PRESENTING A PLURALIZED PAST: ASSESSING THE EFFICACY OF MULTIVOCAL, BISON-THEMED LESSON UNITS AS A PUBLIC EDUCATION AND OUTREACH STRATEGY FOR ARCHAEOLOGY

by

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STATEMENT BY AUTHOR

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DEDICATION

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ABSTRACT

Archaeological education and outreach have become priorities in a discipline that struggles to make its research accessible and relevant to the diverse public. In recent years, researchers have begun to address this issue through the design and implementation of grade school lesson modules on various archaeological topics. Although these lesson modules are readily available, little has been done to assess the efficacy of such public education and outreach agendas. With stimulus and funding from the Blackfeet Tribe and the Montana Department of Transportation, respectively, this thesis addresses this gap by (1) designing archaeological lesson modules for middle school students, and (2) assessing the general efficacy of the lessons. Specifically, the study systematically analyzes four science units for their overall efficacy, general impact, and utility through pre-and-post assessments that measure student understanding and interest. The quantified analyses are then combined to attain an overall percentage of curriculum efficacy. As a public outreach strategy for archaeology, these modules emphasize a pluralistic, multivocal, inclusive, and pragmatic perspective of the past that both connects with a multifaceted, diverse public and avoids educational marginalization of a shared, collective past. Thus, Native perspectives are interwoven with scientific archaeological knowledge to, in essence, pluralize the past. The topical focus of the lessons is bison—a uniquely North American past and present species with which humans have interacted intimately at a multitude of levels but, also, a species that is not always accepted among contemporary ranchers and land users. The curriculum is aimed at middle school students, recognizing that these students, as the future decision-makers,

are a key demographic to target. It is hypothesized that (1) the respectful incorporation of archaeological education in a pluralized, inclusive fashion allows the interdisciplinary potential of archaeology to be more fully realized, and (2) such a strategy allows the significance of bison to be better understood and more widely appreciated.

CHAPTER 1: PROJECT INTRODUCTION, ARCHAEOLOGY WITHIN PUBLIC EDUCATION, AND THEORETICAL APPROACHES

> "One worldview is not necessarily better than the other; each has value" (Watkins and Ferguson 2005: 1383).

PROJECT INTRODUCTION

During a roadway expansion project along U.S. Highway 89 from Browning, Montana, to Saint Mary, Montana, the Blackfeet Nation requested the Montana Department of Transportation (MDOT) to set aside a monetary appropriation for offsite mitigation of cultural properties that would be negatively impacted by the expansion project. The Blackfeet intended to use the funds for the development of a bison-themed curriculum. Once offsite mitigation funds were awarded, the Blackfeet Tribal Historic Preservation Office (THPO) spearheaded the initial bison curriculum project, contracting the Bureau of Applied Research in Anthropology (BARA) at the University of Arizona to design the curriculum. As requested by the Blackfeet THPO, the curriculum highlights the 10,000-year significance of bison for native, and much later, non-native peoples within Montana. These lessons interweave archaeological, ethnographic, historical, and native oral tradition to demonstrate this multi-millennium significance for middle and high school classes.

The purpose of my Master's thesis is to assess the efficacy and overall utility of this curriculum that promotes multivocality, where Native worldviews and knowledge systems are placed alongside scientific, archaeological reconstructions of the past. The subsequent analysis and conclusions of the thesis then highlight a viable route forward

for a more inclusive, empowering, and enfranchising framework that can be used in the design of archaeological lesson modules. For the purposes of my thesis, the analysis is bounded within a curriculum discussing the past, present, and future significance of bison. However, the results are extrapolated to be of benefit to potentially all archaeological lesson topics and curriculums.

The design of these lessons began with one crucial question: In what ways were bison significant to past populations and how are they significant today? In other words, what prompted the Blackfeet to request such a curriculum? Studies examining the long-term significance of bison, the near extirpation of bison in the nineteenth century, and the ongoing restoration of bison are pervasive within the academic disciplines. This includes such diverse fields as paleobiology (see Danz 1997; Reynolds et al. 2003), ecology (see Flores 1991), and certainly archaeology and anthropology (see Brink 2008; Hofman and Todd 2001; Grayson and Meltzer 2002; Peck 2004; Zedeño et al. 2014). Recently, pluralization of research programs via inclusion of native perspectives, oral traditions, and histories has become ever more commonplace (see Barnhardt and Kawagley 2005; Lotenberg 1996; Oetelaar 2014; Stephenson et al. 2001; Zedeño et al. 2008). These studies, and many others not mentioned in this brief review, show bison's central placement within Native American subsistence and, more abstractly, native ontology. Indeed, as stated by Potter et al. (2010:10–11), "bison played a key role in Paleo-Indian, Archaic, and later economies in North America, particularly in the Great Plains" providing not only a form of subsistence, but shelter, clothing, tools, and socio-spiritual sustenance.

As such, Native populations became intimately linked culturally, economically, and spiritually with this key resource. This linkage led to resource specialization and large-scale, communal hunting practices centered predominantly on bison. These multivariate processes culminated in the Plains-Woodland complex that connected large spheres of geographical interaction, from the Greater Southwest to the Eastern Woodlands (Potter et al. 2010:10). Bison became a significant resource to many populations.

The archaeological signatures of bison's significant role in Plains culture and society are clearly evident, from localities like UNESCO's World Heritage Site, Head-Smashed-In Buffalo Jump (Brink 2008) to the Late Prehistoric bison hunters' investment on the landscape—termed landscape engineering—that resulted in burgeoning organizational and sociopolitical complexity (Zedeño et al. 2014). With the arrival of Europeans, however, human-bison interactions were forever altered and their interwoven sociocultural fabric transformed in profound ways. Native subsistence on bison became ever more difficult as commoditization of bison products alongside overhunting contributed to depleting bison populations (Potter et al. 2010:11; Lott and Green 2003:175–179).

Public attitudes were decidedly unsympathetic to the plight of the bison (Lott and Green 2003:179), and the U.S. government capitalized on mass bison hunts to bring about Native submission through resource depletion (Potter et al. 2010:8). However, with the bison quickly en route to extinction, prevailing attitudes began to change (Lott and Green 2003:180). Consequently, legislative measures were taken to manage and ideally preserve this increasingly endangered animal. Between 1864 and 1872, for example,

Montana implemented statutes to reduce the killing of game, including bison. Though enacted, a lack of any real enforcement rendered these statues largely ineffective. In 1872, President Grant established Yellowstone National Park as a means to protect bison and other endangered resources. Several decades later in 1909, the Federal government established a national bison range (Aune et al. 2010:63 and 69). However, in recent years the pendulum has swung back as bison preservationist attitudes have changed toward more anti-bison sentiments and subsequent anti-bison legislation in Montana (Schweber 2013; Hansen 2013).

It is for this reason that the Blackfeet tribe of Montana recognized the need for the introduction of pro-bison curriculum within Montana state education to not only counteract some of this pervasive, anti-bison sentiment, but also to instill a sense of why this species is so important and integral to the many native, and indeed non-native, populations. As part of the Bison Curriculum project, I developed a collaborative research design with six teachers on the Blackfeet reservation to (1) conduct a trial run in which the lessons can be assessed in order to finalize edits, streamline the presentation, and make improvements, and (2) test the efficacy and general utility of multivocal or "pluralized" curriculum as a public education and outreach strategy for archaeology. The final results of this project, which are summarized in this thesis, will be submitted to the Montana Department of Transportation and the Blackfeet Tribe.

CONTEXTUALIZING BISON'S SIGNIFICANCE

I embedded this thesis in a four-fold research context: environmental, cultural, historical, and educational. It strives to (1) validate the necessity of a pro-bison curriculum, (2) display the importance of introducing bison-themed lesson modules into

the Montana state school system, and (3) test the efficacy of such an educational strategy using a pluralized native, non-western perspective alongside a non-native, western perspective of the past in order to connect with a broader public. Thus, the bison lessons include archaeological themes and ethics, as well as Native perspectives about bison, to pluralize the past.

I hypothesize that a pluralized past model will (1) increase the understanding and appreciation of bison as a valuable and indispensable species and (2) facilitate the respectful incorporation of archaeological education in a non-alienating, more inclusive fashion. Doing so will allow the interdisciplinary potential of archaeology to be more fully realized and archaeological education to be more effectively disseminated, appreciated, and understood. My thesis recognizes that middle school students, as the upcoming generation, are a key demographic to target in order to encourage a more sustained and far-reaching understanding of archaeological ethics, goals, and practices into the future. Thus, my hypothesis states that a pluralized, multivocal curriculum will be of positive benefit to student understanding, interest, and empowerment. The null hypothesis in this research design, on the other hand, states that a pluralized lesson model has no impact upon students' engagement with, interest in, and excitement for both bison and archaeology by the end of the unit sequence.

Environmental Context

Prior to European culture contact and colonialism, the American bison had the largest distribution of any North American large herbivore, ranging from the grassy floodplains of Alaska down to the desert grasslands of northern Mexico. Through the millennia of interglacial and glacial periods, the American bison adapted symbiotically with the Great Plains and surrounding environments, contributing to the "co-evolution of

other biota, including grazing adaptations in plants [as well as] mutualistic, commensal and trophic interrelationships" with other species (Gates and Gogan 2010:1). In essence, bison became a key species that contributed to the biodiversity of the continent, and was integral in maintaining the environment's ecological stability. Indeed, the plains bison's presence and behavioral activities helped "to maintain meadows and grasslands on which they, and many other animal and plant species, depended" (Gogan et al. 2010:42).

Bison impact the plains environment in a variety of ways. A highly visible impact is the act of wallowing—creating small depressions in the soil—which influences surface hydrology and water runoff (Figure 1). This facilitates the growth of a several wetland plant species (Gogan et al. 2010:42). Significantly, wallowing, as a behavior, "is not employed by cattle, and, thus, the removal of bison had profound geomorphic implications …" that cattle cannot replace (Butler 2006:452).

Figure 1: Wallowing modifies the landscape.
Taken from Gogan et al. 2010:42 Photos: Dwight Lutesy (inset) and John Gross.

Bison surface trampling also contributes to a variety of beneficial ecological factors (see Butler 2006:452). Perhaps bison's greatest impact on mixed-grass prairie ecosystems is their particular pattern of grazing. Bison usually graze in patches, selecting dominant grasses while avoiding forbs and woodier species (Figure 2). This patchy distribution of

grazed and ungrazed vegetation increases plant diversity by allowing forbs—herbaceous flowery plants—to flourish (Collins et al. 1998).

Figure 2: Bison selecting for cool season grasses and sedges in the mixed-grass prarie. Taken from Steuter and Hedinger (1999:335).

Finally, a study conducted by Knapp et al. (1999:48) found that the interaction of fire with the patch-patterned grazing behavior of bison—but not cattle—is key to conserving and restoring the biotic integrity of the remaining tracts of tall grass prairie." Taking all this into consideration, it is an easy jump to the conclusion that depletion of such a keystone animal species would negatively impact the environmental balance and biodiversity of the plains ecoregion. Educational outreach on the environmental significance of bison is therefore needed to help ameliorate the deleterious, long-term effects of cattle and sheep overgrazing that began with the introduction of these European species into the Great Plains.

Cultural Context

With the receding ice sheets opening the continent approximately 14,000 years ago, bison became integral to yet another species: humans. Since that time, bison acted as a staple resource in the subsistence economies of the indigenous communities. For this reason, "no other wildlife species has exercised such a profound influence on the human history of the continent" (Gates and Gogan 2010:2). Potter et al. (2010:0) state that:

> Few species enjoy a history as rich in archaeology, paleontology, story and legend, oral and documentary history as the American bison. Nor is there another North American species for which the cultural and political significance of an animal is so great. For thousands of years various forms and populations of bison have coexisted with humans in North America, providing sustenance and shaping human social and economic patterns, and influencing national history and international political relationships.

Thus, the American bison has been interwoven into the very fabric of cultural significance, into native peoples' prevailing attitudes and underlying ontology. For the many tribes in Montana—the Blackfeet, Kootenai, Salish, and Crow, to name but a few—bison played a significant role (Adams and Dood 2011:11–13). For the Blackfeet, specifically, bison was a main source of food since time immemorial (Murray 2008:50). In addition to acting as a key subsistence resource, bison held and continue to hold a significant sociocultural status that is evident within Blackfeet oral tradition and material symbolism. The Blackfeet Buffalo lodges (Murray 2008:23–24) and the bison materials used in the Buffalo Dance (McClintock 1910:99) are both emblematic of this cultural status. For these reasons, "the passing of the buffalo gave a death-blow to their [the Blackfeet] tribal origanisation [sic], causing poverty, suffering, Government relief, and a rapid moral decline" (McClintock 1910:506). Clearly evident is a strong link between bison and the sociocultural wellbeing of native populations in Montana.

Historical Context

The arrival of Europeans and the subsequent commercialized market for bison hide irreversibly changed the human-bison interrelationship. As Potter et al. (2010:11) note, bison "provided the economic basis for stable, resilient, land use regimes and social systems." The over-exploitation of bison due to the Euro-American hide markets, therefore, resulted in huge concerns for bison conservation, and indeed, for their very survival. By mid-nineteenth century it was recognized that the continued rate of annual

slaughter of the bison was not sustainable. Commissioner of Indian Affairs Charles E. Mix (1858:364) recognized in his annual report that, in the Montana region, bison "is the principal means of subsistence for the Indians, but, at its present rate of destruction, it will soon become extinct …" It was due to this recognition that Montana between 1864 and 1872, along with several other states, introduced legislation designed to reduce the killing of bison. The early acts proved to be largely ineffectual however (Aune et al. 2010:63). The establishment of Yellowstone National Park by President Ulysses S. Grant in 1872 along with the "Act to Protect the Birds and Animals in Yellowstone National Park and to Punish Crimes in Said Park" was perhaps the first strong move toward bison protection and conservation. Following this was an 1874 bill on bison protection, an 1876 revised act on the killing of bison, an 1879 bill protecting bison for 10 years, the 1909 establishment of the National Bison Range by Congress, and Montana codes 87-1-711 and 712 establishing a bison exhibition park with the former and a bison range with the latter (Adams and Dood 2011:27–31).

Even all of this, however, would have been too little too late without support from the tribal nations (Aune et al. 2010:63). Indeed, Aune et al. (2010:64) state that some "tribes believe that because the animals once sustained their Indian way of life, they, in turn, must help the bison sustain their place on the earth." Thus, the depletion of bison, the key role it played in the balancing of the Plains ecological environment, and the honored placement of the animal within native worldviews warrants the creation and implementation of a bison curriculum centered on showcasing the immense, multi-faceted significance of bison.

This need becomes even more critical in light of the current context of anti-bison legislation in Montana. In 2013, for example, four anti-bison bills were processed by the Montana's state legislature. These bills try to restrict bison ranges and management, even on tribal land. A media network, *Indian Country*, reported that:

> Governor Bullock signed HB 328, introduced by Representative Ted Washburn, which permits state officials to identify "the actual physical location" of buffalo to hunters, according to the bill's text. He vetoed HB 396, introduced by Representative Mike Lang, which would have given county commissioners veto power over bison restoration plans within their counties, including tribal lands and federal public lands. HB 396 also allows bison to be sold by the state Department of Livestock to pay for capturing, testing, quarantining and vaccinating wild bison. Essentially the bill gives county commissioners veto power over tribal lands in relation to bison restoration [Hansen 2013:1].

The anti-bison legislation continued with these two other bills introduced later that year:

> On May 6 Bullock vetoed SB 256 and SB 305. The former, introduced by state Senator Eric Moore, would have made Montana's Fish, Wildlife, and Parks Department liable for any damage to private property caused by wild bison. The latter, introduced by Senator Jim Peterson, proposed changing the definition of "wild bison" or "wild buffalo" to mean "a bison that has never been reduced to captivity and has never been owned by a person" [Hansen 2013:1].

This anti-bison legislation is certainly not the beginning, and it won't be the end of this anti-bison movement unless some form of intervention is created.

Creating a curriculum that highlights bison's multilayered significance will stimulate an appreciation for this animal and its complex and dynamic past. It will also circumvent prevailing, negative attitudes and laws that have been promoted by cattle ranching and meat market lobbyists. In a sentence, the negative attitudes about bison are perhaps best represented by Montana State Senator John Brenden who stated: "Why do you want to spread this creeping cancer, these woolly tanks, around the state of

Montana?" (Robbins 2013). For these reasons, a curriculum has been designed within a framework of outreach—for archaeology, for bison, and for Native history—as part of a multivocal curriculum and subsequent study assessing the efficacy and general utility of such an educational strategy.

Archaeological Education Context

Over the past several decades there has been accentuated attention toward making archaeological research accessible and relevant to the many diverse publics (see Allen and Joyce 2010). Alongside this, community-based, public outreach programs are breaking ground as collaborative solutions that help archaeology become more relevant and meaningful to the local community as well as to the general public. To this end, Little (1996:34) notes that "[o]ne trend that appears clear throughout archaeology is that toward public benefit, including education and outreach, community archaeology, [and] civic engagement." Due to this recent trend, "public archaeology in the USA has, for some, grown in meaning to encompass direct public engagement …" (Smith and McManamon 1991:3). Thus, communicating the role, utility, and interdisciplinary importance of archaeology while simultaneously including localized collaboration has become a significant component in many of these public outreach and community based approaches (see Atalay 2012; Colwell-Chanthaphonh and Ferguson 2008; Little and Zimmerman 2010).

Sarah Bridges (2010), in her article *Archaeology and Ethics*, presented a persuasive case arguing for the continued inclusion of collaborative multivocality within archaeology. She articulates that archaeology has the "capacity for providing a shared vision of the past for multiple publics and stakeholders" (Bridges 2010:242). Quoting

Little (2002:3), Bridges continued by highlighting the fact that "[w]e do archaeology—and spend public money on it—because archaeology provides benefits not only for professional archaeologists but also for the many participants and publics who use and value it." Thus, archaeology not only answers to the mandates of science and academia, but also to the taxpayers, and the many native and non-native stakeholders who hold a vested interest in the past. Following Little's (2002:13-16) ethical train of thought, Bridges (2010:243) stresses that archaeology should be used in such a way as to "convey dynamic and therefore shared visions of the past that represent multiple and diverse public and participant views." The big question Bridges subsequently queries is "[h]ow can archaeologists and other stakeholders achieve a common or shared vision of the past?" A number of possibilities are proposed in the article, including interpretive exhibits; local, tribal and state ordnances; interactive webpages; and school presentations (Bridges 2010). The design and implementation of archaeological curriculums and lesson modules can be added to this list.

Archaeologically themed curricula are certainly not new within the growing discussion on public outreach and educational strategies. Indeed, alongside this educational approach sits a pervasive call to action made by many in the archaeological field highlighting the need for an improved public education and outreach agenda. The edited volume *Archaeology and Education: The Classroom and Beyond* notes this very phenomenon, expressing that calls "for efforts to open archeology to the public have become widespread and have come from such differently placed advocates as Ian Hodder…and Jean Auel" (Smith and McManamon 1991:vii). Evidently, the field of

archaeology is critically deficient in producing successful, sustainable, and most importantly, respectful public education and outreach programs.

Respectfully incorporating archaeological education in a non-alienating, more inclusive fashion allows for the interdisciplinary potential of archaeology to be more fully realized. Henderson and Levstik (2010:2) make this very point, affirming that archaeological study not only "offer[s] insights into archaeological processes (depositions, disturbances, and the like) as well as the processes of archaeology (scientific method, excavation, analysis, and interpretation), it can enhance the humanistic study of the past in all its diversity and time depth…" In this way, archaeologically themed lesson modules become fundamental to historical and cultural study by helping students more fully understand the complexity and temporal breadth of the human experience. On top of this, educators have long recognized and "emphasized archaeology's power to motivate student interest …" (Henderson and Levstik 2010:2). Through this powerful combination, archaeological lesson modules possess a great potential to excite, inspire, and most importantly of all, relate to a far-reaching and diverse demographic: that of grade school students. By tapping into this potentially large and receptive demographic, the call for effective public education and outreach can be more fully realized and capitalized upon.

In recent years, several long-overdue steps have been taken to act on the call to action for greater educational outreach. These steps are largely manifested through the efforts of three major national archeological organizations: the *Society for American Archaeology*, the *Society for Historical Archaeology*, and the *Archaeological Institute of America*. With the backing of these organizations, supported by other professional

societies, federal and state agencies and individuals, the increased commitment to public education has now taken top priority. Symposia and meetings have been designed for the specific purpose of formulating and proposing strategies for archaeological education and public outreach (Smith and McManamon 1991). As a result, a range of archaeological modules have been created.

Although there has been an increase in archaeologically themed educational modules, there has been relatively little research conducted on assessing the efficacy, utility, and overall impact of these lessons modules. As Prothro (2012:5) accurately recognizes, "[a]lthough lesson plans/teaching units in archaeology are common and easily accessible to primary and secondary educators, their efficacy is largely untested." Therefore, further and systematic analysis of archaeological modules is quickly becoming the crucial next step for successful and sustained archaeological education and outreach. Indeed, such analysis is imperative as increasing numbers of educational lesson modules are made publicly available with little, if any, thorough and empirical testing.

The lacunae in research analyzing public educational outreach strategies need to be immediately addressed in a targeted and systematic manner. Ideally, these assessments would determine the overall outreach efficacy, utility, and impact of a particular strategy. Only though such action and analysis is there any hope for improving the public's understanding of and support for archaeological activities in the future. Thus, it becomes readily clear that "the task we [the archaeological community] have before us…[is] to address our various constituencies, educate all of the publics about the past, and make certain we don't alienate or disenfranchise past, present, and future generations"

(Goldstein and Kintigh 2000:189). This is the road set out before the archaeological community, and one that we must take if the discipline is to not only survive, but thrive.

PREVIOUS PUBLICATIONS ABOUT EDUCATIONAL OUTREACH

In order to combat the prevailing anti-bison perspectives, Gates et al. (2010:112) argue for the necessity of increased awareness and public support. Educational outreach is one viable approach to take in order to combat prevailing anti-bison sentiments. With this in mind, the introduction of bison curricula, readings, and bison themed lesson plans have become increasingly accessible and widespread (Garretson 1934; U.S. Mint 2005), some specifically targeting certain states. For example, Kansas has a lesson entitled *American Bison* (National Park Service 2015) and Montana a lesson entitled *Indian Education for All: Montana State Parks Lesson Plan Madison Buffalo Jump State Park* (Montana Office of Public Instruction 2010). Much like the curriculum presented in this thesis, these lesson modules meld archaeology with native perspectives, as well as bison's natural and enculturated history.

For archaeology, there is an exponentially greater abundance of lesson materials. As a result of the burgeoning awareness of the need for archaeological education and outreach, many educators immediately designed lesson modules for grade school students on various archaeological themes and topics. Harper's (2011) *Beyond Artifacts: Teaching Archaeology in the Classroom*, Grebin's (2000) *Digging up the Past*, and Gardner's (1997) *Treasures from the Past* help fill the long recognized deficit in archaeological education and outreach. Harper's 2011 publication presents archaeological topics in easily taught, thematic units that range from excavation techniques, to archaeological ethics, to the debunking of many pervasive misconceptions within pop culture. This

accessible and hands-on curriculum for grade school students creates a valuable template for introduction into the national school system. It has been successful in Florida, where Harper's (2011) *Beyond Artifacts* is part of a larger outreach agenda of the *Florida Public Archaeology Network* (FPAN). Utilizing publication strategies such as this, FPAN has pursued the admirable goal "[t]o promote and facilitate the stewardship, public appreciation, and value of Florida's archaeological heritage through regional centers, partnerships, and community engagement" (Florida Public Archaeology Network 2015). The incorporation of educational modules within a larger archaeological outreach agenda has proven to be effective in Florida, and provides an ideal and easily replicable model for other states.

Of the numerous archaeological lessons available, *Archaeology in a Box,* also known as Archaeology Boxes, has become a popular and prolific lesson model introducing archaeological themes, practices, and concepts to grade school students. The Wisconsin Historical Society (WHS), among other organizations, has made available boxes with built in activities including a field activity and a lab activity. Such a lesson design allows for quick, hands-on units that can be easily introduced into the classroom (Wisconsin Historical Society 2015). The tangible nature of these lessons plays a part in their success.

Brown (2006:1) has designed an *Archaeological Institute of America Educational Department "Shoebox Dig"* lesson in which students can "become archaeologists on a small scale and uncover the stratified layers in a shoebox." Instilling the importance of context and archaeological ethics such as stewardship, this lesson module, like many others, attempts to connect the multidisciplinary and naturally interactive nature of

archaeology with grade school students. Through such a process, it is hoped that such modules can augment excitement for and greater understanding of past human life-ways and histories.

Capturing student interest is just one fertile avenue of archaeology. Perhaps more substantive is archaeology's potential to allow students to relate meaningfully with the past. The *Funds of Knowledge* approach put forth by Vélez-Ibáñez and Greenberg (1992), and later by González et al. (2005:6), attempts to connect meaningfully with a community's history (i.e., their "funds of knowledge") and then bring that collected information into the classroom. Essentially, teachers become ethnographers as they "learn about their students' everyday lives" to "uncover the multidimensionality of student experience." Through this exchange, the teacher-ethnographer comes to a greater, more robust understanding of the "funds of knowledge" present within households and communities. When brought into the classroom as lesson modules, this new understanding pluralizes the pedagogical structure of the lessons, and places alternative discourses, ontologies, and marginalized perspectives on an equal footing with the current dominant epistemology (González et al. 2005). In essence, it creates a more meaningful connection between the student and the content.

Davis' (2005) comprehensive book *How Students Understand the Past: From Theory to Practice* similarly analyzes the many ways people acquire meaning from and develop an interest for the past. However, she also recognizes that empirical or quantitative assessment of this meaningful connection and interest has proven to be difficult at best, if it is done at all:

> There are a number of reasons for not examining what the public learns through archaeology education programs. Assessment requires funding;

> archaeologists often struggle just to pay for the basic requirements of conducting research, such as analysis and curation. The lack of assessment within archaeology education is also due to the fact that, in many situations, archaeologists work with the public because they are required to do so but there are often no expectations regarding actual learning outcomes…Because it is so difficult to evaluate the effectiveness of any type of ethics education, assessment of these programs has been problematic [Davis 2005:17].

Explicated in the passage is the recognized lapse of analytical research in terms of assessing archaeological education even once such educational agendas are implemented. As Davis accurately notes, evaluations and assessment can be difficult and time consuming. However, difficulty should never be an excuse for inaction. Therefore, this thesis takes the bison bull by the horns, so to speak, and implements a follow-through assessment agenda by conducting systematic and comprehensive research into lesson module efficacy, impact, and general utility.

PREVIOUS RESEARCH OF LESSON PLANS

Before I designed and applied an assessment of lesson plans in Browning's middle school classrooms, I investigated similar research designs. Although archaeological lesson plans were abundant, many of these lessons lacked any systematic research on their efficacy, impact, and general utility. And most, if not all, lesson plans lacked formal follow-up assessment of their efficacy as an educational outreach strategy for archaeology. For bison-themed lesson modules, there have been few studies conducted to assess the impacts and efficacy of lessons promoting bison or any other species. Although rare, there are a few studies that analyze archaeological lessons. Eisenwine's (2000) dissertation and subsequent research (Eisenwine 2003) studied the multidisciplinary potential of archaeology within a seventh grade classroom in Pflugerville, Texas. She reported that the study assessed the student learning via (1)

worksheets, (2) student presentations, and (3) an end of the year survey measuring student attitudes toward the unit. All this showed that "students responded favorably to the archaeological material and wanted to learn more about the discipline and the historical period studied." However, aside from naturalistic inquiry, no more robust anthropological or pedagogical theory was provided for her dissertation or her subsequent research.

In a similar study involving fourth grade students, Derbish's (2003) dissertation entitled *That's How You Find out How Real Archaeologists Work—When You Do It Yourself* assessed an archaeology-themed educational program that tried "to determine how children acquire archaeological information and use it to form opinions about archaeological resource protection." Like Eisenwine, Derbish took a more qualitative approach to the study by gathering data from interviews, written narratives, and participant observation. From these data, she examined "how children construct meaning about the past and how their attitudes about, knowledge of, and experiences with the past affect how they learn about archaeology." Again, no particular theoretical approach was provided, though naturalistic inquiry was implied.

Prothro (2012) was perhaps the first to more empirically assess archaeologically themed teaching units. Her study was designed to "test the effects of an archaeology unit presented to sixth graders on their knowledge about the facts and ethics of archaeology, and their attitudes about education" (Prothro 2012:8–9). For her Master's thesis research, Prothro designed archaeological lectures with follow-up assessments. She gathered her data in a similar manner as this project proposal, through student surveys and questionnaires. For the theoretical basis of her study, Prothro (2012:10) used naturalistic

inquiry that requires "an inductive approach and the acceptance of the validity of empirical data." She also drew on sociological education theory that states that education is an effective tool for indoctrination, as repeated empirical testing has shown. Though theoretically sound, there was no further discussion about using broader, more meaningful, or more impactful pedagogical or anthropological theories with any of these research agendas.

San Antonio (2007) was one of the few scholars to analyze an archaeology-themed, educational outreach program through a different theoretical lens, that of critical theory. Working to design a new cultural heritage book entitled *Let's Piece the Past Together: An Archaeological Journey of African-American History for Kids*, San Antonio assessed her outreach stratagem by situating her work within critical theory's position that the "public should take more responsibility to be more informed of their history and less dependent upon professionals" (San Antonio 2007:4). Allowing space for the voices of the silenced minorities within archaeological dialogue—the African American community for San Antonio's research and, in the case of a bison curriculum, the Native American community—is a crucial step forward that needs to be taken by archaeological curriculums.

ANTHROPOLOGICAL AND PEDAGOGICAL THEORY APPLIED TO THE BISON CURRICULUM

To address these shortcomings, the curriculum discussed in my thesis assessed archaeological lesson module efficacy, utility, and general impact in educating and relating the multidisciplinary content to a diverse student body. To do this, my research draws upon critical and pragmatist theory for the foundational underpinnings of lesson module planning, design, and implementation. Within critical theory, there is a concern

for “the ways in which the production of knowledge is historically situated,” and additionally, an “understanding [of] how archaeological findings are relevant to particular social and political interests” (McDavid 1997:117). This acknowledgment paves the way for pragmatist thought that theorizes “an anti-essentialist, anti-foundationalist and pluralist point of view towards truth” (McDavid 2002:305).

However “truth,” in the prevailing pedagogical paradigm, is often presented in a top down, authoritative fashion characterized by Paulo Freire as a “banking education, where pupils are reduced to passive receptacles for teacher transmitted deposits” (Mackie 1980:84). Shortly thereafter, these so-called “deposits” are withdrawn for a test, perhaps—it is hoped—with some interest. Yet such a banking system has been shown to accrue very little interest, in both senses of the word. This is a result of students’ agency—defined as “the ability to act and intervene”—having been largely suppressed. Student agency serves as a “precondition for the acquisition of knowledge, however in this educational system of oppressive epistemological domination, suppressing student agency allows the dominant discourse to remain empowered and uncontested (Mackie 1980:83)

A *critical* pedagogy, then, attempts to circumvent this disempowering process in which “dominant culture, through its universalistic views, creates and perpetuates social inequality” (Hoodfar 1992:304). Critical pedagogies actively act to enfranchise and empower—rather than silence—by recognizing that “knowledge is produced by acknowledging and fostering student agency and credit” (Cercer et al. 2010:155). Additionally, this critical framework recognizes that anthropological pedagogy, like any epistemological structure, does not escape dominant cultural ideologies. It is therefore

influenced by the dominant, hegemonic discourses of its time. It is for this reason that pedagogy is always historically situated within the sociopolitical milieu of its era.

Thus, education becomes a temporally evolving force for the purpose of forwarding the dominant, currently empowered agenda while simultaneously acting to disenfranchise and silence competing, or even complementary, perspectives. Education is not, then, ever completely divorced from politics (Apple 2008). This phenomenon, prevalent in many if not all capitalist societies, was noted by Bourdieu in France. He actively postulated in his theory of domination that the "French educational system tends to reproduce social relations, both in their hierarchical structure and in the social recruitment of 'agents' for the system" (Raynaud 1994:64).

Taking this into account, critical multiculturalism problematizes these dominating social relations by challenging their underlying structures of power and privilege. In particular, it challenges curriculums that simply provide a superficial level of "pluralism" or "multiculturalism" expressed by culturally shallow units on dance, clothing, and food. Instead, a critical multiculturalism aims to meaningfully and dialogically engage students with the complex experiences of various cultural or ethnic groups. In other words, it moves from "a focus of culture as static toward culture as dynamic" (Cercer et al. 2010:152–153). Such a theoretical orientation strives particularly to

> View the teacher-student role as a partnership and not authoritarian in nature. While the exchange and the production of knowledge is reciprocal, it is students' sociopolitical and historical experiences that serve as the foundation for growing the relationship and forging a curriculum [Cercer et al. 2010:155].

A curriculum drawing upon critical multiculturalism is grounded within social justice and remains steadfastly at the intersection of privilege and oppression, operationalized

through (1) content integration, (2) knowledge construction, (3) prejudice reduction, (4) equity pedagogy, and (5) empowering school culture (Ladson-Billings 2008:52).

Thus, critical multiculturalism provides a fruitful theoretical space in which to problematize dominant discourses and disenfranchising pedagogies. Another complementary fertile route of circumvention lies in Paulo Freire's activism and engagement within the very educational system perpetuating inequality, dehumanization, oppression, and, as Bourdieu would call it, "misrecognition." Specifically, it belongs in the veritable trenches of academia, inside the classroom. Indeed, Bell Hooks (1994:12) aptly notes, "[t]he classroom remains the most radical space of possibility within the academy." Within this space, creation of a pedagogical framework that actively rejects "the traditional view that classroom instruction is an objective process removed from the crossroads of power, history, and social context" can be cultivated (Hoodfar 1992:304).

The underlying goal, then, is to help stimulate an environment in which students are encouraged to develop critical and analytical skills to assess dominant cultural biases. Through this process, students are able to "locate themselves, as well as others, in the social system so as to assess the way they and others have been shaped by and in turn shape their social environments" (Hoodfar 1992:304). Therefore, lesson modules incorporating these theoretical orientations allow the lesson content to not only be critically assessed, but for the story of the past to be pluralized.

This theoretical orientation is not new, but has been suggested by Barnhardt and Kawagley (2005) who advocate for a pluralized model linking western research to Native knowledge systems and worldviews (Figure 3). Such a synthesis, they argue, allows for

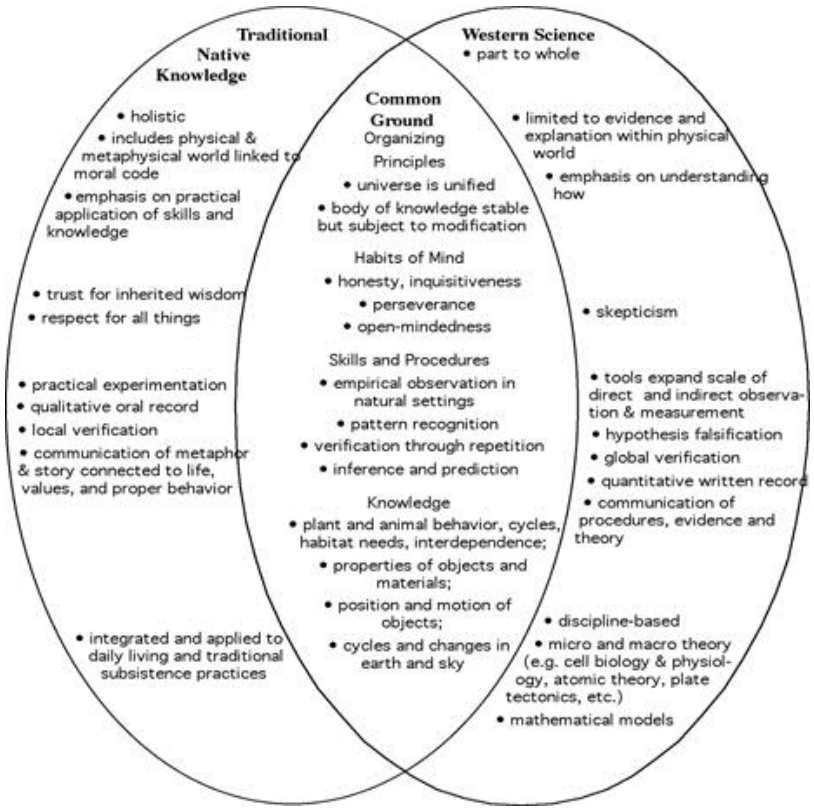

Figure 3: Qualities Associated with Traditional Knowledge and Western Science, taken from Barnhardt and Kawagley 2005.

Indigenous communities to more likely "find value in what emerges and be able to put the new insights into practice toward achieving their own ends as a meaningful exercise in real self-determination" (Barnhardt and Kawagley 2005). Finding the common ground between these two knowledge systems, then, is the key to this pedagogical framework. The diagram highlights a common ground of knowledge related to "plant and animal behavior, cycles, habitat needs, and interdependence." For the bison curriculum, archeological, western science data is synthesized alongside native knowledge as it pertains to bison.

My thesis recognizes that the past does not belong simply to one group, whether that be archaeologists, Native Americans, or any other group vested in the past. Archaeologists and Native Americans in particular often have very "different concepts of

heritage resources and their relation to the past" (Watkins and Ferguson 2005:1383). For example, archaeologists view the archaeological record as decidedly inanimate, to be assessed, measured, and studied. For Native peoples, however, such archaeological sites are animated, imbued with ancestral spirits that carry an impacting influence upon contemporary native societies (Watkins and Ferguson 2005). Therefore, careful inclusion of a more multi-perspective past within education will allow for less domination of one worldview over another.

That being said, a careful line must be drawn between perspectives that have been disenfranchised due to the processes of colonization and sociopolitical marginalization and those that often stem from a more socially privileged, yet academically marginalized "fringe" perspective promoting unsubstantiated, biased, and ethnocentric (dis)information. This is perhaps best exemplified through a case study in northern Michigan where disinformation given through popular literature and various media has contributed "to the persistence of fantasy and mythology surrounding ancient copper mining in Michigan" (Martin 1995:1). Such unsubstantiated disinformation has included everything from claims that Native Americans were not the early copper miners, but rather some mysterious ancient race now gone, to the even more ludicrous idea that giant flotilla voyages were made by the Phoenicians into the Great Lakes region to both teach mining practices to the natives and extract the local copper (Martin 1995). Thus, a clear distinction will have to be made between the more ethical and academically validated perspectives and those "fringe" perspectives that disseminate harmful disinformation. Obviously, then, a full pluralization of perspectives on the past would be too deleterious

to the goals of the lesson modules and the overarching project. Multivocality and pluralization has its limits.

Yet, the intent of the bison curriculum modules are to make the content more relevant to the diverse array of Native and non-Native publics. Therefore, some pluralization is desirable in a project that recognizes "one worldview is not necessarily better than the other; each has value" (Watkins and Ferguson 2005:1383). Thus, the implementation of a pluralistic and multivocal curriculum is argued to not only answer the call to action for increased public awareness about archaeology, but also to more effectively showcase the discipline's relevancy to a diverse array of individuals, and to a larger extent, society as a whole. Such a curriculum is argued to challenge the dominant epistemological model within the United States, a model holding a long recognized nation-building and myth-making discourse naturalizing a very present and pervasive Eurocentric worldview (e.g., Wolf 1997). Indeed, "nowhere is this myth-making scheme more apparent than in the schoolbook versions of the history of the United States (Wolf 1997:5). Dominant discourses have clearly permeated and biased educational contexts and, though not a new or novel idea, should still not go unchallenged.

Therefore, my thesis seeks to counter this nation-wide dominant discourse through an operationalization of the aforementioned critical and pragmatist theories, critical multiculturalism being at the forefront of this blending. Operationalizing these lines of theory will be done by designing lesson modules that emphasize an inclusive, western and non-western, pluralized framework in order to avoid dominant pedagogical biases present within much of the U.S. educational system. Furthermore, these lesson modules seek to inculcate a more practice-based road to understanding in which students are

actively engaged and participating in their education. In essence, the lesson design promotes a student-centered education with student exploration of the topic rather than the more top-down, authoritarian model termed by Freire as the "banking system." A more interactive model allows students and teachers to uncover the shared, collective past together. The significance of bison is then actively discovered, rather than authoritatively dictated.

CHAPTER 2: RESEARCH METHODOLOGY

> *"... the valuation of difference needs to be accompanied by the acceptance of complementarities and by the convergences constructed out of the diversity of worldviews and practices"* (Leonardo Boff 2002: 26 in Escobar 2008: 15-17).

