

**Project Archaeology:
Culturally Contextual Interdisciplinary Inquiry Lessons
for Underserved Populations**

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Introduction

In the United States, African Americans are underrepresented in science careers and underserved in pre-collegiate science education. This project engaged African American elementary students in culturally relevant science education through archaeology and thereby increased positive dispositions toward science. While imagining what the lives of their ancestors were like, students practiced scientific inquiry and used natural sciences to analyze archaeological sites. The project helped to improve science literacy among African American elementary students through archaeological inquiry and expanded inquiry-based archaeology education to three new culturally diverse urban areas.

Background

Educators urgently need culturally relevant science curricula to engage underrepresented audiences in science education (Key 2003). Because archaeology is interdisciplinary and humanistic by nature, it is an innovative way to provide culturally relevant and inclusive science curricula for diverse audiences that has not been previously tried at a national level (Shirley Gholston Key, University of Memphis, 2006: personal communication). Because it is inherently interesting, archaeology is an excellent tool for engaging youth in science education and associated ethical issues (Moe et al. 2002).

Some of the most exciting archaeology in the US today is the archaeology of African Americans. Archaeologists are uncovering the rich history of Africans in North America and in many cases are giving voice to people who lived in slavery and, effectively, have no history except for lists of births and deaths, sales receipts, or cryptic references in the records of their White owners. At Poplar Forest, Thomas Jefferson's woodland retreat, archaeologists traced changes in soil chemistry to identify the locations of root cellars, meat processing areas, and outdoor fire places built and used by slaves 200 years ago (Heath 1999). Variations in soil chemical levels allowed archaeologists to reconstruct the location of fences, outdoor fireplaces, and work activities such as meat processing. Some 200 years ago at Poplar Forest, residents configured their space to maximize light and space for work and to provide a modicum of privacy for relaxing and socializing out of sight of the overseer. Analysis of pollen, charred wood, and phytoliths (microscopic plant silicas), and plant macrofossils provided important clues to the past ecology of the area and some of the wild plant foods that slaves gathered to supplement their diets. Faunal analysis revealed the presence of butchered deer bones; together with pieces of firearms the evidence showed that slaves must have possessed guns and hunted in the nearby forests. Altogether the archaeological data from Poplar Forest create a picture of how individuals and families shaped their lives and maintained control over their living space within the confines of slavery (Heath 1999:67). In sum, archaeology offers a unique and innovative way to study science in the classroom while integrating humanities, ethics, culture history, and cultural understanding.

Project Archaeology (PA), a national education program at Montana State University, provides engaging curricular materials that give our nation's youth the intellectual tools they need to become successful adults and responsible citizens. Project Archaeology materials teach a deeper understanding of our diverse but shared cultural heritage and the scientific methodology and the content required to understand it. The materials are:

- Inquiry based – students complete extensive archaeological inquiries to learn how scientists gather and analyze data and interpret it.

- Interdisciplinary – students are required to use concepts and information from a variety of subjects.
- Culturally relevant and culturally inclusive – students learn the history of traditionally disenfranchised peoples and discover that their descendants are an important part of contemporary society.
- Humanistic – students recognize the role of humanities in archaeological inquiry and explore the ethics of scientific research and resource protection.

Presently, Project Archaeology is delivered to educators through 29 largely independent state and regional programs and is developing in an additional 10 states and regions. The program has already reached over 9,000 teachers nationwide and we estimate that these educators use archaeology to teach more than 200,000 students scientific inquiry and ethics each year. As Project Archaeology expands nationally, we estimate that we will reach over 5,000 educators every year and they in turn will teach 150,000 students annually. The program directly benefits the people of the United States by providing high quality curricular materials and continuing professional support to thousands of educators on a regular basis.

In the United States, people of color, especially African Americans, Native Americans, and Hispanic Americans, are increasing in population, but are still significantly underrepresented in science careers (Nicholson et al. 1994, Hines 2003). Culturally and ethnically diverse individuals have made significant gains in industry and business, but continue to lag behind in science and engineering careers (Carter et al. 2003).

School instruction in science is typically didactic, lacks multicultural content, and occupies very little time in the school day. Not surprisingly, African American, Native American, and Hispanic American school children typically do not score as well nationally in science tests as do White children (National Center for Educational Statistics 2005), and often show little interest in entering science careers when they reach college. “The problem of underrepresentation of people of color in science careers does not begin at the university or high school level but rather at the elementary school level, where there are basic flaws in instruction for many children” (Carter et al. 2003, p. 4). By the time African-American students enter undergraduate education, “...it is too late for them to consider careers in science. If we could model diverse scientific careers at a younger age, we could make a difference to these students” (Eleanor King, Ph.D., Howard University, 2006: personal communication).

Archaeology education could help underserved audiences to study their own history and at the same time use scientific inquiry and supporting science disciplines to ask questions, formulate hypotheses, and to gather, analyze and interpret data. When the content and processes of science are applied to the personal meaning ascribed to past generations we have the opportunity to connect the present day needs of learning science in relevant and meaningful ways to the interests of diverse and discrete groups of learners. This can lead to more positive dispositions towards both science and learning and translate into increased science literacy.

