further assist archaeologists and museum professionals in understanding what aspects of each activity students found the most

exciting, if there were any concepts students found were particularly difficult to understand, or how things could have been done differently.

Museums commonly utilize various tracking methods in evaluating the effectiveness of their programs (Korn 1994). In particular, museums wish to know how patrons become aware of their programs or events. The USU Museum of Anthropology employs both paper and verbal methods in tracking patron visitation; daily visitors are greeted and asked how they heard about the Museum or current event, and are encouraged to fill out short paper surveys at the event's conclusion. Museums can assess the effectiveness of their archaeology education programs through these various measures. Museums can use surveys to determine whether or not visitor attendance increases following these types of events and if students and parents who participate in such events also encourage others to visit the Museum. This type of evaluation provides yet another dimension to better understanding the needs of the public in developing more effective programming.

Based on the results of this small pilot study, children generally enjoy object-based activities *while in the museum.* They enjoy learning about the process and history behind the creation of an object, creating the object, taking the object home, and sharing it with others. This is not to say, however, that children are entirely *uninterested* in science-based activities. As discussed above, there is a tendency toward object-based strategies when teaching archaeology activities in the classroom, particularly in Utah. Given this state of affairs, museums can play a crucial role in providing additional access to science-based activities. The current project also focused on evaluating the effectiveness of *only two* object-based activities and *only two* scientific skills-based

activities. Students clearly enjoy the object-based activities more than the science-based activities, but how can archaeologists and museum professionals modify science-based activities to make them more appealing to students in the museum? Focus groups and student discussion could identify specific issues with science-based activities, and additional workshops covering a wider variety of science-based archaeology activities can glean more information on the overall effectiveness of programs. In the current study, for example, the least popular activity overall was the tree-ring dating activity. If this activity were modified or replaced entirely with another science-based activity on stratigraphy and cross- dating (Smith et al. 1993:49), would the results of student questionnaires be different? If the most popular Fremont pottery activity were replaced with another object-based activity, would the results have also been different? While beyond the scope of the current study, this is a fruitful area of future research that can expand upon and complement the preliminary findings presented here.

Knowing that object-based lesson plans are most effective in engaging children with archaeology in the museum, archaeologists can further strive to weave scientific concepts throughout object-based activities. Context, for example, is an important archaeological concept that teaches students how to apply scientific skills to real-world problems. Object-based activities, such as those that focus on creating a Fremont pot or split twig figurine, can easily be extended beyond the simple recreation of the artifact itself to a discussion of context. While these object-based lesson plans *do* note the physical locations in which the materials are found, they do not address the more practical implications of context. Students engage in relevant, critical and inferential thinking when asked about the kinds of things they own and find particularly important or

valuable. What happens when something they own becomes moved from its original location? What important information about the person or people who created or owned the object is lost when context is disturbed? Object-based lesson plans can also be extended to incorporate mathematical concepts. After creating their own Fremont pottery with clay, students can apply their knowledge of measurement techniques to calculate the circumference of their own or replica pots. This exercises show students that the techniques archaeologists employ in learning about the past are the same kinds of techniques other scientists use in understanding the world around them today, and how scientific concepts such as observation, inference, and context relate on a real-world level.

Concerning the relationships between previous experience, age, gender, and engagement with archaeology activities in the museum, a larger sample size of student participants might have shed additional light on possible relationships between these variables. The preliminary analyses performed here show no statistically significant relationship between whether or not boys or girls prefer different kinds of activities or whether or not 8-year-olds enjoy different activities than 10-year-olds, with the exception of the object-based split-twig figurine activity. As age increases, degree of interest in split-twig figurines decreases – older students may in fact find this type of activity "childish." This finding thus has implications for the types of object-based teaching strategies used within various age groups at the museum, and may be an area worth further investigation.

