STUDYING ZOOARCHAEOLOGY

Students engage in inquiry science to solve the mystery of bones

By Molly Moore, Deborah Wolf, and Virginia L. Butler


Students record observations and make connections to animal skeletons and their own bodies.

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Each bone holds its own mystery. So much so, that questions immediately form as small fingers handle textured markings on the hard surfaces. Why does this bone have a hole in it? Where does it fit? Bones are held and rotated for close inspection as creative minds eagerly share their imaginative questions and begin the inquiry process.

Children often associate the study of bones with dinosaurs or crime scenes. This unit introduces students to *zooarchaeology,* the study of animal remains from archaeological sites. Students in grades 3–5 engage in hands-on activities examining bones, shells, and other "hard parts" of animals. They use their observations as a starting point for developing science process skills or practices to draw inferences about past human behaviors and the connections between people and animals across the ages.

Our project builds on several previous curriculum models that suggest that bones provide a nonintimidating and practical way for students to enter the world of scientific practice (Johnson and Kassing 2002). These lessons may help students connect to the work of scientists, giving them practice developing questions, collecting data, and formulating inferences.

Background

This unit was developed for the At Home At School Summer Enrichment Program of Washington State University–Vancouver, which provides equity and opportunity to children who face systemic roadblocks to education. The unit consists of four to six lessons using animal bones, PowerPoint slides, and online photographs of specimens. Our students used a Portland State University animal bone collection (see sidebar, Finding Bones), though internet-based collections can be used. In our summer program, students visited an archaeological site excavation through the Youth in Parks Program (YIP) offered by the National Park Service at Fort Vancouver National Historic Site. This gave students a chance to see archaeology "in action" and additional context for understanding where zooarchaeological samples originate.

In addition to the school site–based summer program, unit lessons were also taught in several public elementary classrooms during the regular school year and were independent of the summer program. Teachers may adapt these lessons for use during the standard school year, for camp, or for school site–based summer programs to support student science learning in a novel way.

Zooarchaeology

At the start of our unit and with bones on display, students completed the first two sections of a KWL chart (What I Think I Know, What I Want to Know, What I Learned). Students offered: "Zooarchaeologists dig for things!" and "There's a whole world of bones." They wanted answers to questions such as: "What animal did this bone come from?" "What do archaeologists do in the field?" and "Why do you study animal bones?" We used students' prior knowledge and questions to guide our lessons.

We defined keywords such as *artifact* (anything used or deliberately modified or left somewhere by people) and *midden* (an accumulation of garbage), and described methods of archaeological site excavation. PowerPoint slides (see NSTA Connection) provided concrete examples of new terms and concepts and helped students connect to what real archaeologists do. We introduced *zooarchaeology* as the study of a particular kind of artifact—bones, teeth, and shells—that could be from animals and used by humans for food, transportation, decoration, clothing, or tools. Zooarchaeologists study bones to determine the kind of animal present, the part of the body the bones come from, and whether they show evidence of modification (cut, cooked, chewed). Professional researchers study "hard parts" of animals that are preserved in archaeological sites to learn about past human diet, hunting and fishing methods, and ultimately, the long-term relationship between humans and animals (e.g., the processes leading to animal domestication).

Resources: Finding Bones

Obtain cow, pig, sheep, or chicken bones or meat cuts from butcher and bake/boil to remove meat and grease with minimum effort; such bones will not be a hazard for children to handle.

Using bones or replicas is preferable but not necessary for these lessons. Scanned images of bones and whole animal skeletons are available online. Animal bones may be borrowed from local college anthropology or archaeology programs. Bone replicas may also be purchased from science suppliers.

For several of these lessons we shared classroom time with local archaeologists who provided bones and tools.