If America is to keep its place as a global leader in scientific and technological innovation, we must open careers in science to all of our citizens. We will need to begin by providing a better foundation for science literacy for young people of all historical and ethnic origins between the ages of 8-14 years of age. To begin, we must:

- Provide culturally relevant and culturally inclusive science curricula.
- Improve instruction by adding culturally accessible methods such as inquiry-based learning that begins with what the students already know.

- Implement new and untried methods as soon as possible to open opportunities for underserved students to connect with science education and consider careers in science and technology.

This project used archaeology as a tool to connect underserved audiences to science education and improve the science literacy of underrepresented audiences in classrooms thereby increasing their ability to enter science and technology careers. We employed new culturally relevant, inquiry-based materials to teach for deeper understanding of scientific methods and the relationship of science to other subjects including cultural history, the humanities, and ethics. Through three major activities, this project expanded the entire program and its reach by helping establish new programs and sustain existing programs within the Project Archaeology national network.

1. Expanded culturally relevant, inquiry-based science education to three new culturally diverse urban areas to serve underrepresented audiences through three professional development workshops for educators (N=60) of upper elementary aged African American students in 2007. A total of 50 educators attended three workshops in 2007. These educators received and learned to use age appropriate investigations on African American archaeology. Project Archaeology will continue to support these educators after the grant period. Unused grant funds for stipends allowed us to offer an additional workshop for 21 teachers of African American students in Kansas City, Missouri in 2008, however, neither these teachers nor their students were part of the study.
2. Selected teachers (N=7) implemented Project Archaeology curricular materials in classrooms of African American students in upper elementary grades within these three urban areas. The educators will engage students in investigations using authentic archaeological data such as site maps, artifacts, botanical data, soil chemistry results, and oral histories from African American sites.
3. Evaluated the improvements of 118 students in positive dispositions toward science education and science literacy as a result of instruction in archaeological inquiry. Evaluation information was used and will continue to be used to improve existing Project Archaeology educational materials and to ensure that future materials are culturally inclusive and capable of improving science literacy among diverse students.

The Project: Archaeology as Culturally Relevant Science

Project Archaeology recognized the need for connecting underserved audiences to science education using archaeology. The America Honda Foundation agreed to fund the Archaeology as Culturally Relevant Science Curricula (ACRSC) project. We used a national curriculum *Project Archaeology: Investigating Shelter*, with the regional component, "Investigating a Slave Cabin." Together, the two curriculum components use shelter to teach archaeological concepts, content, and stewardship ethics (Letts and Moe 2009). "Investigating a Slave Cabin" is a complete investigation of the Poplar Forest Slave Quarters using authentic data from geography, history, archaeology, and contemporary perspectives (Heath et al. 2007).

In Part One of the investigation of the Poplar Forest Slave Cabin, students meet Gregory Jefferson. Mr. Jefferson is a descendant of enslaved people who once lived at Monticello and Poplar Forest and he acts as the guide through the entire investigation. The students learn about the geography and environment of Poplar Forest.

In Part Two, they examine historical documents and photographs. Two documents show a listing of enslaved people Thomas Jefferson owned in 1774 and in 1805, respectively. Students make inferences about the date and location of two historic photographs of cabins built in the 1880s that probably resemble the Poplar Forest Slave Cabin in many respects.

In Part Three, the students simulate archaeology by doing it backwards. The students are given “artifacts” and asked to place them back on the site map. Once they have placed the artifacts on the map, they make inferences about the site based on the location of the artifacts.

The final part of the investigation, Part Four, brings the archaeological and historical evidence into the present. The students examine why it is important to preserve archaeological sites and our shared heritage. Mr. Harvey Bakari, an interpreter at Colonial Williamsburg, writes, “Archaeology allows us to create a picture of a community of people complete with its own culture. It helps us better understand people who had no voice in society when they lived” (Heath et al. 2007).

Results

Professional Development

In 2007, 50 educators in three US cities, spent two days in professional development workshops. To participate in the workshop educators were required to teach upper elementary aged African American students in culturally diverse urban areas. In 2008, an additional 21 teachers attended a professional development workshop, but were not part of the study.

Table 1. Professional Development Workshops

City	Target Area(s)	Workshop Location	Date	Number
San Diego, CA	Central San Diego	San Diego Archaeological Center	February 2007	16
Kansas City, KS	Northern & Eastern Areas	Shawnee Indian Mission	June 2007	18
Washington, DC	Entire Metropolitan Area	NMNH, Smithsonian	June 2007	16
Kansas City, MO	Entire Metropolitan Area	Discovery Center, Missouri Dept of Conservation	July 2008	21
Total				71

The objectives of the workshops were to provide opportunities for participants to:

- Participate as a learner in PA:IS instruction.
- Explore scientific inquiry as part of archaeology.
- Explore issues in cultural sensitivity in teaching archaeology.
- Develop a plan for teaching and assessing archaeology as culturally relevant science curricula.