A final topic worthy of discussion here is how to account for possible Hawthorne effect on execution and student assessment of activities while in the museum. What

measures are taken to ensure no bias exists on the behalf of the researcher during lesson plan development, instruction, and administration of student questionnaires? The Hawthorne effect refers to the tendency of some people to work harder, perform better, or change their behavior as a result of being watched (Landsberger 1958). Children may be particularly susceptible to this phenomenon, and alter their answers on a questionnaire because they feel it is what the researcher or instructor wants them to do, which can in turn skew the results of a study. One way to deal with this effect in the museum is to ensure that no personal bias is shown on the part of the instructor in execution of lesson plans and activities. In the current study, this was achieved through the unobtrusive observation of students as they completed questionnaires (instructor and assistants did not interact with students or walk around the room), ensuring participant anonymity and equality, and making sure that all activities were conducted in the same manner (McBride 2013). Archaeologists and museum professionals should take care in conducting research with sensitive groups, and remain cognizant of individual learning styles when developing education programs.

The pilot study conducted here at the USU Museum of Anthropology provides a model for further development and monitoring of archaeology education programs in museums. This study indicates that children between the ages of eight and ten prefer hands-on, object-focused archaeology activities while in the museum, a finding that may assist small museums in tailoring their programs to include more object-based activities in their education programs. This project has resulted in the following outcomes: a better understanding of how archaeologists can engage with their audiences, particularly elementary school children; a better understanding of how to portray the importance of

archaeology to the public; and a better understanding of the creative ways in which archaeologists and museum professionals can work together to develop effective educational programming.

CONCLUSIONS

Freeman Tilden (1957), a pioneer in the field of archaeology interpretation in America's National Parks, based his most influential book, *Interpreting our Heritage,* on six key principles. One of these principles lies at the heart of the current research project: the chief aim of interpretation should not be instruction, but *provocation*. While the major goal of this project was to quantitatively assess third and fourth grade students' levels of engagement with object- and scientific skills-based archaeology activities, the most valuable (albeit simple) lesson learned here, as a whole, is that *archaeology education programs are successful in stimulating the minds of children and drawing them into the museum*. Archaeology activities, when properly interpreted as they have been here, engage children on multiple levels by allowing them to think, feel, and become excited in learning about the past – regardless of whether or not those activities are based on objects or scientific-skills development.

In further interpreting the value and importance of this research project to the archaeological community in general, Malloy (2011:1) illustrates the many changes that have occurred in the field of public archaeology and its relevance today:

> Changes in the field of public archaeology over the past two decades have created opportunities for working with the public in deeper and more meaningful ways. These new approaches can help us create the kinds of alliances we need to preserve archaeological and historic sites. Perhaps the most important change in the discipline is that communities now play a much bigger role in archaeology. Rather than simply the recipients of what professional archaeologists have learned, or the labor in our labs and excavation units, communities are actively engaging in all aspects of some archaeological projects. Projects may now be initiated and led by communities themselves, who invite *us* in to help. Public archaeology is now less of a one-way street designed by and for archaeologists to meet the needs of our discipline, and more of a shared endeavor to meet common goals.

Malloy continues to note that the only way that archaeologists can truly gain the support of the public is to demonstrate how archaeology can be of use in the real world – to make archaeology *relevant.* The pilot study conducted at the USU of Museum of Anthropology brings real-world relevance to the forefront of archaeology education, and by using archaeology as a powerful interpretive tool to reach the children of the community, allows the public to play a key role through direct participation. The impacts of such a program can be seen throughout the local community and beyond. Archaeologists should strive to develop more relevant educational programming and seek out opportunities to work with the public in all areas of their discipline. Archaeology can and should be used as a tool to make a positive change in the greater community. By teaching *with* rather than *about* archaeology, archaeologists are well on their way to securing the public's continued interest, support, and understanding.

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APPENDICES

Appendix A. **Fourth Grade Fremont Pottery Lesson Plan: Object-Based Learning**

Summary:

After learning about the Fremont people, students will make their own Fremont-Style pottery. **Emphasizes archaeology as more traditional object-based learning through creation and appreciation of an art form.**

Utah Core Main Curriculum Tie:

Social Studies - 4th Grade
Standard 2 Objective 1
Describe the historical and current impact of various cultural groups on Utah.

Skills used: Fine arts – visual arts, language arts, and social studies

Learning Objectives:

- Refine visual and fine arts skills through recreation of an artifact

Materials:

- Gray or brown air-drying clay
- Make Your Own Fremont-Style Pottery Instruction Sheet
- Summary PowerPoint slides
- Examples of Fremont pottery from the Museum

Background Information For Teacher:

Although a few Fremont sites are found in the surrounding states, Utah was the homeland of the Fremont people. The Fremont lived in Utah from 1,600 to 750 years ago and inhabited the area of Utah north of the Colorado River.