Internet Resources

Archaeological Institute of America
www.archaeological.org

Archaeology Program Teacher Resources
www.nps.gov/history/archeology/public/teach.htm
www.nps.gov/learn/curriculum.cfm

eSkeletons
www.eskeletons.org

Mink and the Iceni Chariot Horse
www.boxvalley.co.uk/nature/sns/wad69/w69-05.asp

National Park Service
www.nps.gov/findapark/index.htm

Newarchaeology
www.newarchaeology.com/bones.php

Society for American Archaeologists
www.saa.org

Virtual Zooarchaeology of the Arctic Project
http://vzap.iri.isu.edu

Students learned they create possible artifacts for future archaeologists to discover when they discard an object or hard part of an animal. Teachers gave examples and students offered, "My necklace could be an artifact." We asked students to name the last food-related artifact they may have created, and heard: "Eating a piece of chicken could make an artifact." Students used a graphic organizer with prompts to record their artifact example in science notebooks. We used an assessment rubric to evaluate students' work and development of scientific thinking (see NSTA Connection). Students completed their self-assessments after each notebook entry. The rubric, which was attached in their notebook, was used as both a formative and summative assessment. During the early stage of using scientific notebooks, students may experience difficulty recording their work. Supporting students through the use of sentence stems and writing prompts provides scaffolding for new users as well as English language learners.

Humans, Animals, and Food

The goal of this lesson was to show students how archaeologists use butchered meats and comparative specimens to build knowledge about animal skeletons as well as bones that are modified by people. Students were also challenged to see how they interact with animals through their food choices and how they leave behind potential artifacts for the archaeological record when they eat animals with bones or other hard parts.

To challenge students to examine their existing knowledge and make connections, we asked them, "What is the most common bird in the United States?" Students answered: "Eagle?" "Blue Jay?" "Crow?" A slide of a skeleton was shown. "What is this bird?" asked the teacher. Students exclaimed, "Chicken!" To create a tangible link between the chicken skeleton and individual bones, we passed around a prepared chicken drumstick (femur) that was part of an earlier meal (see sidebar, "Finding Bones") and discussed how observations of teeth marks on the bone helps us infer whether a human or an animal ate this chicken.

Before distributing the prepared bones, we demonstrated how to firmly handle them just above their desks to prevent breakage. We discussed safety rules, reminding students that observation does not include the sense of taste and that handwashing is important. We ensured all students washed their hands before and after touching the bones and provided latex-free gloves.

We discussed additional modifications and showed prepared examples, such as bones that are gnawed by animals, butchered with saws and axes, burned in a cooking fire, or scraped with knives or sharp rocks to remove the

Students use tools to observe and describe bone specimens.

meat. Students examined cow ribs and identified types of modifications. We were excited to hear students apply new vocabulary during this lively discussion. This was a great opportunity to actively prompt students to use correct scientific terminology. We formatively assessed their ability to clearly describe scientific observations as we walked through the room.

After this demonstration students were divided into small groups while teachers distributed other chicken and cow bones that had been modified in various ways (e.g., from cooking and butchering). Students recorded their observations and wrote two facts they learned about modifications in their science notebooks.

Zooarchaeology Lab

Taking Science to School (Duschl, Schweingruber, and Shouse 2007) advises guiding students to gather data and evidence through experiments and observations. In this lesson students use previously acquired measurement and data-recording skills to observe bones and form inferences about what animals people ate and other ways they used animals. As part of this background, we introduced students to methods of species and skeletal element identification without dissection. For example, elk, cow, and seal bones labeled by species, common name of animal, and skeletal position name (femur, rib, vertebra) were grouped on tables. We provided posters of animal skeletons and related human skeletal systems, rulers, magnifying glasses, scales to measure weight, and a data card for recording observations (see NSTA Connection). We reviewed the safety procedures and ensured students washed their hands before and after handling the bones.

Scientific inquiry involves observing and describing objects. Small groups of students rotated through stations and used their senses (except for taste) to examine, draw, measure, weigh, and describe bone specimens. We were delighted to see students use the posters to match the location of the animal bone relative to their anatomy. Students completed their data cards, discussed their observations, and generated lists of questions in their science

Students practice clearly describing their observations. "What animal or tool made this hole?" Students write inferences in their science notebooks.

notebooks: "What animal or tool made this hole?" "Why is this bone crushed at the end?"

We reminded students that scientists also use experiments, tests, research, collaboration, and their own creativity to learn more about artifacts. We shared slides from a zooarchaeology lab, a university bone collection, and testing equipment to help students understand how scientists use broader sources to acquire new knowledge (see Internet Resources).