Our research question was: To what extent were workshops effective in training teachers in the use of *Project Archaeology: Investigating Shelter*?

A total of 43 workshop evaluations were collected and analyzed. Most respondents felt prepared to teach archaeology in their classrooms. They thought the curriculum was well-designed and would help them teach science and African American history.

Table 2. Workshop Usefulness

Extremely Useful	Useful	Not at all Useful
35	8	0
81%	19%	

Seven of the 50 teachers who attended the workshops piloted the curriculum in their classrooms. These seven teachers exhibited a wide range of abilities in developing a classroom culture amenable to inquiry learning and in asking questions and pushing students to higher levels of learning. Based on classroom observations by the evaluator, teachers are grouped as follows:

- **Level 2** (Elements of Effective Instruction) – 2 teachers
- **Level 3** (Beginning Stages of Well-Designed Instruction) – 3 teachers
- **Level 4** (Accomplished, Effective Instruction) – 1 teacher
- **Level 5** (Exemplary Instruction) – 1 teacher

All seven of the piloting teachers implemented the curriculum with a high level of fidelity as requested by the project evaluator. Because the materials were new to these teachers, they stuck closely to the procedures and did not extend the learning beyond the curriculum as can be expected for first-time users. Teachers appreciated the fact that *Project Archaeology: Investigating Shelter* allowed them to integrate science and social studies, two subjects that they have little time to teach.

Student Learning

The following research questions address the extent to which project goals impacted participating students.

1. To what extent does *Project Archaeology: Investigating Shelter* impact student learning? Do students reflect increased positive dispositions toward science and science education? Are they able to design and conduct scientific inquiry?
2. Do students recognize the integration of science within science and with other disciplines? Are they able to articulate the relationship of science with humanities? Are they able to recognize ethics within scientific endeavors?

During the 2007-2008 and the 2008-2009 academic years, *Project Archaeology: Investigating Shelter* and “Investigating the Poplar Forest Slave Cabin” were implemented and evaluated in seven 4th and 5th grade classrooms in Washington, DC, Kansas City, KS, and San Diego, CA. A total of 7 teachers and 127 students participated in the study. Six of the classrooms (1 in Washington, DC and 5 in Kansas City, KS) contained high percentages (80% - 100%) of African American students and the classroom in San Diego, CA contained a high percentage (50%) of Hispanic/Latino students and all are eligible for free or reduced lunch.

The basic evaluation design was a quasi-experimental approach. Control groups of teachers (N=3) and their students (N=66) served as a comparison group. The students in both groups were assessed on their dispositions towards science education, abilities to conduct and construct scientific inquiry, and knowledge about scientific integration, particularly with humanities and ethics. The study group completed both pre-tests (N=127) and post tests (N=118), while the

control group completed post tests only (N=66). All seven classrooms were observed while a lesson from Project Archaeology was taught and a few students from each class were interviewed.

On pre-tests, the majority of students agreed that science includes questioning, explaining, and testing. The study group increased slightly on post test responses.

Table 3. Response to: “Science means questioning, explaining, and testing.”

	Agree	Not Sure	Disagree	No Response
Pretest (N=127)	71 (56%)	40 (31%)	16 (13%)	0
Control test (N=66)	36 (56%)	26 (39%)	3 (4%)	1 (1%)
Post test (N=118)	75 (64%)	31 (26%)	12 (10%)	0

Post test data show an increase in all student responses to liking, being good at, and thinking that science is fun.

Table 4. Response to: “I like science/I am good at science.”

	Agree Like / Good at		Not Sure Like / Good at		Disagree Like / Good at		No Response Like / Good at	
Pretest (N=127)	78 (61%)	38 (30%)	23 (18%)	70 (55%)	16 (13%)	18 (14%)	10 (8%)	1 (1%)
Control test (N=66)	44 (67%)	19 (29%)	15 (23%)	43 (65%)	7 (10%)	4 (6%)	0	0
Post test (N=118)	85 (72%)	43 (36%)	24 (20%)	65 (55%)	8 (7%)	10 (9%)	1 (1%)	0

Table 5. Response to: “Do you think science is fun?” (SLIDE)

	Yes	No	No Answer/ Don't Know
Pretest (N=127)	90 (71%)	13 (10%)	24 (19%)
Control test (N= 66)	47 (71%)	10 (15%)	9 (14%)
Post test (N=118)	99 (84%)	12 (10%)	7 (6%)

These data suggest that there is an increase in students’ positive dispositions towards science as a result of learning science through *Project Archaeology: Investigating Shelter*.

Students were asked to provide examples of science process skills such as observations, inferences, classifications, and context. Post tests reveal significant gains in students’ ability to recognize and define these science process skills.