The Fremont adapted to many different locations in Utah. They lived near, and depended on, the marshes in Utah river valleys, in farming communities, and for part of the year in caves near the Great Salt Lake. Although the Fremont lived in different locations they all shared similar ways of life. All seem to have made and used gray pottery, built pithouses and either grew or traded for corn.

The Fremont people made sturdy gray pottery in the shape of bowls and narrow-necked jars, some with loop handles. About 1,300 years ago, their pottery began to change and the people started to make pottery painted with beautiful black geometric designs on a white or gray background. Fremont pottery is similar to Anasazi types in decoration; however, each group added a different kind of material (such as sand or crushed rocks) to the clay to make it stronger.

Pithouse villages were common among the Fremont people. Usually villages were small, consisting of only four or five houses at a time. Pithouses were difficult to build; they were semi-subterranean and constructed of mud and plant materials. Most of these dwellings had only one or two rooms with a central hearth and a hole in the ceiling that acted as ventilation and a light source.

Although the Fremont grew corn, beans, and squash, archaeological evidence shows that many of them were still hunters and gathers of wild foods. The bones of deer, mountain sheep, bison, antelope and rabbits as well as charred wild seeds and plant parts are often found at Fremont sites. Insects, especially grasshoppers and crickets, were also eaten since they were nutritious and easy to gather and store.

Archaeologists do not find Fremont artifacts more recent than 750 years of age. The fate of the Fremont people is one of the major questions that archaeologists are trying to answer. Did the Fremont move from the area due to a widespread drought that made it impossible to farm? Did they leave because other groups moved into the area and forced them out? Or did the Fremont and these new arrivals marry and mix cultures, becoming unrecognizable in the archaeological record?

Instructional Procedure:

- Go over the Background Information for Teacher with the children.
- Show printed PowerPoint summary slides and examples of Fremont pottery from the Museum.
- After a brief discussion have students make their own Fremont style pottery to bring to life this ancient culture.

Closure: Student shares their pot with the group.

Evaluation: Student completes post-teaching questionnaire.

Adapted from NHMU: The Fremont People (Utah Education Network 2004)

Appendix B. Fourth Grade Split Twig Figurine Lesson Plan: Object-Based Learning

Summary:

After learning about the people who made these split twig figurines, where they have been found, their possible meanings, and age, as well as the importance of preservation, students will create their own figurine. **Emphasizes archaeology as more traditional object-based learning through creation and appreciation of an art form.**

Utah Core Main Curriculum Tie:

Social Studies – 4th Grade
Standard 2 – Objective 1
Describe the historical and current impact of various cultural groups on Utah.

Skills used: Fine arts – visual arts, language arts, and social studies

Learning Objectives:

- Refine visual and fine arts skills through recreation of an artifact
- Understand the importance of preservation of archaeological materials

Materials:

- Brown pipe cleaners
- Information/instruction pages (for teachers)
- Maps and photographs (summary powerpoint slides) for visual aids

Background Information for Teacher:

Split twig figurines have been found in protected areas within the Grand Canyon, and figurines of similar age have even been found in the Mojave Desert of California and during later times in southern Utah. It is estimated that some of the figurines may be as much as 4000 years old. Figurines appear to represent bighorn sheep and mule deer. Both animals are still very common today.

The peoples who made these little animal figures were most likely the ancestors of some of the modern Native American people who live in the Four Corners area today.

The figurines were made from willow twigs. When the shapes were finished, they were placed in a sacred area in the back of a cave.

Preservation

Perishable artifacts—those made from grasses, twigs, and other organic materials—rarely survive in archaeological sites. All care must be taken to preserve these materials. Scientists wear clean white cotton gloves when analyzing split twig figurines and other organic materials. If you find artifacts, please contact an archaeologist to report the find or notify your State Historic
Preservation Office.

Instructional Procedure:

- Go over the Background Information for Teacher with the students.
- Show the students photographs (like the ones found on the printed powerpoint slides) of real split twig figurines and a map of the areas where they have been found.
- After this brief discussion have students make their own figurines following the instructions provided. Assist students as necessary.