INVESTIGATIVE QUESTIONS

To operationalize the pedagogical construction summarized in Chapter 1, I respond to the call for a thorough and rigorous assessment of lesson plans. The questions structuring my work are:

1. How do archaeology-themed educational assessments demonstrate the level of impact, interest garnered, and efficacy of archaeological education? The few studies that have been conducted to investigate this issue conclude that archaeology-centric education is beneficial (Prothro 2012; San Antonio 2007; Derbish 2003; Eisenwine 2000).
2. Exactly which strategies should be employed for future educational and outreach endeavors? Specifically, is a pluralistic and multi-perspective pedagogical model emphasizing Native American viewpoints alongside scientific, archaeological perspectives an effective, useful, and well-received educational outreach strategy?
3. If a multivocal curriculum design is inadequate or problematic, what adjustments and improvements can be made to make such a program more efficacious and relevant to the multiple interests of contemporary society?

My thesis research was designed to answer these questions specifically among Blackfeet middle school students whose curricula are regulated by national as well as

Montana state standards. I conducted quantitative and qualitative analysis of four science units that emphasize the natural and cultural significance of bison over a period of 10,000 years. The modules I developed embody the concept of multiple truths drawn from pragmatist theory and the concept of archaeological interpretation drawn from critical theory and post-processual theory, in which there are multiple ways of knowing the past. The lessons I developed are thus multivocal in nature. Throughout the science units, the modules interweave multiple native and non-native perspectives while educating students on the complex pre-and-post-contact history of bison, including the sociocultural importance of bison, bison habitat, bison behaviors and adaptations, bison hunting strategies, and finally, current efforts at bison conservation and restoration. Multivocality is a key component in all of these units.

The creation of multivocal modules on archaeological topics for Blackfeet middle school students is combined with an analysis of their efficacy. Middle school pedagogy is viewed as fertile ground for realizing the goals of public archaeology (Smith and McManamon 1991).

PROJECT GOALS AND OUTCOMES

To address my investigative research questions, I created a four-to-five week curriculum sequence highlighting archaeology and the significance of bison. This curriculum was then tested with Blackfeet middle school students in the state of Montana. My goal was to educate students on archaeological topics, as well as the biological and sociocultural significance of bison. The curriculum was presented in several thematic units incorporating temporal stages of human and natural history: (1) the natural history of bison, (2) the Holocene context of bison during the Paleo-Indian and archaic periods,

(3) the historical transition of bison including the near extinction in the late 1800s, (4) bison in contemporary society, (5) the relationship and human interactions with bison over much of the Holocene, and (6) native and non-native interactions during the contact period into the present era. I employed a pluralistic, multivocal, and broadly inclusive lesson template by incorporating and complementing native worldviews alongside archaeological, scientific perspectives. Many lesson modules held an additional goal of debunking widespread, pop-cultural misconceptions about archaeology and bison.

My project aimed to incorporate a list of desired outcomes for the modules. Goals often tend to be broad, general statements that cannot be definitively measured. Outcomes, on the other hand, can act as an iterative cycle of assessment in which the collected evidence "indicates the extent to which … [a] program achieves its [desired] intentions" (University of Texas 2011:1). Desired outcomes for the project assessed in the pre- and post-surveys included (1) increased, class-wide understanding of the significance of bison and the importance of archaeology, (2) increased, class-wide understanding about the current plight of bison conservation, (3) increased excitement for bison, archaeology, and related fields, and (4) class-wide debunking of popular misconceptions about archaeology.

Other assessment outcomes are more general and sought to answer questions about each module's format and content. These questions included: (1) should any of the lessons be revised to enable students to learn the content more effectively? Followed by, (2) do the lesson modules provide the best kind of activities to accentuate student understanding of the content? And lastly, (3) are the lesson outlines clear and the information accessible to the teachers.

The assessment strategy uses a feedback loop to identify desired results, collect data, and analyze information so the findings can be used to make changes to the program (University of Texas 2011:1). The project maintained a close collaboration with Blackfeet teachers before, during, and after lesson implementation to allow for this feedback loop. Furthermore, since the modules will be publicly available online, this feedback loop becomes even more of a central component as teachers using the modules continue to post comments and suggestions for ongoing improvements. Thus, by incorporating the listed outcomes into the pre- and post-survey assessment tools, it was possible to more effectively assess lesson module efficacy and impact, and also enable long-term analysis.

Overall, the intent of the lesson modules was to interweave the significance of bison with archaeological topics, create lesson themes that can be matched to learnable skills such as scientific writing and critical thinking, and produce a greater degree of understanding, interest, and outreach. The second major project goal was to empirically analyze, quantify, and assess lesson efficacy. In this thesis, I analyze and discuss the results obtained to date. The process produced a conceptual model that can potentially be replicated with other students. This model is presented in Chapter 5.

CURRICULUM INTRODUCTION

The key to answering the questions that structure my thesis research was the design of a curriculum that captures and compounds students' interest. I argue, as do Wiggins and McTighe (2005:7), that this is done through a design structure that targets broad concepts and big ideas. This is then supplemented through performance tasks that have students apply the knowledge and understanding that they have acquired. Thus,

understanding essentially becomes "a family of interrelated abilities" in which students actively make connections with overarching big ideas and core concepts throughout the multi-lesson units. A single lesson unit provides too "short a time frame for meeting complex goals" (Wiggins and McTighe 2005:7–8).

To accomplish these pedagogical goals, the specific design process of each unit must begin, counterintuitively, at the end. In other words, before the design of the module commences, the end goals, broad concepts, and big ideas are brought to the planning table. Once delineated, the lesson modules are then explicitly designed to lead students directly to these end goals, concepts, and ideas. Though seemingly obvious in nature, "curriculum guides [for years] have argued against framing objectives in terms of understandings" (Wiggins and McTighe 2005:7–8). Since the mid-twentieth century, and perhaps earlier, designing around understandings was thought to be too nebulous a concept to formulate concrete learning objectives (Bloom 1956). Wiggens and McTighe (2005) directly counter this sentiment by stating that one must distinguish between *knowing* and *understanding*, a distinction that is admittedly difficult to make. Indeed, *Understanding by Design* highlights this very fact, expressing that:

> … there are *different kinds* of understandings, that knowledge and skill *do not* automatically lead to understanding, that student *misunderstanding* is a far bigger problem than we realize, and that assessment of understanding therefore requires evidence that *cannot* be gained from traditional fact-focused testing alone [Wiggens and McTighe 2005:7, emphasis in original].

In recognition of these issues, I sought to more effectively design and comprehensively assess the efficacy of lesson units.

THE CURRICULUM FRAMEWORK

I used the non-prescriptive curriculum outlined by Wiggins and McTighe (2005) to focus on "developing and deepening [an] understanding of important ideas," rather than focus on facts and rote memorization to be regurgitated at a later test date. The traditional, top-down, rote memorization heavy, teacher-student relation has been criticized for decades for its capacity to cultivate an academic environment that enervates critical thinking and hinders true understanding. One of the most notable and vocal critics of the traditional teacher-student relation is Paulo Freire, made famous by his seminal work *Pedagogy of the Oppressed*.

For Paulo Freire, education is a social arena; it manifests itself in the everyday lives of the students. This was the central goal of praxis, the first stage in enacting the pedagogy of the oppressed (Freire 1970:54). For Freire, "[s]uch praxis itself is social, and is directed towards an end—human liberation and the emancipation of those trapped in a culture of silence … Thus public knowledge will be an arena within which political battles must be fought and ethical choices exercised" (Mackie 1980:83).

The *Funds of Knowledge* approach, another praxis-oriented pedagogy, encourages teachers to become ethnographers in which they "learn about their students' everyday lives" so as to "uncover the multidimensionality of student experience" (González et al. 2005:6). Through this exchange, the teacher-ethnographer comes to a greater, more robust understanding of the students "funds of knowledge" present within household and community. When brought back into the classroom as lesson modules, this understanding pluralizes the pedagogical structure, and places alternative discourses, ontologies, and

marginalized perspectives on an equal footing with the current dominant epistemology (González et al. 2005).

These frameworks draw upon a diverse array of anthropological and pedagogical theory that has been available for decades. Yet, to reiterate briefly, little information is currently available to determine how efficacious many of these modules are, or to assess whether the modules accomplished the goals or tenets of their foundational theories. This is especially true for archaeological curricula and education. Given this, I operationalized and empirically assessed modules inspired by the theoretical milieu of student-centered learning. My goal was to determine if lessons provide the effective, inclusive, enfranchising, and impactful strategy we seek in archaeological education and outreach to many diverse publics.

SURVEY QUESTIONS AND ASSESSMENT

In terms of the actual design, the modules have been put through a rigorous process of curriculum development that seeks to "make it more likely … that more students really understand what they are asked to learn" by structuring the lesson units around performance based, unit completion activities that ask students to connect and bind together ideas presented in the individual modules (Wiggins and McTighe 2005:4). Thus, in terms of the assessment of lesson efficacy, I operationalized the analysis through a series of student and teacher surveys designed to (1) empirically determine students' knowledge and preconceived notions about archaeology and native history, in this case, as it pertains to bison, (2) empirically quantify the learning curve during the module, and (3) empirically ascertain which lessons in the module sequence led to a more accurate understanding of, and greater excitement for, archaeology and the significance of bison

by the end of the module sequence. Efficacy, as defined in this study, is (1) the quantifiable amount students learn about a particular lesson topic as determined by student surveys, (2) the quantifiable amount of excitement about the discipline of archaeology as determined by student surveys, and (3) the quantifiable degree to which students would like to see similar lesson sequences introduced in successive years. Survey questions were developed to target these lines of efficacy assessment.

The Prior Knowledge Survey quantifies students' prior knowledge of bison and archaeology, their interest in these topics before lesson implementation, and their career aspirations. Some of the survey questions were inspired by Eisenwine (2000) and Prothro (2012). The questions for this survey are ranked on a 1 to 4 scale, where 1 is "Not at All," 2 is "A Little," 3 is "Some," and 4 is "A Lot":

> Are you familiar with archaeology?
> Have you studied archaeology in any previous classes?
> Are you familiar with bison (also called buffalo by many people)?
> Have you studied bison in any previous classes?
> Have you studied animal behavior and adaptations in any previous classes?
> Have you studied animal anatomy in any previous classes?
> Have you studied native hunting practices, life-ways, histories, and knowledge as it pertains to bison in any previous classes?
> How interested are you in learning about archaeology?
> How interested are you in learning about bison?

Then, in short answer format:

> What do you want to be when you grow up?
> What subject(s) do you like the least?
> What subject(s) do you like the most?

The final survey question asks in "Yes" or "No" format:

> Do you think learning about history is important?

As for the pre- and post-unit surveys, they are identical within each unit and the questions asked are specific to each unit's content. All these surveys have ten questions:

three true or false questions, three multiple choice questions, and four short answer questions. The first six questions are assessed quantitatively and the last four are assessed on a qualitative rubric (Figure 4). Finally, the Completion Survey, designed to be linked to the Prior Knowledge Survey, queries from "Not at All" to "Some" to "A Lot":

How interested are you in learning more about bison?
How interested are you in learning more about archaeology?

It then asks the following questions using a scale that ranges from "Interesting to learn about" to "Not that interesting" to "No Opinion":

What would you tell a friend about bison?
What would you tell a friend about archaeology?
What did you think about archaeology *before* the lessons?
What do you think of about archaeology *after* the lessons?
What did you think about bison *before* the lessons?
What do you think about bison *after* the lessons?

Then, in short answer format, the survey asks:

What about bison do you want to learn more about?
What about archaeology do you want to learn more about?
What do you want to be when you grow up?
What subject(s) do you like the least?
What subject(s) do you like the most?

The final survey question asks in "Yes" or "No" format:

Do you think learning about history is important?

Survey Rubric

The unit assessments used a qualitative grading rubric (Table 1). This grading rubric is a scaled assessment allowing for a greater degree of analysis on the efficacy of the various units. Though more qualitative rather than quantitative, I administered a systematic and targeted empirical assessment. All written survey answers within the pre- and post-unit

assessments were applied to this grading rubric. Getting students to a level of a 3 or 4 was the desired outcome.

Table 1: Qualitative Assessment Rubric

Grading Rubric	**0** **Incomplete**	**1** **Inaccurate/ Incorrect; Lack of Accuracy and Clarity**	**2** **Correct but very Limited in Scope and Under-standing**	**3** **Developed; Correct Use of the Unit's Definitions, Terms, and Concepts**	**4** **A Well Developed Understanding of Concepts**
	-no answer/ left blank with no effort given to answer the question -illegible -repeats terminology in answer with no new information - answer of "*I don't know"*	-unrelated -inaccurate -provided a legible answer to the question but it was incorrect. -provided a simple, short, and incorrect answer	-unclear ideas (confusing) -minimal development -technically correct but there is no effort to connect ideas or elaborate on concepts. -misuse of unit terms - minimum level effort to get the right answer	-limited evidential support, but correct -can be slightly off-topic -gets at key elements or ideas within the short answer or statement --correct use of unit/lesson terminology	- clear and focused conclusion and/or statement -connects concepts and terminology -draws on outside material -accurate details to illustrate/ support answer -transference, connection, and application of unit concepts
Q 1					
Q 2					
Q 3…					

Since each answer is assigned a numeric value, short answers can be quantified to determine class-wide understanding of the topic before and after the module sequence. Adding a short answer component with a qualitative analytical rubric allows for a more thorough and culturally sensitive assessment of student understanding that simple yes or no questions, true or false questions, or multiple choice questions would not be fully able to assess.

CONCLUSIONS

In sum, the theoretical approach applied in this thesis incorporates pragmatist theory combined with critical and student-centric pedagogies to develop a framework conducive to a multivocal, pluralistic, and empowering understanding of a particular area of a people's past. This theoretical framework is then operationalized through the creation of a lesson format focused on student-centered, investigative learning processes and ongoing teacher feedback. The survey instruments then collect and quantify data on (1) the overall change in students' understanding of archaeology and bison after module completion, (2) the overall interest generated by the units after module completion, and (3) teacher feedback on each unit. A percentage of curriculum efficacy can then be calculated by the quantified data. This process is described more fully in Chapter 4.

The collected data allowed for improvements to be made upon the lesson modules, and highlighted fruitful strategies for archaeological outreach. Additionally, the process allowed for a conceptual model to be created, which is presented in the concluding chapter of this thesis. Finally, this approach allowed for more enhanced, streamlined, potent, and thus, more efficacious lesson modules to be created.

CHAPTER 3: LESSON DESIGN CREATION AND IMPLEMENTATION

> *"The task we [the archaeological community] have before us … [is] to address our various constituencies, educate all of the publics about the past, and make certain we don't alienate or disenfranchise past, present, and future generations"* (Goldstein and Kintigh 2000: 189).

JUSTIFICATION OF THE DESIGN AND LESSON MATERIALS

Lesson Design

Ideally, lesson designs should be operationalized through a student-centered and engaged pedagogy complemented with active and ongoing teacher feedback. In this way, students have more control over their learning, circumventing the popular and pervasive top-down, banking system model found in many public school systems (e.g., Freire 1970). Lesson design should also strive to be teacher friendly. Therefore, along with a teacher workshop and individual discussions with the participating teachers, the lessons I developed include Teacher Guides and an extended outline for each lesson. Within this outline are explanations, links for additional resources, and suggestions for optional lesson segments to help guide teachers, many of whom are likely unfamiliar with the suggested lesson content.

Brief PowerPoint presentations are provided for units requiring a more detailed introduction to students. All this serves to help teachers and students adapt these lessons to multitude of classroom contexts. In doing this, I argue the lessons provide the enfranchising, inclusive, student-centered pedagogy and the educational environment students need in order to thrive.

The lessons conform to the Next Generation Science Standards (NGSS) for middle school physical science. Rather than use Montana state standards, I decided to use a geographically broader curricula standard to facilitate the use of these lessons outside the state of Montana. Additionally, these NGSS curricula guidelines were determined to be more progressive, innovative, intersectional, and holistic than the other standards reviewed. Much in line with the collaborative spirit of the bison curriculum, these standards were devised through a collaborative partnership with 26 states working with broad, multidisciplinary teams and a 41-member writing team with partners throughout the country. In particular, these standards have three dimensions: disciplinary core ideas (content), scientific and engineering practices, and cross-cutting concepts. In most states, these dimensions are treated as separate entities in instruction and assessment (Next Generation Science Standards 2015). Integrating content and application in a holistic and intersectional set of science standards naturally complements a multivocal curriculum focused on a pluralized past.

Lesson Summary

My research design manifested into four science units. Appendix A provides detailed outlines of each of the four science units. A description of each unit and both its theoretical and methodological framework is provided below:

Unit 1: Bison Behaviors and Adaptations allows students to actively research a bison behavior or adaptation. This is the introductory unit, requiring the most teacher facilitation. The framework of the lesson encourages the student to uncover the past *with* the teacher, not *for* the teacher. The deliverable of this introductory unit is a "museum walk," a discussion technique that gets students out of their chairs and into a mode of

active engagement to showcase their trait, what they learned, and how it contributes to species success. The museum walk allows for a dialogical exchange that augments student facilitation and agency.

Unit 2: Following Bison through Time uses a timeline collage to enable student groups to research a time period, and then individually create a collage of images about that time period. These student collages are then showcased chronologically along a classroom wall in order to visually depict changes in sociocultural and environmental climates as they pertain to bison. This structure allows Native students to incorporate relevant imagery about the past, reinforced through the unit readings on the bison-Native interactions. This inclusion creates a viable route toward a more pluralized past, in which established and dominant notions of history are circumvented through pluralization. The culminating activity involves student examination of the many continuities and discontinuities along this visual timeline.

Unit 3: Archaeology, Hunting, and Bison Anatomy challenges students to think like an archaeologists and uncover the past through the analysis of bison bones. In a unit about bison jumps and processing camps, the lesson sequence focuses on the tangible nature of archaeology through hands-on station activities. This directly connects students to Native perspectives of the past, in this case, specific to bison hunting and processing camps. Doing this within the science curricula is a key element in allowing a space for multivocality.

Unit 4: Bison Conservation and Restoration provides a culminating lesson to challenge students to think critically about what they have learned. Up to this point, the focus has been on the past and present significance of bison. In this unit students are

asked to look towards the future and design a brochure about a hypothetical bison conservatory. Given that bison restoration and management are gaining currency, students are tasked with creatively synthesizing and applying what they learned in the previous units into a brochure that advertises the (1) goals of their hypothetical bison conservatory, (2) lists why bison are worth restoring, and (3) explains how they propose to restore and manage bison.

Each unit strives to be student driven, where the teacher acts as a facilitator rather than as an authoritarian instructor. Ideally, this creates a space in which student agency is allowed to blossom. The lessons also strive to give a voice to the students, allowing them to work *with* the teacher to uncover the past. Including readings and a textbook that interweaves Native knowledge validates and enfranchises this minority perspective.

Readings

There are several key readings selected for lesson modules to empower Native perspectives and instill a greater pride in Native identity. The main reading is *The Buffalo and the Indian: A Shared Destiny* by Dorothy Hinshaw Patent. This is not a required text because it is not available for free online, and the lessons attempt to make all necessary readings available at no cost. Although not necessary to complete the lesson modules, the textbook is recommended. The book was selected due to its topical nature that highlights bison's significance to Native peoples, particularly in Montana, and because the textbook targets middle school grade students with easily digestible chapters. *The Buffalo and the Indian* conforms to the theoretical nature of the lessons, interweaving western archaeological knowledge with Native perspectives and oral traditions

Links and Websites

The bison curriculum is designed to be free and easily accessible for use by teachers within and outside of Montana. Various websites are thus incorporated into the lessons to provide readily accessible readings for students and teachers. The main websites used for these lessons are presented in Appendix E.

Submitting Form 309: Human Subjects Determination Form

Since the research involved human subjects, Form 309: Human Subjects Determination Form was submitted to the University of Arizona Institutional Review Board (IRB) to determine if the project required IRB approval. The IRB determined that the research would not produce generalizable knowledge, and therefore was not research requiring IRB approval.

CONNECTING WITH TEACHERS

Since the goal of the project involved a continual feedback loop, the lessons were submitted to the Blackfeet Tribal Historic Preservation Office (THPO) for initial feedback and approval before engaging with the students and faculty at interested schools. Once the go-ahead was given by the THPO, I connected with interested teachers. The teachers selected were part of the High School, Middle School, and Elementary School systems on the Blackfeet Indian Reservation in Browning, Montana. These schools, encompassing sixth through ninth grades, were selected due to the fact that the teachers—all but one being native—and the students—mostly all native—would likely be familiar with, and thus critical of, the lesson content. All this would allow for a more effectively assessed curriculum.

Seven teachers expressed an interest in conducting a trial run. After the trial run, a two-day teacher workshop was held to go through each lesson and the associated readings and films to provide a second round of feedback and recommended edits before actual lesson implementation. During the workshop, each teacher was asked to take home the units they wanted to implement, read them over, and note any desired changes. This allowed the teachers to become familiar with the content and the goals of the project, and facilitated a group discussion that critiqued the lessons and suggested edits to improve them from the people actually implementing the curriculum. From this workshop, six of the seven teachers committed to implementing one or more of the four units that were available, and they began implementing the lessons in September, 2014.

Flexibility is Key

Implementing an efficacy assessment can be difficult (Davis 2005:17), and I discovered that coordinating with teachers long-distance at three different schools while these teachers implemented multiple lessons was no easy feat. As to be expected, certain obstacles arose and were mitigated as best as possible. Given the distance of the University of Arizona from the schools in Montana, I was not able to personally document and witness the lessons as they were implemented, and this reduced the amount of information collected about the classroom setting of curriculum implementation. Other hurdles during the lesson sequence involved teachers unable to get the recommended textbooks in a timely fashion, one teacher dropping out of the research due to personal reasons, and the implementation of the lessons taking generally much longer than initially expected. In retrospect, clearer instructions for the pre- and post-surveys would have streamlined the process.

CONCLUDING THE STUDY PERIOD

The trial period ended in December, 2014. The six participating teachers dropped to four, and those four teachers submitted the student surveys—the Prior Knowledge, Pre- and Post-surveys, and Completion surveys—as well as the Teacher Feedback surveys. The lessons took longer than initially planned and the teachers, pressed for time, were not able to start or fully implement all lesson units. Nonetheless, the four remaining teachers and the control group teacher, spanning the seventh to ninth grades, generated close to 3,000 surveys. This proved to be more than enough data to conduct an assessment on lesson content understanding, student interest, overall utility, and general efficacy for all four units.

Implementing the trial-run sequence demonstrated that—though requiring a great deal of coordination, flexibility, and devoted teacher input—conducting an efficacy assessment of this kind was possible. With a well-articulated research design, a teacher-friendly lesson outline, a pool of interested teachers, a feedback loop from research collaborators (teachers and community members), and continual coordination, efficacy assessments of this nature are feasible. While additional streamlining of the assessment strategy presented in this thesis needs to be done, the general assessment structures I present can and should be replicated in order to produce more efficacious archaeology lesson modules into the future.

CHAPTER 4: DATA COLLECTION AND ANALYSIS

> *The lack of assessment within archaeology education is also due to the fact that, in many situations, archaeologists work with the public because they are required to do so but there are often no expectations regarding actual learning outcomes …* [Davis 2005:17].

ASSESSMENT STRUCTURE

The chapter is organized by lesson unit. Within each unit the pre- and post-survey questions have been coded, quantified, and analyzed. The four pre- and post-survey templates are provided in Appendices B and C. The tables generated from these surveys are provided in Appendix D. This analysis takes the form of a series of bar graphs that display the type of change in student understanding from pre-unit to post-unit. In these graphs, the type of change has been coded so that 1 symbolizes a change from incorrect in the pre-survey to correct in the post-survey, 2 symbolizes correct in the pre-survey and correct in the post-survey, 3 symbolizes incorrect in the pre-survey and incorrect in the post-survey, and 4 symbolizes correct in the pre-survey and incorrect in the post-survey. Since the number of participating students fluctuated per unit but averaged about 60, a sample size of 60 students was used for the study group and the control group. The exception to this was Unit 1, where only 30 students were sampled for the study group and the control group.

The study group was the group of students that received an intervention, that is, were given the bison curriculum. The change resulting from this intervention, as mentioned previously, was measured by the pre- and post-assessment surveys. The eighth

grade control group at the middle school—an older grade than the Study Group of seventh graders—did not receive the curriculum but were given the pre- and post-assessment surveys. These control group surveys controlled for any outside variables that might impact the results of the study group. It also created a performance benchmark with which to compare the change in understanding within the study group. In the following analysis, the study group was compared with the control group in the summary statistic sections at the end of each unit.

For this analysis, the coded value 1 (incorrect to correct) is the most desirable change, demonstrating a transformation in student understanding. Thus, a statistical emphasis in this category would demonstrate the efficacy of the unit to convey the content queried by the survey instrument. Coded value 2 (correct to correct) illustrates students' prior knowledge of that content element. This is also a desirable outcome since the content in units 2, 3, and 4 partially build upon and complement the previous unit's content. Therefore, the coded value of 2 seen in the following bar graphs could be representative of pre-unit knowledge or the application of knowledge from a previous unit. Coded value 3 (incorrect to incorrect) is not desirable, because it displays a lack of student understanding. However, an emphasis in this category would illuminate problem areas in the curriculum that need further improvement. These problem areas could be a result of any number of issues, but are more than likely a result of (1) poor unit implementation, (2) a need for clarity within the curriculum content, or (3) an issue with the survey instrument. Finally, an emphasis in coded value 4 (correct to incorrect) displays students' prior knowledge of the material that was then confused by either the curriculum content, teacher implementation of that content, or the survey instrument. The

survey instrument, it should be noted, does not change from pre-survey to post-survey. Category 4 is the least desirable outcome because it demonstrates confusion on the part of the student, the teacher, or both. It would also, however, display areas in the curriculum that need to be refined and clarified in order to ensure student understanding of the topic.

Each survey question is given a short analytical discussion through (1) the inclusion of a bar graph showcasing the types of change in student understanding, (2) the inclusion of a "percentage of change" in correct answers from pre-to-post unit within the study group, (3) the inclusion of a "percentage of change" of the correct answers within the control group from pre-to-post unit, and (4) a brief discussion of the results and its overall significance. The survey questions are included above each bar graph, and for the true or false questions and the multiple choice questions, the correct answer has been highlighted. As mentioned earlier, a comprehensive unit summary is given that includes a bar graph displaying the unit-wide percentage of correct answers beforehand alongside the percentage of correct answers after unit completion for both the study and control groups.

The short answer questions were assessed on a qualitative scale from 0 to 4, where a score of 0 corresponds to a minimal effort incorrect or incomplete answer, and a score of 4 is representative of the student's comprehensive understanding of the content. In order to determine change, the students' answers in the pre-survey and post-survey were summed and divided against the total number of possible points so as to acquire a "percentage of change." The percentages have been rounded to the nearest whole percentile. These are tabulated after each short answer question. The average means of students' scores on the rubric scale within the study group and control group is also

included. At the end of each unit, a unit summary of this qualitative assessment is provided

In terms of student interest as well as their connection with and overall excitement for the material, the Prior Knowledge Survey and the Completion Survey numerically quantify the changes in interest from pre-unit to post-unit for the subjects of bison and archaeology. There were several lines of questions pertaining to student interest that were used in order to attain a more comprehensive and nuanced analysis. These summary statistics on student interest are presented after the four-unit analysis of student understanding.

The final analytical section of this chapter discusses the Teacher Feedback Surveys in order to shed light on what transpired inside the classroom. As I was not present during lesson implementation, these surveys are an important component in assessing unit efficacy. The teacher feedback quantified efficacy on a 0 to 10 scale for each unit. The quantified percentage of efficacy was calculated by summing the response of the teachers on this 0 to 10 scale and dividing it by the total possible points: 8 questions worth 10 points each for a total of 80 points.

In all, the three lines of analysis—the students' pre- and post-unit surveys, the students' interest surveys, and the teacher feedback surveys—are "triangulated" or combined to determine the overall efficacy of the units. An overall *percentage of curriculum efficacy* is then be provided. Finally, as the endpoint in the analysis, the data are discussed in the context of (1) public education and outreach, (2) students' engagement with the content as a student-centered approach to learning, and (3) the utility of a pedagogical structure emphasizing a pluralized past.

UNIT 1: BISON BEHAVIORS AND ADAPTATIONS

This unit focused on introducing bison as a species. Emphasis was placed on bison seasonal behaviors, adaptations in the face of environmental and predatory pressures, and the bison habitat or eco-niche. The unit asked students to research a bison trait or behavior, culminating in a "museum walk" in which students presented in poster format their particular trait and how it contributes to species survival.

Question 1: True/False

True or False: Bison became extinct in the late 1800s.

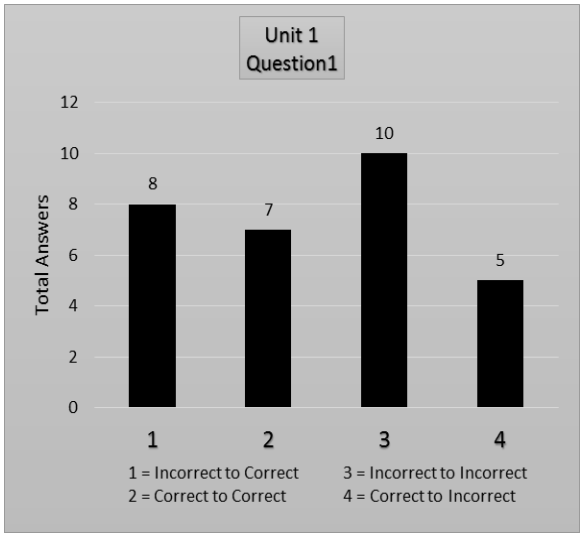

Figure 4: Bar Graph of Question 1 in Unit 1.

This bar graph demonstrates that exactly 50 percent of the students changed their answer from incorrect to correct, or kept the correct answer from pre-survey to post-survey. However, 33 percent aintained an incorrect answer and 17 percent changed from a correct to incorrect answer from pre-survey to post-survey. The data suggest a possibility of student confusion over the word "extinct" as opposed to simply "endangered." Therefore, reinforcement of related terminology and definitions will need to be inserted into the curriculum. That being said, a lack of prior understanding or teaching about ecology and related terminology in general (e.g., extinction, endangered,

predator) goes beyond the scope of these lesson modules to explain these more general concepts. For one, a thorough assessment gauging students' prior knowledge would need to be done.

Question 2: True/False

True or False: There is no genetic difference between a buffalo and a bison.

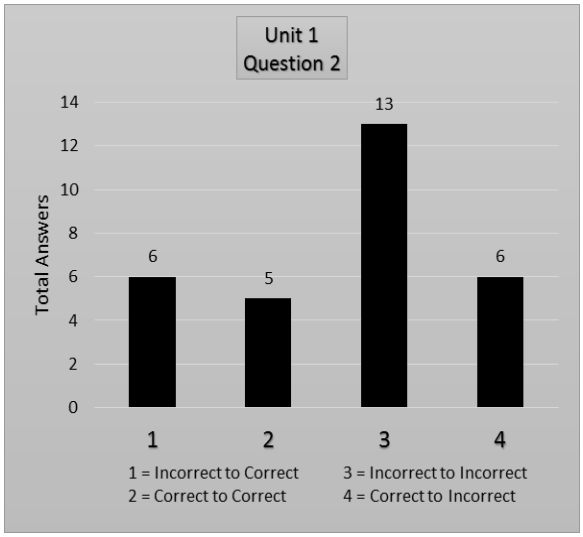

Figure 5: Bar Graph of Question 2 in Unit 1.

This question is certainly tricky, and the bar graph above clearly demonstrates this with only 37 percent of the students correctly understanding that "bison" and "buffalo" are, in point of fact, two separate species. This confusion likely stems from three factors: (1) the teachers use of the word "buffalo" in class, and (2) the textbook entitled *The Buffalo and the Indians: A Shared Destiny* which uses "buffalo" rather than the correct term "bison," and (3) a lack of specificity in distinguishing between the common and scientific name in the survey question itself. Although the distinction should be made within Unit 1, it is not critical to the larger goals of the curriculum.

Question 3: True/False

True or False: Plains bison mostly eat grasses and small sedges.

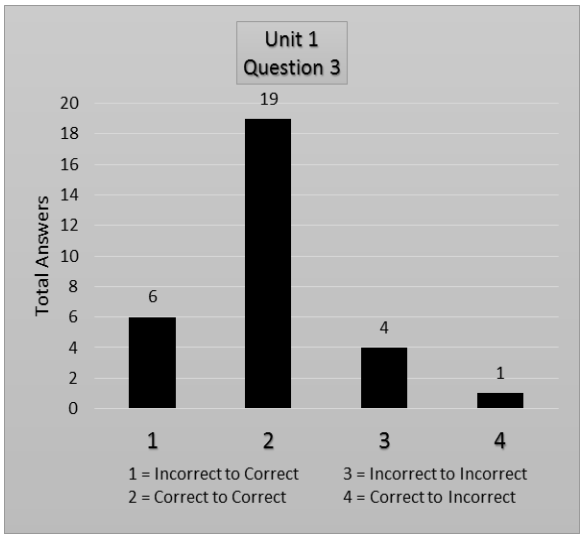

Figure 6: Bar Graph of Question 3 in Unit 1.

The bar graph demonstrates that 83 percent of the students correctly answered the question in the post-survey, with 63 percent of the students maintaining a correct answer from pre to post survey. Clearly, this element was already known to many students, likely due to cultural knowledge and the vicinity of bison herds.

Question 4: Multiple Choice:

Bison are predators when:

a. They need to defend themselves.
b. They are always predators hunting small animals like mice and birds.
c. Only in the winter when food is especially scarce.
d. They will sometimes hunt small rodents to feed their young.
e. Bison are not predators.

As the bar graph below demonstrates, there was clear confusion over whether bison are "herbivores," "omnivores," or "predators." The bar graph demonstrates that 70 percent of the students answered incorrectly in the post-survey. Though perhaps again a tricky question, the data suggests a need in the curriculum to distinguish between these classes, and emphasize bison's strict placement within the category of herbivore.

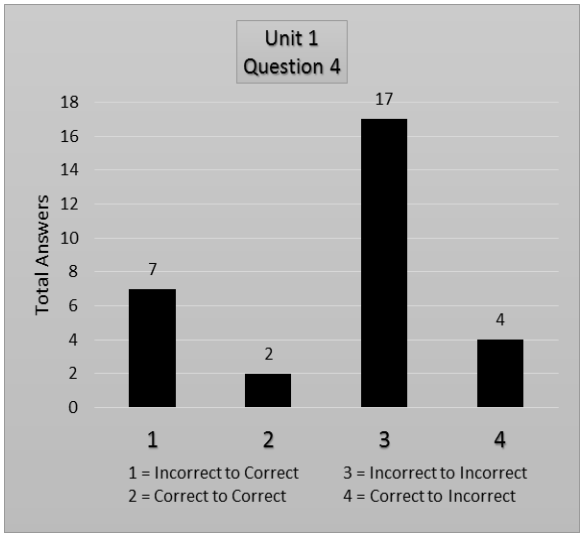

Figure 7: Bar Graph of Question 4 in Unit 1.

Question 5: Multiple Choice

Which environmental adaptation is present in bison?

a. Thick Insulating hide.
b. Ability to eat and digest pine cones, woody sticks, and thick vines.
c. A "plow-like" head and strong neck muscles.
d. Both a and b.
e. Both a and c.

The bar graph below demonstrates 50 percent of the students answered correctly. Of the students who answered incorrectly, 43 percent of the students selected an answer that incorporated a correct component (answer a, c, and e). This suggests many of the

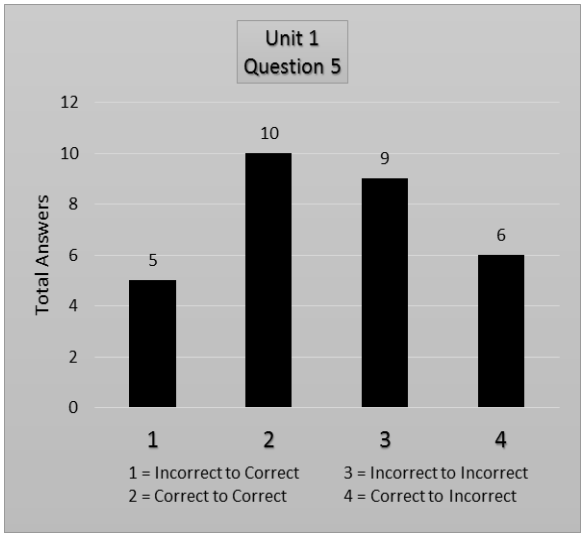

Figure 8: Bar Graph of Question 5 in Unit 1.

students were, in fact, identifying correct elements of bison's environmental adaptations and were either confused by the semantics of the question or did not read the question carefully enough.

Question 6a: Fill in the Blank

Question 6 was unique, and has therefore been divided into five analytical components, 6a through 6e. The bar graphs analyzing students' answers are provided below followed by a brief discussion of the results.

Mark an "x" under the correct season(s) for the following bison behaviors.

	Winter	*Spring*	*Summer*	*Fall*
Wallowing (taking dust baths)				

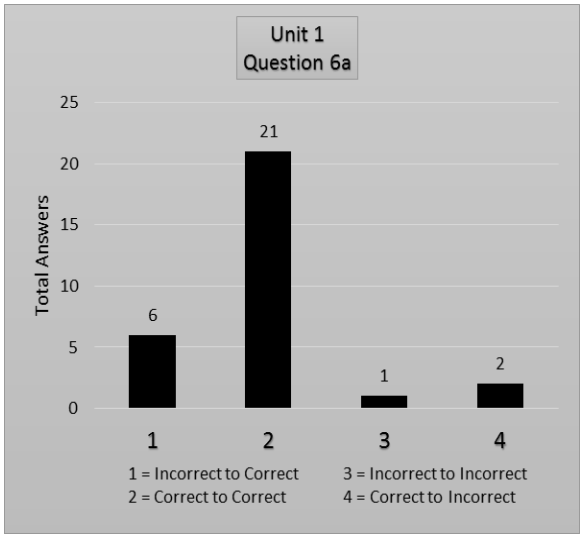

Figure 9: Bar Graph of Question 6a in Unit 1.

The bar graph shows a clear prior knowledge of bison "wallowing," with 70 percent maintaing the correct answer from pre-survey to post-survey by selecting spring, summer, and fall. On top of this, 20 percent changed their answer to the correct answer from pre-survey to post-survey. The data demonstrates this element of the curriculum was well understood.

Question 6b: Fill in the Blank

Mark an "x" under the correct season(s) for the following bison behaviors.

	Winter	*Spring*	*Summer*	*Fall*
Large herding				

The bar graph below shows a clear understanding on the part of the students by the end of the unit seuqence, with 50 percent changing to the correct answer in the post-survey and 30 percent maintaing a correct answer. The data clearly demonstrates student understanding of bison's behavior to group into large herds during the spring, summer, and fall months. A combination of these months were accepted, obviously excluding the incorrect, but still extremely popular pre-survey answer of winter.

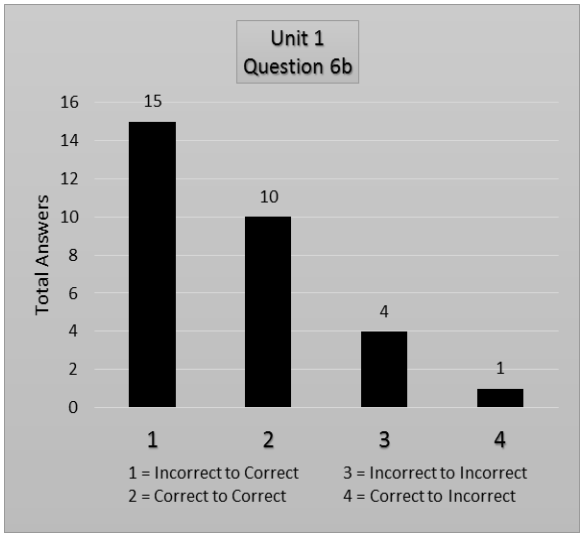

Figure 10: Bar Graph of Question 6b in Unit 1.

Question 6c: Fill in the Blank

Mark an "x" under the correct season(s) for the following bison behaviors.

	Winter	*Spring*	*Summer*	*Fall*
Dividing into small groups				

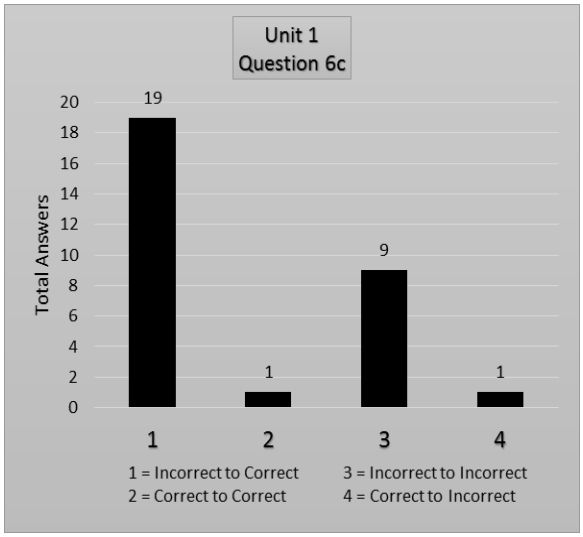

Figure 11: Bar Graph of Question 6c in Unit 1.