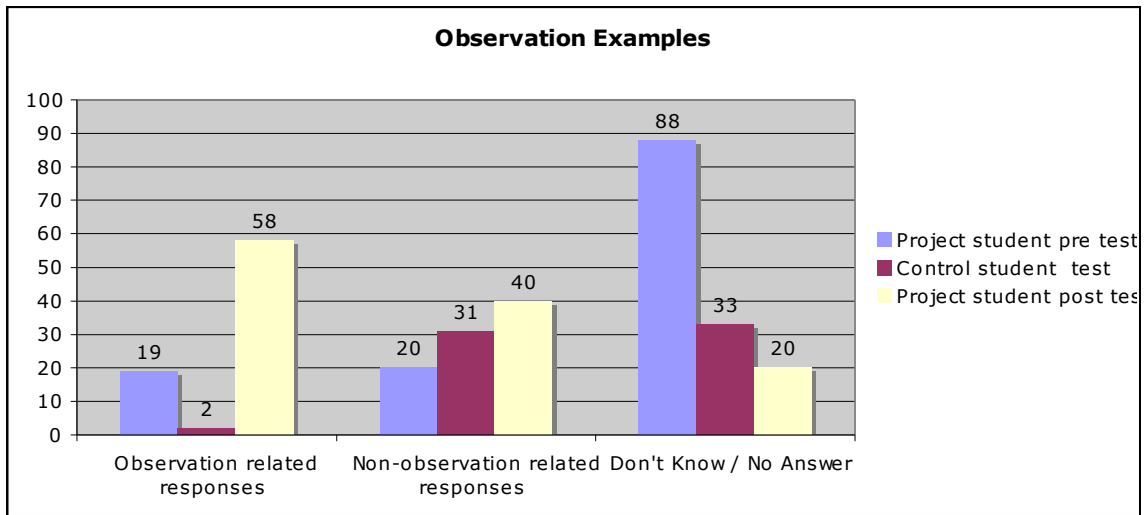


Figure 1. Observation Examples.

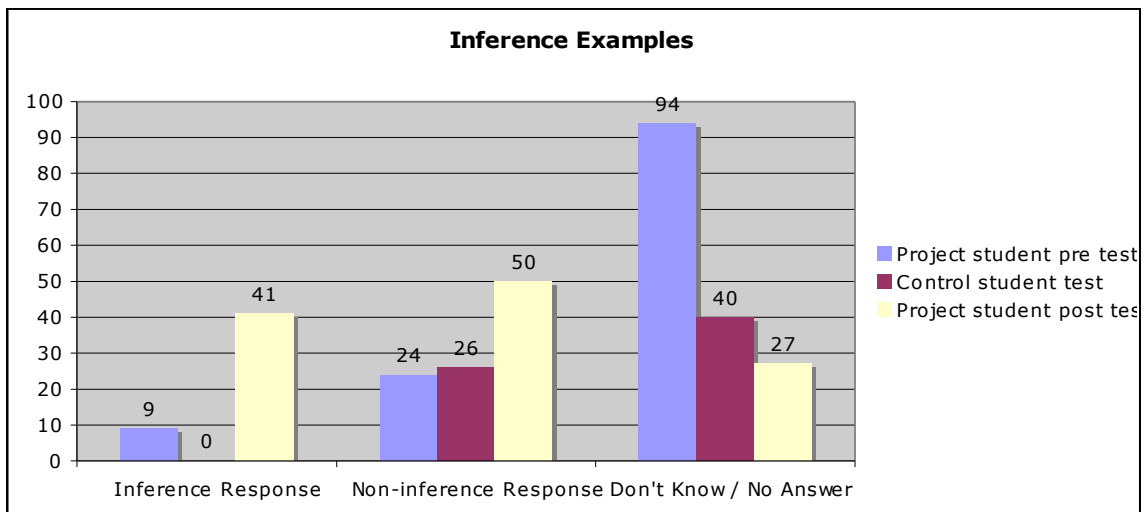


Figure 2. Inference Examples.

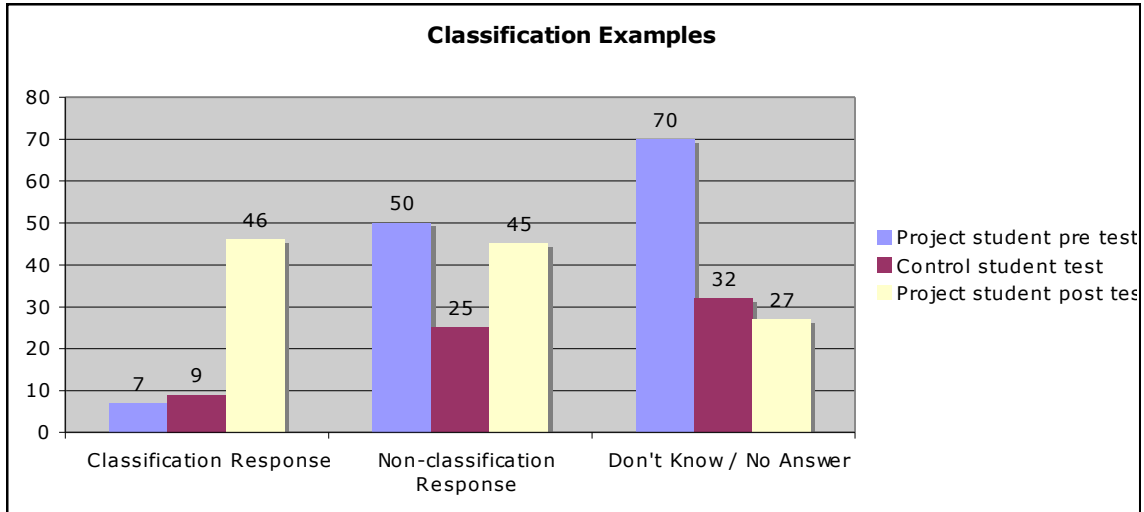


Figure 3. Classification Examples.