Closure: Student shares their figurine with the group.

Evaluation: Student completes post-teaching questionnaire.

Adapted from Split Twig Figurines – Society for American Archaeology (Ellick 2012).

Appendix C. "Tales in the Trash" Fourth Grade Lesson Plan: Scientific Skills-Based Learning

Summary:

After learning about the kinds of archaeological evidence prehistoric cultures left behind in the marshes of the Great Salt Lake, Utah, students will practice proper archaeological excavation and survey techniques, measure and classify "artifacts," and draw data based conclusions from an examination of the materials. **Emphasizes archaeology's effectiveness in scientific skills/STEM development and stresses the importance of proper excavation procedure/not disturbing archaeological remains.**

Main Curriculum Tie:

Social Studies - 4th Grade
Standard 1 Objective 2
Analyze how physical geography affects human life in Utah.

Skills used: Math, science, social studies, language arts, and fine arts – visual

Learning Objectives:

- Learn proper archaeological excavation and survey techniques
- Learn to measure and classify artifacts
- Draw data-based conclusions from examination of archaeological materials
- Learn the importance of not disturbing archaeological remains

Materials:

- "Dig boxes" with various artifacts (potsherds, projectile points, botanical and faunal remains, historic artifacts, etc.) – a total of 5 DIFFERENT artifacts (they will measure, sketch, and describe each one)
- Excavation equipment (trowels, brushes, buckets, etc.)
- Measuring tools
- Paper and pencil to sketch and classify artifacts
- Cultural clutter worksheets
- Orange pin flags for survey activity

Background for Teacher:

The archaeology departments of Utah's universities, the Utah Archaeological Society, and the office of the State Archaeologist joined together in the late 1980s to study the prehistoric sites on the edge of the Great Salt Lake. A number of artifacts and burial sites had been exposed by erosion as the lake rose and receded during the first half of the decade. Numerous sites were identified which contained artifacts from at least two

different cultures. Some seemed to be temporary "camps", while others showed signs of permanent dwellings.

Because the rivers entering the lake flow over a long, gradual slope, the sediments deposited in the meanders of the lakeside marshes contain only fine silt. Heavier particles such as rocks and pebbles drop out higher up in the stream near canyons as the water velocity begins to decrease. Rocks used for fire pits, pottery shards, bones, and other artifacts are easily seen on this fine-grained surface. Any pottery pieces that have been soaked in salty water will crumble when handled because the salt crystals, which form inside the shards, loosen the bonds between the layers of clay.

Removal of artifacts from a site can make analysis difficult or incorrect and can destroy the scientific value of the site. This lesson introduces students to the ethics of archaeology as well as to the types of discoveries that lead to more extensive surveys and excavations.

We will use proper archaeological investigative techniques (excavation, measurement and classification of artifacts, drawing data-based conclusions) to understand this group of people.

Instructional Procedure:

- Tell students the following (or similar) story: "Let's take a stroll along the edge of a marsh near the Great Salt Lake and enjoy the silence away from city noises and crowds. Once in a while, a bird calls or flies overhead. The ground is very even and flat, except for the occasional ditch draining farms to the east. The soil is silt – extremely fine grained, with no rocks or pebbles. In some areas, this silt has a thin coating of fine white salt. Few plants are growing here, where the salty lake waters have been washing during the years of high water. The few scattered plants that are found grow close to the ground. Looking around you notice something different off to your right. There is a patch of darker soil that is gray in color and almost circular. A few rocks lay scattered around here, but nowhere else. Your curiosity is aroused, you inspect the area and find…"
- Teacher and assistants will guide students through proper excavation, mapping, recovering, measuring, and identifying artifacts.
- Students will complete cultural clutter worksheets. Provide assistance as needed.
- After excavation activity: Instruct students in basic survey techniques.

Closure: Group discussion of students' responses.

Evaluation: Student completes post-teaching questionnaire.

Adapted from NMHU: Cultural Clutter – Tales in the Trash (Utah Education Network 2004).