The bar graph again shows a marked distinction in student understanding in the post-survey, with 63 percent of the students changing to the correct answer. Clearly evidenced is a change in student understanding about bison's behavior to group into small herds during the harsh winter months, the only season this behavior occurs.

Question 6d: Fill in the Blank

Mark an "x" under the correct season(s) for the following bison behaviors.

	Winter	*Spring*	*Summer*	*Fall*
Continual movement				

The bar graph below displays a clear depiction of student understanding of the content, with 30 percent correctly changing their answer in the post-survey and another 30 percent maintaing a correct answer. Students identified the correct seasons—a combination of spring, summer, *and* fall were accepted—for the behavior of continual movement in search of fresh grazing grasses.

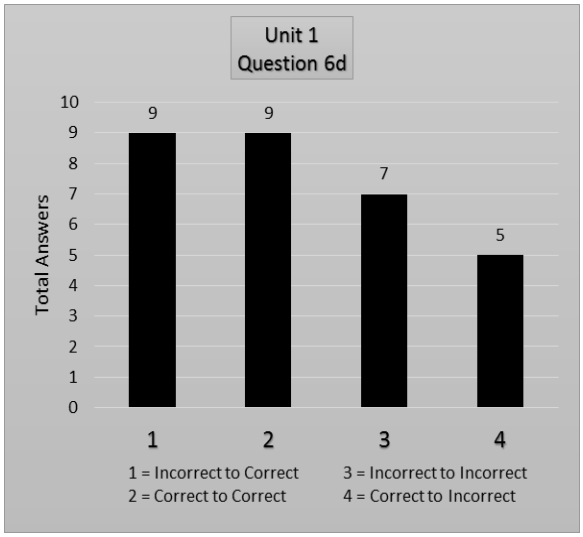

Figure 12: Bar Graph of Question 6d in Unit 1.

Question 6e: Fill in the Blank

Mark an "x" under the correct season(s) for the following bison behaviors.

	Winter	*Spring*	*Summer*	*Fall*
Rutting (Mating)				

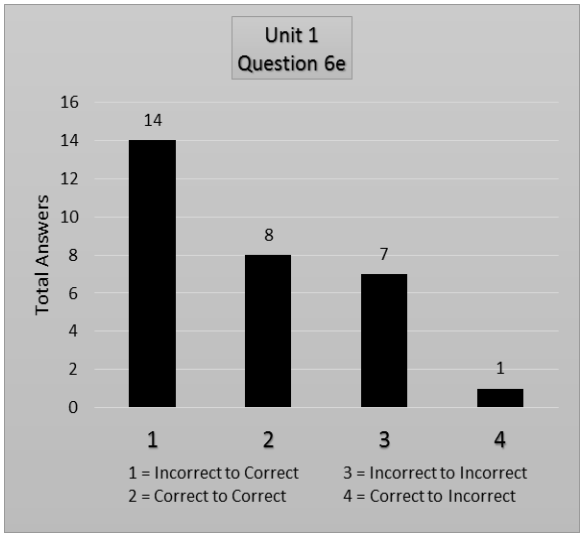

Figure 13: Bar Graph of Question 6e in Unit 1.

The bar graph demonstrates a clear positive change in student understanding, with 47 percent of the students changing to the correct answer in the post-survey. This is on top of 27 percent of the students maintaing the correct answer—summer, fall, or both were accepted—for the seasonal occurrence of the bison behavior of rutting.

Question 7: Short Answer

In the predator/prey relationship, which species do bison often interact with?

Table 2: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 7 in Unit 1.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group	27	23%	49	41%	+18%
Control Group	20	17%	19	16%	-1%

The quantified change (i.e., improvement) in the study group increased by 18 percent. The quantified change in the control group decreased by one percent. The mean score in the study group increased from .9 to 1.63. The mean score of the control group decreased from .58 to .63. The analyses demonstrate a distinct increase in student understanding and content proficiency. A mean score of 1.63 on the qualitative rubric, however, is still under the "minimal correct understanding" rubric score of 2. This score was lowered by 20 percent rate of incomplete or blank answers. Once these are eliminated, student mean rubric score falls exactly at 2. This suggests a need for increased emphasis on the key terms and definitions of predator and prey relationships within the lesson unit. The relative consistency in the control group suggests no outside variables impacted the results of the study group.

Question 8: Short Answer

What environmental and/or predatory pressures might be influencing bison's adaptation to birth their young in the spring?

Table 3: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 8 in Unit 1.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group	19	16%	46	38%	+19%
Control Group	14	12%	19	16%	+5%

The quantified change (i.e., improvement) in the study group increased by 19 percent. The quantified change in the control group increased by five percent. The mean score in the study group increased from .63 to 1.53. The mean score of the control group increased from .47 to .63. These analyses demonstrate a marked increase in the study group understanding. Although there was improvement in the study group, the data suggests a need for heightened emphasis on bison adaptations and behaviors. In this particular case, emphasis on the adaptive pressure for bison to birth calves in the spring so as to provide enough time for the calves to develop to best survive the harsh winter months where predators often prey upon weak bison. The relative consistency in the control group suggests no outside variables impacted the results of the study group.

Question 9: Short Answer

Describe one bison trait in detail and how it contributes to species survival:

The quantified change (i.e., improvement) in the study group increased by 17 percent. The quantified change in the control group increased by four percent. The mean score in the study group increased from .87 to 1.57. The mean score of the control group increased from .77 to .90. These analyses demonstrate a clear improvement in

Table 4: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 9 in Unit 1.

	Totaled Scores in Pre-Survey	%	Totaled Scores in Post-Survey	%	Percentage of Change
Study Group	26	22%	47	39%	+17%
Control Group	23	19%	27	23%	+4%

understanding within the study group. Yet, as this post-survey analysis has shown, there is much room for improvement in order to get students' scores to a 3 on the rubric scale. A score of 3 represents "a developed answer with correct use of the unit's terms and concepts." The relative consistency in the control group suggests no outside variables impacted the results of the study group.

Question 10: Short Answer

What traits have allowed bison to be well adapted to surviving the winter?

Table 5: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 10 in Unit 1.

	Totaled Scores in Pre-Survey	%	Totaled Scores in Post-Survey	%	Percentage of Change
Study Group	29	24%	58	48%	+24%
Control Group	42	35%	29	24%	-11%

The quantified change (i.e., improvement) in the study group increased by 24 percent. The quantified change in the control group decreased by 11 percent. The mean score in the study group increased from .97 to 1.93. The mean score of the control group decreased from 1.40 to .97. This is a distinct improvement within the study group, with

students overall mean score improving by one whole point on the rubric scale. Though the preferable placement of students' scores is at a 2, this is an improvement in understanding that underlines the efficacy of the curriculum as it pertains to this content element. The marginal decrease in the control group suggests no outside variables impacted the positive change of the study group.

Unit 1 Summary

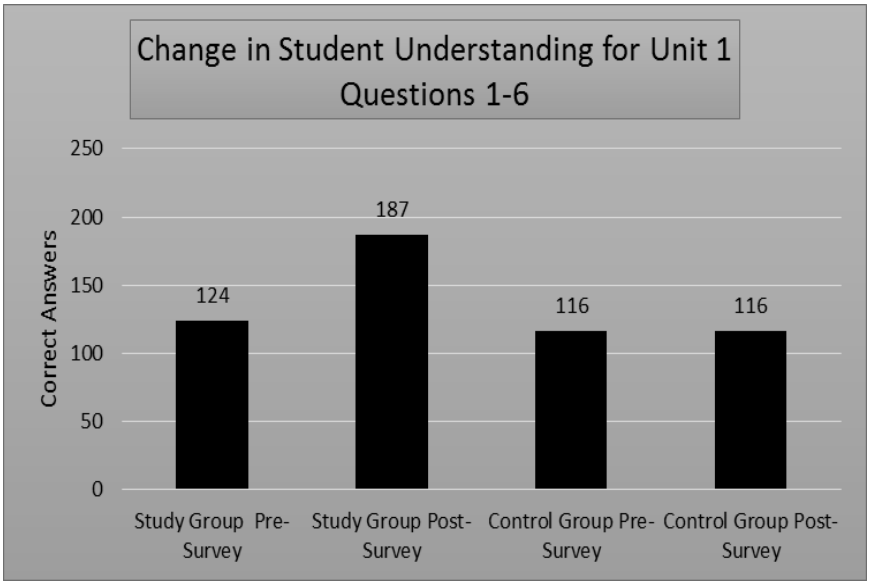

Figure 14: Summary Bar Graph of Correctly Answered True/False and Multiple Choice Questions for Unit 1.

For Unit 1 true or false questions and multiple choice questions, student surveys changed from 124 correct answers out of 300 possible correct answers in the pre-survey to 187 correct answers out of 300 possible correct answers in the post-survey (Figure 14). Calculated into a percentage of student understanding, students moved from 41 percent to 62 percent, an overall increase of 21 percent in student understanding. There was no change in the control group which answered 37 percent of the questions correctly in both the pre and post surveys. These summary statistics highlight the distinct improvement in understanding within the study group with no change in the control group.

For the short answer questions assessed on a qualitative rubric scale, a major improvement is evidenced (Figure 15). Students moved from a score of 101 to 200 out of a total of 480 possible points. Represented as a percentage, students moved from 21 percent in the pre-survey to 42 percent in the post-survey, an increase of 21 percent.

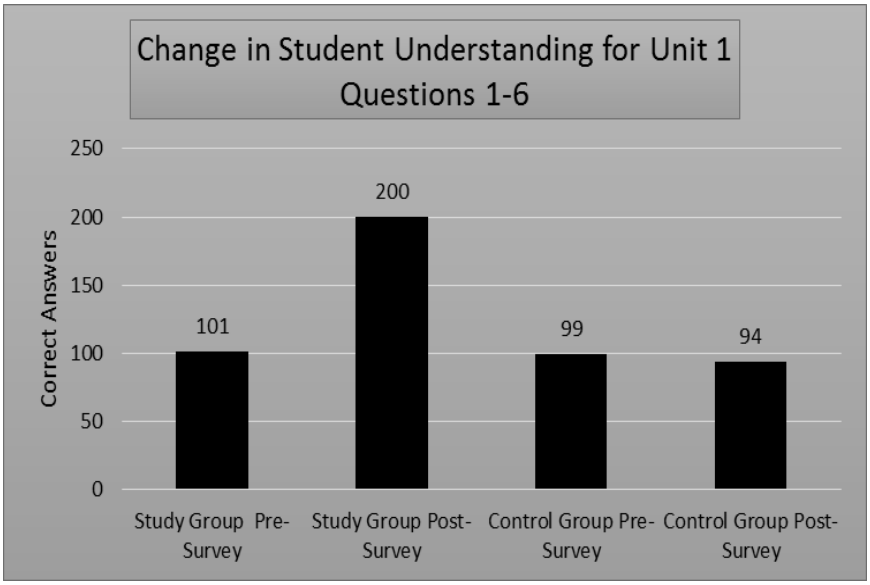

Figure 15: Summary Bar Graph of Summed Qualitative Rubric Scores for Unit 1.

Proportionally, there was a 99 percent pre-to-post unit improvement in understanding pertaining to the topics quieried by the survey instrument.

As this was the first trial using an untested survey instrument, there is likely some bias in the collected data. This can only be mitigated with additional time and regularized implementation of the survey instrument. With both limited time and resources, however, this was not attained. Therefore, it is recognized that the data collected does not completely capture student understanding. That being said, a positive change within the study group is still present, demonstrating the overall efficacy of Unit 1 in terms of student understanding.

UNIT 2: FOLLOWING BISON THROUGH TIME

Unit 2 examined the 10,000-year sociocultural and natural significance of bison. The unit centered on the construction of a timeline, in which the class was divided into three time periods. Each group researched this particular time period as it pertains to bison and human interactions, creating a collage of words and images that represented this temporal segment. The students then grouped into their time periods and placed their collages in chronological order. The outcome was a comparative and contrastive visual display of the three time periods.

Question 1: True/False

True or False: The North American bison range use to extend from northern Mexico up into Alaska.

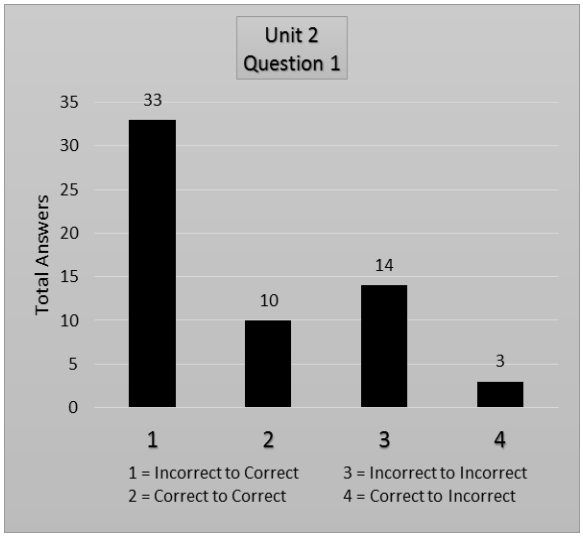

Figure 16: Bar Graph of Question 1 in Unit 2.

As the graph indicates, there is a sharp curve in student understanding in the post survey (represented by the 1 column). Since 33 students moved from an incorrect answer in the pre-survey to the correct answer in the post survey), it is a clear indication that the topic of the pre-historic bison range is an effective component within the curriculum.

Question 2: True/False

True or False: By the end of the 1880's there were less than 1000 bison left in America.

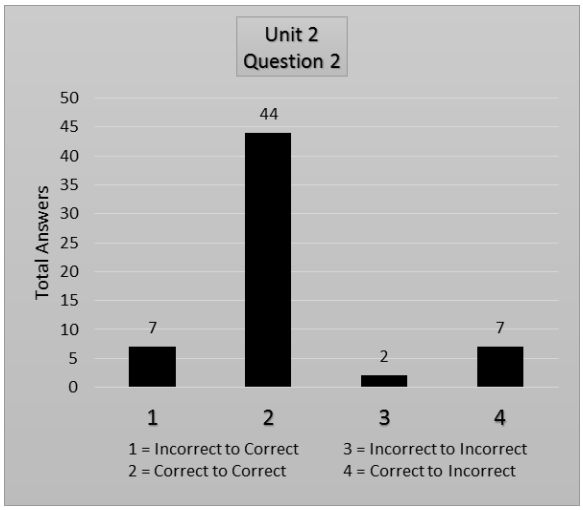

Figure 17: Bar Graph of Question 2 in Unit 2.

As the bar graph below indicates, the majority of students already understood that bison populations were severely depleted at the end of the nineteenth century. This suggests either the students acquired this knowledge in Unit or, as bison are an integral part of Blackfeet cultural heritage, it is a well-known fact within the community.

Question 3: True/False

True or False: Bison became extinct in North America due to over-hunting in the early 1900s and had to be reintroduced into North America from Asia.

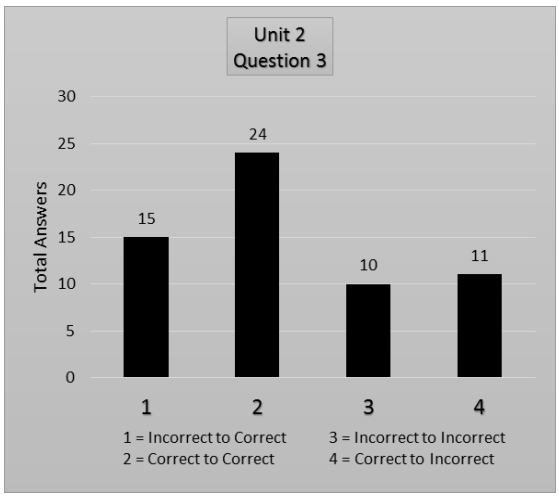

Figure 18: Bar Graph of Question 3 in Unit 2.

Though 35 percent of the students answered the post-survey incorrectly, there is still a distinct majority—65 percent of the sample—who got the correct answer. The confusion likely stems not as much from the terminological distinction of "extinct" versus "endangered" but the intensity and freqeuncy at which both units displayed the largescale and graphic extirpation of bison. It is certainly no easy thing to forget. That being said, the graph indicates that there is still a need to reinforce the difference between endangered and extinct within the lesson content.

Question 4: Multiple Choice

According to native oral tradition, some native peoples said that the bison originated from _____ where it was also said they returned to when bison numbers dwindled from over-hunting.

a. The sky
b. The sea
c. Underground
d. The mountains of the north
e. The southern jungles

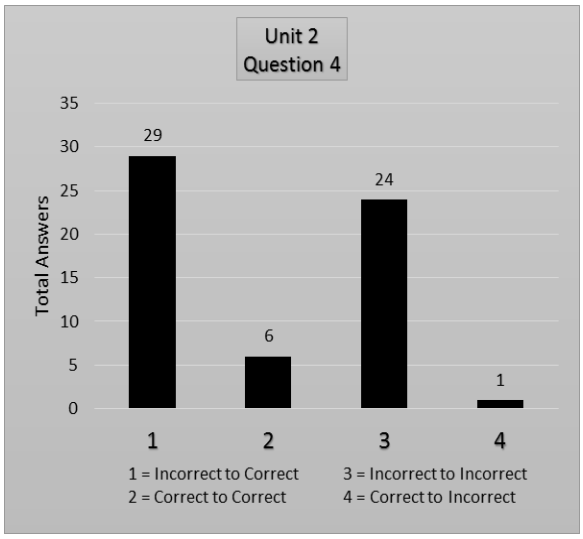

Figure 19: Bar Graph of Question 4 in Unit 2.

The graph indicates that prior to implementing the unit, the study group did not know the answer to the question. In the post-survey, 58 percent of the students got the correct answer while 42 percent answered incorrectly. As the question pertains to oral

tradition, the issue might not necessarily be the lesson content or implementation, but rather, a lack of thoroughness on the part of the researcher to determine if there are alternative oral traditions about the origin of bison. Since 73 percent of the students selected answer d (the mountains of the north) in the pre-survey and 43 percent in the post-survey, there is a distinct liklihood of an alternative oral tradition embedded within Blackfeet oral history and culture. The other possibility is an issue with the interview instrument itself. Scientifically speaking, bison did migrate into north America from the Asian Steppes into the montane north before spreading across the plains of North America, a fact that could easily be affecting the answers of the students.

Question 5: Multiple Choice

Native Americans would sometimes hunt bison by _____.

a) Driving them into corrals
b) Driving them over cliffs
c) Using a bow and arrow
d) All of the above
e) Both a and c

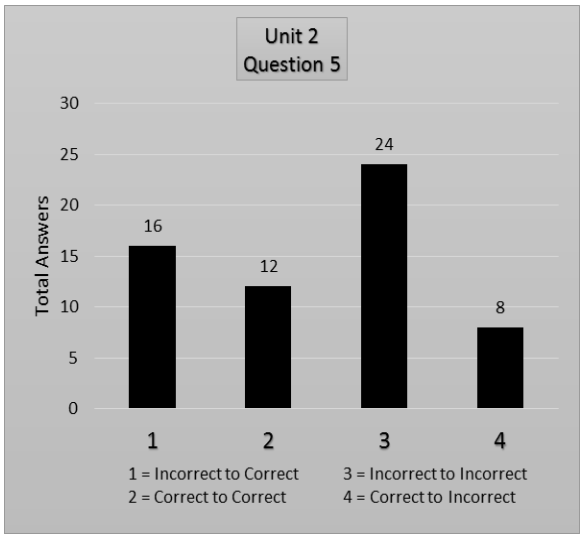

Figure 20: Bar Graph of Question 5 in Unit 2.

This question is certainly tricky, and as the graph indicates, the study group certainly found this to be so. The data indicates 42 percent of the students circled b (driving them over cliffs) in the pre-survey and 47 percent in the post-survey. This suggests that the bison jumps were known before unit implementation and also was the focus of the content. The bison jump can certainly capture attention, and this was certainly the case at the cost of a lack of understanding about alternative bison hunting strategies. Therefore, this bar graph indicates a need for stronger emphasis in the variety of hunting strategies. This includes bison drive lines ending in corrals and, with the adoption of the horse, the use of bows and arrows to single-handedly hunt bison .

Question 6: Multiple Choice

In the late 1800s after years of overhunting, some of the last wild bison were found:

a) In the Olympic National Forest
b) On a rancher's property
c) In Yosemite National Park
d) In Yellowstone National Park
e) In a small zoo in North Dakota

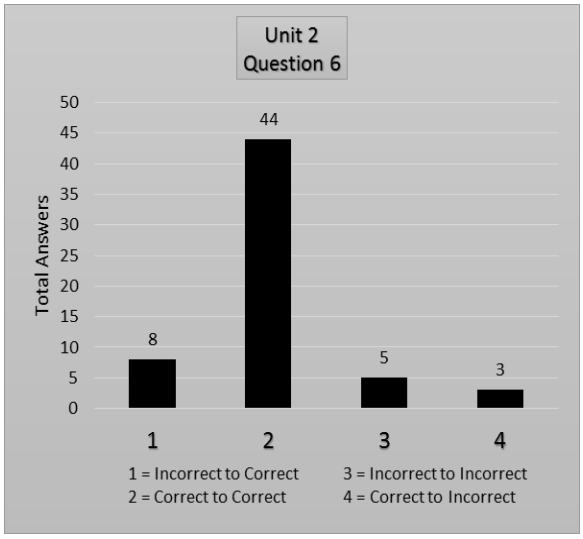

Figure 21: Bar Graph of Question 6 in Unit 2.

As the graph indicates, the statistical majority of 44 students, or 73 percent, maintained the answer of Yellowstone National Park from pre-survey to post-survey.

This suggests either students knew the answer before unit implementation (perhaps due to the vicinity of Yellowstone National Park) or gained that information from Unit 1. Since Unit 1 features a video about Yellowstone, it is more than likely a combination of both. In either case, the graph indicates that the topic was effectively conveyed within the lesson content with 87 percent of the students in the study group selecting the correct answer.

Question 7: Short Answer

What was happening to the climate in North America starting about 10,000 years ago?

Table 6: Change in Qualitative Rubric Scores
From Pre-Survey to Post-Survey for Question 7, Unit 2.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group	76	33%	111	50%	+17%
Control Group	33	14%	33	14%	0%

The quantified change (i.e., improvement) in the study group increased by 17 percent. There was no quantified change in the control group. The average mean in the study group increased from 1.34 to 1.98. The average mean of the control group stayed at .55. These statistical analyses highlight the fact that there was some improvement in student understanding of the content as it pertains to the paleo-climate 10,000 years ago. There is indeed, however, much more room for improvement in this area of the lesson content in order to attain an average score of 3 or 4 on the rubric scale. The relative consistency in the control group suggests no outside variables impacted the results of the study group.

Question 8: Short Answer

List 3 factors that played into the extreme depopulation of the bison?

Table 7: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 8, Unit 2.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group	96	43%	141	63%	+20%
Control Group	32	13%	33	14%	+1%

The quantified change in the study group increased by 20 percent. The quantified change in the control group increased by one percent. The average mean of students' scores in the study group increased from 1.71 to 2.52. The average mean of the control group decreased from .53 to .55. These statistical analyses demonstrate that student understanding increased nearly one degree on the rubric scale, moving from "correct but limited in scope and understanding" to "a developed understanding with correct use of the unit's definitions, terms, and concepts." The results, however, suggest there is still need for a heightened focus on bison depopulation within the curriculum in order to move student understanding to an average score of 3 or 4 on the rubric scale. The relative consistency in the control group suggests no outside variables impacted the results of the study group.

Question 9: Short Answer

Describe the bison habitat or eco-niche.

The quantified change in the study group increased by 19 percent. The quantified change in the control group increased by one percent. The average mean of students'

Table 8: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 9, Unit 2.

	Totaled Scores in Pre-Survey	%	Totaled Scores in Post-Survey	%	Percentage of Change
Study Group	88	39%	129	58%	+19%
Control Group	28	12%	32	13%	+1%

scores in the study group increased from 1.57 to 2.30. The average mean of the control group increased from .44 to .53. These statistical analyses demonstrate that student understanding increased nearly one degree on the rubric scale, moving from an average of "correct but limited in scope and understanding" to an average of "developed understanding with correct use of the unit's definitions, terms, and concepts." The results still highlight the fact that there is a need for heightened emphasis on the bison habitat within the curriculum in order to improve student understanding to an average score of 3 or 4 on the rubric scale. The relative consistency in the control group suggests no outside variables impacted the results of the study group.

Question 10: Short Answer

In what ways were bison significant to Native American peoples in Montana?

Table 9: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 10, Unit 2.

	Totaled Scores in Pre-Survey	%	Totaled Scores in Post-Survey	%	Percentage of Change
Study Group	116	52%	143	64%	+12%
Control Group	59	25%	38	16%	-9%

The quantified change in the study group increased by 12 percent. The quantified change in the control group decreased by nine percent. The average mean of students' scores in the study group increased from 2.07 to 2.55. The average mean of the control group decreased from .93 to .63. These statistical analyses demonstrate a fairly high level of content understanding prior to the unit, which is not surprising considering the study group is derived entirely from schools on the Blackfeet reservation. The nine percent drop in the control group is likely a result of student apathy rather than a loss of knowledge. Even still, with no increase in content understanding within the control group, the data suggests no outside variables were at play to impact the results of the study group.

Unit 2 Summary

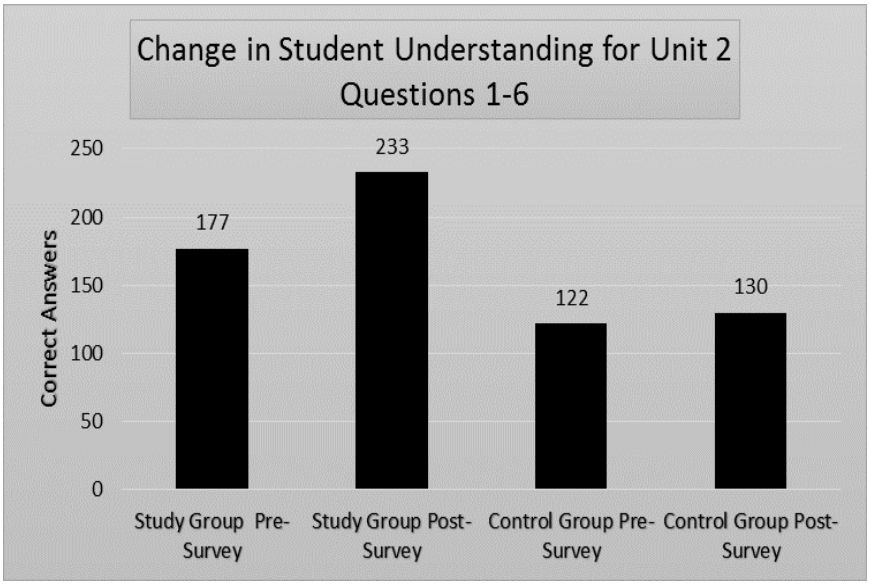

Figure 22: Summary Bar Graph of Correctly Answered True/False and Multiple Choice Questions for Unit 2.

For the true or false and multiple choice questions in Unit 2—questions 1 through 6—the summary graph shows a total of 177 correct answers out of 360 possible correct answers. This amounts to 49 percent in the pre-survey. For the post-survey, there are 233

correct answers, or 65 percent. The overall positive change in student understanding was an increase of 16 percent. This is compared to the control group total of 122 correct answers in the pre-survey, or 34 percent, and 130 correct answers in the post-survey, or 36 percent, for an overall decrease of two percent. As Unit 2 builds upon Unit 1, a fairly high level of content understanding is understandable in the pre-survey. However, there is still a signifcant increase demonstrating the efficacy of the unit.

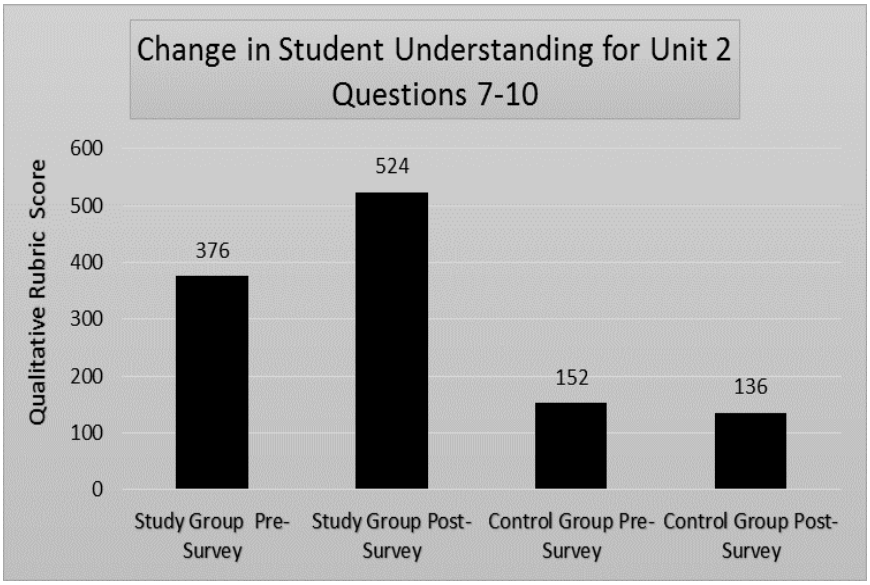

Figure 23: Summary Bar Graph of Summed Qualitative Rubric Scores for Unit 2.

For short answer questions 7 through 10 in the study group, the graph displays an overall score of 376 points out of 960, or 39 percent of the possible points on the qualitative rubric for the pre-survey. The post survey totaled 524 points, or 55 percent, for an overall improvement of 16 percent in student understanding. This is compared to the control group that totaled 152 points, or 16 percent, for the pre-survey, and 136 points, or 14 percent in the post-survey, for an overall decrease by two percent.

UNIT 3: ARCHAEOLOGY, HUNTING PRACTICES, AND BISON ANATOMY

Unit 3 focuses on the interactions of bison and people, with much more of science focus. Even still, in this unit students learn about the complex and dynamic hunting strategies employed by various populations through Native oral tradition and archaeological data. Native hunting practices are discussed and the sociocultural, spiritual, economic, and subsistence-based significance of bison is emphasized. The unit culminates in a lab exercise where culturally modified bison bones are identified and named.

Question 1: True/False

True or False: Archaeology is the study of dinosaur bones.

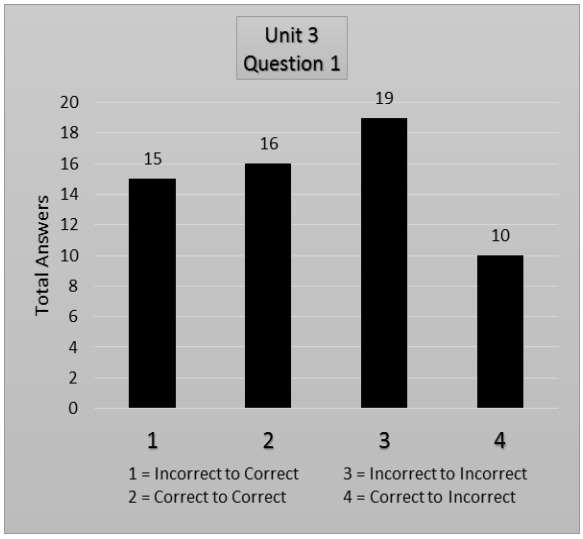

Figure 24: Summary Bar Graph of Question 1 in Unit 3.

This is a straightforward question with less straighforward results. Clearly, there was confusion over the definition of archaeology, with 52 percent selecting the correct answer and 48 percent selecting the wrong answer in the post-survey. The data in the control group is skewed in favor of archaeology defined as dinosaur excavating paleontologists (70 percent incorrectly defined archaeology as the excavation of dinosaur bones). This suggests several things: (1) either the majority of students were guessing,

resulting in a relativly equal distribution of correct and incorrect answers, or (2) there is a preconceived notion that archaeologists excavate dinasaur bones (70 percent of the Control Group and 52 percent of the Study Group in the pre-survey), or (3) both were at play. Either way, the data underline the fact that there is a need for further clarity in the lesson outline so that the teachers have the resources and subsequent understanding of archaeology that will then be carried over to the students.

Question 2: True/False

True or False: Oral traditions are Native American wisdom, history, and stories passed down vocally from generation to generation.

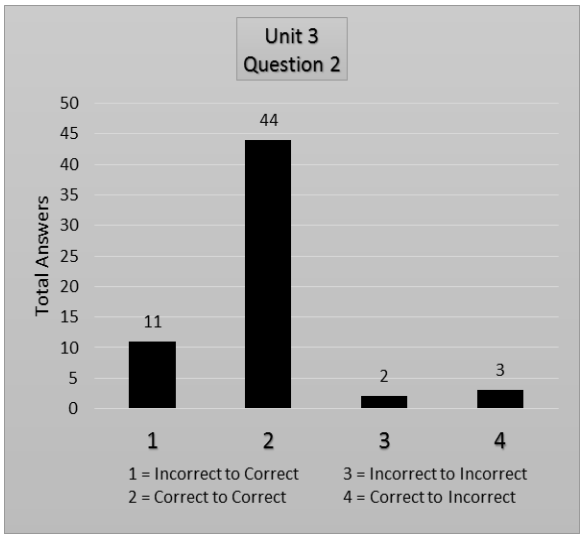

Figure 25: Summary Bar Graph of Question 2 in Unit 3.

This question was devised when several non-native schools were interested in participating which, ultimately, did not happen. The bar graph above demonstrates 92 percent of the students already had very strong ideas of what oral tradition and oral history meant, likely due to its important placement within Blackfeet culture.

Question 3: True/False

*True or False: Cut marks on bone **always** mean it was processed by humans for food and tools.*

The bar graph below suggests confusion on the part of the students, and to be fair,

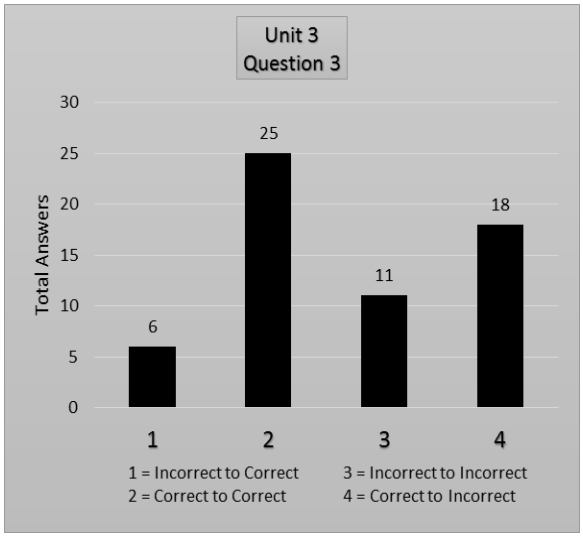

Figure 26: Summary Bar Graph of Question 3 in Unit 3.

it is a trickier question than most. The readings within the unit provide the answer, mentioning the natural, non-cultural processes that result in bone modification. That being said, only 52 percent of students got the correct answer with 30 percent changing their answer from correct to incorrect. For the purposes of this unit's bison processing camp theme, the distinction between the two is not as important as a comprehensive understanding of the activities and processes by which archaeologists interpret the past using the butchered faunal remains and remnant tipi rings of a bison processing camp. The superficiality of the question is the fault of the survey instrument, and arguably not a lack of student understanding.

Question 4: Multiple Choice

What does an archaeologist do?

a. *Collect rainfall data in an area.*
b. *Study the past by analyzing such things as old settlements and agricultural plots.*
c. *Excavate dinosaur bones to put together a full skeleton.*
d. *Study the planets and the stars.*
e. *Treasure hunt for antiquities like Indiana Jones or Laura Croft from Tomb Raider.*

This question was meant to be a little tricky. As the bar graph below demonstrates,

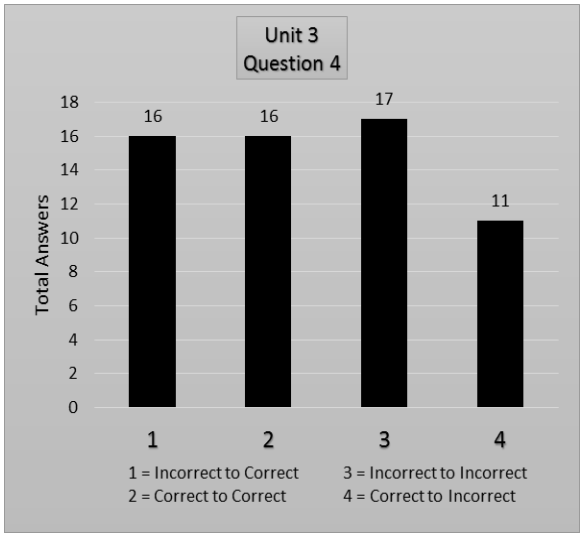

Figure 27: Summary Bar Graph of Question 4 in Unit 3.

53 percent of the students identified the correct professional description of archaeology, with the majority of the other half, 38 percent, selecting answer c: excavate dinosaur bones to put together a full skeleton. Therefore, the students have a general understanding that archaeologists study the past. And, this distinction between archaeology and paleontology is one often missed by the general public. Reinforcement of this distinction within the curriculum by stressing that archaeology is the study of the *human* past would likely bring about the desired results.

Question 5: Multiple Choice

Native peoples hunted bison for their:

a. Hides to make clothing.
b. Meat to get food products.
c. Bones to make tools.
d. Bones to get the marrow for food.
e. *All of the above*.

As the bar graph below suggests, prior knowledge was at play with 83 percent of the students getting the correct answer in the pre-survey, and an incredible 95 percent of the students getting the correct answer in the post-survey. Belonging to a Native community with roots in bison hunting likely provided prior knowledge for this question,

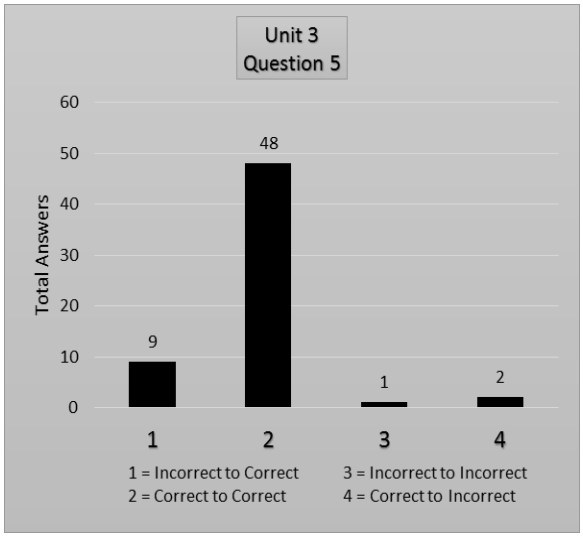

Figure 28: Summary Bar Graph of Question 5 in Unit 3.

or the previous two units which do discuss bison hunting, or indeed, both these sources. Needless to say, an impressive 95 percent of the students got the correct answer.

Question 6: Multiple Choice

Which of the bone(s) below compose part of a bison leg bone?

a. *Os Coxae*
b. *Femur*
c. *Caudals*
d. *Lumbars*
e. *Both b and d*

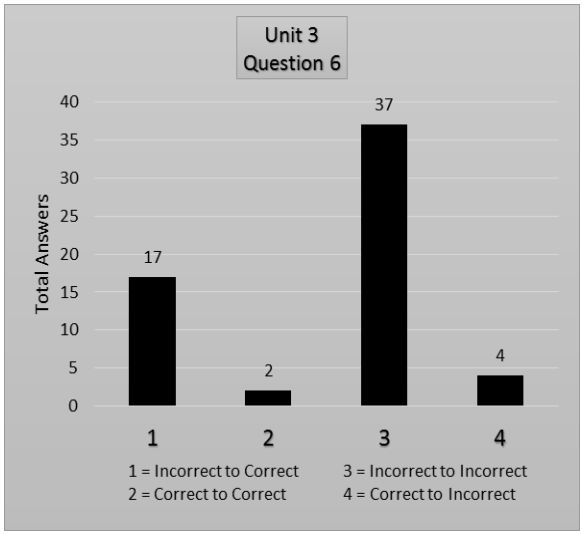

Figure 29: Summary Bar Graph of Question 6 in Unit 6.