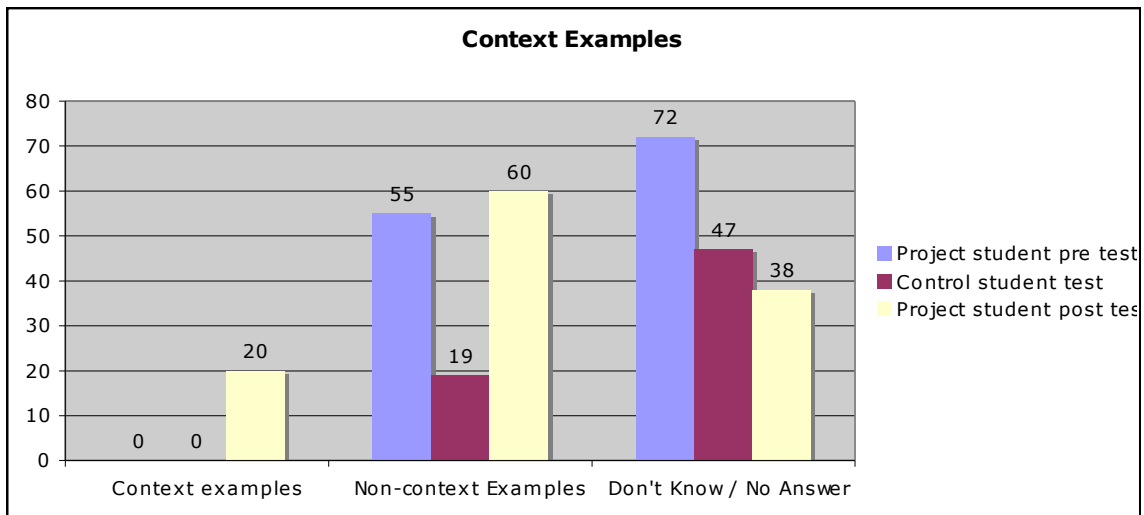


Figure 4. Context Examples.

When asked what can be learned by investigating shelter through archaeology, several students connected to their own heritage. Post test examples include: “We can learn their diet, habitat, and culture.” “We learned about slaves and studied they (their) cabins and studed (studied) how big or small it was. We kinda (kind of) learned about there (their) culture 2(too).” “How we made things and how we did things.”

A thread throughout the Project Archaeology: Investigating Shelter curriculum is the preservation of archaeological sites and cultural resources. To measure students’ ideas about preservation and ethics, they were asked about behavior at an archaeological site – both things one should do and what they should not do. The difference in responses between the pre test / control test and the

post test responses was the significant reduction of Don't Know / No answer responses and the inclusion of Contact Authorities. Several of the other positive responses such as Study and Learn and Be Careful / Don't Touch also increased.

Figure 5. Pretest Responses.