Appendix D. Fourth Grade Tree-Ring Dating Lesson Plan: Scientific Skills-Based Learning

Summary:

After learning about how archaeologists employ tree-ring dating in understanding past human life, students will participate in an exercise in which they examine fictional core samples and annual growth rings to determine the age of a tree and a forest ranger's cabin. **Emphasizes archaeology's effectiveness in scientific skills/STEM development.**

Utah Core Curriculum Tie:

Social Studies – 4th Grade
Standard 2 – Objective 1
Describe the historical and current impact of various cultural groups on Utah
Skills used: Math, science, and social studies

Learning Objectives:

- Use math skills to interpret age of trees used in constructing houses by counting annual tree rings
- Name two things archaeologists can learn about a site from tree rings (age of archaeological structures, information about wet and dry years)

Materials:

- "Lab-Aids" Dendrochronology Kit
- Tree-ring dating worksheets (found in kit)
- Pencils
- Examples of prehistoric wooden structures
- Dendrochronology display outside Museum

Background Information for Teacher:

Tree-ring dating is an absolute dating technique using the growth rings of trees to determine the average age of a stand of trees. It is used to determine the age of wooden objects and wooden components of buildings at archaeological sites. A specific date for each growth ring can be assigned based on a characteristic pattern produced by alternating wet and dry years.

Forestry workers use an instrument called an increment borer to obtain core samples from trees in a particular area. The increment borer is twisted ½ the diameter through the tree and then removed. This produces a core sample approximately 1/8 inch in diameter. The hole produced is then plugged in order to prevent infection in the tree. By counting the number of xylem rings in this tree and other trees in a given area, the average age of a

stand of trees is determined. Wet and dry years are identified through examination of individual rings (the spaces between the dark lines).Thicker rings indicate wetter years and thinner years indicate drier years.

Archaeologists often use tree rings to help determine the age of a particular ruin. A piece of a wooden structure is obtained and the xylem pattern is compared with a master chart dating back several hundred and even several thousands of years. In some cases, tree ring dating is more accurate than radiocarbon dating.

Instructional Procedure:

- Go over the Background Information for Teacher with students.
- Show and discuss with students the Fremont pithouse exhibit display in the museum and dendrochronology display outside the museum.
- Working individually or in pairs, have students use the materials inside the "Lab-Aids" dendrochronology kit to complete the questions on the worksheet. Assist students as necessary.

Closure: Discuss the answers to the questions as a whole group; ask questions to reinforce learning objectives.

Evaluation: Student completes post-teaching questionnaire.

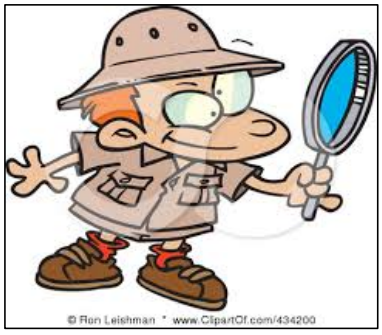
Adapted from the Lab-Aids: Dendrochronology Tree Ring Dating Kit (Lab-Aids, Inc. 2000)

Appendix E. Pre-Teaching Questionnaire

Can You Dig It? Help teach Miss C. and her friends all about Archaeology!

1. What is archaeology?
   - A. The study of art
   - B. The study of past human life
   - C. The study of dinosaurs
   - D. The study of plants

2. How do archaeologists look for and find archaeological sites?



3. What kinds of things do archaeologists look for and find?
   - A. Dinosaur fossils
   - B. Old buildings, arrowheads, pottery, bones
   - C. Treasure

4. Where have you learned about archaeology?
   - A. At school
   - B. From my family or friends
   - C. At a museum
   - D. From a book
   - E. From TV or movies
   - F. From another place (where?): _____

5. Is this your first time participating in an archaeology project?

   _____ yes _____ no

5. Personal information:

   _____ Male _____ Female
   _____ Age

Thank you very much for your help! The questions you have answered will help Miss C. and her friends create fun archaeology programs ☺

Appendix F. Post-Teaching Questionnaire

Did You Dig It? Tell Miss C. and her friends about what you learned today!

1. Use Mr. Smiley to tell Miss C. and her friends how excited you got about each activity!

Create your own Fremont pottery

Create your own split twig figurines

Tree-ring dating

"Tales in the Trash" excavation activity

2. Would you like to participate in more archaeology projects?

_____ yes _____ no

If yes, what kinds of projects?