The question derives from the unit's focus on bison anatomy, and it is another tricky question. The bar graph above immediately highlights student confusion, with 68

percent of students selecting the incorrect answer. However, upon closer analysis, 60 percent of these students who selected incorrectly chose answer e: both femur and lumbars. Clearly, the students identified the correct bone, and then they were unsure about the lumbars, a part of the lower spine. Since the phrasing of the question used the plural "bone(s)," this could have been the source of student confusion. Taken together (answer b and e), 92 percent of the students correctly recognized that the femur is a skeletal component of a bison leg. These data also potentially reflect a lack of prior knowledge in basic anatomy that, again, is beyond the scope of these lesson modules.

Question 7: Short Answer

List 4 activities that occurred at a bison processing camp?

Table 10: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 7 in Unit 3.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group	70	29%	138	58%	+29%
Control Group	25	10%	34	14%	+4%

The quantified change in the study group increased by 29 percent. The quantified change in the control group increased by four percent. The average mean of students' scores in the study group increased from 1.17 to 2.3. The average mean of the control group increased from .42 to .56. These statistical analyses demonstrate a marked improvement within the study group. The rubric score of 2.24, however, suggests a need for further curriculum emphasis on bison processing camp activities in order to move students to the desired 3 or 4 on the rubric scale. The relative consistency in the control group suggests no outside variables impacted the positive change in the study group.

Question 8: Short Answer

Write two questions *archaeologists or faunal (animal) experts would ask when studying bone:*

Table 11: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 8 in Unit 3.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group	98	41%	115	48%	+8%
Control Group	58	24%	38	16%	-8%

The quantified change in the study group increased by eight percent. The quantified change in the control group decreased by eight percent. The average mean of students' scores in the study group increased from 1.63 to 1.92. The average mean of the control group decreased from .97 to .63. These analyses demonstrate minor improvement within the study group. The survey question likely contributed to this, as students wrote questions they would ask archaeologists, rather than questions archaeologists might ask. Perhaps a clearer survey question to get at the desired outcome would have been: If you were an archaeologist researching a really old bison processing site, what would be TWO questions you would ask as part of your research? This would serve to transition students' thinking from that of asking the archaeologist to that of being the archaeologist. Overall, the lack of distinct improvement on the part of the students is likely due to the survey instrument, rather than a lack of understanding on the part of the students. The relative consistency in the control group suggests no outside variables impacted the positive change in the study group.

Question 9: Short Answer

Some bison bones are black and charred, others are fairly fresh, while still others look bleached and weathered. What do these variations in the bones mean to archaeologists?

Table 12: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 9 in Unit 3.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group	84	35%	119	50%	+15%
Control Group	22	9%	25	10%	+1%

The quantified change in the study group increased by 15 percent. The quantified change in the control group increased by one percent. The average mean of students' scores in the study group increased from 1.40 to 1.98. The average mean of the control group increased from .37 to .42. These analyses demonstrate slight improvement within the study group. The score of 1.98 on the rubric, however, corresponds to the bare minimum level of understanding needed to get the answer correct. Many students identified that the variability in bone condition corresponded, in part, with age but could not explain why. Only 10 percent of students identified that processing and cooking techniques would result in bone breakage and carbonization. And again, only 10 percent of students correctly identified the taphonomic processes that would result in variation in bone condition. To be fair, understanding the taphonomic processes can be difficult for archaeologists, however, a larger emphasis on taphonomy within the curriculum would certainly be good. The relative consistency in the control group suggests no outside variables impacted the positive change of the study group.

Question 10: Short Answer

Describe a bison jump. What activities occurred there?

Table 13: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 10 in Unit 3.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group	117	49%	186	78%	+29%
Control Group	70	29%	57	24%	-5%

The quantified change in the study group increased by 29 percent. The quantified change in the control group decreased by five percent. The average mean of students' scores in the study group increased from 1.95 to 3.10. The average mean of the control group decreased from 1.17 to .95. These statistical analyses demonstrate a major improvement within the study group—over one whole point on the 4 point rubric scale—with an overall average score of just over 3. This is the exact improvement desired, demonstrating on average a lack of understanding of the topic in the pre-survey (below 2) to a sufficient understanding of the topic (above 3). For this question, 40 percent of students scored a 4, demonstrating a well-developed understanding of the units' concepts and terminology for this question. In contrast, the change in the control group was minimal suggesting no outside variables impacted the study group's positive change.

Unit 3 Summary

For Unit 3, the bar graph below demonstrates a small eight percent increase from 55 percent to 63 percent in student understanding from pre-to-post survey. This is compared to a seven percent decrease in the control group from 44 percent to 37 percent. It is clear that the students in the study group were confused about the lesson material.

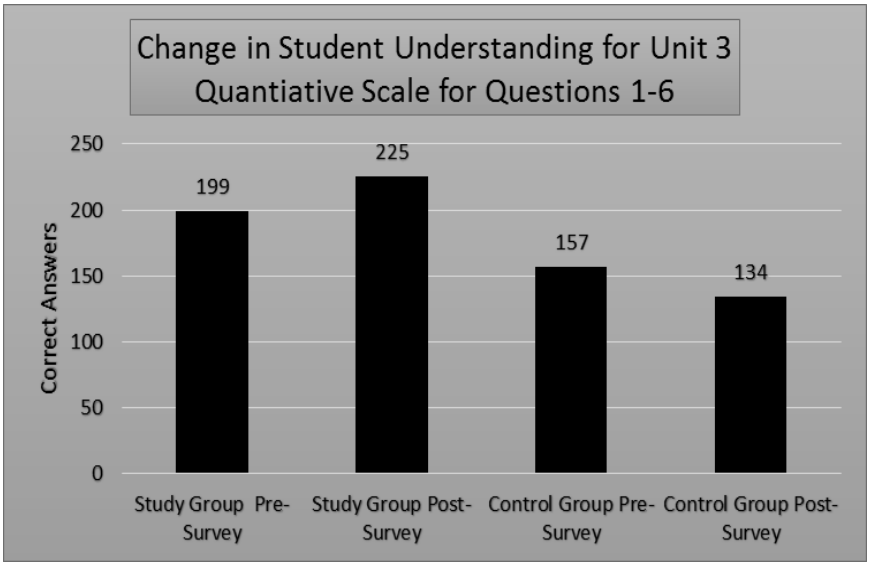

Figure 30: Summary Bar Graph of Correctly Answered True/False and Multiple Choice Questions for Unit 3.

The minimal increase in student understanding suggests a lack of clarity in curriculum, or an unclear and ineffective survey instrument, or indeed, a combination of both. As was mentioned earlier in this unit analysis, several questions were worded poorly in the survey instrument likely adding to student confusion. The efficacy of the unit, therefore, might be greater than the survey instrument was able to assess.

For the qualitative assessment, the bar graph below shows a 20 percent improvement in content understanding within the study group, moving from 38 percent to 58 percent on the qualitative rubric scale with a total point value of 960. This is in contrast to the control group that decreased two percent, moving from 18 percent to 16 percent on the qualitative rubric scale. The bar graph suggests that the first six questions measured quantitatively was not a good measure of student understanding of the unit, likely due to issues with the survey instrument. Between the two measures—qualitative and quantitative—there was an overall improvement of 14 percent in student understanding of the unit content for the study group, and a five percent decrease in the control group.

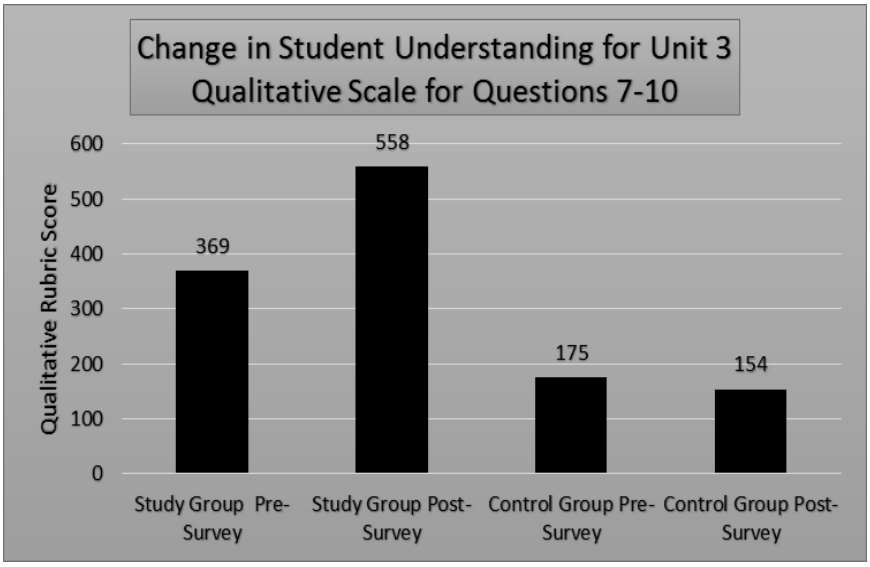

Figure 31: Summary Bar Graph of Summed Qualitative Rubric Scores for Unit 3.

UNIT 4: HUMAN IMPACTS AND THE SURVIVAL OF BISON

Question 1: True/False

True or False: The rescue of the bison in the 20th century kept the wood bison and plains bison genetically distinct so that they remain two distinct species today.

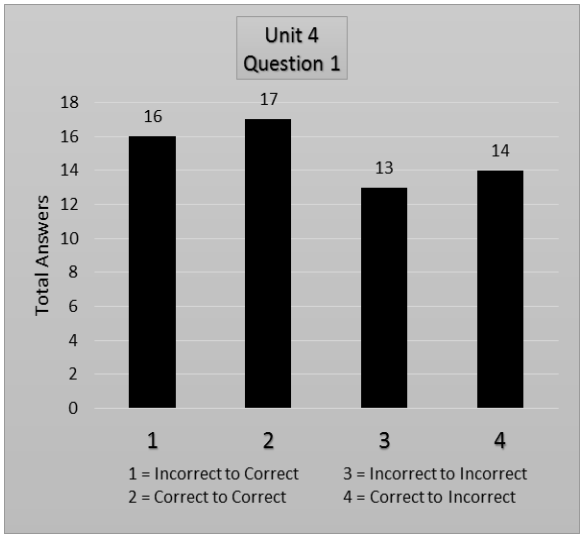

Figure 32: Bar Graph of Question 1 in Unit 4.

The graph indicates that 55 percent of the students (columns 1 and 2) got the correct answer: plains bison and wood bison are two distinct subspecies. This suggests confusion or a lack of emphasis in content discussing the two subspecies. Adding to this, recent research suggests that plains bison and wood bison are, in point of fact, not

phylogenetically distinct species due to the historical interbreeding that took place (Cronin et al. 2013). I had not learned this information prior to lesson implementation. However, since this research was likely inaccessible to the students, it likely had little to no impact on the results. With much of the lesson readings, media, and general content within the curriculum pre-dating this research, the lesson content highlights the phenotypical and geographical subspecies distinctions between wood bison found largely in Canada and the plains bison found largely in the United States. The new research will, however, need to be introduced into the lessons as an ongoing debate for the sake of scientific accuracy.

Question 2: True/False

True or False: Only Yellowstone National Park harbors the United States' last truly wild bison.

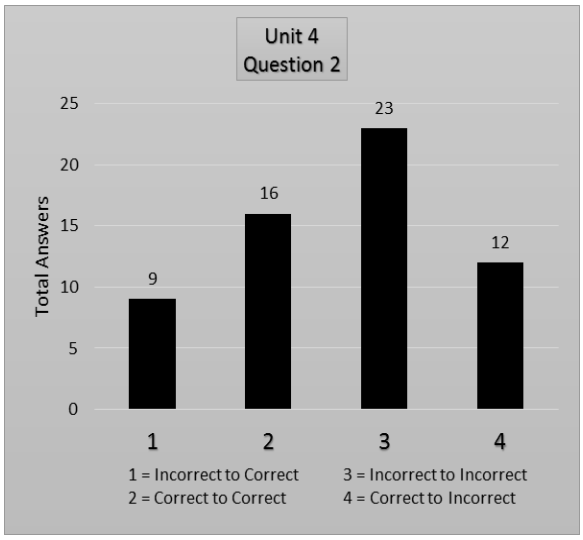

Figure 33: Bar Graph of Question 2 in Unit 4.

The graph displays a clear confusion on the part of the students, with only 42 percent of the students getting the correct answer. This is potentially due to a poorly worded survey question. Perhaps a clearer question would read: True or False—Yellowstone National Park harbors the last free-roaming and unfenced bison within the

United States. The Unit 4 content does feature Yellowstone National Park, but the results suggest a need for further emphasis highlighting the park's efforts to harbor amd maintain this last unfenced and free-roaming population of bison.

Question 3: True/Fasle

True or False: Many bison living on ranches have acquired cattle genes due to the contamination of pure bison bloodlines with ranching cattle.

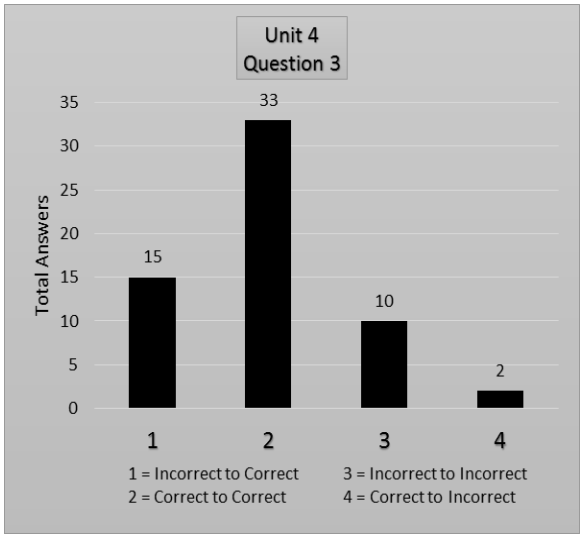

Figure 34: Bar Graph of Question 3 in Unit 4.

The graph above displays a clear understanding on the part of the students, with 80 percent getting the correct answer in the post-survey. The data, therefore, is indicative of an efficacious topical component within the unit.

Question 4: Multiple Choice

The chances of brucellosis transmission between wild bison and vaccinated domestic cattle has been characterized to be

a. Very low to low
b. Moderate
c. High to very high
d. Indeterminable at this time
e. Impossible, Brucellosis does not affect bison in any way

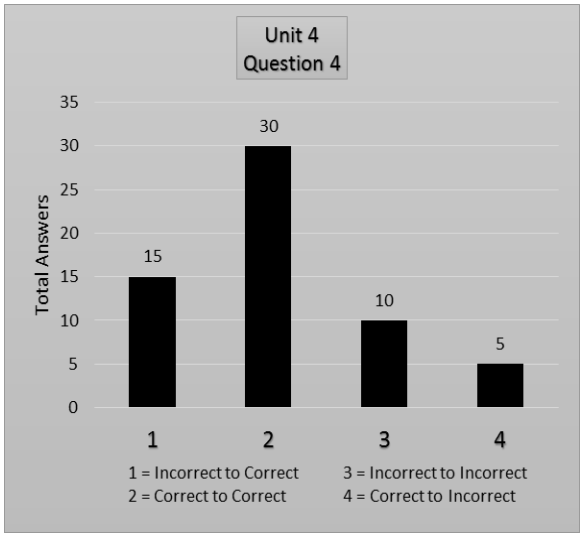

Figure 35: Bar Graph of Question 4 in Unit 4.

Again, a clear distinction is evidenced in the graph, with student correctness at 75 percent. However, since there was little emphasis within the content on the chances of brucellosis transmission, two answers were deemed acceptable: "moderate" and "very low to low" as the debate over brucellosis continues. The main point of the question was to emphasize that the high transmission of brucellosis from bison to cattle is a hyperbole; it is an inaccuracy used by the cattle and meat industry to instill trepidation over bison restoration. Overall, the data suggested the students well understood this point.

Question 5: Multiple Choice

Bison conservation is currently being done by

a) National Parks
b) State Parks
c) Wildlife refuges
d) Native American Tribes
e) All of the above

The graph illustrates that the students either knew this content element beforehand or gained it from one of the previous units. The total students receiving a correct answer in the post-survey was 68 percent, demonstrating an efficacious component in the lesson.

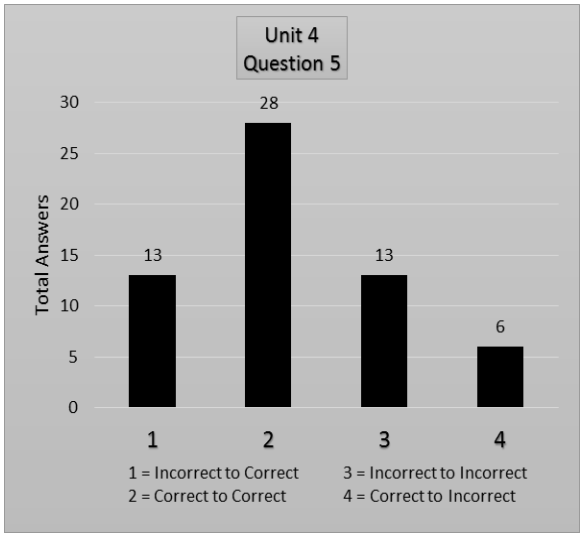

Figure 36: Bar Graph of Question 5 in Unit 4.

Question 6: Multiple Choice

Bison are unique in American culture because they are considered

a) Wildlife
b) Legally protected from being killed
c) Domesticated livestock
d) Both a and c
e) Both b and c

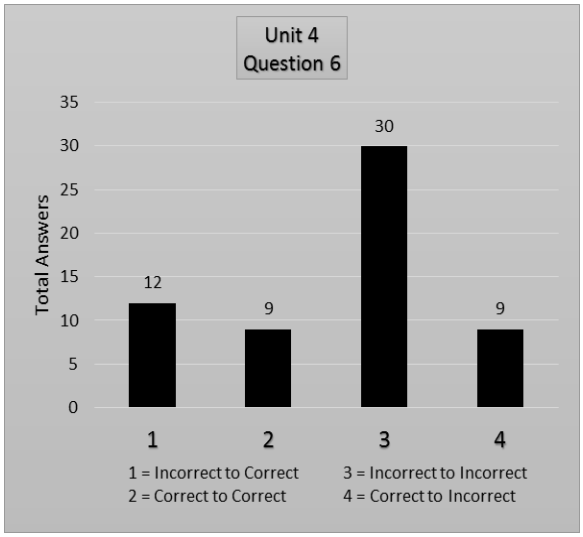

Figure 37: Bar Graph of Question 6 in Unit 4.

This question was certainly tricky, and the graph reflects this. Students frequently selected wildlife or legally protected, but only 35 percent selected both wildlife and domesticated livestock in the post-survey. Bison hold a unique position of being both

wildlife and domesticated livestock, and this ambiguity reflects itself in politics. The data highlight the fact that further emphasis needs to be placed on this unique status and the resultant political ambiguity it creates.

Question 7: Short Answer

Name 3 actions that have been taken to conserve the American bison?

Table 14: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 7 in Unit 4.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group	110	46%	154	64%	+18%
Control Group	30	13%	24	10%	-3%

The quantified change in the study group increased by 18 percent. The quantified change in the control group decreased by three percent. The average mean of students' scores in the study group increased from 1.83 to 2.6. The average mean of the control group decreased from .50 to .40. These statistical analyses demonstrate that there was a distinct increase in understanding in the study group on the topic of bison conservation, moving from "correct but limited in scope and understanding" to "a developed understanding with correct use of the unit's definitions, terms, and concepts." As stated before, however, there is need for increased emphasis on bison conservation activities within the curriculum in order to improve student understanding to an average score of 3 or 4 on the rubric scale. The relative consistency in the control group suggests no outside variables impacted the results of the study group.

Question 8: Short Answer

List TWO problems or difficulties bison conservation and restoration faces?

Table 15: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 8 in Unit 4.

	Totaled Scores in Pre-Survey	%	Totaled Scores in Post-Survey	%	Percentage of Change
Study Group	101	42%	136	57%	+15%
Control Group	17	7%	29	12%	+5%

The quantified change in the study group increased by 15 percent. The quantified change in the control group increased by five percent. The average mean of students' scores in the study group increased from 1.68 to 2.27. The average mean of the control group increased from .28 to .48. These statistical analyses demonstrate that there was a distinct increase in understanding in the study group on the topic of bison restoration and conservation. The results also demonstrate, however, that there is still need for heightened emphasis on bison conservation and restoration within the curriculum in order to improve student understanding to an average score of 3 or 4 on the rubric scale. The relative consistency in the control group suggests no outside variables impacted the results of the study group.

Question 9: Short Answer

Provide at least ONE solution for helping counteract the problems/ difficulties listed above for bison restoration and conservation.

The quantified change in the study group increased by nine percent. The quantified change in the control group increased by five percent. The average mean of students' scores in the study group increased from 1.80 to 2.15. The average mean of the control

Table 16: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 9 in Unit 4.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group	108	45%	129	54%	+9%
Control Group	12	5%	23	10%	+5%

group increased from .20 to .38. These statistical analyses demonstrate that there was not a very distinct increase in understanding in the study group on the topic of strategies and solutions for bison restoration and conservation. The results further demonstrate that there is a lot of need for both inclusion and emphasis on strategies of bison conservation and restoration within the curriculum. Reevaluating this aspect of the curriculum does uncover that many of the lesson materials stress *difficulties* present in bison restoration, but very little of the material emphasize *solutions* to these difficulties. Though, solutions are indeed present within the lesson materials. Therefore, emphasis needs to be placed on these solutions within the curriculum in order to augment student understanding of this critical component. The relative consistency in the control group suggests no outside variables impacted the results of the study group.

Question 10: Short Answer

Is bison restoration/conservation important? YES NO
Why? EXPLAIN your answer!

The quantified change in the study group increased by nine percent. The quantified change in the control group decreased by two percent. The average mean of students' scores in the study group increased from 1.87 to 2.17. The average mean of the control group decreased from .63 to .55. These statistical analyses demonstrate that there was not

Table 17: Change in Qualitative Rubric Scores from Pre-Survey to Post-Survey for Question 10 in Unit 4.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group	112	45%	130	54%	+9%
Control Group	38	16%	33	14%	-2%

a very distinct increase in understanding in the study group on the topic of bison restoration and conservation. Though all students in the post-survey circled "YES" bison restoration is important, there was not a high rate of justification. Some students did score a 4, however others simply circled "YES" without providing any justification whatsoever, thereby earning the incomplete rubric score of 0. The results also show a relatively high understanding of this answer beforehand, with many sufficient answers before lesson implementation. This could be due to previous lessons or because the question is more opinion based. Like the previous Unit 4 short answer questions, it does highlight a need for heightened emphasis on bison conservation and restoration within the curriculum in order to improve student understanding to an average score of 3 or 4 on the rubric scale. The relative consistency in the control group suggests no outside variables impacted the results of the study group.

Unit 4 Summary

The graph illustrates that for questions 1 through 6 in Unit 4, the study group improved from 178, or 49 percent of the correct answers in the pre-survey, to 206, or 57 percent in the post survey, an increase of eight percent. The high score of correct answers in the pre-survey is likely a combination of prior knowledge and knowledge gained from

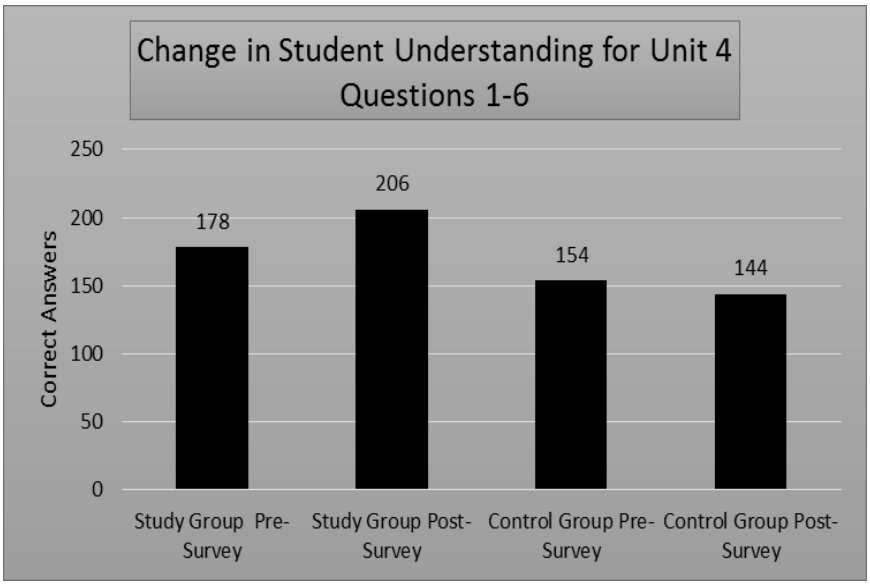

Figure 38: Summary Bar Graph of Correctly Answered True/False and Multiple Choice Questions for Unit 4.

the previous units. In the control group, the pre-survey totaled 154 correct answers, or 43 percent, and the post-survey totaled 144 correct answers, or 40 percent, a decrease of three percent. The overall data suggests no outside variables impacted the study group.

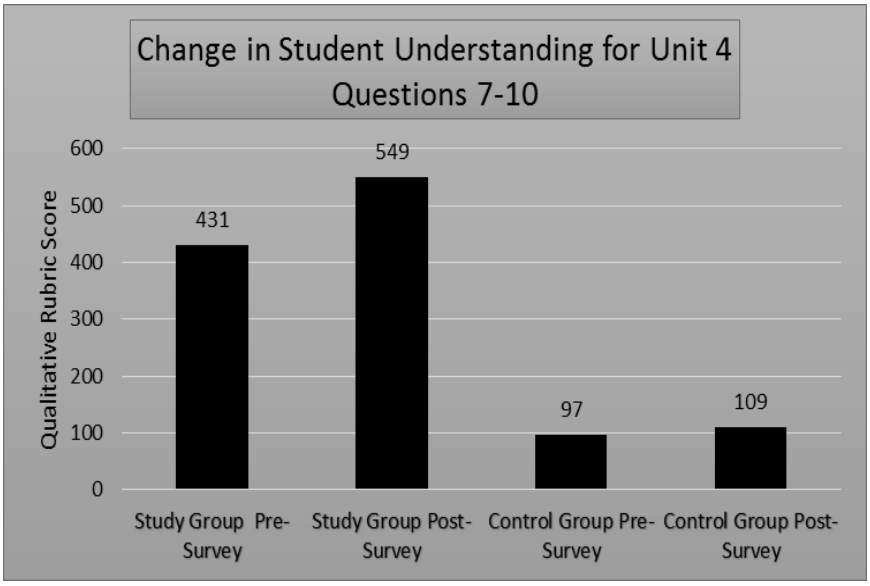

Figure 39: Summary Bar Graph of Summed Qualitative Rubric Scores for Unit 4.

For questions 7 through 10 in Unit 4, the graph displays a score of 431 in the pre-survey, or 45 percent, and a score of 549 in the post-survey, or 57 percent, resulting in an overall increase of 12 percent. The high score in the pre-survey is likely a combination of

prior knowledge before lesson implementation and knowledge acquired from the previous units. The control group totaled 97 points in the pre-survey, or 10 percent, and 11 percent in the post survey, an increase of one percent. The overall data suggests no outside variables impacted the study group.

SUMMARY OF STUDENT UNDERSTANDING

For the study group, the overall change in student understanding from pre-unit to post-unit combining quantitative and qualitative assessments is an increase of 15 percent. For the control group, the change was a decrease of two percent. Figures 38 and 39 below graphically display the unit summaries, a quantitative assessment for the former and a qualitative assessment for the latter. The overall results show clear positive change in the study group, much in line with previous research on archaeological education assessments (Prothro 2012; Eisenwine 2000). The results also show a lack of significant improvement in the control group across all four units.

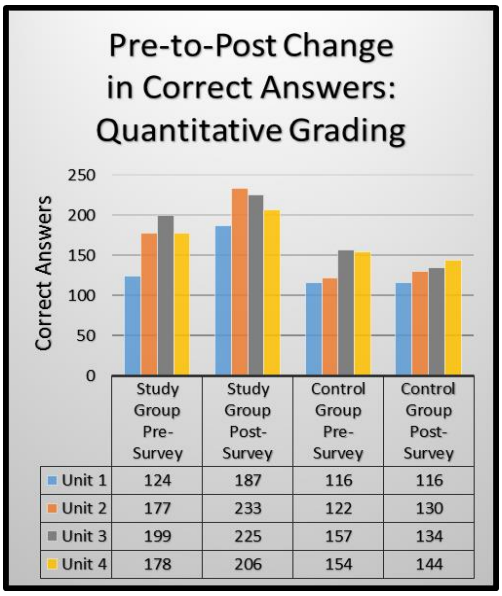

Figure 40: Curriculum Summary of True/False and Multiple Choice Questions.

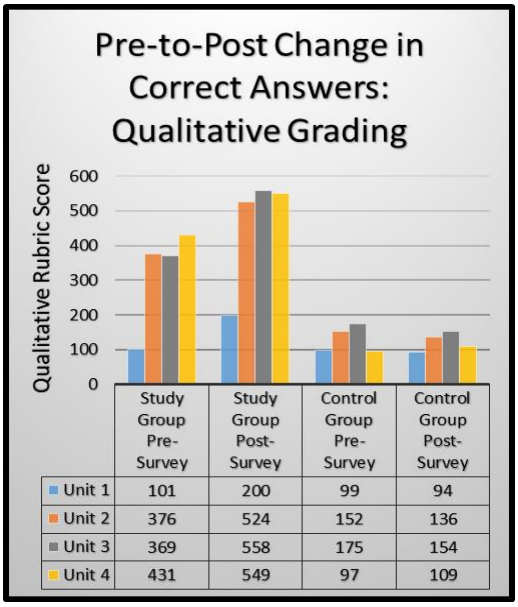

Figure 41: Curriculum Summary of Short Answer Questions Assessed on a Qualitative Rubric.

Testing for Statistical Significance

So far, the data analysis has assessed efficacy without the use of rigorous statistical tests to determine the significance of change. Therefore, a Chi Square Test was used to determine the *statistical* significance of the combined four-unit curriculum in terms of student understanding. A one-tailed Chi Square Test for cross-classified data, specifically, determines whether two classifications of nominal scale data are independent from one another (Shennan 1988:70–72). In other words, it calculates the probability that the results of the study group did not occur by random chance when compared to the results of the control group. And, as a one-tailed test, it sets the direction of change toward that of improvement. If the Chi Square Test showed change in the opposite direction (i.e., student confusion), the hypothesis (H_1) presented below would have to be rejected. A significance level, or alpha, of .05 was set, as is standard convention in most statistical tests (Shennan 1989:69). Therefore, a value generated from the Chi Square Test falling under .05 would indicate that there is less than a five percent

probability the results of the study group were due to random chance. For the test, two hypotheses were used, a null hypothesis (H_0) and the positive change hypothesis (H_1):

> H_0: the bison curriculum had no effect on student understanding, and thus, the variation in collected data was due to random chance.
>
> H_1: the bison curriculum resulted in a positive improvement in student understanding that was not due to random chance.

If the results of the Chi Square Test are less than .05, the null hypothesis or H_0 is rejected and H_1 statistically validated.

To determine the statistical significance of the pre-to-post change in student understanding—and through that, validate the summary statistics of student understanding used to calculate overall curriculum efficacy—the difference in correct answers from pre-survey to post-survey was tested within both the study and control groups. The observed values analyzed in the curriculum are on the left in Table 18 (totaled from Figure 39), and the expected results generated by the first step of the Chi Square Test are on the right. Then, applying the Chi Square Test, the resultant value rounded to the nearest thousandth for the combined four-unit, quantitatively assessed true or false and multiple choice student answers is p = 0.007. This value generated by the Chi

Table 18: Chi Square Test of Quantitative Assessment on Student Understanding for All Units.

Quantitative Observed Results	**Pre-Survey**	**Post-Survey**	**Total**	**Quantitative Expected Results**	**Pre-Survey**	**Post-Survey**	**Total**
Study Group	554	664	1218	**Study Group**	583.86	634.14	1218
Control Group	433	408	841	**Control Group**	403.14	437.85	841
Total	987	1072	2059	**Total**	987	1072	2059
Probability (p) = 0.007							

Square Test is well under the alpha, .05, demonstrating that the change in correct true or false and multiple choice answers is statistically significant.

For the short answer questions assessed by the qualitative rubric, the observed values acquired from the qualitative rubric scores found in Figure 40 are totaled and tabulated on the left side of Table 19. The expected values calculated in the first step of the Chi Square Test are on the right side. Applying the Chi Square Test generated a resultant value of $p < 0.001$. Again**,** the value is well under the designated alpha of .05, suggesting in both cases that there is a very low probability the collected data was due to random chance. Thus, both Chi Square Tests clearly demonstrate that the positive change in study group understanding is statistically significant.

Table 19: Chi Square Test of Qualitative Assessment on Student Understanding for All Units.

Qualitative Observed Results	**Pre-Survey**	**Post-Survey**	**Total**	**Qualitative Expected Results**	**Pre-Survey**	**Post-Survey**	**Total**
Study Group	1277	1831	3108	**Study Group**	1356.547	1751.45	3108
Control Group	523	493	1016	**Control Group**	443.4529	572.547	1016
Total	1800	2324	4124	**Total**	1800	2324	4124
Probability (p) = .0000000068							

PRIOR KNOWLEDGE AND COMPLETION SURVEYS

The Prior Knowledge and Completion Surveys were designed to assess changes in student interest. This was both on a general level with questions asking about their particular career interests, favorite subjects at school, and least favorite subjects at school as well as on a curriculum specific level with questions that quantified students interest in bison and archaeology before and after the unit sequence. The Prior Knowledge and

Completion Surveys were sampled from students who had taken *all four* units, split between two teachers (n=60). The results of this are presented below:

Connection 1

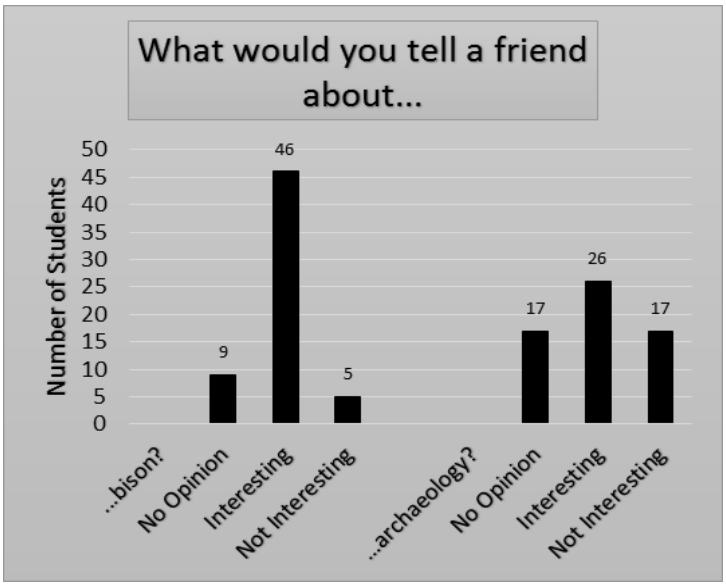

Figure 42: Bar Graph Quantifying Student Interest to Share Curriculum Information.

The bar graph above depicts a clear distribution of students who would tell friends that bison are interesting (n=46, or 77 percent). The results for archaeology are less well defined, though many students (n=26, or 46 percent) did find the topic engaging and interesting enough to tell a friend that archaeology was interesting. However, the results are far less conclusive. These data suggest that the majority of students found the content around bison to be stimulating and engaging, pointing to the topical efficacy of the unit sequence. For archaeology, the less pronounced interest could be a result of (1) only one unit (Unit 3) focusing specifically on archaeology, (2) a lack of emphasis and interest on the part of the teacher, (3) a lack of emphasis on archaeology within the curriculum as a whole, and (4) a combination of these. Perhaps more emphasis throughout the curriculum would increase student interest in archaeology to that of bison.

Connections 2-5

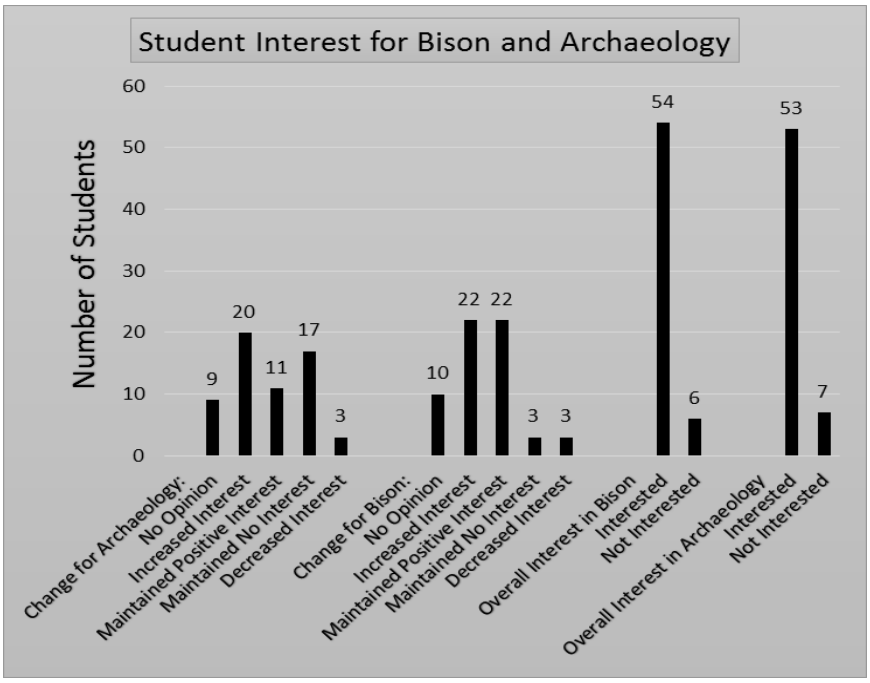

Figure 43: Bar Graph of Student Interest for Bison and Archaeology.

The bar graph above tallies four questions (or connections) in the Prior Knowledge to Completion Surveys: (1) the change in student interest for archaeology from pre-to-post unit, (2) the change in student interest for bison from pre-to-post unit, (3) the total positive interest in bison versus no interest at the end of the unit sequence, and (4) the total positive interest in archaeology versus no interest at the end of the unit sequence. A clearly defined pattern can be evidenced in the graph above, with connections 2 and 3 and connections 4 and 5 measuring interest in different sections of the survey. Going in sequential order from left to right, connection 2 demonstates that student interest in archaeology both increased (n=20, or 33 percent) and is maintained (n=11, or 18 percent), for a total of 51 percent of the students. Connection 5 also graphically assentuates interest in archaeology with 88 percent of the students holding a positive interest for archaeology. Since the same surveys were used, the disparity in quantified

interest between connection 2 and connection 5 suggests students themeslves were perhaps somewhat uncertain about their interest in archaeology as opposed to bison. Bison, to be sure, saw high levels of interest. In connection 3, student interest in bison both distinctly increases (n=22, or 37 percent) and is maintained (n=22, or 37 percent), for a total of 74 percent of students interested in bison. Connection 4 shows this positive interest (n=54) even more drastically, with 90 percent of the students interested in bison by the end of the four unit sequence.

Connection 6

Table 20: Quantified Student Interest and Derived Percentages for Bison and Archaeology.

	Totaled Scores in Pre-Survey	**%**	**Totaled Scores in Post-Survey**	**%**	**Percentage of Change**
Study Group Interest in Bison	156	87%	147	82%	-5%
Study Group Interest in Archaeology	129	72%	135	75%	+3%

As a last measure of interest, student interest was quantified from pre-to-post survey, using a scale of 1 to 3 where 1 was "no interest" and 3 was "very interested." The total possible point value on this scale would be, then, 60 students x 3 units of analytical measurement for a total of 180 points. As the table above demonstrates, student interest in bison was at 87 percent before unit implementation, and dropped only slightly to 82 percent. Though decreasing, students had a very high interest level about bison—and high expectations—before the curriculum implementation, and upon completion, those high expectations and high interest levels appear mostly to have been met. In other

words, the students' high level of interest was maintained. This phenomenon was the same with archaeology, where students held a high 72 percent interest level in archaeology before the curriculum implementation, and maintained it with a slightly higher 75 percent interest at the end of the curriculum sequence. In terms of this line of analysis for curriculum efficacy, the maintained high interest levels speak for itself. This quantified analysis is used in the final curriculum assessment to follow, calculating the overall "percentage of curriculum efficacy."

