TIME TEAM AMERICA

How Many Bison Might Have Died Here: How Archaeologists Use Math as a Tool for their Research

Math: Grade Level: 6-12

Courtesy of USDA, Agricultural Research Service

MATERIALS

The materials needed for this activity are:

- Calculator
- Paper and pencil

Courtesy of Peter Bostrom

How Does Archaeology Use Math?

Archaeologists use math constantly while conducting research. This activity allows youth to see how math is used to understand human culture and behavior.

What?

Youth will use math, specifically something known as the minimum number of animal units (MAU) formula, to learn how archaeologists estimate the number of animals that humans might have used when they occupied a particular site.

Why?

Youth will learn to use the MAU to solve a problem. They will engage in interpretation as they discuss how they think humans behaved and utilized animals.

How?

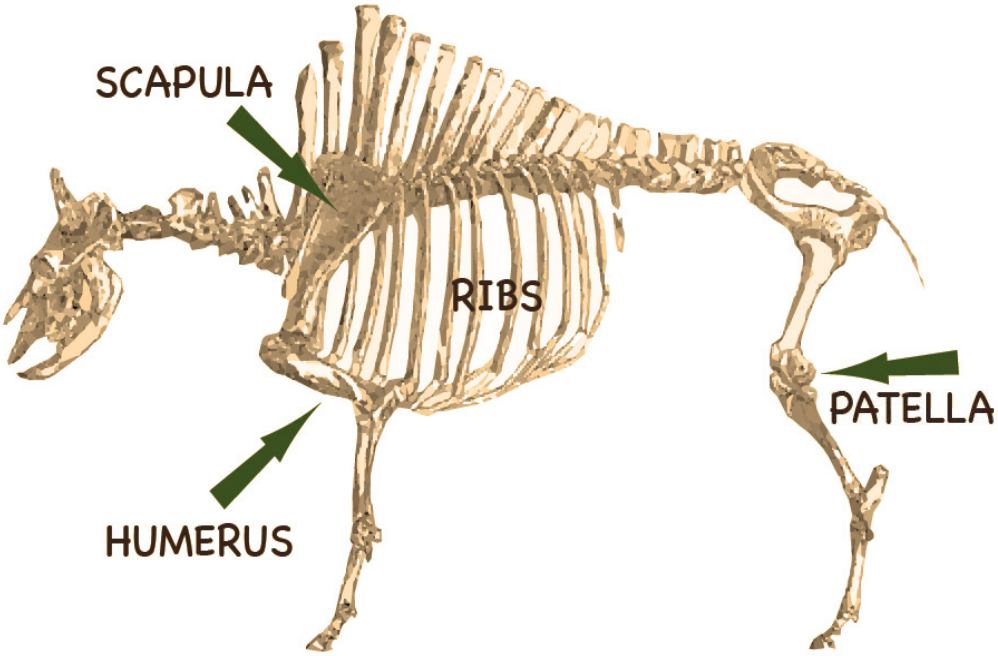
Write the minimum number of animal units (MAU) formula on a chalkboard or a handout. Also give youth a complete list of the number (count) of each kind of bone found in a bison skeleton.

Begin by telling the story of Lewis Binford who developed this approach to estimating the number of animals at a site. Binford is considered one of the most influential American archaeologists of the 20th century, yet he rarely conducted fieldwork. He felt that the traditional goals in archaeology of defining new artifact types or cultures was deficient, and never made a headline-grabbing discovery. Finding things was never as important to Binford as finding things *out*. He felt that mid-20th century approaches to archaeology (at the time called culture history) focused too much on merely describing artifacts and sites and their placement in time and space. He believed that archaeologists were not grappling with larger questions, for example, how past cultures adapted to their environment or changed over time. Starting in the 1960s, Binford worked to make archaeology more anthropological, evolutionary, and scientific (yes, he is one of the early leaders who brought STEM into archaeology!). His contributions over the next forty years (he died in 2011) resulted in radical changes in archaeological theory, methods, and most importantly, explanations of what the artifacts and remains meant. One of his contributions was the MAU formula, which was a mathematical tool that an archaeologist could use to analyze animal bones found at a site in order to estimate the number of animals present.

Have youth engage in this activity:

You're an archaeologist out on a dig and you find a pile of 6 bison femurs and 30 ribs. How many animals did it take to make the pile?

First have youth make guesses, what mathematicians call estimates, using logic and the information about the number of each kind of bone in a bison to puzzle out an answer. Remind them that there might be different strategies for figuring this out. For example, one approach could be to pair off the femurs and ribs: 6 femurs = 3 individual



bison; 30 ribs = 1 individual bison; with the 2 leftover there must have been more than 1 bison...etc.) Working through this should ideally give youth an intuitive understanding of the mathematics underlying the MAU, which Binford proposed in 1978:

Formula: Divide the total number of bones excavated by the total number of that particular bone in the whole animal. Then divide it by the highest MAU total to obtain a percentage (BINFORD, 1978).

After the youth have familiarized themselves with the formula, give them another archaeological problem to solve (individually or as a group). The example below is based on a bison and the number of individual bones located in a complete bison skeleton. You can talk about the traditional tools made with bison bones in order to help youth understand the cultural implications and why an archaeologist might be interested in knowing how many animals were present at the site that could be used to make tools—and as food.

The 2nd problem: *Archaeologists excavate a site and find bison bones. You are the head archaeologist and have found what you think are 10 bison. There are 5 scapula, 240 ribs, 20 patella, and 20 humerus bones recovered. What is the MAU for each type of bone? What does this tell you about the people that killed the bison?*

NOTE: When it comes time to calculate percentages, ideally youth will be familiar with the idea that percents, decimals, and fractions are all just ways to compare a "part" to the "whole". That's the intuitive definition that most youth begin to learn as early as grade 2 or 3. Framing the calculations along these lines may make them more intuitive for youth. Here the "whole" is the MAU for the whole pile—how many animals it took to make this pile. The "part" is the MAU for whatever type of bone you care about. If it's scapula, then divide the part by the whole, 2.5/10 = 0.25.

If a youth is struggling, have s/he first write, for example, 0.25 as a fraction: 25/100. From there they can read off the percentage according to the definition of percent: "for every 100." So "25 for every 100" is the same as "25 percent" or just 25%.

After the students solve the problem have them discuss which bones are missing from the total assemblage and which bones the people removed to use for possible tools.

Solution: Divide the total number of bones excavated by the total number of that particular bone in the whole animal. Next, divide it by the highest MAU total to obtain a percentage.

5/2 = 2.5
240/28= 8.5
20/2 =10
20/2= 10

Divide it by the highest MAU total to obtain a percentage.

10 is the highest MAU number, divide each answer by .10

2.5/10 = 0.25 = 25%
8.5/10 = 0.85 = 85%
10/10 = 1.0 = 100%
10/10 = 1.0 = 10

Courtesy of National Park Service

What did you discover?

Have a discussion about Binford's contributions to archaeology. How do youth think he came up with the MAU formula? Discuss the traditional tools made with bison bones and what this technology allowed people at the site to do.