_____ another summer day camp like this one
_____ visits or digs at real archaeology sites
_____ archaeology activities at school
_____ visits to archaeology museums
_____ other: _____

3. Do you think you will tell your family (parents, grandparents, brothers and sisters) or friends about what you did today?

_____ yes _____ no

4. Do you think your friends would like to participate in archaeology activities?

_____ yes _____ no

5. Personal information:

_____ Male _____ Female
_____ Age

Thank you very much for your help! The questions you have answered will help Miss C. and her friends design fun archaeology programs ☺

Appendix G. Institutional Review Board Approval for Research

Institutional Review Board

USU Assurance: FWA#00003308

UtahState University
OFFICE OF RESEARCH AND GRADUATE STUDIES

Full Accreditation

Expedite #7

Letter of Approval

FROM:

Melanie Domenech Rodriguez, IRB Chair

True M. Rubal, IRB Administrator

To: Bonnie Glass-Coffin, Candice Cravins
Date: May 20, 2013
Protocol #: 5169
Title: Effective Strategies For Teaching Archaeology In An Informal Educational Setting
Risk: Minimal risk

Your proposal has been reviewed by the Institutional Review Board and is approved under expedite procedure #7 (based on the Department of Health and Human Services (DHHS) regulations for the protection of human research subjects, 45 CFR Part 46, as amended to include provisions of the Federal Policy for the Protection of Human Subjects, November 9, 1998):

> Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.This approval applies only to the proposal currently on file for the period of one year. If your study extends beyond this approval period, you must contact this office to request an annual review of this research. Any change affecting human subjects must be approved by the Board prior to implementation. Injuries or any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Institutional Review Board.

This approval applies only to the proposal currently on file for the period of one year. If your study extends beyond this approval period, you must contact this office to request an annual review of this research. Any change affecting human subjects must be approved by the Board prior to implementation. Injuries or any unanticipated problems involving risk to subjects or to others must be reported immediately to the Chair of the Institutional Review Board.

Prior to involving human subjects, properly executed informed consent must be obtained from each subject or from an authorized representative, and documentation of informed consent must be kept on file for at least three years after the project ends. Each subject must be furnished with a copy of the informed consent document for their personal records.

4460 Old Main Hill Logan, UT 84322-4460 PH: (435) 797-1821 Fax: (435) 797-3769 WEB: irb.usu.edu EMAIL: irb@usu.edu

Appendix H. Informed Consent: Letter of Information to Parents

Utah State University
Department of Sociology, Social Work, and Anthropology
0730 Old Main Hill
Logan UT 84322-0730
Telephone: (435) 797-1230

USU IRB Approval: May 29, 2013
Approval Terminates: 05/19/2014
Protocol 5169
IRB Password Protected per IRB Administrator

LETTER OF INFORMATION

Effective Strategies for Teaching Archaeology in an Informal Education Setting

Introduction/ Purpose Dr. Bonnie Glass-Coffin, in the Department of Sociology, Social Work, and Anthropology at Utah State University, is conducting a research study to explore the most effective strategies for teaching archaeology in informal education settings. There will be approximately 250 third and fourth grade students from local schools participating in this study. The proposed project will explore the most effective ways to teach archaeology within an informal education setting. In cooperation with the USU Museum of Anthropology, research will be conducted during a weeklong summer archaeology day camp in June 2013. The primary investigator's student researcher, Candice Cravins, will administer and supervise all learning activities and completion of student questionnaires. The data collected from the study, published in a master's thesis, will assist archaeologists in creating more effective public outreach and education programs for children.

Procedures To explore the most engaging ways to teach archaeology within an informal education setting, two styles or modes of teaching archaeology will be contrasted and evaluated: object-based teaching and scientific, hypothesis-driven teaching. The teaching styles will be evaluated based on student level of excitement about the various activities – which activities are the most interesting and engaging? The first mode of teaching archaeology focuses on object-based learning. This mode of teaching, traditionally used in the museum environment, emphasizes the use of primary resources (for example, artifacts) in learning about past people, events, and everyday life. The second mode of teaching focuses on scientific skills development, specifically skills related to math and measurement and the application of scientific methods in answering research questions.