TEACHER FEEDBACK SURVEYS

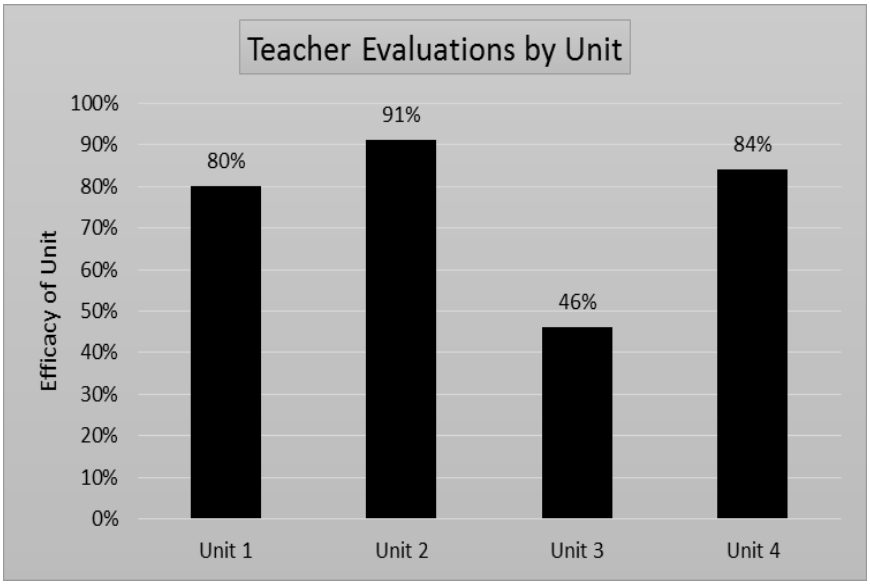

Figure 44: Bar Graph Displaying Percentage of Efficacy by Unit from the Teacher Feedback Surveys.

The bar graph above depicts the quantified teacher feedback provided by three teachers who implemented the units. Teachers were asked to rank a list of statements on a scale of 1 to 10, where 1 represented "not true at all," 5 represented "moderately true," and 10 represented "overwhelmingly true." Afterward, the teachers were asked to explain any scores below 5 in order for the project to gain insights for lesson unit improvements. The statements listed in the teacher feedback survey were:

- Students were excited and actively engaged with the material.
- Students wanted to learn more about the material.
- The lesson(s) in the unit effectively communicated to students the significance and importance of bison.
- The lessons in the unit effectively communicated the themes, topics, and ethics within archaeology.
- The lesson summaries and outlines were clear, easy to follow, and easy to implement.
- The readings were appropriate and provided the students with the necessary information to complete the unit.
- The films were appropriate and provided the students with the necessary information to complete the unit
- The worksheets and handouts provided in the unit(s) were easy to follow, appropriate for the grade level, and worked well with the lesson.
- The suggested links, additional materials, and notes for the teacher were utilized, and found to be useful, effective, and helpful with the lesson implementation.

The numerical values scoring each statement by unit were tallied, and a percentage of efficacy calculated, as figure 43 displays. Overall, the data suggest Unit 3 will need the most edits and revisions, with teacher evaluations of the unit at 46 percent efficacy. The main comments from Unit 3 were much in line with the overarching feedback points for all the units: the readings and vocabulary fell at more of a high school level, making some of the lessons challenging for the middle school audience. As each classroom setting is different, often and unfortunately linked to the socioeconomic context of the school, this feedback will be addressed within the curriculum by providing readings on various scales of difficulty. Thereby, grade appropriate readings will be provided in the lessons so that a diverse and varied seventh to ninth grade student audience can be reached.

In order to gain further insights into the low teacher score which Unit 3 received, I organized and led a follow up assessment. For this assessment, Unit 3 was revised with more PowerPoint content for the teacher and a targeted lesson plan for the students. The results were drastically different from the first rendition. Change in student understanding

for the quantitatively assessed questions improved significantly, increasing from 56 percent to 92 percent in correct answers from pre- to post-survey. For the qualitatively assessed questions, student increased from a total combined score of 18 points out of 256 to 151 points out of 256 total points possible. This is an increase from 7 percent to 59 percent on the rubric scale. Change in teacher understanding was positive, with the teacher saying it was easy to follow and the kids loved it (Teacher 3, personal communication 2015). Finally, based on the excellent questions the students asked during the second trial run, I realized teachers do not have the resources to fully answer many of the excellent, but specific, questions. For example, some of the questions students asked included:

> How do archaeologists know where to dig?
> How do they know what ancient people did?
> Do archaeologists need permission to excavate?
> How do they know how the artifacts were used?
> What happens when you don't have enough puzzle pieces (i.e., artifacts)?

Therefore, augmenting teacher resources and creating teacher PowerPoints are recommended steps to improve the accessibility of the content for the teacher.

BISON CURRICULUM SUMMARY

The preceding tables and graphs all work to determine the efficacy of the curriculum by quantifying (1) student understanding, (2) student interest, and (3) teacher feedback. This thesis then triangulates these lines of analysis to determine the overall percentage of efficacy of the curriculum. The summary statistics table below displays the triangulation process. This process was designed to give an estimation of the overall effect and utility of the curriculum.

Table 21: Percentage of Curriculum Efficacy Derived by Triangulation (Combination) of Three Lines of Evidence (1) Student Understanding, (2) Student Interest, and (3) Teacher Feedback.

	Percentage of Student Understanding Quant. and Qual.		Percentage of Student Interest	Percentage of Efficacy from Teacher Feedback
Unit 1	62%	42%	X	80%
Unit 2	65%	55%	X	91%
Unit 3	63%	58%	X	46%
Unit 4	57%	57%	X	84%
Quantified Interest in Bison	X		82%	X
Quantified Interest in Archaeology	X		75%	X
Totaled Percentage of the Category	57%		79%	75%
Percentage of Curriculum Efficacy	**70%**			

As the table above demonstrates, the column totals are calculated showing the totaled percentages of each line of evidence. Based on student's correct answers out of the total possible correct answers, student understanding is calculated to be at 57 percent. Quantified in the post survey, student interest at the end of the curriculum sequence was calculated to be at 79 percent. Teacher feedback was quantified and calculated to be at 75 percent. These lines of analysis are then themselves combined to form an overall total "percentage of curriculum efficacy." Combining these lines of analysis generates an overall percentage of 70 percent. Edits will certainly need to be made, but with an efficacy rating of 70 percent, the data suggests that the curriculum was successful.

CONNECTING THE RESULTS BACK TO THE RESEARCH DESIGN

The ultimate goal of this research was twofold: (1) assess the efficacy of the curriculum and determine areas for improvements, and (2) assess the efficacy of a

multivocal or "pluralized" approach to history as a public education and outreach strategy for archaeology. There is a discussion of the results for the first research objective below while a longer discussion of the second objective is presented in Chapter 5.

For the first research objective, the data demonstrated that for the entire curriculum the overall student understanding in the study group increased by 15 percent compared to a two percent decrease in the control group. This measurement of student understanding is, admittedly, likely skewed somewhat due to an untested survey instrument. There is, however, a clear improvement in understanding amongst the students in the study group. More significantly still, the curriculum content piqued student interest. By the end of the four-unit sequence, 89 percent of students were interested in the lesson topics of bison and archaeology—no easy feat with middle school students!

The data also expressed the need for evaluation and reevaluation of lesson materials. The first formulation of a curriculum is rarely ever the most effective, necessitating ongoing student and teacher input. This curriculum was certainly no exception! Overall, the triangulation process of combining student understanding, student interest, and teacher feedback into a determination of efficacy suggests that the curriculum *was effective*. However, a number of edits will need to be addressed, particular content points emphasized, outlines clarified, and lessons streamlined. That being said, this study was still a much-needed step forward in the exploration of how archaeological curriculums are implemented and received. Ultimately, archaeological curriculums need to be empowering and enfranchising to all communities—Native and non-Native alike—who hold a vested interest in the past.

CHAPTER 5: MOVING TOWARD AN EMPOWERING AND ENFRANCHSING CURRICULUM

> *"...the cultural histories and practices of Native students are rarely incorporated into the learning environment. As a result, achievement gaps persist with Native American students scoring lower than any other racial/ethnic group in the basic levels of reading, math, and history"* (U.S. Commission on Civil Rights 2003:xi).

RESEARCH CONCLUSIONS

The research design I developed gives voice to the students and teachers who deal with curricula on a daily basis, yet are often voiceless in its actual development; Native perspectives, in particular, hold a minimal role in curriculum development. Therefore, the research design focused on maintaining a strong collaborative ethic with the Blackfeet Tribe, manifested through a feedback loop before, during, and after curriculum creation and implementation. Additionally, as a culturally "western" and white outsider, the feedback loop mitigated the western biases that I brought into the curriculum. One step toward decolonizing pedagogy starts with active participation from the community, if not the full design of the curriculum itself. A decolonizing pedagogy strives to resist, deconstruct, and critically engage dominant ideologies, create a space for alternative perspectives, and accentuate autonomy of historically marginalized groups. In the case of the bison curriculum, the project began with an invitation from the Blackfeet for the design of the curriculum, with a specific content and message in mind: the significance of bison to Indigenous peoples. This was reinforced throughout the curriculum.

This community-invited approach to designing primary and secondary school curricula has been conceptually formulated into a model for replicability in other projects (Figure 46). This thesis completed Phase 1 (Stages 1, 2, 3, and 4), ending with recommendations from the teachers for a collaborative redesign incorporating student and teacher feedback (Stage 4). Therefore, the next step in the process is to return the curriculum to the community partners so that they can work to target key components for identity empowerment (Stage 5). Doing this allows for the final construction of a curriculum that engages students' interest, accentuates student understanding, cultivates student agency, and empowers student identity (Stage 6).

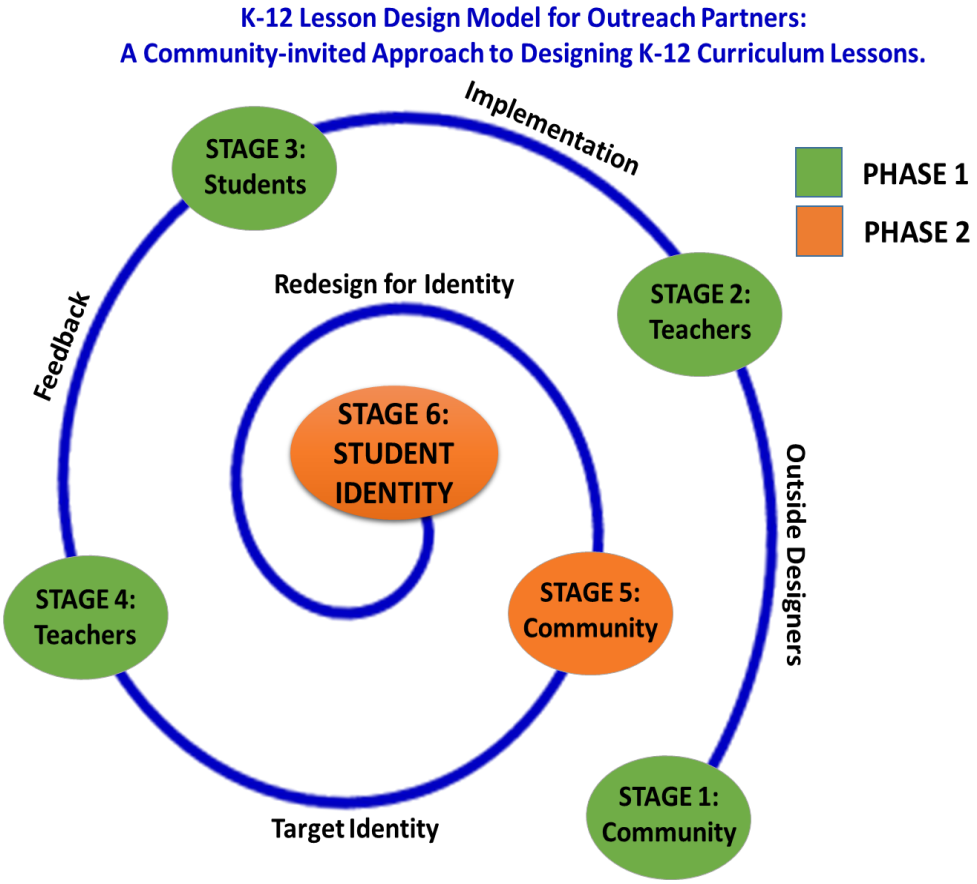

Figure 45: K-12 Lesson Design Model for Outreach Partners:
A Community-invited Approach to Designing Primary and Secondary School Curricula.

PHASE 1

STAGE 1: Community

- Outside designers invited by the community to create learning materials
- Community experts on lesson content guide project goals and outcomes

STAGE 2: Teachers

- Collaborative teacher workshop that introduces learning products
- FOCUS on Learning tool **Accessibility**
    - Do the teachers find the curriculum content accessible?

STAGE 3: Students

- Students are introduced to the new content.
- FOCUS on Student **Understanding** and **Interest** (via Assessment tools)
    - Is there interest by the students?
    - Is there understanding by the students?

STAGE 4: Teachers

- Collaborative redesign with the teachers after curriculum assessment and feedback
- FOCUS on the role of **Identity** via the learning materials
    - Incorporate stronger connections to student and community identity

PHASE 2

STAGE 5: Community

- Redesign with community partners to solidify identity focus
- Outside experts move to an advisory role only and the community assumes ownership of the product to be adjusted for identity empowerment as they see fit
- FOCUS on **Incorporating identity values**
- Teachers come in with new expertise

STAGE 6: Identity

- Students are introduced to new content which now has a strong focus on identity
- GOAL is to determine if **identity empowerment** can be attained

Within this conceptual model, the continual feedback loop facilitates student and teacher agency. Multivocality is then achieved through the active participation of native voices and epistemologies in both the design and implementation of the curricula. The goal, then, is an interactive, student-centered approach to Indigenous education, complemented by a pluralization of Native and western knowledge systems. In this vein, Garcia and Shirley (2012:77–78) write that in "todays context, Indigenous education is about creating a schooling experience that is blended, balanced and inclusive of both Western and Indigenous values and knowledge systems." They further note that the

culminating goal in indigenous education is to "enact a schooling experience that is rooted in self-education, self-determination and sovereignty for Indigenous peoples."

This is the ultimate goal of the bison curriculum, and one that the conceptual model aims to meet through its connection with community identity and identity empowerment. Overall, it is hoped that through this process a more streamlined, efficacious, and culturally sensitive curriculum was developed for submission to the Montana Department of Transportation, the Blackfeet Nation, and through them, the public schools throughout Montana. The discussion below begins to unpack the responses to this process.

Pluralizing the Past: A Multivocal Curriculum

The thesis data I collected were used to (1) both determine the efficacy of each individual unit and the curriculum as a whole, and (2) determine weak content areas that need further improvements, edits, and streamlining. As highlighted in Chapter 4, the triangulation of the three lines of analysis highlights an efficacious curriculum, with an overall efficacy rating of 70 percent. The analysis also provided areas for potential edits and content adjustments. Both these elements were successfully addressed in the research design.

The research design also held an underlying goal of creating and assessing a curriculum that worked to empower and enfranchise the historically "silenced minorities" (Mackie 1980:83; Gal 1989) by introducing alternative discourses and historically marginalized perspectives. This was operationalized through a multivocal past—a pluralization of histories about the past in which non-western, Native worldviews were complemented with western archaeological perspectives. Specifically, elements of Native, non-western epistemology and history—such as oral traditions and place

names—were interwoven with western interpretations of history, and archaeological and scientific analysis of the past. This pluralization allowed for Native perspectives to be recognized, and through that, the academic enfranchisement of Native students.

I realized that to fully assess this goal was beyond the scope of this research design, due to a variety of reasons. First, the fact that I was not present before, during, and after lesson implementation to assess student empowerment was a major issue. Second, middle school students are, by and large, unaware of the hegemonic forces that influence curriculum and pedagogy. Third, direct survey questions asking a student's level of empowerment generated by a pluralized curriculum simply would not be feasible.

Although a full assessment of student empowerment, identity validation, and enfranchisement is not possible within this research design (but would be possible when Stage 6 of the conceptual model presented above is reached), there are two lines of analysis that can provide insights: student interest and teacher feedback. Assessing the efficacy of a pluralized past model, in this case, remains somewhat qualitative in nature. But, that does not mean it is any less significant or meaningful. Students' answers within the Pre-Unit Interest Survey expressed disinterest in dominant (i.e., western or "white") versions of history. One student went so far as to put "Indians" as his favorite subject in school, and "white people" as his least favorite subject. The majority of students also expressed a high interest in exploring the topics of bison and archaeology before lesson implementation. Clearly, it wasn't the subjects they were disinterested in, but an overbearingly dominant and "white" version of history present even within Native curricula. Also clear is the awareness among students of this Eurocentric bias.

Interest, then, is the first line of analysis in which to determine the efficacy of a multivocal curriculum that attempts to circumvent Eurocentric biases. As mentioned previously, the quantified student interest was determined to be at an impressive 89 percent. This cannot be ignored; such a high level of maintained interest until unit completion speaks for itself. The students were engaged with the content and found the curriculum to be relevant and meaningful. Through the interest survey, the multivocal lens used to interpret the past appears to be an effective approach. It allowed for a pluralization of knowledge systems that complemented Native epistemologies about the past.

The second line of analysis, the teachers' responses and observations during the lesson sequence, provide further insights into the students' level of engagement, interest, and participation in the curriculum content compared to standardized, federally structured curricula. Teachers were asked: *were students engaged, empowered, and interested in the content?* One teacher wrote: "Totally! They worked quietly when called for or were engaged and talkative when called for (which is odd and miraculous!)—they really get into things relating to their culture" (Teacher 1, personal communication 2015). Another teacher wrote:

> The 7th grade students were excited and looked forward to the days that we would be studying the bison curriculum. They were particularly interested in bison conservation and the activities/videos in Unit 4. Their interest level and ability to connect in a cultural aspect kept them engaged and interested in the content of the curriculum [Teacher 2, personal communication 2015].

Another question in the Teacher Feedback Survey prompted teachers to think about meaningful curriculum: *Do you think your students connected with the content in a meaningful way?* One teacher replied: "Yes! Totally! Asking questions, be proactive with

information, actively wanting to learn to learn more and discuss" (Teacher 1, personal communication 2015). Another teacher responded:

> The interest level in the bison curriculum increased significantly as the cultural connection was identified and discussed. They were well aware of the importance of the bison to our ancestors and sad when they learned how our culture and traditional way of life was impacted so negatively during the 19th century when the bison were nearly eradicated. As well, the students were very enthusiastic when they learned of the conservation practices in place today and how they could help. They look forward to the time when Iinii [bison] returns to the Blackfeet on an even larger scale as an important part of our future [Teacher 2, personal communication 2015].

These elements witnessed by the teachers begin to unpack this complex and final objective of the research design: to assess student enfranchisement and empowerment from a pluralized perspective of the past. The teachers' feedback—though not directly from the students—is still a valuable level of observation in which to assess the efficacy of a pluralized past and underlying student empowerment. I recommend that for the next iteration of a project such as this, a careful and more robust comparative study of student engagement, interest, and identity occur between a federally backed, Eurocentric curricula and a multivocal, pluralized-past unit. Then, as the conceptual model above indicates, all six stages must be implemented and assessed. Only then can there be a more thorough assessment analyzing the changes, if any, on student engagement, interest, and identity.

CONCLUDING THOUGHTS

Education is not a neutral enterprise, but is grounded within the dominant sociopolitical expression of its era. Certain ideologies, ontologies, and knowledge systems are selected over others, whether consciously or not. It can therefore never be fully divorced from politics (Apple 2008). Similarly, as Lomawaima and McCarty

(2006:xxiv) underline, "history is a social construction … no historical account is disinterested or politically neutral." The bison curriculum is certainly not politically neutral, yet, neither are federally standardized curricula. The bison curriculum, however, strives to empower marginalized and disenfranchised Native perspectives by expressing the *indigenous* significance of bison alongside scientific perspectives. Federal or state standardized curricula, on the other hand, often perpetuate a mono-historical perspective. This ultimately results in disenfranchising curricula. Much has been written on textbook history perpetuating a nation-building, myth-making discourse (Wolf 1997:5). And, much has been written on schools acting as institutions for the distribution, assimilation, and validation of dominant ideologies (Bourdieu 1982; Lomawaima and McCarty 2006; Raynaud 1994). Indeed, schools "create and recreate forms of consciousness that enable social control to be maintained without the necessity of dominant groups having to resort to overt mechanisms of domination" (Apple 2008:2).

In addition to curricula, federal and state laws themselves can work to institutionalize dominant perspectives at the expense of alternative perspectives. Currently, this is clearly visible in Arizona through its recent 2010 ethnic studies law, HB 2281, passed to ban discourses that counter the dominant paradigm. Specifically, the ethnic studies law,

> Contains four sections that limit public school curricula. First, no course or class may 'promote the overthrow of the United States government.' Second, no course may 'promote resentment toward a race or class of people.' Third, no course may be 'designed primarily for pupils of a particular ethnic group.' Finally, no course may 'advocate ethnic solidarity instead of treatment of pupils as individuals' [Lundholm 2011:1043].

This law demonstrates that alternative histories and perspectives continue to not only be unconsciously suppressed, but actively challenged.

It is in this context where the demonstration of the efficacy of multivocal, pluralized curricula will actively counter forces that essentially bleach history of perspectives of color and render it into its current white-centric incarnation. Such a curricula would facilitate student recognition of alternative discourses and history, the first step in the decolonizing process. Students will then gain a more respectful, holistic understanding of Native knowledge systems that will carry on into the future. Students, as the upcoming generation, will be key policy-makers and such a curricula would facilitate more respectful, informed decisions. The key is a pluralized past model that balances scientific knowledge with alternative worldviews. Therefore, the next step in archaeological education is not to debunk scientific, western-centric dissemination of knowledge, but to allow for alternative, historically disempowered voices to complement the dominant perspective. We have reached a point in pedagogy where multivocality must become reality.

APPENDIX A: UNIT OUTLINES

Unit 1: Bison Behaviors and Adaptations

Lesson 1: Have you "Herd" of Bison

Objective: Students will be introduced to bison (also known as buffalo) by watching a documentary about the bison living in Yellowstone National Park. During the film, students will complete a film worksheet.

Students will understand: How bison have adapted to their eco-niche taking into account environmental, seasonal, and predatory pressures. They will also gain an understanding about the various bison adaptations and behaviors that have contributed to general species and reproductive success.

Students will be able to: Do a film analysis to learn about the adaptations and behaviors.

Essential Question(s): How have bison adapted to their eco-niche? What behaviors and adaptations have allowed them to more effectively utilize their habitat and contribute to their overall species success?

Estimated Time Lesson 1: Approximately 1 class period

Handout(s)/Worksheet(s)/Teacher Guide(s):

(1) Worksheet 1: *Bison: Documentary on the Buffalo in* Yellowstone

Prior Knowledge: No prior knowledge is necessary for this module.

Reading(s): No readings are required for Lesson 1

Documentaries/Film Clips: (1) *Bison: Documentary on the Buffalo of Yellowstone*

Other Optional Documentaries available for free online: (1) *Cold Warriors: Wolves and Buffalo* PBS Documentary, (2) *American Buffalo: Spirit of a Nation* PBS Documentary, (3) *Rutting and Mating*: a YouTube video

Key Terms: Bison; Buffalo; Eco-Niche; Environment; Seasonal, Environmental, and Predatory Pressures; Reproductive Success; Herbivore; Evolutionary Behaviors; Adaptations

NGSS Science Standards: MS-LS1 From Molecules to Organism

MS-LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors…affect the probability of successful reproduction…

MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Disciplinary Core Ideas: LS1:B

Crosscutting Concepts: Cause and Effect

Lesson Outline:

An Introduction to Bison

1. The teacher will introduce students to bison as a species, its major characteristics, location, etc. by presenting the short PowerPoint provided in the module and then watching *Bison: Documentary on the Buffalo of Yellowstone* available online on YouTube (approx. 55 minutes).
2. Students will take notes on the corresponding worksheet provided (**Worksheet 1: *Bison Documentary on the Buffalo in Yellowstone*).** *Note: The worksheets can be adapted for the optional videos as well.*
    1. Video Link - http://www.youtube.com/watch?v=Uo8CH3cGCGU (Bison in National Parks)
    2. Film can also be found at: http://www.bison.tv/videos-bison-documentary-on-the-buffalo-%5BUo8CH3cGCGU%5D.cfm
3. If continuation to lesson 2 of this unit is planned, give students **Handout 1: Student Instructions for Group Poster Project** which explains the rest of the lesson module sequence.
4. To close the class session if there is time, students can be asked to write or think about how the adaptations and behaviors that have helped bison survive and thrive.

Unit 1: Bison Behaviors and Adaptations

Lesson 2: Bison Uncovered

Objective: Students will work in small groups (3-4) to research the bison eco-niche, examining one particular behavior or evolutionary adaptation that has contributed to species survival.

Students will understand: How bison have adapted to their eco-niche taking into account environmental, seasonal, and predatory pressures. They will also gain an understanding about the various bison traits that have contributed to reproductive and general species success.

Students will be able to: Research, record, and understand the different adaptations and behaviors contributing to bison species success as well as identify the similarities and differences between the various traits.

Essential Question(s): How have bison adapted to their eco-niche? What behaviors and adaptations have allowed them to more effectively utilize their habitat and contribute to their overall species success?

Estimated Time Lesson 2: 1 class period (with an optional 2nd class period)

Handout(s)/Worksheet(s)/Teacher Guide(s):

(1) Handout 1 (If not provided already): Student Instructions for Group Poster Project
(2) Worksheet 2: Research Template (1 per group)
(3) Worksheet 2: Teacher Guide
(4) Bison Factsheet 1 Student Handout (1 per group)
(5) Bison Factsheet 2 Student Handout (1 per group)

Prior Knowledge: No prior knowledge is necessary for this module.

Readings: (1) *The Buffalo and the Indians,* (2) Bison Fact Sheets

Documentaries/Film Clips: Optional documentaries to be shown while teacher reviews Worksheet 2: (1) *Cold Warriors: Wolves and Buffalo* PBS Documentary, (1) *American Buffalo: Spirit of a Nation* PBS Documentary, (2) *Rutting and Mating*: a YouTube video

Key Terms: Bison; Buffalo; Eco-Niche; Environment; Environmental, Seasonal, and Predatory Pressures; Reproductive Success; Herbivore; Evolutionary Behaviors; Adaptations

NGSS Science Standards: MS-LS1 From Molecules to Organism:

MS-LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors…affect the probability of successful reproduction…

MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Disciplinary Core Ideas: LS1:B

Crosscutting Concepts: Cause and Effect

Lesson Outline:

Students are divided into small working groups (3-4 members) to be assigned one trait to research. Up to 10 traits have been provided below: 5 Behaviors & 5 Adaptations.

Part 1: Exploring Bison Traits

1. Display on overhead or hand out copies (if you have not already) of the **Handout 1: Student Instructions for Groups Poster Projects** found in Lesson 1 of this Unit. Students will follow the instructions on the handout for the remainder of the poster project.

2. Each group will get copies of the recommended readings to use in their research. *Note: The provided readings listed below plus the Lesson 1 film (Bison: Documentary on the Buffalo of Yellowstone) will give students enough information to complete the assignment. HOWEVER, students are most certainly encouraged to gather more information from other sources (i.e., other books or websites)*
    a. Readings from *The Buffalo and the Indians*, pp. 1-7 (introduction to bison)
    b. Readings from *The Buffalo and the Indians*, pp. 8-13 (seasonal behaviors/adaptations of bison)
    c. Readings from Bison Fact Sheets. Direct students to these two websites if online access is available for students. IF NOT, adapted printable versions ARE included at the end of the module:
        i. Fact Sheet #1 available at: http://www.defenders.org/bison/basic-facts
        ii. Fact Sheet #2 available at: http://library.sandiegozoo.org/factsheets/bison/bison.htm#behavior

3. Using the list provided below (a. Behaviors or b. Evolutionary Adaptations), groups will be given one trait to research. Each behavior or adaptation has influenced bison

species success and survival in some way. If the teacher allows, student groups may suggest an alternative behavior or evolutionary adaptation not provided below (*Note: some traits listed could arguably be on both lists, however it is largely irrelevant for the module sequence*):

1. Behaviors: (1) group congregating and herding behavior (2) rutting (mating), (3) dividing into smaller groups and the breaking apart of the large herd, (4) tendency to run if spooked (5) continual movement while in large herds
2. Evolutionary Adaptations: (1) birthing young at a particular time of the year, (2) grass eating herbivores, (3) calves have the ability to run within a few hours of birth, (4) thick warming and insulating hide, (5) powerful "plow-like" head with strong neck muscles

4. Students must follow the Research Criteria provided on the example template (**Worksheet 2: Bison Behavior and Adaptations**) to record their findings. They are as follows:
    a. Describe the specific trait (behavior or adaptation)
    b. Explain its impact on bison survival and provide argument points as to why this trait has contributed to bison species success
    c. Provide pictures or an info-graphic of this characteristic trait and provide a written supplement explaining those picture(s)
    d. List the research and data they collected about the trait
    e. Students should also use their notes from the video shown in class as part of their investigation.

5. Students will submit for teacher review their **Worksheet 2: Bison Behavior and Adaptations**. Once teacher-approved, students can begin creating their posters. If students are not done, they can finish it as in-class homework while the teacher reviews.

Optional Part 2: Additional documentary

1. Optional (50 minutes): If the teacher needs time to review students' **Worksheet 2: Bison Behavior and Adaptations**, the teacher may opt to show a second video/film at this time for one class period while outlines are reviewed.

Optional videos:

a. **Recommended optional film**: *Cold Warriors: Wolves and Buffalo Nature Documentary,* 53:08 minutes, worksheet IS included in module, available free online at http://www.youtube.com/watch?v=cGfKTnsAjhs

i. Provides more information about predator/prey relationships
ii. Supplements and compliments *Bison Documentary on the Buffalo of Yellowstone* and provides info about bison behavior and adaptations

b. *Rutting and Mating*, a YouTube video, NO worksheet included, can be found at: http://www.youtube.com/watch?v=9UxUVGIxWXo
c. *American Buffalo: Spirit of a Nation* PBS Documentary, NO worksheet included, can be found at: http://www.pbs.org/wnet/nature/episodes/american-buffalo-spirit-of-a-nation/troubled-herds/2181/

Unit 1: Bison Behaviors and Adaptations

Lesson 3: Bison Presented

Objective: Students will create a poster displaying their particular behavior or adaptation. The posters will explain why the trait has helped bison species survival. After completion of the posters, the class will conduct a "presentation walk" moving to each poster and having the representative group briefly explain the trait.

Estimated Time Lesson 1: Approximately 2 class periods

Students will understand: How bison have adapted to their eco-niche taking into account environmental, seasonal, and predatory pressures. Students will learn about bison adaptations and behaviors that have contributed to reproductive success.

Essential Question(s): How have bison adapted to their eco-niche? What behaviors and adaptations have allowed them to more effectively utilize their habitat and contribute to their overall species success?

Students will be able to:

(1) Design and create a presentation poster using all the data and analysis from their group research in which they identify seasonal behaviors and environmental adaptations of bison.
(2) Compare and contrast the different adaptations and behaviors. By doing so students can identify the similarities and differences between the adaptive and behavioral strategies as well as see how they all interrelate.

Students Will Need: Poster board, picture printouts, poster design materials (markers, glue, construction paper), access to internet for research, and ability to print text and pictures for the posters

Handout(s)/Worksheet(s)/Teacher Guide(s):

(1) Worksheet 3: Adaptation and Behavior Matrix (1 per student)
(2) Unit 1 Quiz: Bison Species Behavior and Adaptations
(3) *Note:* Teacher Guides are provided

Prior Knowledge: No prior knowledge is necessary for this lesson module.

Readings: No readings for this part of the lesson sequence

Documentaries/Film Clips: No documentaries of films are required.

Key Terms: Bison, Buffalo, Niche, Environment, Environmental and Seasonal Pressures, Predatory Pressures, Reproductive Success, Herbivore, Evolutionary Behaviors, Adaptations

Standards: MS-LS1 From Molecules to Organism:

MS-LS1-4: Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors…affect the probability of successful reproduction…

MS-LS1-5: Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms.

Disciplinary Core Ideas: LS1:B

Crosscutting Concepts: Cause and Effect

Lesson Outline:

Part 1 (50-90 minutes): Poster Project

Using their individual research worksheet and notes, the groups must now design an informative poster to be shared or presented with the rest of the class.

1. Students will analyze the data they have collected and compile the information collected from the different group members.
2. Posters must address all research and data collected. They must feature their argument for why it has helped bison species success.
3. Posters provided by school if able, or students can find inexpensive poster-board

Part 2 (50 minutes): Presentation Walk

2. Upon completion of the posters, students will display their posters for a "presentation walk" in which all students will visit each poster. Visiting students will record data on their Matrix sheet (**Worksheet 3: Bison Adaptation and Behavior Matrix**).

Part 3 Closure Activity: Quiz OR Writing Assignment

1. The matrix will be used as a reference tool for a 'quiz/review activity' in which they can compare and contrast adaptations and behaviors. This quiz review activity is included at the end of the lesson modules as **Worksheet 4: Lesson Module Completion**
2. As an alternative to the end of the unit assessment quiz, a 2-3 page writing assignment answering the unit's essential questions can be another option.
    a. Unit 1 Essential Question: How have bison adapted to their eco-niche? What behaviors and adaptations have allowed them to more effectively utilize their habitat and contribute to their overall species success?

Unit 2: Bison Through Time

Lesson 1: Introductory Film

Objective: Students will watch *Facing the Storm: Story of the American Bison* to learn more about the pre-and-post contact natural and enculturated history of the bison. During the film they will complete a worksheet.

Estimated Time: 1 class period

Students Will Understand: That the bison ecosystem encompasses a vast spatial and temporal area with a great amount of diversity, change, and fluctuation. Examples of this include:

- Bison herds once dominated the grassland ecosystems of the United States.
- It has been estimated that with the first human interactions in the Great Plains, estimates of over 40 million *Bison bison,* or American Bison, roamed the land.
- By 1900, a little over 1,000 bison could be found with only a handful of wild bison left in Yellowstone National Park.

Students will be able to: Critically engage with the topic and themes by watching the film and completing the worksheet to prepare themselves for the rest of the Unit 2 sequence.

Essential Question(s): How has the bison eco-niche changed over time? How have humans played a role in impacting the bison eco-niche?

Prior Knowledge: Though not critical for the completion of this module, Unit 1: Bison Species Behaviors and Adaptations

Students Will Need: No materials are needed for Unit 2: Lesson 1

Handout(s)/Worksheet(s)/Teacher Guide(s):

(1) Worksheet 1: Facing the Storm Film
(2) Worksheet 1 Teacher Guide

Readings: No readings are assigned for this section of the lesson.

Key Terms: Ecosystem, Eco-Niche, Holocene, Pre-contact Period, Contact Period, National Park, Human Predation, Population Pressure, Population Density, Great Plains

NGSS Science Standards: MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resources availability on organisms and populations of organisms in an ecosystem,
MS-LS2-2: Construct and explanation that predicts patterns of interactions among organisms across multiple ecosystems
MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem
MS-LS2-4: Construct and argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Disciplinary Core Ideas: LS2A, LS2B, LS2C

Crosscutting Concepts Patterns, Cause and Effect, Stability and Change

Lesson 1 Outline:

Part 1: Film

3. The teacher will introduce the background information by showing students the first part of the following film: *Facing the Storm: Story of the American Bison* Documentary ending at *29:10*.
    a. If the documentary is unavailable, a power point presentation has been provided introducing students to the history of bison. If there is time after the film, the teacher can utilize this time to show some of the power point.
    b. While watching the film, students will fill out **Worksheet 1: *Facing the Storm***

4. After completion of the ½ hour film segment, students will turn in **Worksheet 1: *Facing the Storm***.

5. The teacher can now lead a brief discussion reviewing the film and the answers on the worksheet for the remainder of the period.

6. *NOTE: If teacher desires, Lesson 2 can be started after completion of the film to expedite the Unit 2 lesson sequence*

Unit 2: Bison Through Time

Lesson 2: Research for the Bison Ecosystem Timeline Collage

Objective: Students will work individually to research (using the lesson module readings and those listed in the handout accompanying this assignment) one of 3 time periods over the past 10,000 year span of bison history.

Estimated Time: 2-3 classroom hours and 2-3 student homework hours

Students Will Understand: That the bison ecosystem encompasses a vast spatial and temporal area with a great amount of diversity, change, and fluctuation. Examples of this include:

- Bison herds once dominated the grassland ecosystems of the United States.
- It has been estimated that with the first human interactions in the Great Plains, estimates of over 40 million *Bison bison,* or American Bison, roamed the land.
- By 1900, a little over 1,000 bison could be found with only a handful of wild bison left in Yellowstone National Park.

Students will be able to:

1. Research a time period (1 of the 3 provided in the module) and then works as a group to create a visual collage depicting that specific time period in bison history.
2. Utilize research of past climatic conditions, environmental and predatory pressures, human hunting activities, estimated bison populations densities, and any other relevant information to write a 1 page descriptive synopsis of the collage.
3. Assemble a class timeline (ideally on an easily visible classroom wall) to showcase the changing bison ecosystem through time.

Essential Question(s): How has the bison eco-niche changed over time? How have humans played a role in impacting the bison eco-niche?

Prior Knowledge: Though not critical for the completion of this module, Unit 1 will more fully introduce the students to the bison species.

Students Will Need: Paper printouts, craft materials (crayons/colored pencils, markers, glue, construction paper), 8 x 10 collage paper, stack of magazines w/ high density of pictures, and a computer (or computer lab) with an internet connection for research and collage material.

Handout(s)/Worksheet(s)/Teacher Guide(s):
(1) Worksheet 2: Bison Ecosystem Time Period
(2) Worksheet 2: Teacher Guide (There is 1 teacher guide for each time period)
(3) Handout 1: Bison Timeline Summary Reading (1 for each of the 3 time periods)
(4) Handout 2: Research Resources for Students
(5) Bison fact sheet (in case *Unit* for Students
(6) Bison fact sheet (in case *Unit 1: Bison Species Behaviors and Adaptations* was skipped

Readings: (1) *The Buffalo and the Indians,* Reading handouts provided by the module (Handout 3: Research Resources for Students, Handout 4: Bison Timeline summary readings with lists of website links for further student research

Key Terms: Ecosystem, Pleistocene, Holocene, Pre-contact Period, Contact Period, National Park, Human Predation, Population Pressure, Population Density, Great Plains

National Science Standards: MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resources availability on organisms and populations of organisms in an ecosystem,
MS-LS2-2: Construct and explanation that predicts patterns of interactions among organisms across multiple ecosystems
MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem
MS-LS2-4: Construct and argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Disciplinary Core Ideas: LS2A, LS2B, LS2C
Crosscutting Concepts Patterns, Cause and Effect, Stability and Change

Lesson Outline:

In Class ASSIGNMENT—Individual Research Activity. This part of the lesson should take approximately 2 class periods *(Note: the research is expected to take only 1 weekend or 1-2 week days to complete. If the teacher feels a second day of research is needed, the second class period is recommended to be spent at the COMPUTER LAB to facilitate student research)*

Part 1: Timeline Activity

1. After the film and overview presented in class, each student will be given a spot on the 10,000 year timeline in one of the three time periods listed below so that there are three evenly numbered (or as close to evenly numbered) groups:
    i. Early-Middle Holocene (10,000 BC to 6,000 BC)
    ii. Middle-Late Holocene (6,000 BC to1500 AD)
    iii. Contact Period (1500 AD to Present)
2. Students are assigned to research bison during the timeframe they have been given.
3. Each student must use **Worksheet 2: Bison Ecosystem Time Period** as a guide for recording the information they are uncovering during their research. (*Note:* **Teacher Guides** *for EACH time period have been provided by the module. These guides can be used both to point students in the right direction and, if desired, assess their work before the students begin creation of their time period collage during part 3 of this module sequence*).
4. Students will be given **Handout 1: Summary Readings of Time Periods** which provides students with a general overview of their time period. Each of the 3 time period readings is included below. Students will find a lot of the information to complete their Worksheet 2 in these readings but they will need to do some outside research using **Handout 2: Research Resources for Students** as well. A

Bison Fact Sheet has been provided if Unit 1 was skipped for additional information.