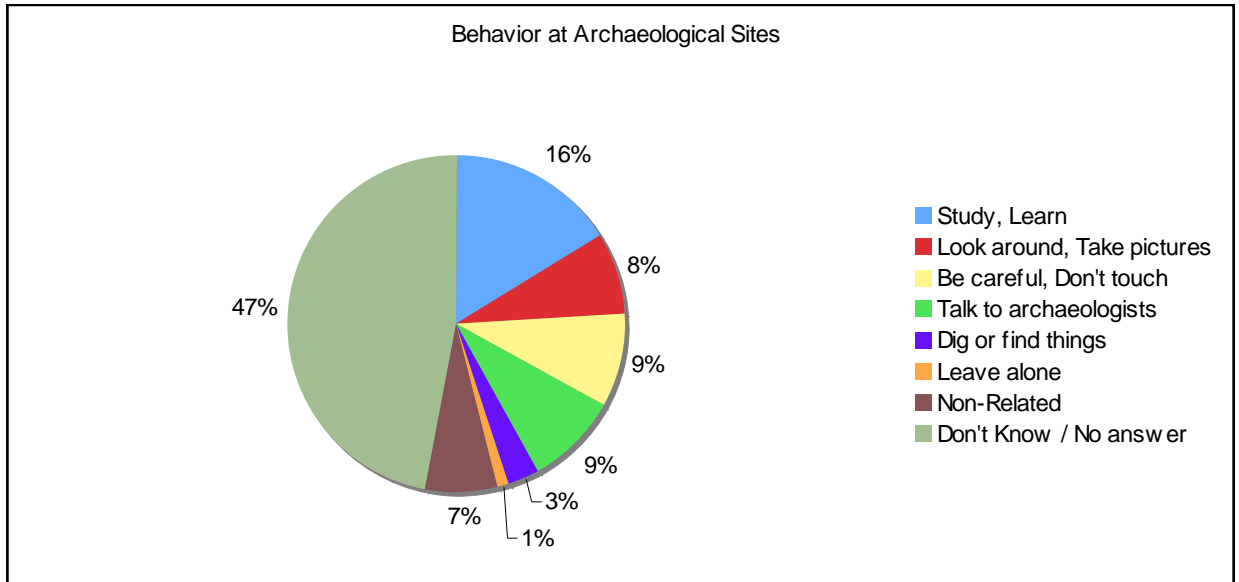


Figure 6. Control Group Responses.

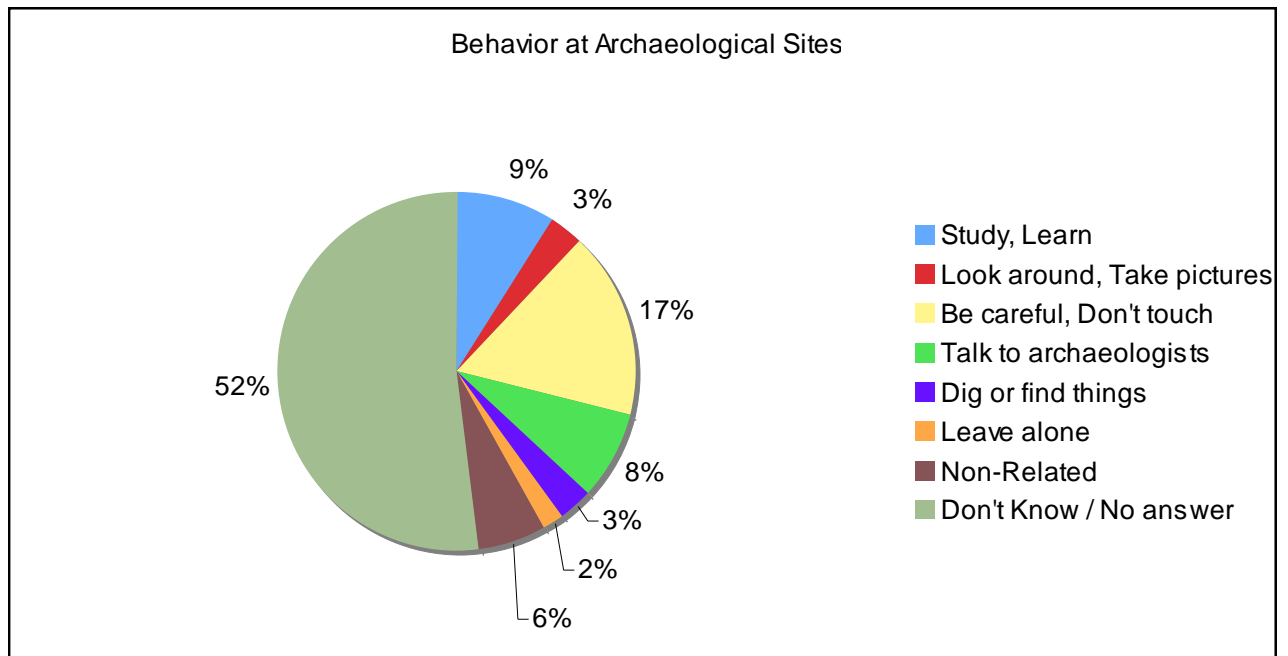
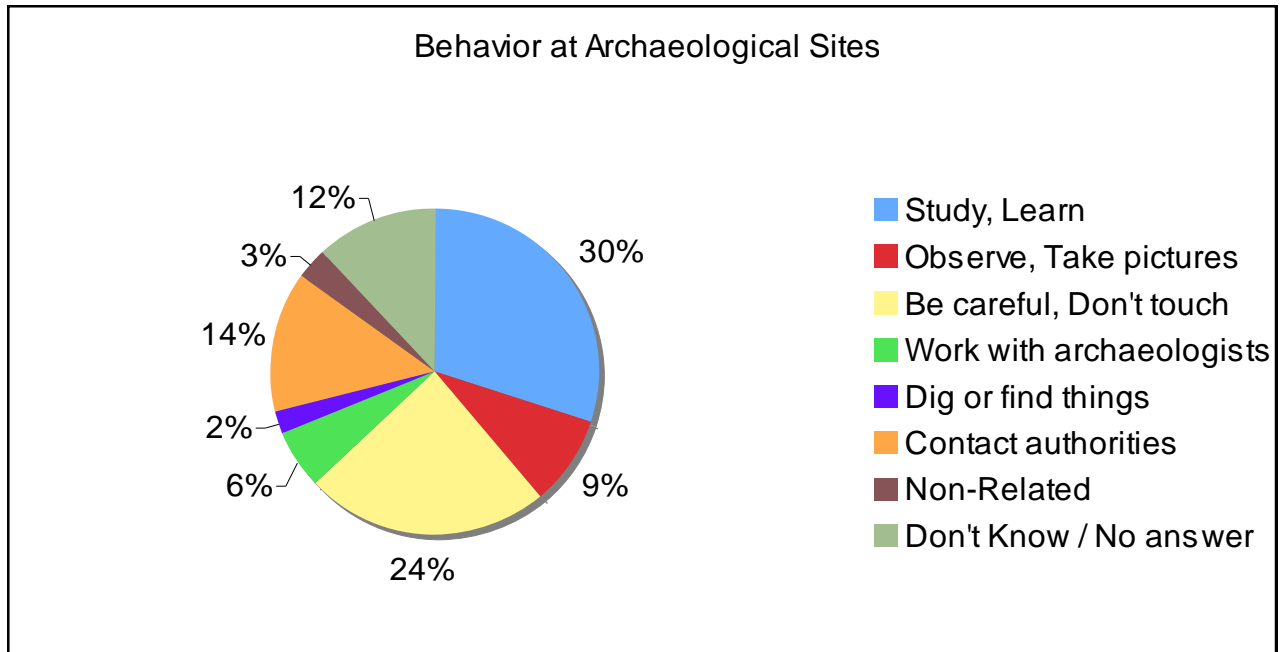