Four 4th grade-level appropriate lesson plans will be developed and administered to students. Two lesson plans will utilize object-based teaching strategies, and two lesson plans will focus on scientific skills development. These lesson plans will engage students in hands-on learning activities, such as creating their own Fremont pottery, participating in a mock archaeological excavation, creating their own split twig figurines, and learning about tree-ring dating.

Prior to administration of the lesson plans and activities, students will be given a "pre-teaching questionnaire" to assess their previous knowledge of and excitement about archaeology. No personally identifiable information will be collected on these pre-teaching questionnaires, and each questionnaire will be assigned a random number to assist in analysis. Student age and sex will be collected.

To assess which activities students found the most interesting, as well as overall learning success, students will be given a "post-teaching questionnaire." Each questionnaire will use the same random numbering system as the pre-teaching questionnaires, and students will be given the same number. This system will ensure that possible correlations between students' previous knowledge of archaeology and level of excitement in the various activities, for example, can be examined.

Alternative Procedures Students can still participate in camp activities without completing the pre- and-post-activity questionnaires that encompass the research component of this project.

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LETTER OF INFORMATION

Effective Strategies for Teaching Archaeology in an Informal Education Setting

Risks Participation in this research study may involve minimal risks or discomfort. Risks associated with participating in the various activities are minimal, meaning the risks do not extend beyond those ordinarily encountered during daily life or normal classroom activities. Loss of confidentiality may occur if registration forms become lost or compromised, but these are not directly connected to individual participants since student questionnaires (the primary means of collection of data) are anonymous. Participant registration forms and study data in digital form will be stored on a secured computer, and paper questionnaires will be stored in a locked file cabinet in a secured area of the Museum of Anthropology.

Benefits The information gained from this study may assist archaeologists, museum professionals, and education specialists in creating more relevant, engaging, and exciting archaeology education programs. By identifying the most engaging archaeology activities, museums and other informal learning institutions (for example, those that are part of the National Park Service, Bureau of Land Management, state parks, and other cultural and scientific learning centers) can focus their attention on integrating these types of activities into their education programs so that they can better communicate with their audiences. Children will be more excited to learn about archaeology (and science in general) if archaeologists can identify what kinds of activities they are most interested in, which results in a very positive outcome in the students' direct interest.

Explanation & offer to answer questions Candice L. Cravins has explained this research study to you and answered your questions. If you have other questions or research-related problems, you may reach Principal Investigator Dr. Bonnie Glass-Coffin at (435) 797-4064 or Student Researcher Candice L. Cravins at (435) 797-7545.

Voluntary nature of participation and right to withdraw without consequence Participation in research is entirely voluntary. You or your child may refuse to participate or withdraw at any time without consequence.

Confidentiality Research records will be kept confidential, consistent with federal and state regulations. Only the principal investigator Dr. Bonnie Glass-Coffin and student researcher Candice Cravins will have access to the data, which will be kept in a locked file cabinet or on a password protected computer in a locked room to maintain confidentiality. To protect your privacy, personal, identifiable information will be removed from study documents and replaced with a study identifier. Identifying information will be stored separately from data and will be kept until the completion of the project in spring 2014. At that time all personal, identifiable information will be destroyed.

IRB Approval Statement The Institutional Review Board for the protection of human participants at Utah State University has approved this research study. If you have any questions or concerns about your rights or a research-related injury and would like to contact someone other than the research team, you may contact the IRB Administrator at (435) 797-0567 or email irb@usu.edu to obtain information or to offer input.

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USU IRB Approval: May 29, 2013
Approval Terminates: 05/19/2014
Protocol 5169
IRB Password Protected per IRB Administrator

LETTER OF INFORMATION

Effective Strategies for Teaching Archaeology in an Informal Education Setting

Investigator Statement "I certify that the research study has been explained to the individual, by me or my research staff, and that the individual understands the nature and purpose, the possible risks and benefits associated with taking part in this research study. Any questions that have been raised have been answered."

Dr. Bonnie Glass-Coffin
Principal Investigator
(435)797-4064
bonnie.glasscoffin@usu.edu

Candice L. Cravins, Student Researcher
Museum of Anthropology: (435)797-7545
ccravins@hotmail.com

Appendix I. Archaeology Day Camp Flier