5. For further research, students can use **Handout 2: Research Resources for Students** which lists additional online reference materials that can be used.
    a. In **Handout 2: Research Resources for Students** there are recommended readings from the module textbook *The Buffalo and the Indians*. If possible, printouts of the pages listed should be made available AND/OR copies of the book for students to read in class.
6. During their research, students will analyze the pressures and changes in the environment that in some way affected bison ecology, bison populations, and general species success. Students must identify and record on their individual **Worksheet 2: Bison Ecosystem Time Period** the following:
    a. Describe the environment of their time period.
    b. Provide some interesting facts about bison in their time period
    c. List the species putting predatory or competitive pressure on bison
        i. Predation from wolves, bears, and other carnivores)
        ii. The current competition with cattle (bison competing with cattle for grazing land) and the historical "domestication" of some bison.
    d. What climatic conditions are present during their time period:
        i. E.g., cold spell during the transition from Pleistocene to the Holocene also called the Younger Dryas
        ii. E.g., warming trend after the Younger Dryas that saw the extinction of megafauna (large animals like the giant sloth and mammoth)
    e. Human hunting of bison
        i. Native hunting during the pre-contact period
        ii. Human hunting and fur trading post-contact period that brought about the near extermination or extinction of the bison
    f. Give a brief explanatory sentence on how they think bison were important during their particular time period
    g. Students can draw or find 2 images of bison, predators, or the environment that represent their time period. Old magazines can be used as well as images printed online. (*NOTE: if students don't have access to internet or printing resources at home, class time should be designated in a computer lab for students to research and collect images.*)

Unit 2: Bison Through Time

Lesson 3: Bison Ecosystem Timeline Collage and Writing Assignment

Objective: Drawing from their research and what has been presented in class, students will work in groups to design a collage of words and images displaying the particular time period in bison history. Whereupon, they will write a ½ page essay

Estimated Time: 1 class period

Students Will Understand: That the bison ecosystem encompasses a vast spatial and temporal area with a great amount of diversity, change, and fluctuation. Examples of this include:

- Bison herds once dominated the grassland ecosystems of the United States.
- It has been estimated that with the first human interactions in the Great Plains, estimates of over 40 million *Bison bison,* or American Bison, roamed the land.
- By 1900, a little over 1,000 bison could be found with only a handful of wild bison left in Yellowstone National Park.

Students will be able to: Critically engage with the topic and themes by synthesizing what they learned during their research and class discussions into a final product, a time line collage. From this final product and use of a comparative and contrastive Venn diagram, students can easily assess the similarities and differences between the time periods. Drawing upon this, students will write a ½ page paper explaining these similarities and differences in the bison ecosystem.

Essential Question(s): How has the bison eco-niche changed over time? How have humans played a role in impacting the bison eco-niche?

Prior Knowledge: Though not critical for the completion of this module, Unit 1 will more fully introduce the students to the bison species.

Students Will Need: No materials are need for this lesson module

Handout(s)/Worksheet(s)/Teacher Guide(s): (1) Handout 3: Collage Example Template

Readings: No readings are required for this section of the module

Key Terms: Ecosystem, Pleistocene, Holocene, Pre-contact Period, Contact Period, National Park, Human Predation, Population Pressure, Population Density, Great Plains

NGSS Science Standards: MS-LS2 Ecosystems: Interactions, Energy, and Dynamics

MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resources availability on organisms and populations of organisms in an ecosystem,
MS-LS2-2: Construct and explanation that predicts patterns of interactions among organisms across multiple ecosystems
MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem
MS-LS2-4: Construct and argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Disciplinary Core Ideas: LS2A, LS2B, LS2C

Crosscutting Concepts Patterns, Cause and Effect, Stability and Change

Lesson Outline:

Part 1: Presenting the Collage Poster

Once students have completed their research, they will join with other students in their particular time period and work collectively on a group collage, sharing activity.

1. Students will compile the information from **Worksheet 2: Bison Ecosystem Time Period**, including their image(s) and proceed to:
    a. Students will group up into their time periods
    b. All students researching the same time period will collaborate to design a collage of images and key terms that illustrate their time period.
2. Students will utilize their answers on their **Worksheet 2: Bison Ecosystem Time Period** to generate the content for their group collages as well as utilize the images they brought with them to class.
    a. The goal is to convey in **words**, **phrases**, and **imagery** what that time period looked like for the bison.
    b. Three poster-size sheets of paper, one for each time group, will need to be provided for the students. *(NOTE:* **Handout 3: Collage Example Template** *has been provided at the end of the module to use as a template for the project. This is a miniature collage as an example, students' collages should be much larger)*
3. Collage posters will be displayed in the classroom and the 3 time periods (10,000 BC to 6,000 B.C.; 6,000 B.C. to A.D.1500; and A.D. 1500 to Present) can be discussed as a class or through short group presentations.
4. Suggestion: Teacher can draw a Venn diagram as a recording tool for the discussion. Students can record the Venn in their notes.

Part 2: Unit Reflection Essay Assignment:

1. Using the 3 poster collages for reference and after the group discussion about the time periods, students must each **WRITE a 2 page essay** describing the similarities and differences between the 3 time periods specifically as it pertains to

bison history. In it they should also make note of the Essential Questions of Unit 2: How has the bison eco-niche changed over time? How have humans played a role in impacting the bison eco-niche?

2. To help students make connections of similarities and differences for the essay, refer back to the Venn diagram created in class.
    a. This can be done at the end of class if there is time and/or assigned for homework if students are unable to complete 2 page comparison essay in class.
    b. The essay must have:
        i. Introduction statement
        ii. 2 similarities and 2 differences between the 3 time periods
        iii. Closing statement

Unit 3: Archaeology, Hunting, and Bison Anatomy

Lesson 1: Introduction to Archaeology and Bison Bones

Objective: The students will be given readings and a presentation introducing the discipline of archaeology, bison skeletal anatomy, and culturally processed bison bone. Students will complete the reading assignment and answer the subsequent questions to complete the lesson.

Estimated Time: Approximately 2 class periods

Students will understand: The impact of human hunting of bison through time and the role of:

- Oral histories of human predation among Native American tribes;
- Archaeological evidence of bison hunting through marks on bones;
- Technological and social advances evidenced in landscape features such as drive lanes and bison jumps;
- Written documentation of bison hunting into historical times.

Students will be able to: Learn about the basics of archaeology, bison skeletal anatomy and physiology, and how the two relate to each other when explaining past human interactions with bison. By the end of the lesson they will be able to identify bison skeletal anatomy and explain how culturally modified bones might help with archaeological insights and practice.

Essential Question(s): How can archaeological practices help solve some of the mysteries of the past? In particular, what can examining bison processing camps tell us about past human life-ways and practices?

Prior Knowledge: This module is designed to be a stand-alone unit, however, the previous modules would provide a more robust and comprehensive background in particular Science Unit 2: Bison Through Time.

Students Will Need: No further materials for lesson 1 of Unit 3.

Provided Handouts: (1) *Reading 1: What is Archaeology,* (2) *Handout 1: Bison Bone Guide,*

Readings: No additional readings are required for lesson 1 of Unit 3 other than the readings already provided in the module.

Key Terms: Archaeology, Archaeologist, Human Predation, Overkill, Extinction, Endangered Species, Processing, Bison Drive Lanes, Bison Jumps, Skeletal Anatomy, Processing Camp

NGSS Science Standards: Earth and Human Activity

MS-ESS3-3: Apply Scientific Principles to design a method for monitoring and minimizing human impact on the environment

MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Disciplinary Core Ideas:
ESS3.C: Human Impacts on Earth Systems

Crosscutting Concepts: Patterns, Cause and Effect

Lesson Outline:

Introduction to Archaeology

1. Using the provided short PowerPoint Presentation the teacher will introduce the students to archaeology and bison bones. The PowerPoint will include what archaeology is and what it is not as well present information about bison skeletal anatomy.
    a. This presentation will include:
        i. Debunking pop culture misconceptions (Indiana Jones and Tomb Raider)
        ii. Goals of contemporary archaeology
        iii. Some basic information about bison skeletal anatomy. Teacher notes about the power point presentation HAVE been provided for teacher ease and convenience
    b. After presentation student will be **Reading 1: What is Archaeology?** that should be completed during class or as homework before the Exploratory Lab begins.
        i. **Reading 1: What is Archaeology**. The readings can also be found at: http://encyclopedia.kids.net.au/page/ar/Archaeology
        ii. Students will receive **Handout 1: Bison Bone Guide**
        *iii. Notes: if previous lesson modules were not utilized, the **Bison Fact Sheet** Reading can be an additional homework reading OR made into an 11th station.*

2. As an optional piece, the teacher may opt out of a full PowerPoint presentation and discussions and instead invite a guest speaker to also talk about archaeology. Speakers could be:
    a. Native Speaker
    b. Archaeologist/Museum Curator
    c. Other qualified professional

Unit 3: Archaeology, Hunting, and Bison Anatomy

Lesson 2: Lab Challenge

Objective: Students will participate in several labs in order to identify bison skeletal anatomy, briefly read key articles, and participate in short activities all related to the hunting of bison, culturally modified bone, and archaeology.

Estimated Time: 1 class period

Students will understand: The impact of human hunting of bison through time.

The role of:

- Oral histories of human predation among Native American tribes;
- Archaeological evidence of bison hunting through marks on bones;
- Technological and social advances evidenced in landscape features such as drive lanes and bison jumps;
- Written documentation of bison hunting into historical times.

Students will be able to: (1) participate in labs that reinforce ideas about the human impact on natural and animal resources (specifically with bison), per-capita consumption of bison meat, changes in human predation and consumption practices, and assess the overall human impact on the ecosystem and bison eco-niche, especially in terms of the human influence upon the near extinction of bison. (2) Synthesize the information from the labs and presentations and write a 1 page report on how archaeological knowledge gleaned from bison bones informs the present.

Essential Question(s): How can archaeological practices help solve some of the mysteries of the past? In particular, what can examining bison processing camps tell us about past human life-ways and practices?

Prior Knowledge: This module is designed to be a stand-alone lesson, however, the previous modules would provide a more robust and comprehensive background.

Students Will Need: Lab 1: Bison Identification Worksheet (provided), Lab 2: Paper cutouts of bison skeleton (provided), scissors, pencils, Lab 3: Bison bones with cut marks, lab gloves, pencils, and worksheet paper. Paper Assignment: computer with an internet connection

Provided Handouts: (1) *Worksheet 1: Exploratory Lab Station Challenge!* (2) Station Readings (3) *Bison Fact Sheet* if previous modules were not used (4) *Reading 2: What the Bones Say* as an alternative if the module sequence textbook *The Buffalo and the Indians* is unavailable

Readings: Select sections from *The Buffalo and the Indians*, pp. 22-29

Key Terms: Archaeology, Archaeologist, Human Predation, Overkill, Extinction, Endangered Species, Processing, Bison Drive Lanes, Bison Jumps, Skeletal Anatomy, Processing Camp, Environment, Culturally Modified Bone, Cut Marks, Faunal, Microfauna, Megafauna

NGSS Science Standards: Earth and Human Activity

MS-ESS3-3: Apply Scientific Principles to design a method for monitoring and minimizing human impact on the environment

MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Disciplinary Core Ideas:
ESS3.C: Human Impacts on Earth Systems

Crosscutting Concepts: Patterns, Cause and Effect

Lesson Outline

Part 1: Be the archaeologist--Exploratory Lab Station Challenge!

1. Students will be challenged to analyze the data given to them in the following format:
    d. There will be 10 interactive stations.
    e. Students will have approximately 5-10 minutes (adapt as time allows) at each station.
    f. They must complete as many stations as possible.
    g. At each station they will fill out the questions provide on **Worksheet 1: Exploratory Lab Station Challenge!** This has been included in the module below.
3. Before starting the stations, students will take 5-10 minutes to read a short section from the module textbook *The Buffalo and the Indians.* Using pages 22-24 (Buffalo Meat section), students must answer the 2 questions listed at the top of **Worksheet 1: Exploratory Lab Station Challenge!** BEFORE starting the Exploratory Lab.

Note: If the textbook The Buffalo and the Indians is unavailable, an alternative option is use the Station 10 reading: What the Bones Say which is provided in the module.

3. Starting the Exploratory Lab—The 10 Stations:

Station 1: Bison Skeleton Labeling. Students will label the bison skeleton. They must label at least 10 bones.

Station 2: Bison Skeleton Reassembling. Opening one of the bags with the cut-up pieces of bison skeleton (*teacher must prepare this ahead of time*), students must assemble the skeleton correctly. Then, they must answer the following questions: what bone is the mandible? What bone is the femur? What bone is the scapula? (*NOTE*: *The teacher must put a letter on the back of each piece of paper beforehand*) Once they choose the part they believe is the mandible, femur, and scapula they must put the corresponding letter on the back of the piece of paper on their lab worksheet.

Station 3: Lab of Painted Bone. Answer the following: What is the processing technique used? What bone is it? What do you think was the purpose of painting this bone?

Station 4: Lab of Burned Bone. Answer the following: What is the processing technique used? What bone is it? Why was the purpose of burning this bone?

Station 5: Lab of Crushed Bone. Answer the following: What is the processing technique used? What bone is it? What do you think was the purpose of this processing technique?

Station 6: Lab of Bone with Cut Marks. Answer the following: What is the processing technique used? What bone is it? Why do you think there are cut marks on this bone?

Station 7: Bone Marrow Lab. Answer the following: What is the processing technique used? What bone is it? What do you think was the purpose of this processing technique?

Station 8: Reading from *The Buffalo and the Indians:* Using pp. 24-29 (buffalo meat and processing the buffalo section), students must answer the 2 questions listed in the worksheet.

Station 9: Bison Jump Reading. Students must answer the 2 questions from the *Bison Jump Reading*. The reading IS provided in the module and can also be found at: http://www.texasbeyondhistory.net/bonfire/index.html

Station 10: *What the Bones Say* Reading. Students must answer the question from the readings for station 10 provided in the module. Excerpt Taken From: http://www.texasbeyondhistory.net/bonfire/index.html

Optional Station 11 (if previous lesson modules were not utilized): Students can read the ***Bison Fact Sheet*** as an additional station. The fact sheet is provided below.

Note: All necessary station readings and interactive activities have been included in the module below

Part 3: Module Completion Writing Assignment:

Students will write a 2 page position piece on how archaeological knowledge gleaned from bison bones informs the present. The Unit 3 Essential Questions should be answered in the essay: How can archaeological practices help solve some of the mysteries of the past? In particular, what can examining bison processing camps tell us about past human life-ways and practices?

1. Students must use what they learned from the stations to also address:
    a. What is archaeology and why is it important?

b. How do archaeologists know what humans did in the past?
c. What could painting a bone signify?
d. What do cut marks or burning or crushing on bone tell us about human food harvesting and processing practices?

Unit 4: Human Impact, Activity, and the Survival of Bison

LESSON 1: Bison Protection and Conservation

Objective: Students will discover the trajectory of bison conservation from the initial efforts in the late 1800s to the present.

Estimated Time: 2-3 class periods with time required outside of class for students to work on the brochure assignment.

Students will understand: The concept of endangered and extinct species, what efforts were done to minimize human impacts in the past, and what is currently being done to minimize human impact on the bison eco-niche.

Students will be able to: Design and create a brochure about bison conservation, synthesizing all information learned in this module (and the previous ones if applicable) to formulate an argument for the need of bison conservation.

Essential Question(s): What efforts were made early on to protect bison from outright extinction? What efforts are currently being made toward bison protection, conservation, and restoration?

Prior Knowledge (if any): Previous lesson modules are not necessary, however, they would provide a more robust and comprehensive background for this assignment.

Students Will Need: Paper for the brochure, internet connection, examples of local tri-fold brochures to use as a reference.

Handouts: (1) Handout 1: *The Great Buffalo Saga* Documentary Worksheet, (2) Handout 2: Bison Conservation Area Worksheet (to be filled out during the recommended field trip or guest speaker presentation if possible), (3) Handout 3: Bison Fact Sheet (4) Handout 4: Bison Conservation Brochure Template, (5) Handout 5: Resources for Students

Readings: *The Buffalo and the Indians* and Buffalo Field Campaign

Key Terms: Conservatory, Endangered Species, Extinct, Eco-niche, Human Predation, Natural Resources, Human Pressure, Environment, Over-hunting

NGSS Science Standards: Earth and Human Activity

MS-ESS3-3: Apply Scientific Principles to design a method for monitoring and minimizing human impact on the environment

MS-ESS3-4: Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

Disciplinary Core Ideas:
ESS3.C: Human Impacts on Earth Systems

Crosscutting Concepts: Patterns, Cause and Effect

Lesson Outline: Bison Conservation Brochure and Presentation

Part 1: Background Film and Presentation

1. Films and Film Worksheets
    a. Students will watch *The Great Buffalo Saga* Documentary, approx. 56 min., showing the bison revival and conservation efforts from the late 1800s onward, film worksheet included with this module, available to watch online at: http://www.nfb.ca/film/great_buffalo_saga
    b. They will fill out **Handout 1: *The Great Buffalo Saga* Documentary Worksheet** while watching the documentary.
2. The teacher will now present the PowerPoint provided by the module addressing what bison conservation strategies are occurring today. Students should be told to take notes as the teacher presents the content to be used later in the module. Addressed in the PowerPoint will be the following:
    a. About what has been done in the past in terms of halting the rapid movement toward bison extinction
    b. About the many steps forward in current bison conservation practices
    c. Locations of different wildlife refuges for bison
    d. About endangered and extinct species, and where bison fit on that spectrum.
3. PowerPoint content taken from:
    a. *The Buffalo and the Indians*, pp. 59-61 (bison conservation efforts) and pp. 63-78 (Living in the Present and the Future)
    b. *Buffalo Field Campaign*: http://www.buffalofieldcampaign.org/actnow/solutions.html
    c. *Restoring the Thunder: Bison Conservation in Great Plains National Parks*: A look at the past, present, and future of bison conservation in the Great Plains: http://www.nps.gov/badl/naturescience/bison-conservation.htm
4. If previous Science Unit modules were not utilizes, hand out the **Handout 3: Bison Fact Sheet** to students to provide more information.

Part 2: Field Trip or Guest Expert

1. To be able to experience what conservation strategies are like, students will go on a Field Trip to a bison conservation area. If that is not possible a guest speaker and bison expert can be invited to the classroom to talk to students.
2. Students will record their visit to the bison conservation site on the worksheet provided (**Handout 2: Bison Conservation Area Worksheet**).

Part 3: Tri-Fold Brochure

1. Teacher can review with students the qualities of what makes an effective brochure.
2. Students will use their notes, examples of the tri-fold brochures from local organizations, information from the documentary, lecture, and field trip to design a tri-folded brochure of a hypothetical bison conservatory in which they will list:
    b. The negative and positive impacts caused by humans upon the bison ecosystem
    c. Address how human population pressures and consumption of natural resources has adversely impacted bison over time
    d. Promote the bison conservatory as a way to counteract adverse impacts to the bison ecosystem.
        i. Describe why it is necessary and defend the position
        ii. Briefly explain the history of bison
        iii. How it minimizes human impact upon the species
        iv. What aspects of the conservatory are sustainable and why is it effective
    e. See example of brochure provided (**Handout 4: Bison Conservation Brochure Template**, back and front side) for students to follow.
    f. Give students **Handout 5: Resources for Students** which is full of links to websites about bison conservation to give students ideas for their hypothetical bison conservation plan and brochure.
3. Supplementary readings and resources are likely needed. Therefore, please provide the following links to students:
    a. A Vision for 21st Century Bison Conservation in the Midwest Region: http://www.nps.gov/badl/naturescience/upload/BisonVision.pdf
    b. Bison Conservation video: http://www.nps.gov/badl/naturescience/upload/BisonVision.pdf
    c. *Buffalo Field Campaign*: http://www.buffalofieldcampaign.org/actnow/solutions.html
    d. *The American Bison Society*: http://www.wcs.org/saving-wildlife/hoofed-mammals/bison/the-american-bison-society.aspx

4. As an optional completion assessment, students can write a 2 page essay answering the essential questions listed in Unit 4: What efforts were made early on to protect bison from outright extinction? What efforts are currently being made toward bison protection, conservation, and restoration?

APPENDIX B: STUDENT SURVEY TEMPLATES

Unit 1 Pre and Post Survey Template

Student Name:_____ Today's Date: _____

School: _____

Grade: _____

True or False 1-3:

2. ____ Bison became extinct in the late 1800s.
3. ____ There is no genetic difference between a buffalo and a bison.
4. ____ Plains bison mostly eat grasses and small sedges.

Multiple Choice 4-6:

5. Bison are predators when:

    a. They need to defend themselves.
    b. They are always predators hunting small animals like mice and birds.
    c. Only in the winter when food is especially scarce.
    d. They will sometimes hunt small rodents to feed their young.
    e. Bison are not predators.

6. Which environmental adaptation is present in bison?

    a. Thick Insulating hide.
    b. Ability to eat and digest pine cones, woody sticks, and thick vines.
    c. A "plow-like" head and strong neck muscles.
    d. Both a and b.
    e. Both a and c.

7. Mark an (x) under the correct season(s) for the following bison behaviors.

	Winter	Spring	Summer	Fall
Wallowing (taking dust baths)				
Large herding				
Dividing into small groups				

Continual movement				
Rutting (Mating)				

Short Answers 7-10:

8. In the predator/prey relationship, which species do bison often interact with?

9. What environmental and/or predatory pressures might be influencing bison's adaptation to birth their young in the spring?

10. Describe one bison trait in detail and how it contributes to species survival:

11. What traits have allowed bison to be well adapted to surviving the winter?

Unit 2 Pre and Post Survey Template

Student Name:_____ Today's Date: _____

School: _____

Grade: _____

True or False 1-3:

1. ____ The North American bison range use to extend from Mexico up into Alaska.
2. ____ By the end of the 1880's there was less than 1000 bison left in North America.
3. ____ Bison became extinct in North America due to over-hunting in the early 1900s and had to be reintroduced into North America from Asia.

Multiple Choice 4-6:

4. According to oral tradition, some native peoples said that the bison originated from ____ where it was also said they returned to when bison numbers dwindled from over-hunting.
    a. The sky
    b. The sea
    c. Underground
    d. The mountains of the north
    e. The southern jungles

5. Native Americans would sometimes hunt bison by
    a. Driving them into corrals
    b. Driving them over cliffs
    c. Using a bow and arrow
    d. Both a and c
    e. All of the above

6. In the late 1800s after years of overhunting, some of the last bison were found
    a. In the Olympic National Forest
    b. On a rancher's property where some bison had intermixed with the cattle
    c. In Yosemite National Park
    d. In Yellowstone National Park
    e. In a small zoo in North Dakota

Short Answers 7-10:

7. What was happening to the climate in North America starting about 10,000 years ago?

8. List 3 factors that played into the extreme depopulation of the bison?

9. Describe the bison habitat or eco-niche:

10. In what ways were bison significant to Native American peoples in Montana?

Unit 3 Pre and Post Template

Student Name:_____ Today's Date: _____

School: _____

Grade: _____

True or False 1-3:

1. ____Archaeology is the study of dinosaur bones.
3. ____ Oral traditions are Native American wisdom, history, and stories passed down vocally from generation to generation.
4. ____ Cut marks on bones always means it was processed by humans for food and tools.

Multiple Choice 4-6:

5. What does an archaeologist do?
    a. Collect rainfall data in an area.
    b. Study the past by analyzing old settlements and agricultural plots.
    c. Excavate dinosaur bones to create a full skeleton.
    d. Look at river bends for rock deposits.
    e. Treasure hunt for antiquities like Indiana Jones or Laura Croft from *Tomb Raider*.

6. Native peoples hunted bison for their:
    a. Hides to make clothing.
    b. Meat to get food products.
    c. Bones to make tools.
    d. Bones to get the marrow for food.
    e. All of the above.

7. Which of the bone(s) below compose part of a bison leg bone?
    a. Os Coxae
    b. Femur
    c. Caudals
    d. Lumbars
    e. Both b and d

Short Answers 7-10:

8. List 4 activities that occurred at a bison processing camp?

9. **Write two questions** that CAN be answered by archaeologists or faunal (animal) experts when studying bone:

10. Some bison bones are black and charred, others are fairly fresh, while still others look bleached and weathered. What do these variations in the bones mean to archaeologists?

11. Describe a bison jump. What activities occurred there?

Unit 4 Pre and Post Template

Student Name:_____ Today's Date: _____

School: _____

Grade: _____

True or False 1-3:

2. ____ The rescue of the bison in the 20th century kept the wood bison and plains bison genetically distinct so that they remain two distinct species today.
3. ____ Only Yellowstone National Park harbors America's last truly-wild bison.
4. ____ Many bison living on ranches have acquired cattle genes due to the contamination of pure bison bloodlines with ranching cattle.

Multiple Choice 4-6:

5. The chances of brucellosis transmission between wild bison and vaccinated domestic cattle has been characterized to be
    a. Very low to low
    b. Moderate
    c. High to very high
    d. Indeterminable at this time
    e. Impossible, Brucellosis does not affect bison in any way

6. Bison conservation is currently being done by
    a. National Parks
    b. State Parks
    c. Wildlife refuges
    d. Native American Tribes
    e. All of the above

7. Bison are unique in American culture because they are considered
    a. Wildlife
    b. Legally protected from being killed
    c. Domesticated livestock
    d. Both a and c
    e. Both b and c

Short Answers 7-10:

8. Name 3 actions that have been taken to conserve the American bison?

9. List TWO problems or difficulties bison conservation faces?

10. Provide at least ONE solution for helping counteract the problem/ difficulties listed above for bison restoration and conservation:

11. Is bison restoration/conservation important? YES NO
    Why? EXPLAIN your answer!

APPENDIX C: TEACHER SURVEY TEMPLATE

Teacher Name:_____ Today's Date: _____

School: _____

Subject(s) Taught: _____Grade Level(s): _____

Since these answers will be utilized to make all necessary adjustments and improvements on the lesson modules before they are made public, please be as thorough & descriptive as possible.

1. What Unit(s) did you teach?

Science Unit 1: Bison Behaviors and Adaptations	YES	NO
Science Unit 2: Bison as a Species	YES	NO
Science Unit 3: Archaeology, Hunting, and Bison Anatomy	YES	NO
Science Unit 4: Human Impact, Activity, and Bison Survival	YES	NO
Language Arts Unit 1: Bison and Ritual in Native Culture	YES	NO

2. Do you feel the overall module sequence was effective? YES NO
3. For each unit you taught, please rank the following statements on a scale from 1-10 where: **1** = NOT at all true, **5** = moderately true, and **10** = overwhelmingly true:

Answer each statement with a numeric grade (1-10) for each lesson you implemented:	**Lang. Arts**	**UNIT 1**	**UNIT 2**	**UNIT 3**	**UNIT 4**
4. Students were excited and actively engaged with the material:					
5. Students seem to want to learn more about the material:					
6. The lesson(s) in the unit effectively communicated to students the significance and importance of bison:					
7. (If unit 3 was done), the lesson effectively communicated ideas	--	--	--		--

about archaeological topics and ethics:					
8. The **lesson summary and outline(s)** were clear, easy to follow, and easy to implement:					
9. The r**eadings** were appropriate and provided the students with the necessary information to complete the module sequence:					
10. The **films** were appropriate and provided the students with the necessary information to complete the module sequence:					
11. The **worksheets and handouts** provided in the unit(s) were easy to follow, appropriate for the grade level, and worked well:					
12. The suggested **links, added materials, and notes for the teacher** were utilized, found to be effective, and helped with the lesson implementation:					

NOTE: There's a place to explain your lower scores on the following page. Feel free to be critical, any feedback you have will be used to improve the lessons to help make the lessons the best they can be! THANKS SO MUCH!!!

13. What aspects of the lesson module(s) did you not like and how could they be improved upon?

14. Are there additional resource materials that you would like to see added to the lessons?

15. Were the worksheets and handouts included in the module effective? If they need improvement, what would you suggest?

16. Would you want to teach these lesson module(s) again in the future? Why or why not?

17. Within your yearly curriculum, where do you feel is the best fit for the lesson modules you taught?

18. What address would you like the $50.00 reimbursement check for completing this form sent to?

19. Were your students engaged and interested in the content? How and in what way?

20. Do you think your students connected with this curriculum in a meaningful way? (Do you think they found it empowering as it talked about Native American issues?)

APPENDIX D: DATA TABLES OF PROJECT RESULTS

Coding Sheet

Pre/Post Answer Codes for Study Group	
Q1	False = 1
	True = 2
	Null = 0
Q2	False = 1
	True = 2
	Null = 0
Q3	False = 1
	True = 2
	Null = 0
Q4	A = 1
	B = 2
	C = 3
	D = 4
	E = 5
	Null= 0

Q5	A = 1
	B = 2
	C = 3
	D = 4
	Null = 0
	E = 5
Q6	A = 1
	B = 2
	C = 3
	D = 4
	Null = 0
	E = 5
Q7	A = 1
	B = 2
	C = 3
	D = 4
	Null = 0
	E = 5
	Rubric if qualitative
Q8	Rubric
Q9	Rubric
Q10	Rubric

Coded Change (Δ)	
Null	0
Incorrect to Correct	1
Correct to Correct	2
Incorrect to Incorrect	3
Correct to Incorrect	4

Control Group Pre/Post	Answer Code
Incorrect	1
Correct	2
Null	0

Change (Δ) for Connections 1-6	
Positive/ Positive Change	1
Negative/ Negative Change	2
No Change/ Irrelevant Change	3
No Opinion/ Null/ Undetermined	0

Change (Δ) for Connections 7-8	
1	not interesting to Interesting
2	Interesting to Interesting
3	not interesting to not Interesting
4	Interesting to not Interesting
0	No opinion/ Null

Change (Δ) for Connections 9 and 10
On a quantified "interest" scale of 1-3

Unit 1 Study Group Data Table

U1 Study Group			Q1		Q2		Q3		Q4		Q5		Q6a		Q6b		Q6c		Q6d		Q6e		Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Q1 Pre	Q1 Post	Q1 Δ	Q2 Pre	Q2 Post	Q2 Δ	Q3 Pre	Q3 Post	Q3 Δ	Q4 Pre	Q4 Post	Q4 Δ	Q5 Pre	Q5 Post	Q5 Δ	Q6a Δ	Q6b Δ	Q6c Δ	Q6d Δ	Q6e Δ	Pre	Post	Pre	Post	Pre	Post	Pre	Post
U1-2	8th	1	1	2	4	2	1	1	2	2	2	5	2	3	5	4	4	1	1	1	1	1	0	3	0	1	0	1	0	1
U1-3	8th	1	1	1	3	2	1	1	2	2	2	1	5	1	4	2	3	1	2	1	2	6	0	0	0	0	1	0	0	0
U1-4	8th	1	1	2	4	2	2	3	2	2	2	1	1	3	5	5	2	2	3	3	3	2	0	2	1	2	1	2	1	2
U1-5	8th	1	2	1	1	1	2	4	2	2	2	1	1	3	5	5	2	1	1	1	2	1	3	3	2	4	1	1	1	1
U1-6	8th	1	2	2	3	1	1	2	2	2	2	0	5	1	1	5	1	2	5	5	5	5	1	0	0	0	0	0	0	0
U1-7	7th	2	1	2	1	2	1	1	2	2	2	1	5	1	5	5	2	2	1	1	2	1	0	1	0	0	0	0	0	1
U1-8	7th	2	2	2	3	2	2	3	1	1	3	2	1	3	5	5	2	2	1	6	4	1	1	1	1	2	1	0	1	2
U1-9	7th	2	1	1	2	1	2	4	2	2	2	5	1	4	5	5	2	2	3	1	1	2	1	0	2	0	1	0	0	0
U1-10	7th	2	2	1	1	1	1	2	1	2	1	5	5	2	5	4	4	2	1	1	3	2	1	2	2	2	1	3	1	3
U1-11	7th	2	1	2	4	2	1	1	1	2	1	4	3	3	4	5	1	0	2	6	4	4	0	0	0	0	0	0	0	0
U1-12	7th	2	2	1	1	2	2	3	1	2	1	5	1	4	5	5	2	2	2	1	1	1	0	3	0	2	1	2	1	3
U1-13	7th	2	1	1	2	2	2	3	2	2	2	5	1	4	4	1	3	2	1	3	4	2	0	2	0	2	0	1	2	2
U1-14	7th	2	2	1	1	1	2	4	1	1	3	1	5	1	1	3	3	2	3	3	3	1	0	0	0	2	2	0	0	3
U1-15	7th	2	1	1	2	2	2	3	2	2	2	1	5	1	5	4	4	1	2	1	3	2	0	1	0	3	0	3	2	4
U1-16	7th	2	1	2	4	2	2	3	2	2	2	1	1	3	1	3	3	2	1	1	2	1	1	3	1	4	2	3	2	4
U1-17	7th	2	2	2	3	1	1	2	2	2	2	1	1	3	5	5	2	2	1	1	3	3	1	1	0	0	1	0	1	0
U1-18	7th	2	2	1	1	1	2	4	2	2	2	1	5	1	5	5	2	1	2	1	3	1	2	2	1	2	1	1	2	3
U1-19	7th	2	1	2	3	2	1	1	2	2	2	1	1	3	1	5	1	4	1	3	2	1	2	1	1	1	1	2	2	2
U1-20	7th	2	1	1	2	1	2	4	0	2	1	1	1	3	2	5	1	2	1	1	1	1	2	2	1	2	2	3	2	3
U1-21	7th	2	1	2	4	2	2	3	2	2	2	1	5	1	5	5	2	2	1	1	4	1	2	2	0	2	2	3	1	3
U1-22	7th	2	2	1	1	2	2	3	1	2	1	1	1	3	5	4	4	2	4	1	1	3	0	0	0	0	0	0	0	0
U1-23	7th	2	0	1	1	0	2	3	0	1	3	1	1	3	4	1	3	1	2	1	2	2	1	1	1	1	1	1	1	2
U1-24	7th	2	2	2	3	2	1	1	1	2	1	1	2	3	4	1	3	2	2	2	4	3	2	3	2	0	0	2	2	1
U1-25	7th	2	2	2	3	1	1	2	2	2	2	1	1	3	4	1	3	2	2	3	2	2	1	1	1	2	2	3	2	3
U1-26	7th	2	2	2	3	1	1	2	2	2	2	5	1	4	5	5	2	2	1	1	2	1	0	3	0	4	0	2	0	3
U1-27	7th	2	1	1	2	1	2	4	2	2	2	5	5	2	4	4	3	2	1	1	1	1	0	2	0	1	0	3	0	2
U1-28	7th	2	1	1	2	2	2	3	2	2	2	4	1	3	5	2	4	2	1	1	1	2	2	3	1	1	2	2	2	3
U1-29	7th	2	2	2	3	2	2	3	1	1	3	4	3	3	5	1	4	2	1	4	1	3	1	1	0	2	0	3	0	2
U1-30	7th	2	1	1	2	2	2	3	2	2	2	1	1	3	2	5	1	4	2	3	2	1	2	3	1	2	2	3	3	2
U1-31	7th	2	2	2	3	2	2	3	1	1	3	4	1	3	2	4	3	2	2	1	1	3	1	3	1	2	1	3	0	3

Unit 1 Control Group Data Table

CONTROL GROUP UNIT 1			Q1		Q2		Q3		Q4		Q5		Q6a		Q6b		Q6c		Q6d		Q6e		Q7		Q8		Q9		Q10	
Student ID	**Grade**	**Teacher**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
CG-1	8th	Gray	2	2	2	2	2	2	1	1	2	1	2	2	2	2	2	2	2	2	2	2	0	0	0	1	0	1	2	2
CG-2	8th	Gray	2	2	1	1	1	1	1	1	1	2	2	2	2	2	2	1	2	2	2	2	1	1	0	1	0	1	1	2
CG-3	8th	Gray	1	1	1	1	1	1	1	1	1	2	1	2	1	2	2	2	2	2	2	2	0	0	0	0	2	0	2	0
CG-4	8th	Gray	1	1	1	2	1	1	2	1	1	2	1	2	2	2	2	2	1	2	2	2	0	0	0	0	2	2	2	2
CG-5	8th	Gray	1	1	2	2	1	1	2	2	1	1	1	2	2	1	1	2	2	2	2	2	1	1	2	1	3	3	2	1
CG-6	8th	Gray	1	1	2	2	1	1	2	1	1	1	2	2	2	2	2	2	2	2	2	2	0	0	0	0	3	0	3	0
CG-7	8th	Gray	1	1	1	1	1	1	1	1	2	2	2	2	2	1	2	2	2	2	2	1	2	3	2	1	0	0	0	0
CG-8	8th	Gray	1	2	2	1	1	1	2	2	1	2	1	2	2	2	2	2	2	2	1	2	1	0	0	0	1	0	2	0
CG-9	8th	Gray	2	1	2	1	2	1	2	2	2	2	2	2	2	2	2	2	2	1	1	1	0	0	0	0	0	0	0	0
CG-10	8th	Gray	1	1	2	1	1	1	1	2	1	2	2	2	2	2	1	2	1	2	1	2	1	1	1	1	1	1	1	1
CG-11	8th	Gray	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	2	2	1	1	3	3	1	1	1	0	0	0
CG-12	8th	Gray	1	2	2	1	1	2	2	2	2	2	2	2	2	1	2	2	1	1	2	1	2	0	0	0	0	0	0	0
CG-13	8th	Gray	2	1	2	1	1	1	1	2	1	1	2	2	2	2	2	2	2	2	1	2	0	0	0	0	0	0	2	0
CG-14	8th	Gray	2	2	1	1	1	1	2	2	1	2	1	1	1	2	2	2	2	1	2	2	0	0	1	1	2	1	2	2
CG-15	8th	Gray	1	1	2	1	1	1	2	1	1	2	1	1	2	2	1	2	2	1	2	2	0	0	2	0	2	2	2	2
CG-16	8th	Gray	1	1	2	2	1	2	2	2	1	2	1	2	2	2	2	2	2	2	2	2	1	0	0	0	0	0	2	0
CG-17	8th	Gray	1	2	2	2	1	2	2	2	1	2	2	2	1	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-18	8th	Gray	2	1	1	2	1	1	2	2	2	2	2	1	2	2	2	2	2	2	2	2	1	0	0	0	0	0	2	0
CG-19	8th	Gray	1	1	1	1	1	1	2	2	2	2	2	1	1	2	1	2	1	2	1	1	0	0	0	1	0	2	2	2
CG-20	8th	Gray	2	1	1	2	1	2	2	2	2	1	2	2	2	2	2	2	2	2	2	2	1	0	0	0	0	0	3	0

CONTROL GROUP UNIT 1			Q1		Q2		Q3		Q4		Q5		Q6a		Q6b		Q6c		Q6d		Q6e		Q7		Q8		Q9		Q10	
Student ID	**Grade**	**Teacher**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
CG-21	8th	Gray	1	1	1	2	1	1	2	1	2	1	2	2	2	2	2	2	2	2	1	2	0	0	0	0	0	0	0	2
CG-22	8th	Gray	2	1	1	2	1	2	1	1	2	1	2	2	1	2	2	1	1	1	2	1	0	1	0	1	2	2	0	2
CG-24	8th	Gray	2	1	2	2	1	1	2	1	2	1	1	1	1	2	1	2	1	1	2	2	1	0	2	2	1	1	2	2
CG-25	8th	Gray	2	1	1	2	1	1	1	2	2	2	1	1	2	1	2	1	2	2	2	2	1	1	1	1	0	3	3	3
CG-26	8th	Gray	2	1	2	2	1	2	1	1	1	2	1	1	2	1	2	1	2	2	2	1	0	1	0	2	0	2	2	0
CG-27	8th	Gray	1	2	1	2	2	2	2	2	1	2	2	1	2	1	2	2	2	2	2	2	0	1	1	1	1	1	0	2
CG-28	8th	Gray	1	2	2	2	1	1	2	1	2	2	1	1	1	1	2	1	2	2	2	2	1	2	0	1	2	2	2	1
CG-29	8th	Gray	1	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	0	0	0	0	0	1	0
CG-30	8th	Gray	2	1	2	2	1	1	2	1	1	1	2	1	2	2	2	2	2	2	2	1	1	2	0	0	0	2	0	2
CG-31	8th	Gray	1	1	2	2	1	2	2	2	1	2	2	2	2	1	2	2	1	2	2	2	1	2	1	3	0	1	2	1
CG-32	8th	Gray	1	1	2	1	1	1	1	2	1	2	1	1	2	2	2	2	2	2	2	1	1	1	1	1	1	2	2	1
CG-33	8th	Gray	1	1	2	2	1	1	2	2	2	2	2	1	1	2	1	2	2	2	2	1	1	1	0	1	2	2	2	2
CG-34	8th	Gray	1	1	2	2	1	1	2	1	1	1	2	1	2	1	2	1	1	2	2	1	0	0	0	1	0	2	0	2
CG-35	8th	Gray	1	2	1	1	1	1	2	2	2	1	1	2	2	1	2	2	2	2	2	2	0	0	0	1	0	1	0	0
CG-36	8th	Gray	1	1	2	2	1	1	2	2	2	2	1	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-37	8th	Gray	1	2	1	2	2	2	2	2	1	1	2	2	2	2	2	1	2	1	2	2	0	0	0	0	0	0	0	2
CG-38	8th	Gray	1	2	2	2	1	1	2	2	2	2	1	1	2	2	2	2	2	2	2	1	1	0	0	0	0	1	0	1
CG-39	8th	Gray	1	2	1	2	1	2	2	2	1	2	2	1	1	1	2	2	2	2	2	2	1	0	1	0	0	0	2	0
CG-40	8th	Gray	1	2	2	1	1	1	1	2	2	2	1	2	2	2	2	2	2	2	2	2	0	0	2	0	1	0	2	0
CG-41	8th	Gray	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	1	2	1	2	0	0	0	0	0	0	0	2
CG-42	8th	Gray	1	1	2	1	1	1	2	1	1	2	1	2	2	2	2	2	2	2	2	2	0	0	1	0	0	0	2	0