The students asked questions, shared information, and recorded inferences in their notebooks. "How would I test my inference?" "What other information do I need in order to make better inferences?" "If the test doesn't work, what else could have made this mark?"

A Bone Mystery

Taking Science to School (Duschl, Schweingruber, and Shouse 2007) encourages giving students opportunities to use nonexperimental methods such as observation, historical reconstruction, and analysis. Obtaining the whole picture is like putting together a puzzle. Archaeologists need evidence from observations as well as tests, bone collections, field notes, and their creative minds to solve puzzles. In this section we demonstrated how archaeologists use the context in which a bone is found with other branches of science to solve puzzles.

We challenged students to use data we provided to develop inferences about the origins of the Alde River Femur (see Internet Resources). This bone was found in England under a bridge after a winter flood in 2007. We showed photographs of the discovery and asked students to develop three inferences based on their limited observations or personal experiences. Students practiced using observations from today to infer human behavior in the past.

"What brought the bone to the ledge under the bridge?" Using a think-pair-share structure, the class recorded inferences on a chart with sentence stems (underlined). "<u>I infer that</u> an animal brought the bone <u>based on the observation</u> that there were animal droppings by the bone." "<u>I infer that</u> a flood brought the bone under the bridge <u>because I know from my own experience</u> that water moves things."

Science is a process in which an established body of knowledge is continually being extended, refined, and revised—an important concept for students to grasp (Duschl, Schweingruber, and Shouse 2007). In forming scientific habits of mind, students must seek new information through additional tests, research, and connections to other bodies of knowledge, so we introduced new evidence. Students viewed a slide identifying observations and historical facts about the Alde River area, including a bronze bust of the Roman Emperor Claudius, which was found in the river in 1907 within 2 km of the horse femur discovered in 2007. Using comparative measurements, the researcher determined that the horse femur is too large to be from a donkey and too small to be from a modern horse. The students viewed a data chart (see Internet Resources) confirming the femur length is closest to that of horses from the Danebury Iron Age (5th to 1st century BC).

"With this new evidence, do we need to rewrite our inferences? Does our new data conflict with our inferences or support them?" Students shared their new thinking and reformulated their inferences using the sentence stems (underlined): "I infer that the horse fell into the water with the statue based on the observation that they were found near each other." "I infer that it was an old buried horse; the grave flooded, and erosion brought the bone under the bridge, based on the observation of the mud on the bone." Students recorded their new inferences in science notebooks, practicing the way scientists may change inferences based on new evidence or by looking at existing evidence in a new way.

Conclusion

We concluded with the What I Learned portion of the KWL chart. Students placed in small groups referred to their science notebooks and reflected on their learning by sharing their responses to question prompts they recorded throughout the unit. The groups were asked to record and share one question with the class that they still have that came about because of their learning. This supports the science skill of continually forming questions. Student learning was actively accessed during subsequent field trips to Fort Vancouver, where they shared their knowledge with National Park Service archaeologists. The students correctly explained what they learned about artifacts, how humans create them, and where they can be found. "I learned that I could make artifacts every time I eat a animal with bones," remarked one student.

When a Fort Vancouver archaeologist discussed our current use of regional landfills rather than local middens, and the study of halos of garbage around settlement dwellings, the children reported they were able to understand the vocabulary and concepts, and related them to their own lives. We encourage teachers to seek archaeology excavations where students can link their knowledge to active scientific inquiry. Teachers may contact their State Historic Preservation Office (see Internet Resources) for knowledge about archaeological resources in their area. Knowing that the students at this summer enrichment program chose their daily courses from about eight offerings, we were touched to hear one student exclaim, "Everyone at AHAS (At Home At School) should take this class." ■

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Print Resources

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Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996):

Content Standards

Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry (K–8)

Standard G: History and Nature of Science

- Science as a human endeavor (K–8)
- Nature of science (5–8)

National Research Council (NRC). 1996. *National science education standards.* Washington, DC: National Academies Press.

NSTA Connection

Download the PowerPoint slides, data card handout, and rubric at *www.nsta.org/SC1204.*