Figure 7: Post test Responses.



When asked how the study of archaeology can benefit us today or in the future, most students thought that there was some benefit. Post test responses contained some general references to the importance of learning history, but also included more personal reasons about knowing about one's ancestors and "where I come from." One student wrote: "B-cuz (Because) 4 (for) an example there used 2 (to) be problems with race. We learned 4rom (from) there (their) mistakes and all colors get along now." Another wrote: "We can change what we do and be like them and we can tell others." These responses indicate that students were personally affected by learning about archaeology, which is something culturally relevant curricular materials are designed to do.

Conclusions

Students in this study were clearly interested in learning about the Poplar Forest Slave cabin through archaeology. The content of the materials had a personal impact on most of the students. One student mentioned that she has never had the opportunity to learn about the history of her ancestors before doing this unit. Some students expressed an interest in becoming archaeologists; something they probably wouldn't have thought of before investigating a shelter through archaeology.

Students liked examining artifacts, reading, working in quadrants, making collages of shelters, and studying slave cabins. In addition, data show that the students' ideas about and dispositions towards science increased as a result of participating in the ACRSC project. Their understanding of scientific processes improved and they were able to articulate their learning of inquiry skills such as observation, inference, and questioning. They were able to explain what they were doing in their archaeology unit and what they were learning from the experience. Students also refined their ideas about ethical behavior at archaeological sites. Although there were three students who in post tests said that they would dig to find artifacts, the vast majority thought it would be better

to learn, work with archaeologists, or contact authorities if they found or visited archaeological sites.

Gains in student learning and dispositions toward science were moderate to slight, but consistent across all measures. The ACRSC project was part of the formative evaluation of *Project Archaeology: Investigating Shelter*. At the time of implementation, the curricular materials were in draft form; they have been revised and refined considerably since then. We think that gains in the future will be greater when the finished materials are implemented. Additionally, all seven of the teachers were using the materials for the first time and their students had experienced little, if any, inquiry-based instruction. Only one or two of the seven teachers could be considered master teachers and one was a first year teacher who struggled with both classroom management and the new content.

The history of slavery in the United States may be painful for today's descendants of enslaved Africans. For this reason, the slave quarters at Poplar Forest may represent what applied archaeologists call "difficult heritage" for young African American students (Colwell-Chanthaphonh & Ferguson, 2008; Barbara Heath, 2006, personal communication). Everyone believes that the conditions of slavery were unequivocally horrific. In contrast, the archaeological data at Poplar Forest shows that the residents of the cabin were relatively well-fed, owned firearms, hunted and gathered in the nearby forest, had some money, and retained certain aspects of their African culture. While study results are generally positive, we must be mindful that this contrast may have created some cognitive dissonance in our young subjects. While the archaeological record of African Americans provides a promising vehicle for delivering science education, we must always be vigilant about how "difficult heritage" will be assimilated and interpreted by our students.

Project Outcomes

This project served 71 teachers of African American students (11 more than the proposed 60 teachers) with high-quality, inquiry-based professional development in three urban centers. Seven of the proposed nine teachers implemented the materials in their classrooms and participated in the evaluation portion of the project. A total of 127 students received instruction with the culturally relevant science materials and 118 students completed all learning assessment protocols.