CONTROL GROUP UNIT 1			Q1		Q2		Q3		Q4		Q5		Q6a		Q6b		Q6c		Q6d		Q6e		Q7		Q8		Q9		Q10	
Student ID	**Grade**	**Teacher**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
CG-43	8th	Gray	1	1	2	1	2	1	2	1	1	2	1	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-44	8th	Gray	1	1	1	2	1	1	2	2	2	2	1	1	2	2	2	1	2	2	2	2	0	0	2	0	2	0	0	0
CG-45	8th	Gray	1	1	2	2	1	2	2	2	2	1	1	2	2	2	2	2	2	2	2	2	0	1	0	0	0	0	2	2
CG-46	8th	Gray	1	1	1	2	1	1	2	2	1	1	1	2	2	1	1	1	2	2	1	1	0	0	1	1	1	2	1	2
CG-47	8th	Gray	1	1	1	2	1	1	1	2	2	1	1	2	2	1	2	2	2	2	1	2	1	1	0	1	1	1	1	2
CG-48	8th	Gray	1	1	2	2	1	2	2	2	1	1	1	2	2	2	2	2	2	2	2	1	0	2	1	0	0	1	0	1
CG-49	8th	Gray	1	1	2	2	1	1	1	2	2	2	2	2	2	1	1	2	1	1	2	1	2	0	2	0	2	0	2	0
CG-51	8th	Gray	1	2	2	1	1	1	2	2	1	2	2	2	2	2	2	1	1	2	2	2	1	0	2	0	0	0	2	1
CG-52	8th	Gray	1	2	2	2	2	2	2	2	1	2	2	2	2	2	2	1	2	1	2	2	0	0	0	0	1	1	1	2
CG-63	8th	Gray	2	1	2	1	1	1	2	2	2	1	2	2	1	1	1	2	2	2	1	2	1	2	1	0	1	1	2	0
CG-64	8th	Gray	1	1	1	2	2	1	2	2	2	2	2	2	2	1	2	1	2	2	2	2	1	1	0	1	2	1	2	1
CG-65	8th	Gray	2	2	2	2	1	1	2	2	1	2	2	2	2	2	1	2	2	2	1	2	2	2	2	2	2	1	3	2
CG-66	8th	Gray	2	2	2	2	1	2	2	2	1	2	1	2	2	2	2	2	2	2	2	1	2	0	1	0	2	0	1	0
CG-67	8th	Gray	1	1	2	1	1	1	1	2	1	2	2	1	2	2	2	2	1	2	2	2	0	0	0	0	0	0	0	2
CG-68	8th	Gray	1	1	2	2	1	1	2	2	2	2	1	2	2	2	2	2	2	2	2	2	0	1	2	1	2	2	2	2
CG-69	8th	Gray	1	1	1	2	1	1	2	2	1	2	1	2	2	2	2	2	2	2	2	1	0	0	2	0	0	0	2	0
CG-72	8th	Gray	1	1	2	1	1	1	2	2	1	1	1	2	2	2	1	2	2	2	2	2	2	1	0	1	2	2	2	2
CG-73	8th	Gray	2	1	1	2	1	2	1	2	1	2	1	2	2	1	2	1	2	2	2	2	0	0	0	1	0	0	0	0
CG-74	8th	Gray	2	2	2	1	1	1	2	2	1	2	1	2	1	2	1	2	2	2	2	1	0	0	0	0	2	2	2	2

Unit 2 Study Group Data Table

Study Group Unit 2 (Δ measures change in student answers)			Q1			Q2			Q3			Q4			Q5			Q6			Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Q1 Δ	Pre	Post	Q2 Δ	Pre	Post	Q3 Δ	Pre	Post	Q4 Δ	Pre	Post	Q5 Δ	Pre	Post	Q6 Δ	Pre	Post	Pre	Post	Pre	Post	Pre	Post
U2-1	7th	Bearchild	1	2	1	2	2	2	1	1	2	4	4	2	2	2	3	4	4	2	1	2	0	1	0	0	0	1
U2-6	7th	Bearchild	1	2	1	2	2	2	2	1	1	4	4	2	5	5	2	4	4	2	2	3	3	4	0	3	0	2
U2-7	7th	Bearchild	1	1	3	2	2	2	2	2	3	4	3	1	2	2	3	4	4	2	3	3	2	3	1	3	2	2
U2-2	8th	Hellman	1	2	1	1	1	3	2	2	3	2	4	1	4	2	3	3	3	3	0	0	0	0	0	0	0	0
U2-3	8th	Hellman	1	1	3	2	1	4	1	1	3	4	1	4	2	2	3	4	4	2	0	0	0	0	0	0	0	0
U2-4	8th	Hellman	2	1	4	2	2	2	1	2	4	4	4	2	2	2	3	4	4	2	0	0	0	0	0	0	0	0
U2-5	8th	Hellman	1	2	1	1	2	1	2	1	1	4	3	1	2	4	1	4	4	2	0	0	0	0	0	0	0	0
U2-8	7th	Bearchild	2	2	2	2	2	2	1	2	4	4	4	3	5	2	4	4	4	2	3	3	2	2	3	2	3	3
U2-9	7th	Bearchild	2	2	2	2	2	2	1	1	3	4	1	3	5	4	4	4	4	2	2	2	2	3	2	4	3	3
U2-10	7th	Bearchild	1	2	1	1	2	1	2	1	1	0	3	1	2	4	3	4	4	2	1	3	2	2	1	1	3	3
U2-11	7th	Bearchild	1	2	1	2	2	2	2	1	1	4	3	1	4	5	1	2	4	1	1	2	2	4	1	3	2	4
U2-12	7th	Bearchild	1	1	3	2	2	2	1	1	2	4	3	1	3	5	1	4	4	2	1	2	1	3	1	3	3	3
U2-13	7th	Bearchild	2	1	4	1	2	1	1	2	4	4	4	3	2	2	3	4	4	2	2	2	1	3	1	3	3	4
U2-14	7th	Bearchild	1	2	1	2	1	4	1	2	4	4	4	3	5	2	4	4	4	2	1	2	1	3	3	3	3	3
U2-15	7th	Bearchild	1	2	1	2	2	2	1	1	2	4	4	3	5	5	2	4	4	2	2	2	3	3	3	3	2	3
U2-16	7th	Bearchild	2	2	2	2	2	2	1	1	2	4	1	1	2	5	1	4	2	4	2	2	2	3	3	3	3	0
U2-17	7th	Bearchild	1	2	1	2	2	2	1	1	2	1	4	3	5	5	2	4	4	2	2	1	3	4	3	3	4	4
U2-18	7th	Bearchild	2	2	2	2	2	2	1	1	2	1	4	3	2	5	1	4	4	2	1	3	3	3	2	3	3	4
U2-19	7th	Bearchild	2	2	2	2	2	2	1	1	2	4	4	3	5	2	4	3	3	3	1	2	2	3	2	1	3	3
U2-20	7th	Bearchild	2	2	2	2	2	2	1	1	2	1	4	3	2	5	1	4	2	3	2	2	2	2	1	2	3	2
U2-21	7th	Bearchild	1	2	1	2	2	2	1	1	2	4	3	1	2	5	1	4	4	2	1	2	2	3	2	3	3	3

Study Group Unit 2 (Δ measures change in student answers)			Q1			Q2			Q3			Q4			Q5			Q6			Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Q1 Δ	Pre	Post	Q2 Δ	Pre	Post	Q3 Δ	Pre	Post	Q4 Δ	Pre	Post	Q5 Δ	Pre	Post	Q6 Δ	Pre	Post	Pre	Post	Pre	Post	Pre	Post
U2-22	7th	Bearchild	1	1	3	2	2	2	1	1	2	4	3	1	3	5	1	3	2	3	1	2	1	3	1	2	3	3
U2-23	7th	Bearchild	1	2	1	2	2	2	1	1	2	4	4	3	2	5	1	4	4	2	2	3	3	3	2	3	3	3
U2-24	7th	Bearchild	1	2	1	1	1	3	1	1	2	4	4	3	5	2	4	4	4	2	1	1	2	3	1	1	1	2
U2-25	7th	Bearchild	1	2	1	2	2	2	2	1	1	4	3	1	5	5	2	3	4	1	1	3	1	1	2	2	1	2
U2-26	7th	Bearchild	1	1	3	2	2	2	2	2	3	3	3	2	4	2	3	4	4	2	1	1	1	2	1	1	3	2
U2-27	7th	Bearchild	1	2	1	2	2	2	2	1	1	4	3	1	5	5	2	4	4	2	1	2	2	2	3	3	3	3
U2-28	7th	Bearchild	2	2	2	2	2	2	1	1	2	2	3	1	3	5	1	1	4	1	2	2	2	3	2	1	3	3
U2-29	7th	Bearchild	1	1	3	2	2	2	2	2	3	3	3	2	5	4	4	4	4	2	1	1	1	2	1	3	3	3
U2-30	7th	Bearchild	1	2	1	2	2	2	1	1	2	4	3	1	2	5	1	4	4	2	1	2	2	3	2	3	1	3
U2-31	7th	Bearchild	1	2	1	2	2	2	1	1	2	4	3	1	5	2	4	4	4	2	1	2	2	2	3	3	2	3
U2-32	7th	Bearchild	1	1	3	2	2	2	1	1	2	4	3	1	5	5	2	1	4	1	1	1	2	2	1	2	2	1
U2-33	7th	Bearchild	1	2	1	2	2	2	2	2	3	2	3	1	4	2	3	4	4	2	1	2	1	3	1	2	2	2
U2-34	7th	Bearchild	1	2	1	2	2	2	1	1	2	1	3	1	2	5	1	4	4	2	2	2	2	3	1	2	2	4
U2-35	7th	Bearchild	1	2	1	2	2	2	2	1	1	3	3	2	2	5	1	4	4	2	1	2	1	2	2	3	2	3
U2-36	7th	Bearchild	1	2	1	2	1	4	2	1	1	4	4	3	5	5	2	4	4	2	1	2	2	3	2	3	3	4
U2-37	7th	Bearchild	1	1	3	2	2	2	1	2	3	4	3	1	4	5	1	2	2	3	1	1	2	3	1	3	1	3
U2-38	7th	Bearchild	2	2	2	2	2	2	1	1	2	4	4	3	5	5	2	4	4	2	2	2	1	3	3	3	3	2
U2-39	7th	Bearchild	2	1	4	2	1	4	1	2	4	4	3	1	2	2	3	4	2	4	3	2	2	3	2	2	3	3
U2-40	7th	Bearchild	2	2	2	1	2	1	1	1	2	1	3	1	2	5	1	4	1	4	1	2	2	2	2	1	0	3
U2-41	7th	Bearchild	1	1	3	2	2	2	1	1	2	4	4	3	5	2	4	4	4	2	1	2	0	1	0	1	0	2
U2-42	7th	Bearchild	1	2	1	2	2	2	2	1	1	4	4	3	3	5	1	5	4	1	1	1	1	2	1	2	1	3
U2-43	7th	Bearchild	1	1	3	2	2	2	2	2	3	4	3	1	2	1	3	4	4	2	1	2	2	3	1	3	2	3

Study Group Unit 2 (Δ measures change in student answers)			Q1			Q2			Q3			Q4			Q5			Q6			Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Q1 Δ	Pre	Post	Q2 Δ	Pre	Post	Q3 Δ	Pre	Post	Q4 Δ	Pre	Post	Q5 Δ	Pre	Post	Q6 Δ	Pre	Post	Pre	Post	Pre	Post	Pre	Post
U2-44	7th	Bearchild	1	2	1	2	2	2	1	1	2	4	3	1	2	2	3	4	4	2	1	1	1	3	3	3	2	3
U2-45	7th	Bearchild	1	2	1	2	1	4	1	2	4	4	4	3	2	2	3	3	4	1	1	1	2	3	1	3	2	3
U2-46	7th	Bearchild	1	2	1	2	2	2	1	2	4	1	4	3	2	2	3	4	4	2	1	2	1	3	0	2	0	3
U2-47	7th	Bearchild	1	1	3	2	2	2	2	1	1	4	3	1	3	2	3	1	4	1	1	1	1	2	2	2	0	3
U2-48	7th	Bearchild	1	2	1	2	1	4	1	2	4	4	3	1	1	2	3	4	4	2	1	1	1	2	1	2	1	3
U2-49	7th	Bearchild	1	1	3	2	2	2	1	2	4	4	3	1	2	2	3	4	4	2	1	3	3	3	3	3	3	0
U2-50	7th	Bearchild	1	2	1	2	2	2	1	1	2	4	4	3	5	5	2	4	4	2	1	3	2	3	1	3	2	2
U2-51	7th	Bearchild	1	2	1	2	2	2	2	1	1	4	3	1	5	5	2	4	4	2	2	2	2	2	1	2	3	3
U2-52	7th	Bearchild	1	2	1	1	2	1	2	1	1	4	4	3	4	2	3	4	4	2	1	2	2	3	0	0	2	0
U2-53	7th	Bearchild	1	1	3	2	2	2	2	2	3	1	4	3	1	2	3	4	4	2	2	1	0	0	0	0	0	0
U2-54	7th	Bearchild	1	2	1	2	1	4	1	1	2	0	4	3	5	5	2	4	4	2	0	2	2	3	2	3	3	1
U2-55	7th	Bearchild	1	2	1	1	2	1	2	1	1	4	4	3	4	2	3	4	4	2	1	3	1	3	2	3	2	2
U2-56	7th	Bearchild	1	1	3	2	2	2	2	1	1	1	4	3	4	2	3	1	4	1	2	3	2	0	1	2	1	3
U2-57	7th	Bearchild	1	2	1	2	2	2	1	2	4	4	3	1	5	5	2	4	4	2	1	2	2	0	2	0	3	2
U2-58	7th	Bearchild	1	2	1	2	2	2	2	1	1	4	3	1	2	2	3	4	4	2	2	2	3	3	1	3	3	3
U2-59	7th	Bearchild	2	2	2	1	2	1	1	2	4	4	3	1	2	2	3	4	4	2	1	3	2	3	3	3	0	3
U2-60	7th	Bearchild	1	2	1	2	2	2	1	1	2	4	0	3	2	2	3	4	4	2	1	1	1	2	1	3	2	2

Unit 2 Control Group Data Table

Control Group Unit 2			Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
CG-4	8th	Gray	2	2	1	1	2	2	2	1	1	1	1	1	2	1	1	2	2	2	3	3
CG-5	8th	Gray	1	2	1	1	1	2	2	2	1	1	1	1	3	2	0	3	2	2	2	2
CG-7	8th	Gray	2	2	1	1	2	2	2	2	1	1	1	1	2	1	3	2	3	1	3	2
CG-8	8th	Gray	1	1	2	2	2	1	2	1	2	2	2	1	1	1	0	0	0	0	0	0
CG-9	8th	Gray	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-10	8th	Gray	1	1	2	2	2	1	2	1	1	2	2	2	0	0	0	0	0	0	0	0
CG-11	8th	Gray	1	1	2	1	1	1	2	2	2	1	2	2	0	0	0	0	0	0	0	0
CG-12	8th	Gray	2	1	2	2	2	1	2	2	2	2	2	1	0	0	0	0	0	0	0	0
CG-14	8th	Gray	2	1	1	2	2	1	2	2	2	2	2	1	0	1	0	2	0	0	0	0
CG-16	8th	Gray	2	2	1	1	1	1	2	2	1	2	1	1	0	0	0	0	0	0	0	0
CG-17	8th	Gray	1	2	1	1	1	2	2	2	1	2	2	2	1	0	2	0	0	0	0	0
CG-18	8th	Gray	2	1	1	2	1	2	2	2	2	2	2	1	1	0	0	0	0	0	3	0
CG-20	8th	Gray	2	1	1	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-21	8th	Gray	1	1	2	1	2	2	2	1	2	2	2	1	0	0	0	0	0	0	0	0
CG-22	8th	Gray	2	1	1	1	2	1	2	2	1	1	2	1	0	1	0	1	0	0	0	0
CG-23	8th	Gray	2	2	2	2	1	2	2	2	2	1	2	2	0	0	0	0	0	0	0	0
CG-24	8th	Gray	1	2	1	1	2	1	2	2	1	1	1	1	1	2	0	2	1	1	1	2

Control Group Unit 2			Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
CG-25	8th	Gray	2	1	1	1	1	1	2	1	2	1	2	1	0	0	1	0	0	0	2	0
CG-26	8th	Gray	1	1	1	1	1	1	2	1	1	1	1	1	0	0	0	0	0	0	0	0
CG-27	8th	Gray	1	1	1	2	1	2	2	2	2	2	1	1	1	1	1	1	1	1	2	2
CG-28	8th	Gray	2	1	2	1	2	1	2	2	2	2	1	2	1	1	1	0	0	2	3	2
CG-30	8th	Gray	2	1	2	1	1	2	2	2	2	2	1	2	0	0	0	0	0	0	3	0
CG-31	8th	Gray	2	1	1	1	1	1	2	2	1	1	2	1	1	1	1	1	0	1	2	1
CG-32	8th	Gray	1	1	1	2	1	2	2	2	1	1	2	1	3	2	2	2	2	2	2	2
CG-33	8th	Gray	1	1	2	2	1	2	2	1	2	2	1	2	1	1	0	2	1	1	3	2
CG-34	8th	Gray	2	2	2	1	1	1	2	2	2	2	2	2	0	0	0	1	0	2	0	2
CG-35	8th	Gray	1	1	2	1	2	1	2	2	2	2	2	1	0	0	0	0	0	0	0	0
CG-36	8th	Gray	2	2	2	2	1	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-37	8th	Gray	2	1	1	2	2	2	2	2	2	2	1	1	0	0	0	0	0	0	0	0
CG-38	8th	Gray	1	2	2	2	1	2	2	2	1	1	1	2	1	0	1	0	0	0	2	0
CG-39	8th	Gray	2	2	1	2	2	2	2	2	2	2	1	2	0	0	1	0	2	0	2	0
CG-40	8th	Gray	1	1	2	2	1	2	2	2	1	2	1	2	0	0	2	0	0	0	0	0
CG-41	8th	Gray	2	1	2	1	1	2	2	2	2	2	1	2	0	0	0	0	0	2	0	2
CG-42	8th	Gray	1	1	1	2	1	1	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-43	8th	Gray	2	2	1	1	2	2	2	1	1	2	1	1	0	1	0	0	0	0	0	0

Control Group Unit 2			Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
CG-44	8th	Gray	2	1	2	1	1	1	2	2	2	2	1	2	0	0	0	0	0	0	0	0
CG-45	8th	Gray	2	2	2	1	1	2	2	2	2	1	1	1	0	0	0	0	0	0	2	0
CG-46	8th	Gray	1	1	1	2	2	1	2	2	1	1	2	2	2	1	1	1	2	1	2	2
CG-47	8th	Gray	2	1	2	2	1	2	2	2	2	1	2	1	0	0	0	0	0	0	0	0
CG-49	8th	Gray	2	2	1	1	2	1	2	2	1	2	2	2	0	0	2	0	0	0	2	0
CG-50	8th	Gray	1	1	2	2	2	1	2	2	2	2	2	2	2	2	0	0	0	0	0	0
CG-51	8th	Gray	1	2	1	2	1	2	2	2	2	1	1	2	0	1	0	1	0	1	0	2
CG-52	8th	Gray	2	2	2	1	2	2	2	2	1	2	1	1	0	1	1	1	2	2	2	0
CG-53	8th	Gray	1	1	1	1	1	1	2	2	2	2	1	2	1	1	1	0	0	0	0	0
CG-54	8th	Gray	1	2	1	1	2	1	2	2	1	1	1	2	1	0	0	1	0	1	3	2
CG-55	8th	Gray	2	2	1	2	2	1	2	2	1	1	1	1	1	2	1	1	2	2	2	2
CG-56	8th	Gray	1	1	1	2	2	2	2	2	2	1	1	2	0	0	0	1	1	1	3	0
CG-57	8th	Gray	2	2	2	1	2	2	2	2	2	1	1	2	1	0	1	0	0	0	0	0
CG-58	8th	Gray	1	2	1	1	1	1	2	2	1	2	1	2	1	0	1	0	0	0	0	0
CG-59	8th	Gray	1	2	1	1	1	1	2	2	1	2	1	2	2	0	3	0	1	0	3	0
CG-63	8th	Gray	1	2	2	1	2	2	2	2	1	2	2	2	0	0	0	0	2	0	2	0
CG-64	8th	Gray	1	2	2	2	2	2	2	2	2	2	2	1	0	1	0	1	0	1	0	0
CG-65	8th	Gray	1	2	2	2	2	2	1	2	1	2	2	2	1	0	1	0	1	0	2	0

Control Group Unit 2			Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
CG-66	8th	Gray	2	1	1	2	2	2	2	2	2	2	1	2	0	0	0	0	0	0	0	0
CG-67	8th	Gray	1	1	2	1	2	1	2	2	1	2	2	1	0	2	0	1	0	2	0	2
CG-68	8th	Gray	1	2	1	1	1	1	2	2	1	2	1	1	2	2	2	1	1	1	1	1
CG-69	8th	Gray	2	2	1	1	1	1	2	2	2	2	1	2	0	0	0	0	0	0	0	0
CG-70	8th	Gray	1	2	2	1	2	2	2	2	2	1	2	2	0	1	0	2	0	0	0	1
CG-71	8th	Gray	1	2	1	1	2	1	2	2	2	1	1	1	0	1	0	2	0	2	0	2
CG-72	8th	Gray	2	2	1	1	2	2	2	2	1	2	1	1	0	2	2	1	2	1	2	2

Unit 3 Study Group Data Table

Study Group Unit 3 (Δ measures change in answer)			Q1			Q2			Q3			Q4			Q5			Q6			Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Pre	Post	Pre	Post	Pre	Post
U3-1	7th	Goss	2	2	3	2	2	2	1	2	4	2	3	4	5	5	2	5	5	3	2	2	2	2	3	3	2	4
U3-2	7th	Goss	1	1	2	2	2	2	2	2	3	5	2	1	1	5	1	5	5	3	1	1	1	1	1	1	2	2
U3-3	7th	Goss	2	1	1	2	2	2	1	2	4	2	0	4	5	5	2	5	5	3	0	1	2	2	2	2	1	4
U3-4	7th	Goss	1	1	2	2	2	2	1	1	2	2	5	4	5	5	2	5	5	3	0	2	2	2	1	2	3	4
U3-5	7th	Goss	2	1	1	1	2	1	2	1	1	3	2	1	5	5	2	5	5	3	1	3	2	3	2	2	3	3
U3-6	7th	Goss	2	2	3	2	2	2	2	2	3	3	2	1	5	5	2	5	3	3	2	2	2	3	2	3	2	4
U3-7	7th	Goss	1	1	2	2	2	2	1	1	2	2	2	2	5	5	2	5	5	3	1	2	2	2	2	2	2	3
U3-8	7th	Goss	2	2	3	2	2	2	1	2	4	3	3	3	5	5	2	4	5	3	1	1	2	3	2	2	3	3
U3-9	7th	Goss	1	1	2	2	2	2	2	2	3	4	2	1	5	5	2	2	2	2	1	2	2	2	1	3	2	3
U3-10	7th	Goss	1	2	4	2	2	2	1	1	2	4	3	2	5	5	2	2	2	2	1	1	1	2	1	1	2	2
U3-11	7th	Goss	2	2	3	2	2	2	1	1	2	2	2	2	5	5	2	4	2	1	2	1	2	3	2	2	2	2
U3-12	7th	Goss	1	2	4	2	2	2	1	1	2	2	4	4	5	5	2	4	5	3	0	4	2	2	0	3	2	4
U3-13	7th	Goss	1	2	4	2	2	2	2	2	3	2	3	4	5	5	2	5	2	1	0	3	2	2	0	3	2	3
U3-14	7th	Goss	1	2	4	2	1	4	2	2	3	2	5	4	5	5	2	5	5	3	1	1	2	2	1	1	2	3
U3-15	7th	Goss	1	1	2	2	2	2	1	2	4	2	1	4	5	5	2	5	5	3	2	4	2	2	3	2	3	3
U3-16	7th	Goss	1	1	2	2	1	4	1	1	2	2	2	1	5	5	2	5	5	3	1	3	1	1	2	1	2	2
U3-17	7th	Goss	1	2	4	2	2	2	1	2	4	4	3	3	5	5	2	3	5	3	1	2	3	2	2	2	2	2
U3-18	7th	Goss	2	1	1	2	2	2	1	1	2	2	2	2	5	5	2	5	5	3	1	1	2	3	1	2	2	3
U3-19	7th	Goss	2	1	1	2	2	2	1	2	4	2	2	2	5	5	2	2	1	4	1	3	2	3	2	2	2	2
U3-20	7th	Goss	1	1	2	2	2	2	2	2	3	2	2	2	2	5	1	5	5	3	2	1	2	2	2	2	2	3

Study Group Unit 3 (Δ measures change in answer)			Q1			Q2			Q3			Q4			Q5			Q6			Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Pre	Post	Pre	Post	Pre	Post
U3-21	7th	Goss	1	1	2	2	2	2	1	1	2	3	5	3	5	5	2	5	5	3	1	2	2	1	1	1	2	2
U3-22	7th	Goss	1	1	2	2	2	2	1	2	4	2	3	4	5	5	2	5	5	3	1	3	2	2	2	2	2	3
U3-23	7th	Goss	1	1	2	2	2	2	1	2	4	2	2	2	5	5	2	5	2	1	1	3	2	2	2	3	2	3
U3-24	7th	Goss	2	2	3	1	1	3	2	2	3	2	3	4	5	5	2	5	5	3	1	1	1	1	1	2	2	2
U3-25	7th	Goss	2	1	1	2	2	2	1	2	4	3	2	1	5	4	4	5	5	3	0	3	0	1	0	2	0	2
U3-26	7th	Goss	2	2	3	1	2	1	2	1	1	5	3	3	5	5	2	5	2	1	1	3	2	2	2	2	2	2
U3-27	7th	Goss	2	1	1	1	2	1	1	2	4	2	2	2	3	5	1	5	5	3	1	3	0	2	1	2	2	2
U3-28	7th	Goss	1	1	2	2	2	2	1	1	2	2	2	2	5	1	4	5	5	3	0	3	0	3	0	1	3	3
U3-29	7th	Goss	1	1	2	2	1	4	1	2	4	3	2	1	5	5	2	2	5	4	1	2	1	1	1	1	2	3
U3-30	7th	Goss	1	2	4	2	2	2	1	1	2	2	3	4	5	5	2	4	5	3	1	3	2	2	2	2	2	2
U3-31	7th	Goss	2	2	3	1	2	1	1	2	4	3	2	1	5	5	2	5	2	1	3	3	2	2	2	3	2	4
U3-32	7th	Goss	2	2	3	2	2	2	1	1	2	5	3	3	5	5	2	1	5	3	1	3	2	2	2	2	2	2
U3-33	7th	Goss	2	2	3	1	2	1	1	2	4	2	2	2	5	5	2	5	5	3	1	3	1	3	2	3	2	4
U3-34	7th	Goss	1	1	2	2	2	2	1	2	4	0	0	3	5	5	2	5	2	1	1	3	1	2	2	3	2	4
U3-35	7th	Goss	1	2	4	2	2	2	1	2	4	2	2	2	5	5	2	5	2	1	1	2	2	2	2	2	1	4
U3-36	7th	Goss	2	2	3	2	2	2	1	1	2	3	3	3	5	5	2	5	2	1	2	3	2	2	2	2	2	4
U3-37	7th	Goss	2	2	3	0	1	3	0	1	1	3	3	3	5	5	2	5	5	3	1	3	1	2	1	3	2	4
U3-38	7th	Goss	1	1	2	2	2	2	2	2	3	2	2	2	1	5	1	5	5	3	0	3	2	2	1	3	1	4
U3-39	7th	Goss	2	2	3	1	2	1	2	2	3	5	1	3	5	5	2	5	2	1	0	3	2	2	1	0	1	3
U3-40	7th	Goss	2	2	3	1	2	1	2	2	3	3	3	3	5	5	2	5	2	1	0	3	2	2	1	2	2	4
U3-41	7th	Goss	2	2	3	2	2	2	1	1	2	1	3	3	5	5	2	5	2	1	2	2	2	2	1	2	2	3
U3-42	7th	Goss	2	1	1	2	2	2	1	1	2	3	3	3	5	5	2	5	2	1	1	1	0	2	0	1	1	4

Study Group Unit 3 (Δ measures change in answer)			Q1			Q2			Q3			Q4			Q5			Q6			Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Δ	Pre	Post	Pre	Post	Pre	Post	Pre	Post
U3-43	7th	Goss	1	1	2	1	2	1	1	2	4	2	3	4	3	5	1	2	1	4	1	1	1	1	1	1	1	2
U3-44	7th	Goss	2	2	3	1	2	1	2	2	3	1	2	1	1	5	1	3	2	1	1	1	0	0	1	1	1	1
U3-45	7th	Goss	0	1	1	2	2	2	1	1	2	2	2	2	5	5	2	5	5	3	0	2	2	2	2	2	2	2
U3-46	7th	Goss	2	1	1	2	2	2	2	1	1	3	3	3	5	1	4	5	5	3	1	1	1	1	1	2	1	2
U3-47	7th	Goss	1	1	2	2	2	2	1	1	2	2	2	2	5	5	2	5	5	3	1	2	2	2	2	2	2	4
U3-48	7th	Goss	2	1	1	2	2	2	1	2	4	5	2	1	5	5	1	2	4	4	1	3	1	1	1	2	2	4
U3-49	7th	Goss	1	2	4	2	2	2	1	1	2	3	2	1	5	5	2	5	5	3	2	3	1	2	2	3	3	4
U3-50	7th	Goss	2	2	3	2	2	2	1	1	2	1	3	3	0	5	1	1	2	1	1	1	1	2	0	2	0	3
U3-51	7th	Goss	2	1	1	1	2	1	1	1	2	5	2	1	5	5	2	5	2	1	3	0	2	0	1	3	2	4
U3-52	7th	Goss	2	2	3	2	2	2	1	1	2	3	2	1	5	5	2	5	2	1	3	3	2	2	1	3	3	3
U3-53	7th	Goss	2	1	1	2	2	2	1	1	2	3	3	3	5	5	2	5	5	3	1	3	2	2	1	1	2	4
U3-54	7th	Goss	1	2	4	2	2	2	1	1	2	2	2	2	5	5	2	5	3	3	2	3	2	2	1	1	2	4
U3-55	7th	Goss	1	2	4	2	2	2	2	1	1	3	2	1	5	5	2	5	4	3	2	3	2	2	2	2	3	4
U3-56	7th	Goss	2	1	1	2	2	2	1	2	4	3	2	1	2	5	1	5	2	1	1	2	2	2	2	2	2	3
U3-57	7th	Goss	2	2	3	2	2	2	1	1	2	3	3	3	5	5	2	5	5	3	1	3	2	2	1	1	2	4
U3-58	7th	Goss	2	1	1	2	2	2	2	1	1	2	2	2	5	5	2	5	5	3	3	3	2	2	1	2	2	4
U3-59	7th	Goss	2	2	3	1	2	1	1	1	2	4	3	3	5	5	2	5	4	3	1	3	2	2	1	2	2	4
U3-60	7th	Goss	2	1	1	2	2	2	1	1	2	3	2	1	5	5	2	5	5	3	3	3	2	2	2	2	3	3

Unit 3 Control Group Data Table

Control Group Unit 3 (1=correct, 2 = incorrect)			Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
CG-1	8th	Gray	2	2	2	2	2	2	2	1	1	1	1	1	0	0	0	0	0	0	0	0
CG-4	8th	Gray	2	1	1	1	1	1	2	2	1	1	2	1	0	3	3	3	1	1	3	3
CG-5	8th	Gray	2	2	1	1	1	1	2	1	1	2	2	2	3	2	3	1	1	1	2	1
CG-6	8th	Gray	2	2	1	2	1	2	2	2	2	2	2	2	0	0	3	0	0	0	3	0
CG-7	8th	Gray	2	2	1	1	1	2	2	2	1	1	2	2	2	3	1	1	2	1	3	2
CG-8	8th	Gray	2	2	2	2	2	2	1	2	2	2	2	2	0	0	2	0	1	0	2	0
CG-9	8th	Gray	1	1	1	2	1	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-12	8th	Gray	2	1	2	1	2	2	2	1	2	2	2	2	0	0	0	0	0	0	0	0
CG-13	8th	Gray	2	2	2	2	1	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-15	8th	Gray	2	2	1	1	1	1	2	2	1	1	2	1	0	2	0	2	2	0	0	3
CG-16	8th	Gray	2	1	2	1	2	2	2	1	2	2	2	2	0	0	0	0	0	0	0	0
CG-17	8th	Gray	1	2	1	2	1	2	2	2	1	2	2	2	1	0	0	0	0	0	2	0
CG-18	8th	Gray	2	2	1	2	2	2	2	2	1	2	2	2	0	0	3	0	0	0	2	0
CG-20	8th	Gray	2	2	2	1	2	1	2	2	2	1	2	2	0	0	0	0	0	0	0	3
CG-21	8th	Gray	1	2	1	1	1	2	2	2	2	1	1	2	0	0	0	2	0	0	0	0
CG-22	8th	Gray	1	1	1	1	1	2	2	1	2	1	1	2	0	1	0	2	0	2	0	1
CG-23	8th	Gray	2	2	2	2	2	2	2	1	2	2	2	2	2	0	0	0	0	0	0	0
CG-24	8th	Gray	2	2	1	1	1	2	2	1	1	1	2	2	0	1	2	2	1	2	3	2
CG-25	8th	Gray	2	1	2	1	2	2	2	2	2	1	1	2	0	1	0	2	0	2	0	2
CG-26	8th	Gray	2	1	1	1	1	2	1	2	1	1	1	1	0	2	0	1	0	1	1	2
CG-30	8th	Gray	1	2	1	1	1	2	2	2	1	2	2	2	0	0	2	0	0	0	0	0

Control Group Unit 3 (1=correct, 2 = incorrect)			Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
CG-31	8th	Gray	2	2	1	1	1	2	2	1	1	1	2	1	0	1	2	1	0	1	3	2
CG-32	8th	Gray	1	2	1	2	1	2	1	1	1	2	2	2	0	1	3	1	2	1	3	2
CG-33	8th	Gray	1	2	2	2	2	2	2	2	1	1	2	2	1	1	0	0	1	0	0	2
CG-34	8th	Gray	2	2	1	2	1	2	2	2	1	2	2	2	0	2	0	1	0	0	0	0
CG-35	8th	Gray	2	2	1	1	1	1	1	2	1	2	2	1	0	0	0	0	0	0	0	0
CG-36	8th	Gray	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0	0	0
CG-37	8th	Gray	2	2	1	2	1	2	2	1	1	1	1	2	0	0	0	0	0	0	0	0
CG-38	8th	Gray	2	1	1	2	1	2	2	2	1	2	2	2	1	0	2	1	0	0	0	0
CG-39	8th	Gray	2	2	1	1	2	1	2	2	1	2	2	2	0	0	1	0	0	0	2	0
CG-40	8th	Gray	2	1	1	1	1	1	2	2	1	1	2	2	2	2	2	0	1	0	2	0
CG-41	8th	Gray	2	2	2	2	2	2	2	1	1	2	2	2	0	0	2	0	0	0	4	0
CG-42	8th	Gray	1	2	1	1	2	1	2	1	2	2	2	2	0	0	0	0	0	0	0	2
CG-43	8th	Gray	1	2	1	2	2	2	1	2	1	2	2	2	0	0	0	0	1	0	0	2
CG-44	8th	Gray	1	1	1	1	1	1	2	1	1	2	2	2	0	0	0	0	0	0	0	0
CG-45	8th	Gray	2	1	1	1	2	1	2	2	1	2	2	2	0	0	1	0	0	0	4	0
CG-46	8th	Gray	2	2	1	2	1	2	2	2	1	2	2	2	3	0	2	3	1	1	2	2
CG-47	8th	Gray	1	2	1	2	1	2	2	2	1	1	2	2	0	0	1	1	0	1	0	1
CG-48	8th	Gray	2	1	2	2	2	2	2	2	2	2	2	2	0	0	2	0	0	0	0	0
CG-49	8th	Gray	1	2	1	2	2	1	1	1	1	2	2	2	0	0	1	0	0	0	2	0
CG-50	8th	Gray	2	2	1	1	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-51	8th	Gray	2	2	2	1	1	2	2	2	1	1	2	2	0	1	1	0	0	0	0	0
CG-52	8th	Gray	1	2	1	2	2	2	1	2	1	2	2	2	0	0	1	0	0	0	3	2

Control Group Unit 3 (1=correct, 2 = incorrect)			Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
CG-53	8th	Gray	2	1	1	1	2	1	2	2	1	2	2	2	3	0	3	2	1	0	2	3
CG-54	8th	Gray	1	2	1	1	1	1	1	2	1	1	1	2	0	0	2	1	3	2	4	2
CG-55	8th	Gray	2	2	1	1	1	1	1	1	1	1	2	2	0	1	0	2	0	2	2	2
CG-56	8th	Gray	2	2	2	1	2	1	2	2	1	2	2	2	0	2	0	1	0	0	2	0
CG-57	8th	Gray	2	1	2	1	2	1	1	2	2	2	2	1	0	1	1	1	0	1	1	1
CG-58	8th	Gray	1	1	1	1	2	1	1	1	1	1	2	1	3	3	3	1	1	0	3	2
CG-59	8th	Gray	1	2	1	2	2	2	2	2	1	2	2	2	0	0	1	0	0	0	2	1
CG-63	8th	Gray	2	2	2	2	1	2	2	2	1	2	2	2	0	0	1	0	0	0	3	0
CG-64	8th	Gray	1	2	2	1	1	2	2	1	2	1	2	2	0	1	0	0	0	1	0	2
CG-65	8th	Gray	2	2	1	1	1	1	2	1	1	2	1	2	0	0	1	0	0	0	0	1
CG-67	8th	Gray	1	2	1	1	2	1	2	2	2	1	1	1	0	0	0	1	0	2	2	3
CG-68	8th	Gray	2	2	1	1	2	1	1	1	1	1	2	2	0	1	1	1	1	1	2	4
CG-69	8th	Gray	1	1	1	1	2	1	1	2	1	2	2	1	3	0	3	0	0	0	0	0
CG-70	8th	Gray	1	1	1	1	2	2	2	2	1	2	2	2	0	0	1	1	1	0	0	0
CG-71	8th	Gray	1	1	1	1	1	1	1	1	2	1	2	1	0	2	0	2	0	1	0	1
CG-72	8th	Gray	2	2	2	1	2	2	2	1	2	1	2	2	1	0	0	0	1	1	1	1
CG-73	8th	Gray	2	2	1	1	2	2	2	2	1	1	1	2	0	0	1	1	0	0	0	0

Unit 4 Study Group Data Table

Study Group Unit 4 (Pre/Post # 1-5 = coded answers, Δ = change in answer)			Q1			Q2			Q3			Q4			Q5			Q6			Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Q1 Δ	Pre	Post	Q2 Δ	Pre	Post	Q3 Δ	Pre	Post	Q4 Δ	Pre	Post	Q5 Δ	Pre	Post	Q6 Δ	Pre	Post	Pre	Post	Pre	Post	Pre	Post
U4-1	7th	Bearchild	2	2	3	1	1	3	1	2	1	1	1	2	5	5	2	4	5	4	2	3	2	2	2	2	3	3
U4-2	7th	Bearchild	1	1	2	1	2	1	1	2	1	2	4	3	5	5	2	4	4	2	4	3	3	4	2	3	3	3
U4-3	7th	Bearchild	1	2	4	1	1	3	2	2	2	4	2	1	5	5	2	2	4	1	3	3	3	3	3	3	2	4
U4-4	7th	Bearchild	1	1	2	2	2	2	2	2	2	2	2	2	5	5	2	5	4	1	3	3	2	3	3	3	3	4
U4-5	7th	Bearchild	1	1	2	2	2	2	2	2	2	2	2	2	5	5	2	4	2	4	2	2	2	3	2	2	2	2
U4-6	7th	Bearchild	1	2	4	2	2	2	2	2	2	5	1	1	5	5	2	5	5	3	2	4	2	4	2	3	2	4
U4-7	7th	Bearchild	2	1	1	1	1	3	1	2	1	2	1	1	5	5	2	4	4	2	1	3	1	2	1	2	1	3
U4-8	7th	Bearchild	2	2	3	2	1	4	2	2	2	5	3	3	1	1	3	1	1	3	1	1	2	2	3	2	5	3
U4-9	7th	Bearchild	1	2	4	1	2	1	2	2	2	0	2	1	5	5	2	5	5	3	2	3	2	3	2	2	0	2
U4-10	7th	Bearchild	2	2	3	2	2	2	1	1	3	1	5	4	1	1	3	2	4	1	2	4	2	2	3	3	2	3
U4-11	7th	Bearchild	1	1	2	2	1	4	1	2	1	2	2	2	1	5	1	3	2	3	2	3	2	3	2	3	3	3
U4-12	7th	Bearchild	1	1	2	2	2	2	1	1	3	4	1	1	5	5	2	1	0	3	2	2	2	2	2	3	2	3
U4-13	7th	Bearchild	1	1	2	1	1	3	2	2	2	3	2	1	5	5	2	2	1	3	2	3	2	2	3	3	2	3
U4-14	7th	Bearchild	1	2	4	2	1	4	2	2	2	1	2	2	5	4	4	4	2	4	0	3	0	0	0	0	0	0
U4-15	7th	Bearchild	1	2	4	1	1	3	2	2	2	1	2	2	5	4	4	2	2	3	2	3	2	0	1	0	0	0
U4-16	7th	Bearchild	2	1	1	1	1	3	2	2	2	2	2	2	5	5	2	1	5	3	3	3	2	3	2	3	2	3
U4-17	7th	Bearchild	1	2	4	1	1	3	2	2	2	2	2	2	1	5	1	2	5	3	3	4	2	3	3	3	3	3
U4-18	7th	Bearchild	2	1	1	2	1	4	2	2	2	2	2	2	5	5	2	2	4	1	3	3	2	3	2	2	3	3
U4-19	7th	Bearchild	1	2	4	2	1	4	1	2	1	2	4	3	1	5	1	4	4	2	0	2	2	3	0	3	0	2
U4-20	7th	Bearchild	2	2	3	2	2	2	1	1	3	3	2	1	5	5	2	1	1	3	3	3	2	2	2	3	2	3
U4-21	7th	Bearchild	1	2	4	2	1	4	1	1	3	1	1	2	5	5	2	5	5	3	2	2	2	2	2	2	1	0

Study Group Unit 4 (Pre/Post # 1-5 = coded answers, Δ = change in answer)			Q1			Q2			Q3			Q4			Q5			Q6			Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Q1 Δ	Pre	Post	Q2 Δ	Pre	Post	Q3 Δ	Pre	Post	Q4 Δ	Pre	Post	Q5 Δ	Pre	Post	Q6 Δ	Pre	Post	Pre	Post	Pre	Post	Pre	Post
U4-22	7th	Bearchild	2	1	1	1	1	3	2	2	2	2	1	1	5	5	2	1	4	1	3	2	2	2	3	3	3	3
U4-23	7th	Bearchild	2	2	3	2	2	2	1	1	3	2	3	3	1	1	3	2	4	1	3	2	2	2	2	2	1	2
U4-24	7th	Bearchild	2	2	3	1	1	3	2	2	2	3	3	3	4	1	3	4	4	2	1	1	1	2	2	2	1	1
U4-25	7th	Bearchild	2	1	1	1	2	1	2	1	4	2	3	3	5	1	4	4	4	2	0	3	1	2	2	2	2	2
U4-26	7th	Bearchild	1	1	2	1	2	1	2	2	2	2	2	2	5	5	2	5	1	3	3	3	3	0	2	0	3	0
U4-27	7th	Bearchild	1	2	4	1	1	3	1	2	1	1	1	2	5	4	4	0	2	3	2	3	2	2	2	2	0	2
U4-28	7th	Bearchild	2	2	3	1	1	3	1	2	1	4	2	1	5	5	2	1	5	3	2	2	1	2	2	1	1	2
U4-29	7th	Bearchild	2	2	3	1	1	3	2	2	2	2	2	2	5	5	2	1	5	3	0	3	2	3	3	3	0	2
U4-30	7th	Bearchild	1	1	2	2	1	4	2	2	2	5	2	1	5	5	2	5	4	4	3	3	2	2	1	3	2	2
U4-31	7th	Bearchild	2	2	3	1	1	3	1	2	1	1	5	4	5	5	2	4	4	2	3	3	2	3	3	3	3	3
U4-32	7th	Bearchild	2	2	3	2	2	2	1	1	3	2	3	3	1	3	3	1	5	3	2	2	1	3	2	2	2	0
U4-33	7th	Bearchild	2	1	1	2	1	4	2	2	2	5	3	3	5	5	2	2	4	1	3	3	1	3	3	3	4	3
U4-34	7th	Bearchild	2	2	3	2	2	2	1	2	1	2	2	2	1	5	1	1	5	3	2	3	2	2	2	2	2	2
U4-35	7th	Bearchild	2	2	3	1	2	1	2	2	2	2	4	4	5	5	2	1	5	3	1	3	1	2	0	2	2	2
U4-36	7th	Bearchild	1	2	4	1	1	3	2	2	2	4	2	1	5	5	2	5	4	1	3	3	2	3	2	3	3	3
U4-37	7th	Bearchild	2	2	3	1	1	3	2	2	2	2	2	2	5	5	2	5	5	3	1	3	0	3	0	2	0	1
U4-38	7th	Bearchild	1	1	2	2	2	2	1	2	1	2	3	3	1	1	3	1	1	3	0	1	0	1	0	1	0	0
U4-39	7th	Bearchild	2	1	1	1	1	3	2	2	2	2	3	3	5	1	4	4	1	4	2	1	2	2	2	1	3	3
U4-40	7th	Bearchild	2	1	1	1	1	3	2	2	2	2	2	2	1	4	3	1	5	3	2	2	1	1	3	3	2	3
U4-41	7th	Bearchild	2	2	3	2	1	4	2	2	2	5	2	1	1	5	1	5	4	1	2	3	1	2	0	1	0	3
U4-42	7th	Bearchild	2	2	3	1	1	3	1	2	1	2	2	2	1	5	1	5	4	1	2	3	1	1	1	3	2	2
U4-43	7th	Bearchild	1	2	4	2	1	4	2	2	2	2	2	2	5	5	2	4	4	2	2	2	2	2	2	2	2	2

Study Group Unit 4 (Pre/Post # 1-5 = coded answers, Δ = change in answer)			Q1			Q2			Q3			Q4			Q5			Q6			Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Q1 Δ	Pre	Post	Q2 Δ	Pre	Post	Q3 Δ	Pre	Post	Q4 Δ	Pre	Post	Q5 Δ	Pre	Post	Q6 Δ	Pre	Post	Pre	Post	Pre	Post	Pre	Post
U4-44	7th	Bearchild	1	2	4	1	1	3	2	2	2	5	1	1	1	2	3	1	1	3	1	1	1	1	1	2	0	0
U4-45	7th	Bearchild	1	2	4	1	2	1	1	1	3	2	2	2	1	5	1	1	4	1	2	3	2	3	2	3	3	3
U4-46	7th	Bearchild	1	1	2	2	2	2	1	1	3	2	2	2	1	4	3	5	1	3	2	2	2	2	2	2	2	2
U4-47	7th	Bearchild	1	1	2	2	2	2	2	2	2	2	2	2	5	5	2	4	2	4	2	3	2	2	3	3	3	3
U4-48	7th	Bearchild	2	2	3	1	2	1	1	1	3	5	2	1	1	4	3	1	2	3	2	2	2	2	3	2	3	2
U4-49	7th	Bearchild	2	1	1	2	2	2	1	2	1	2	2	2	5	5	2	4	1	4	1	3	1	2	0	0	0	0
U4-50	7th	Bearchild	1	1	2	2	2	2	2	2	2	3	2	1	5	5	2	1	4	1	1	3	2	3	2	3	2	3
U4-51	7th	Bearchild	2	1	1	1	2	1	2	2	2	2	2	2	1	5	1	4	4	2	1	3	1	3	1	3	1	2
U4-52	7th	Bearchild	1	2	4	2	1	4	2	2	2	1	2	2	1	5	1	1	5	3	0	3	2	3	1	0	0	0
U4-53	7th	Bearchild	1	2	4	1	1	3	2	1	4	2	2	2	3	5	1	2	2	3	0	3	0	2	0	3	2	3
U4-54	7th	Bearchild	2	1	1	2	1	4	2	2	2	2	2	2	1	5	1	4	5	4	3	3	2	3	2	3	3	3
U4-55	7th	Bearchild	2	2	3	1	1	3	2	2	2	1	2	2	1	4	3	3	2	3	2	3	2	3	2	3	3	3
U4-56	7th	Bearchild	2	1	1	2	2	2	1	2	1	1	2	2	1	5	1	1	1	3	2	2	1	2	2	1	2	2
U4-57	7th	Bearchild	0	0	3	1	2	1	0	0	3	2	2	2	1	1	3	4	1	4	1	1	1	1	2	2	2	2
U4-58	7th	Bearchild	1	2	4	1	1	3	1	2	1	2	2	2	4	4	3	2	2	3	1	2	1	3	1	2	2	1
U4-59	7th	Bearchild	2	1	1	1	1	3	2	2	2	1	5	4	1	5	1	4	4	2	1	2	3	3	1	1	2	2
U4-60	7th	Bearchild	2	1	1	2	2	2	1	2	1	2	3	4	5	1	4	1	1	3	2	1	3	2	2	0	3	2

Unit 4 Control Group Data Table

Control Group Unit 4 (1= correct, 2=incorrect, Δ = Type of change in answer)			Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
CG-1	8th	Gray	1	1	1	1	2	2	1	1	2	1	1	2	0	0	0	0	0	0	0	0
CG-4	8th	Gray	2	2	1	2	2	1	1	1	2	2	2	1	0	1	1	2	2	2	2	1
CG-5	8th	Gray	2	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-6	8th	Gray	1	2	2	2	1	2	1	2	1	2	2	2	3	0	0	0	0	0	0	0
CG-7	8th	Gray	1	2	1	1	1	1	2	2	1	1	1	1	2	1	1	0	2	0	1	0
CG-8	8th	Gray	2	2	2	2	1	2	2	2	2	2	1	2	0	0	0	0	0	0	0	0
CG-9	8th	Gray	1	1	2	2	2	1	1	1	2	2	2	2	0	0	0	0	0	0	0	0
CG-12	8th	Gray	2	2	2	2	2	1	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-16	8th	Gray	2	2	2	1	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-17	8th	Gray	2	2	2	2	1	2	2	2	1	2	1	2	0	0	0	0	0	0	3	0
CG-18	8th	Gray	1	2	2	2	1	1	2	1	2	2	2	1	0	0	0	0	0	0	0	0
CG-20	8th	Gray	1	2	2	2	1	1	1	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-21	8th	Gray	1	2	1	1	2	1	1	1	2	2	2	1	0	0	1	0	0	0	0	0
CG-22	8th	Gray	2	1	1	1	2	1	1	2	2	1	2	2	0	0	0	0	0	0	0	0
CG-23	8th	Gray	1	2	2	2	2	2	2	2	1	1	2	2	0	0	0	0	0	0	0	0
CG-24	8th	Gray	1	2	2	1	2	1	1	1	1	1	1	2	0	1	1	2	2	1	2	2
CG-25	8th	Gray	2	2	2	2	2	1	2	1	2	1	1	2	0	2	0	2	0	1	0	1
CG-28	8th	Gray	2	2	2	2	2	1	1	1	2	2	2	2	1	0	1	1	0	0	0	0
CG-29	8th	Gray	2	2	2	2	2	2	2	1	1	2	2	2	0	0	0	0	0	0	0	0
CG-31	8th	Gray	1	2	2	2	1	1	1	2	1	2	1	2	1	1	0	1	1	1	2	2
CG-32	8th	Gray	2	2	1	1	2	1	1	2	1	2	2	2	1	1	1	1	2	1	3	2

Control Group Unit 4 (1= correct, 2=incorrect, Δ = Type of change in answer)			Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
CG-33	8th	Gray	2	2	1	1	2	1	2	1	2	2	2	2	0	0	0	0	1	0	0	0
CG-34	8th	Gray	2	1	1	2	1	2	2	2	1	2	1	2	0	1	0	1	0	0	0	0
CG-35	8th	Gray	1	1	1	2	1	1	1	1	1	2	2	2	0	0	0	0	0	0	0	0
CG-36	8th	Gray	2	1	2	1	1	2	1	1	2	2	2	2	0	0	0	0	0	0	0	0
CG-37	8th	Gray	1	1	2	1	2	2	2	2	1	2	2	1	0	0	0	0	0	1	0	0
CG-38	8th	Gray	1	2	1	2	2	2	1	1	2	2	2	1	1	0	1	0	0	0	1	1
CG-39	8th	Gray	1	2	1	2	1	1	2	2	2	2	2	2	0	0	0	0	0	0	2	0
CG-40	8th	Gray	2	2	2	1	1	1	1	2	1	2	1	2	0	0	0	0	0	0	1	0
CG-41	8th	Gray	2	2	2	1	1	1	2	2	1	2	2	2	0	0	0	1	0	0	1	0
CG-42	8th	Gray	1	2	1	2	2	2	1	1	1	2	1	2	0	0	0	0	0	0	0	0
CG-43	8th	Gray	1	1	2	1	2	1	1	1	2	2	1	1	0	0	0	0	0	0	0	1
CG-44	8th	Gray	1	2	2	2	1	2	2	1	1	1	2	2	0	0	0	0	0	0	0	0
CG-45	8th	Gray	2	1	2	1	1	2	1	2	1	2	1	2	0	0	1	0	0	0	0	0
CG-46	8th	Gray	1	1	1	2	2	1	1	1	1	2	1	2	3	0	0	2	0	1	0	0
CG-47	8th	Gray	1	2	2	1	2	2	2	2	2	2	2	1	1	0	0	0	0	0	0	0
CG-48	8th	Gray	2	2	2	2	2	1	2	2	2	2	2	2	0	1	1	0	0	0	2	0
CG-49	8th	Gray	1	2	2	2	1	1	1	1	2	2	2	2	0	0	0	0	0	0	2	0
CG-50	8th	Gray	2	2	2	2	1	1	2	2	2	2	2	2	0	0	0	0	0	0	0	0
CG-51	8th	Gray	1	2	1	2	2	1	2	1	1	2	2	1	0	0	0	0	0	0	0	0
CG-53	8th	Gray	2	2	2	2	1	1	1	2	1	2	2	2	3	0	3	0	1	0	3	2
CG-54	8th	Gray	2	1	2	1	2	2	2	1	2	2	1	2	0	1	0	1	0	1	0	2
CG-55	8th	Gray	1	2	1	2	2	1	1	1	2	1	2	1	2	0	2	1	0	2	0	2

Control Group Unit 4 (1= correct, 2=incorrect, Δ = Type of change in answer)			Q1		Q2		Q3		Q4		Q5		Q6		Q7		Q8		Q9		Q10	
Student ID	Grade	Teacher	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
CG-56	8th	Gray	2	2	2	2	2	2	2	2	1	2	2	1	0	0	0	1	0	0	0	1
CG-57	8th	Gray	2	2	2	2	1	2	1	1	2	1	2	1	1	1	0	1	0	1	0	0
CG-58	8th	Gray	1	2	2	2	1	1	1	1	2	1	2	1	0	1	0	1	0	1	2	0
CG-59	8th	Gray	2	1	1	2	2	1	2	1	2	2	2	2	1	2	0	0	0	1	0	0
CG-60	8th	Gray	1	2	1	2	1	2	1	1	2	1	2	2	2	2	0	1	0	1	3	2
CG-61	8th	Gray	2	1	1	1	2	1	1	2	2	1	2	2	1	1	1	1	0	1	0	2
CG-62	8th	Gray	1	1	2	1	1	2	1	2	1	1	1	2	2	0	0	1	0	1	0	0
CG-63	8th	Gray	1	2	1	2	1	2	2	1	1	2	2	2	0	0	0	0	0	0	2	0
CG-64	8th	Gray	2	1	2	1	1	1	2	2	2	1	2	2	2	1	0	2	0	1	0	2
CG-65	8th	Gray	2	1	2	2	1	1	1	1	1	2	1	1	1	0	0	0	0	0	0	0
CG-67	8th	Gray	2	2	2	2	2	2	2	1	2	1	2	1	0	1	0	1	0	1	0	3
CG-68	8th	Gray	2	1	2	1	2	1	1	2	1	1	1	2	0	1	1	1	0	1	2	2
CG-70	8th	Gray	1	2	1	2	1	1	1	1	2	1	2	2	0	0	0	1	0	0	0	1
CG-71	8th	Gray	2	1	2	1	2	2	2	1	2	1	2	1	0	2	0	0	0	1	2	2
CG-72	8th	Gray	1	2	1	1	1	1	1	1	1	1	2	2	2	2	1	2	1	2	2	0
CG-73	8th	Gray	1	1	1	1	1	2	2	2	2	2	2	2	0	0	0	1	0	0	0	2
CG-75	8th	Gray	1	2	2	2	2	1	2	1	2	2	1	2	0	0	0	0	0	0	0	0

Prior Knowledge and Completion Surveys

Prior Knowledge and Completion Survey			Connection 1			Connection 2			Connection 3			Connection 4		Connection 5		Connection 6			Connection 7			Connection 8			Connection 9				Connection 10			
Student Interest (Connection 9 & 10): Scale 1-3 for Prior and Completion. Note: In Prior, 2 and 3 are coded as 2, 4 is coded as 3			**What do you want to be when you grow up?**			**What subject do you like the most?**			**What subject do you like the least?**			**What would you tell a friend about bison?**		**What would you tell a friend about archaeology?**		**Do you think learning about history is important?**			**Opinion about Archaeology**			**Opinion about Bison**			**Student Interest Level in Bison**				**Student Interest Level in Archaeology**			
Student	**Grade**	**Teacher**	**Prior Knowledge**	**Completion**	**C1 Δ**	**Prior**	**Comp.**	**C2 Δ**	**Prior**	**Comp.**	**C3 Δ**	**Completion**	**C4 Δ**	**Completion**	**C5 Δ**	**Prior**	**Comp.**	**C6 Δ**	**Before: Q7**	**After: Q8**	**C7 Δ**	**Before: Q9**	**After: Q10**	**C8 Δ**	**Prior**	**Comp. Q1**	**Comp. Q3**	**C9 Δ**	**Prior**	**Comp. Q2**	**Comp. Q4**	**C10 Δ**
PKC-1	7th	Goss	Military	Military	3	Robotics	Bison	1	Lang. Arts	Archaeology	2	Interesting	1	Interesting	1	Yes	Yes	1	Interesting	Interesting	2	Interesting	Interesting	2	2	3	3	1	2	3	3	1
PKC-2	7th	Goss	Nurse	Undetermined	3	Math	Math	3	Reading	P.E.	3	Interesting	1	Interesting	1	Yes	Yes	1	No opinion	Interesting	1	Interesting	Interesting	2	2	2	2	1	2	2	2	1

PKC-8	PKC-7	PKC-6	PKC-5	PKC-4	PKC-3	Prior Knowledge and Completion Survey
7th	7th	7th	7th	7th	7th	
Goss	Goss	Goss	Goss	Goss	Goss	
Dentist	Carpenter	Sports	Military	Nurse	Sports	Connection 1
Dentist	Carpenter	Teacher	Military	Undetermined	Sports	
3	3	3	3	3	3	
Science/ Social Studies	P.E.	Science	None	Language	Reading	Connection 2
Science/ Social Studies	Science and P.E.	Science	Art	Science/ Writing	Reading	
3	1	3	3	1	3	
Math	Science	Social Studies	Math	Math/Social Studies	Social Studies	Connection 3
Language Arts	Math and Reading	Social Studies	Science/ Reading/ Social	Math/ Social Studies	Math	
3	1	3	2	3	1	
Interesting	Interesting	Interesting	Not Interesting	No Opinion	Interesting	Connection 4
1	1	1	2	0	1	
Not Interesting	Interesting	Interesting	No Opinion	Not Interesting	No Opinion	Connection 5
2	1	1	0	2	0	
Yes	Yes	Yes	Yes	Yes	Yes	Connection 6
Yes	Yes	Yes	Yes	Yes	Yes	
1	1	1	1	1	1	
Not Interesting	Interesting	Not Interesting	No opinion	No opinion	Not Interesting	Connection 7
Not Interesting	No Opinion	Interesting	Not Interesting	Interesting	Not Interesting	
3	0	1	3	1	3	
Interesting	Interesting	Not Interesting	No Opinion	Interesting	Interesting	Connection 8
Interesting	Not Interesting	No Opinion	No Opinion	Not Interesting	No Opinion	
2	4	0	0	4	0	
3	3	3	2	3	3	Connection 9
2	2	1	1	2	1	
2	3	3	1	2	3	
1	1	1	2	1	1	
2	1	2	2	1	2	Connection 10
1	2	1	2	1	2	
1	2	2	2	2	2	
2	1	1	1	1	1	

PKC-13	PKC-12	PKC-11	PKC-10	PKC-9	Prior Knowledge and Completion Survey
7th	7th	7th	7th	7th	
Bearchild	Bearchild	Goss	Goss	Goss	
Sports	Chef	Oil Rigger	Lawyer	Police Officer	Connection 1
Military	ARCHAEOLOGIST!!!	Oil Rigger	Lawyer	Police Officer	
3	1	3	3	3	
P.E.	Reading/ Choir	Native Arts	Writing/ Math	Hunting	Connection 2
BISON!!!	Reading	Science	Social Studies	Science	
1	3	1	1	1	
Track	Math	Math	Reading/ P.E.	Science	Connection 3
Writing	Math	Math	Math/ Language Arts	Reading/ Social Studies	
3	3	3	3	1	
Interesting	Interesting	Not Interesting	No Opinion	Interesting	Connection 4
1	1	2	0	1	
Interesting	Interesting	No Opinion	Interesting	No Opinion	Connection 5
1	1	0	1	0	
Yes	Yes	Yes	Yes	Yes	Connection 6
Yes	Yes	Yes	Yes	Yes	
1	1	1	1	1	
No opinion	Interesting	No opinion	Interesting	Not Interesting	Connection 7
Interesting	Interesting	Not Interesting	No Opinion	No Opinion	
1	2	3	0	0	
No Opinion	Interesting	Interesting	Not Interesting	Interesting	Connection 8
Interesting	Interesting	Interesting	Not Interesting	Interesting	
1	2	2	3	2	
3	3	3	3	3	Connection 9
2	2	2	2	2	
3	3	3	2	3	
1	1	1	1	1	
3	3	2	2	2	Connection 10
2	1	1	2	2	
3	3	1	3	3	
1	1	2	1	1	

PKC-19	PKC-18	PKC-17	PKC-16	PKC-15	PKC-14	Prior Knowledge and Completion Survey
7th	7th	7th	7th	7th	7th	
Bearchild	Bearchild	Bearchild	Bearchild	Bearchild	Bearchild	
Nurse	Sports	Search and Rescue	Teacher	Dentist	Doctor	Connection 1
Teacher	Sports	Engineer	Teacher	Dentist	Military	
3	3	3	3	3	3	
Social Studies/ Science	Native American	Recess	Math	Social Studies/ Science	Science and Math	Connection 2
Social Studies	P.E.	BISON!!!	Math/ Social Studies/ Science	Math	Math	
3	3	1	1	2	3	
Reading	Math	School	Language Arts	Reading/ Lang. Arts	Lang. Arts	Connection 3
Reading/ Science	Language Arts	Bison Today	Reading	Language Arts	Language Arts	
2	3	3	3	3	3	
Interesting	Interesting	Interesting	Interesting	No Opinion	Interesting	Connection 4
1	1	1	1	0	1	
Interesting	Interesting	Interesting	Interesting	No Opinion	Interesting	Connection 5
1	1	1	1	0	1	
Blank	Yes	Yes	Yes	Yes	Yes	Connection 6
Yes	Yes	Yes	Yes	Yes	Yes	
1	1	1	1	1	1	
Not Interesting	Not Interesting	Not Interesting	Not Interesting	No opinion	Interesting	Connection 7
Interesting	Interesting	Interesting	Interesting	No Opinion	Interesting	
1	1	1	1	0	2	
Interesting	Interesting	Interesting	Interesting	Interesting	No Opinion	Connection 8
Interesting	Interesting	Interesting	Interesting	No Opinion	No Opinion	
2	2	2	2	0	0	
3	3	3	2	3	3	Connection 9
2	2	3	2	2	2	
3	3	2	3	2	2	
1	1	1	1	1	1	
2	3	3	2	3	2	Connection 10
1	3	2	1	1	1	
3	2	3	3	1	1	
1	1	1	1	2	2	

PKC-25	PKC-24	PKC-23	PKC-22	PKC-21	PKC-20	Prior Knowledge and Completion Survey
7th	7th	7th	7th	7th	7th	
Bearchild	Bearchild	Bearchild	Bearchild	Bearchild	Bearchild	
Doctor	Lawyer	Vet	Architect	Video Game Designer	Military	Connection 1
Doctor/ Military	Lawyer	Animator	Sports	Video Game Designer	Military	
3	3	3	3	3	3	
Math/Social Studies	Science/ Social Studies	Reading/ Health	Math/ Social Studies	Reading	Math/ Science	Connection 2
Math/ Social Studies	Science/ Social Studies	Reading/ Art	Social Studies	Technology	Math	
3	3	3	3	3	3	
None	Math	Math	Reading/ Lang. Arts	Math	Language Arts/ Reading	Connection 3
None	Reading/ Language Arts	Math/ Reading	Reading/ Language Arts	Math	Reading	
3	3	3	3	3	3	
Interesting	Interesting	Not Interesting	Interesting	Interesting	Interesting	Connection 4
1	1	2	1	1	1	
No Opinion	Interesting	Not Interesting	Interesting	No Opinion	Interesting	Connection 5
0	1	2	1	0	1	
No	Yes	Yes	Yes	Yes	Yes	Connection 6
Yes	Yes	Blank	Yes	Blank	Blank	
1	1	0	1	0	0	
No opinion	Not Interesting	No opinion	No opinion	Interesting	Interesting	Connection 7
No Opinion	Interesting	Not Interesting	Interesting	Not Interesting	Interesting	
0	1	3	1	4	2	
Interesting	Interesting	No Opinion	Not Interesting	Interesting	Interesting	Connection 8
Interesting	Interesting	No Opinion	Interesting	Interesting	Interesting	
2	2	0	1	2	2	
3	2	1	2	3	3	Connection 9
3	3	1	1	2	2	
3	3	1	3	3	3	
1	1	2	1	1	1	
2	2	2	2	2	3	Connection 10
2	3	1	1	2	2	
2	3	2	3	2	3	
1	1	1	1	1	1	

PKC-30	PKC-29	PKC-28	PKC-27	PKC-26	Prior Knowledge and Completion Survey
7th	7th	7th	7th	7th	
Bearchild	Bearchild	Bearchild	Bearchild	Bearchild	
Military	Doctor	ARCHAEOLOGIST/ Scientist/ Author	Lawyer	Sports	Connection 1
Nanotechnologis t	Doctor	ARCHAEOLOGIST!!!/ Author	Lawyer	Sports	
3	3	1	3	3	
Social Studies/ Math	Math/ Fine Arts	Social Studies/ Science	Arts/ Math/ Science	P. E.	Connection 2
Science and Social Studies	Math	Science	Math/ Arts / Health	Math/ Social Studies	
1	3	3	2	1	
Language Arts	Language Arts	Math	Social Studies	Math	Connection 3
Language Arts	Reading	Math	Science/ Social Studies	Science	
3	3	3	2	2	
Interesting	No Opinion	Not Interesting	Interesting	Interesting	Connection 4
1	0	2	1	1	
Interesting	No Opinion	Not Interesting	Interesting	No Opinion	Connection 5
1	0	2	1	0	
Yes	Yes	Yes	Yes	Yes	Connection 6
Yes	Yes	Yes	Yes	Yes	
1	1	1	1	1	
Interesting	Not Interesting	No opinion	Not Interesting	Not Interesting	Connection 7
Interesting	Not Interesting	Not Interesting	Interesting	Not Interesting	
2	3	3	1	3	
Interesting	Not Interesting	No Opinion	Not Interesting	Interesting	Connection 8
Interesting	No Opinion	Not Interesting	Interesting	Interesting	
2	0	4	1	2	
2	2	2	3	3	Connection 9
2	1	2	3	1	
2	2	1	2	3	
1	1	2	1	1	
3	2	3	2	2	Connection 10
3	1	2	2	1	
3	2	2	2	3	
1	1	1	1	1	

PKC-36	PKC-35	PKC-34	PKC-33	PKC-32	PKC-31	Prior Knowledge and Completion Survey
7th	7th	7th	7th	7th	7th	
Bearchild	Bearchild	Bearchild	Bearchild	Bearchild	Bearchild	
Doctor	Military	Sports	Military	Teacher	History Teacher	Connection 1
Military	Police Officer	Sports	Military	Doctor	Sports	
3	3	3	3	3	3	
Social Studies/ Art	P.E.	P.E.	P.E./ Science/ Math	Robotics	Math/ Language Arts/ Science	Connection 2
Social Studies	Reading	P.E.	Language Arts	Bison	Science/ Social Studies	
3	3	3	3	1	1	
Language Arts/ Reading	Health	Reading	Language Arts	Language Arts	Art and Technology	Connection 3
Language Arts	Math	Language Arts	Science	Writing	Art	
3	3	3	2	3	3	
Interesting	Interesting	Interesting	Interesting	Interesting	Interesting	Connection 4
1	1	1	1	1	1	
Interesting	No Opinion	Not Interesting	Interesting	No Opinion	Interesting	Connection 5
1	0	2	1	0	1	
Yes	Yes	Yes	Yes	Yes	Yes	Connection 6
Blank	Yes	Yes	Yes	Yes	Yes	
0	1	1	1	1	1	
Blank	Not Interesting	Not Interesting	Interesting	Not Interesting	Interesting	Connection 7
Not Interesting	Not Interesting	Not Interesting	Not Interesting	Interesting	Interesting	
3	3	3	4	1	2	
Not Interesting	Not Interesting	Interesting	Not Interesting	Not Interesting	Interesting	Connection 8
Blank	Interesting	Interesting	Not Interesting	Interesting	Interesting	
0	1	2	3	1	2	
3	3	2	2	2	3	Connection 9
2	2	2	2	2	3	
2	3	2	2	3	3	
1	1	1	1	1	1	
3	2	2	2	2	3	Connection 10
2	1	2	1	2	2	
2	2	1	2	2	3	
1	1	2	1	1	1	

PKC-42	PKC-41	PKC-40	PKC-39	PKC-38	PKC-37	Prior Knowledge and Completion Survey
7th	7th	7th	7th	7th	7th	
Bearchild	Bearchild	Bearchild	Bearchild	Bearchild	Bearchild	
Police Officer	Nurse	Sports	Teacher	Police Officer	Smoke Jumper	Connection 1
Police Officer	Science Teacher	Sports	Architect	Police Officer	Smoke Jumper	
3	3	3	3	3	3	
Science/ Social Studies	Social Studies	Math/ Robotics	Math	P.E.	P.E.	Connection 2
Science/ Social Studies	Science	Math/ Robotics	Math/ Social Studies	Math	Forestry	
3	3	3	1	3	3	
Math	Reading	Language Arts	Language Arts	Health	Language Arts	Connection 3
Math	Reading	Reading	Reading	Health	Unknown	
3	3	3	3	3	3	
Interesting	Interesting	No Opinion	Interesting	No Opinion	Interesting	Connection 4
1	1	0	1	0	1	
No Opinion	Not Interesting	No Opinion	Interesting	No Opinion	Interesting	Connection 5
0	1	0	1	2	1	
Yes	Yes	Yes	Yes	Yes	Yes	Connection 6
Yes	Yes	Yes	Yes	Yes	Blank	
1	1	1	1	1	0	
Not Interesting	Not Interesting	No opinion	Not Interesting	Interesting	Not Interesting	Connection 7
Interesting	No Opinion	Interesting	Interesting	Interesting	Interesting	
1	0	1	1	2	1	
Interesting	Not Interesting	Interesting	Not Interesting	Interesting	Not Interesting	Connection 8
Interesting	Interesting	Not Interesting	Interesting	Interesting	Interesting	
1	1	2	1	2	1	
3	3	2	3	2	3	Connection 9
2	1	1	2	2	1	
3	3	2	3	2	3	
1	1	1	1	1	1	
3	2	2	3	2	2	Connection 10
2	2	1	2	1	1	
3	1	2	3	2	3	
1	2	1	1	1	1	

PKC-48	PKC-47	PKC-46	PKC-45	PKC-44	PKC-43	Prior Knowledge and Completion Survey
7th	7th	7th	7th	7th	7th	
Goss	Goss	Goss	Goss	Goss	Goss	
Sports	Lawyer	Nurse	Veterinarian	Scientist	Military	Connection 1
Police Officer	Lawyer	Nurse	Veterinarian	Police Officer	BISON MANAGER	
3	3	3	3	3	1	
P.E.	P.E.	P.E.	P.E.	Science	History	Connection 2
Reading	Language Arts	Science	Archaeology	Science	Film	
3	3	1	1	3	3	
P.E.	Language Arts/ Social Studies	Math	Science	Animals	Writing	Connection 3
Science	Math	Social Studies	Bison	Nothing	Writing	
3	1	2	2	3	3	
No Opinion	Interesting	Interesting	No Opinion	Not Interesting	Interesting	Connection 4
0	1	1	0	2	1	
Not Interesting	Not Interesting	Not Interesting	Not Interesting	Not Interesting	No Opinion	Connection 5
2	2	2	2	2	0	
Yes	Yes	Yes	Yes	Yes	Yes	Connection 6
Yes	Blank	Blank	Yes	Yes	Yes	
1	0	0	1	1	1	
No opinion	Not Interesting	Interesting	Interesting	Not Interesting	Interesting	Connection 7
Not Interesting	Interesting	No Opinion	No Opinion	Not Interesting	Interesting	
2	1	0	0	3	2	
No Opinion	Not Interesting	Not Interesting	Interesting	Not Interesting	Interesting	Connection 8
Interesting	Interesting	Interesting	Interesting	Not Interesting	Interesting	
1	1	1	1	3	2	
3	3	2	2	3	3	Connection 9
2	2	2	2	2	3	
2	3	1	1	1	2	
1	1	2	2	2	1	
1	1	2	2	1	3	Connection 10
2	2	2	2	1	2	
3	2	2	2	1	3	
1	1	1	1	2	1	

PKC-54	PKC-53	PKC-52	PKC-51	PKC-50	PKC-49	Prior Knowledge and Completion Survey
7th	7th	7th	7th	7th	7th	
Goss	Goss	Goss	Goss	Goss	Goss	
X	X	X	X	Vet	Police Officer	Connection 1
X	X	X	X	Veterinarian	Police Officer	
X	X	X	X	3	3	
X	X	X	X	X	P.E	Connection 2
X	X	X	X	X	Unknown	
X	X	X	X	X	3	
X	X	X	X	X	Unknown	Connection 3
X	X	X	X	X	Math	
X	X	X	X	X	3	
Interesting	Interesting	Interesting	Interesting	Interesting	Interesting	Connection 4
1	1	1	1	1	1	
Not Interesting	Interesting	Not Interesting	Not Interesting	No Opinion	No Opinion	Connection 5
2	1	2	2	0	0	
yes	yes	yes	Yes	Yes	Yes	Connection 6
yes	yes	yes	Yes	Yes	Yes	
1	1	1	1	1	1	
No opinion	Interesting	No opinion	Interesting	Interesting	Interesting	Connection 7
Not Interesting	Interesting	Not Interesting	Interesting	Interesting	No Opinion	
3	2	3	1	2	0	
No Opinion	Not Interesting	Interesting	Interesting	Interesting	Interesting	Connection 8
Interesting	Interesting	No Opinion	Interesting	Interesting	Interesting	
1	1	0	1	2	1	
2	2	3	3	3	3	Connection 9
2	2	2	2	3	3	
3	3	2	2	3	3	
1	1	1	1	1	1	
1	2	2	2	3	3	Connection 10
1	2	2	2	3	2	
2	2	2	2	3	2	
1	1	1	1	1	1	

PKC-60	PKC-59	PKC-58	PKC-57	PKC-56	PKC-55	Prior Knowledge and Completion Survey
7th	7th	7th	7th	7th	7th	
Goss	Goss	Goss	Goss	Goss	Goss	
X	X	X	X	X	X	Connection 1
X	X	X	X	X	X	
X	X	X	X	X	X	
X	X	X	X	X	X	Connection 2
X	X	X	X	X	X	
X	X	X	X	X	X	
X	X	X	X	X	X	Connection 3
X	X	X	X	X	X	
X	X	X	X	X	X	
Interesting	Interesting	Interesting	Interesting	No Opinion	Interesting	Connection 4
1	1	1	1	0	1	
Not Interesting	Interesting	No Opinion	Not Interesting	Interesting	Not Interesting	Connection 5
2	1	0	2	1	2	
yes	Yes	yes	yes	yes	yes	Connection 6
yes	Yes	yes	yes	yes	yes	
1	1	1	1	1	1	
Not Interesting	Interesting	Not Interesting	Not Interesting	Interesting	Not Interesting	Connection 7
Not Interesting	Interesting	Interesting	Not Interesting	Not Interesting	Not Interesting	
3	1	1	3	4	3	
Interesting	Interesting	Not Interesting	Interesting	Interesting	Interesting	Connection 8
Interesting	Interesting	Interesting	Interesting	No Opinion	Interesting	
1	1	1	1	0	1	
2	3	3	2	2	2	Connection 9
2	3	2	2	2	2	
3	3	2	2	3	3	
1	3	1	1	1	1	
2	3	2	2	1	2	Connection 10
1	3	1	1	2	2	
2	3	2	2	3	2	
1	3	1	1	1	1	

APPENDIX E: FURTHER RESOURCES

BISON:

Reading: http://www.nps.gov/badl/naturescience/upload/BisonVision.pdf
Bison Documentary: http://www.bison.tv/videos-bison-documentary-on-the-buffalo-%5BUo8CH3cGCGU%5D.cfm
Reading: http://www.texasbeyondhistory.net/bonfire/index.html
Fact Sheet: http://www.defenders.org/bison/basic-facts
Bison Osteology: http://lamar.colostate.edu/~lctodd/bison.htm
Great Buffalo Saga Documentary: https://www.nfb.ca/film/great_buffalo_saga
Cold Warriors Bison Documentary: http://www.youtube.com/watch?v=Zj82dImOwdw
Yellowstone Bison Reading: http://www.nps.gov/yell/learn/nature/bison.htm
Reading: http://animals.nationalgeographic.com/animals/mammals/american-bison/
Fun Facts for Kids: http://www.animalfactguide.com/animal-facts/american-bison/
Bison in Yellowstone Film Clip: https://www.youtube.com/watch?v=_XWL31_50R8
Facing the Storm: https://www.youtube.com/watch?v=_XWL31_50R8
The Buffalo War: http://www.pbs.org/buffalowar/
- **--Resources:** http://www.pbs.org/buffalowar/resources.html
- **--Lesson Modules:** http://www.pbs.org/buffalowar/guides.html

The Montana Experience: Stories from the Big Sky Country: The Return (2012): https://www.youtube.com/watch?v=kZ3HtWcXXbE&list=PLYSMxORqGlAkk3NI0Di8x5cLRw-t6wl-B&index=4
Bison Facts: http://www.bioexpedition.com/american-bison/
Bison Skeleton Image: http://photos.archeozoo.org/picture/2602-bison_bonasus/category/91-bovides_langen_bovidae_lang_langes_bovidos_lang_

ARCHAEOLOGY:

Archaeology for Kids: http://idahoptv.org/dialogue4kids/season7/archaeology/facts.cfm
Archaeology for Kids: http://www.digonsite.com/
Introduction to Archaeology Video for Kids: https://www.youtube.com/watch?v=hSY6-bV0ATk
Archaeology Science for Kids: http://www.sciencekids.co.nz/sciencefacts/careers/archaeologist.html
Public Archaeology: http://www.saa.org/publicftp/public/resources/lessonplans.html
Beyond Artifacts: Teaching Archaeology in the Classroom (Lesson Modules): http://www.flpublicarchaeology.org/resources/BeyondArtifacts2011.pdf
Education: https://rcnnolly.files.wordpress.com/2013/11/ncss-handouts.pdf
Archaeological Educational Resources (A Comprehensive Bibliography): http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=10&ved=0CFgQFjAJ&url=http%3A%2F%2Fwww.nh.gov%2Fnhdhr%2Fprograms%2Fdocuments%2Farchaeological_edu_resources.doc&ei=ZCwTVau1CYqpNqfYg-gG&usg=AFQjCNGYFBSotCaLjo4VcCCNCHvprXrruw&sig2=9BfdJpwIQHXeLFWHQcD57w&bvm=bv.89217033,d.eXY

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