The completion of this project was delayed by several factors; for example, we had to reschedule the workshops in Kansas City and Washington because teachers could not leave their classrooms for professional development during the school year. Earlier contacts with all three school districts indicated that teachers would be allowed to attend workshops as long as stipends for substitutes were provided. We also found that many teachers in our study simply did not have the opportunity to pilot new curriculum materials. These factors contribute to the difficulties associated with providing under-represented students with innovative, culturally relevant science curricula. We experienced little difficulty in identifying educators of African American students in Kansas City, Kansas and in the Washington, DC area and recruiting them for the workshops once we had rescheduled the workshops for the summer months. While the San Diego area supports a large, identifiable African American population, our partner at the San Diego Archaeological Center (SDAC) experienced difficulty in finding educators from this community and recruiting them for the workshop (Annemarie Cox 2007; personal communication). Many of the teachers that Ms. Cox contacted were interested in culturally relevant science curricula, but said that they simply could not participate in the workshop or pilot any new materials without administrative permission, something that is very difficult to obtain as district restrictions on

professional development increase. However, since that time, SDAC has developed a partnership with the San Diego Unified School District to include Project Archaeology curricula in approved professional development and to encourage teachers to participate in Project Archaeology workshops based on culturally relevant education materials. In summary, there remain challenges to providing culturally relevant, inquiry-based materials for educators who teach African American students.

Nationally, science and social studies are often relegated to only one or two hours per week making it difficult for teachers to implement new materials. We proposed to pilot and evaluate *Project Archaeology: Investigating Shelter* and “Investigating a Slave Cabin” in nine classrooms nationally, three in each of the target urban areas. One teacher in the Washington area was able to pilot and evaluate the materials. A second teacher in Washington planned to pilot the materials, but sadly, passed away in November 2007. Other teachers reported that they did not have time due to rapidly established reforms in district curriculum requirements. Seven teachers in the Kansas City area planned to participate in the study and five were able to do so. Two teachers reported that they had run out of time to implement the materials. After more than a year of recruiting in the San Diego School District, one after-school instructor who attended the 2007 “Investigating a Slave Cabin” workshop agreed to participate in the study.

Four teachers from Washington, DC reported that the materials were too difficult for students in grades 4 and 5. While another Washington teacher successfully implemented the materials in her 5th grade classroom, we recognize that teachers may need more pedagogical support for teaching science literacy. Inquiry-based instruction involves reading from a variety of sources and extending prior knowledge. Nonfiction reading and writing is an important part of inquiry-based instruction. Due to the difference in text structure and organization of nonfiction, instructional strategies that build students’ understanding of how to read nonfiction are necessary. In response to the Washington teachers’ concerns, we plan to provide additional scaffolding for readers engaged in nonfiction science text. Possible strategies include reading and thinking aloud and the use of graphic organizers. Continual instruction and reinforcement of a student’s personal use of reading strategies is also necessary. Reading strategies that assist the learner to build meaning while reading include: using prior knowledge, reading on for more information, and asking questions while reading. In general we found that there are a number of related literacy skills required to support the “Investigating a Slave Cabin” curriculum materials and these must be addressed with underserved populations in a systematic way in order to insure student acquisition of science process skills.

While the challenges of providing culturally relevant, science curricula to underserved African American students are significant, the final outcomes are worthwhile. The students in this study were thoughtfully engaged in meaningful learning about their ancestors and their history through archaeological science. Their gains in science literacy were moderate, but consistent across all measures. Results of this study have been used to improve the curricular materials and will be used to provide additional pedagogical support to teachers of underserved students.

Future Research

This study provided a firm foundation for additional research on the efficacy of culturally relevant, inquiry-based science education curricula for teaching science literacy with underserved audiences. Our experience in all three areas indicated that professional development policies change rapidly in somewhat unpredictable ways and thus, sufficient lead time is needed to ensure that innovations in research and practice can proceed as planned.

Based on the results of this study, learning assessment protocols could be revised to better elicit student understanding of science inquiry concepts and to assess science literacy. Interviews would help identify deep conceptual understanding as well as misconceptions. Revised protocols and learning assessment probes could be used to design and conduct similar studies in other urban centers. Piloting and evaluation with students in rural regions would provide a useful comparison to students from urban areas. These more in-depth research methodologies and data acquisition methods are labor intensive and are best implemented over extended periods of time.

Additional archaeological investigations of shelters in early free-black communities can provide students with a less “difficult heritage” with which to study history and the lives of their ancestors. Recent archaeological projects in free-black communities such as New Philadelphia, Illinois; Alexandria, Virginia; Prince William County, Maryland; and the Yates Neighborhood in Houston, Texas provide excellent resources for developing new culturally relevant curricular materials. Comparing the learning outcomes of students using each type of investigation would provide broader perspectives and insight into the range of culturally relevant science curricula on archaeological sites where African Americans lived and worked.

Concerning the broad issue of culturally relevant curriculum for underserved audiences, more research is needed on student achievement as measured by authentic or alternative measures. In addition further study is needed on how teachers define and implement culturally appropriate curriculum and the factors that may interfere with common school practice (Tarajean 1999). Although there were obstacles to conducting this research and implementing culturally contextual curriculum in schools, it is clear that curricular materials like “Investigating a Slave Cabin” are the building blocks to achieving a challenging, relevant, thought provoking and responsive science education for underserved populations.

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