**Mound Math**
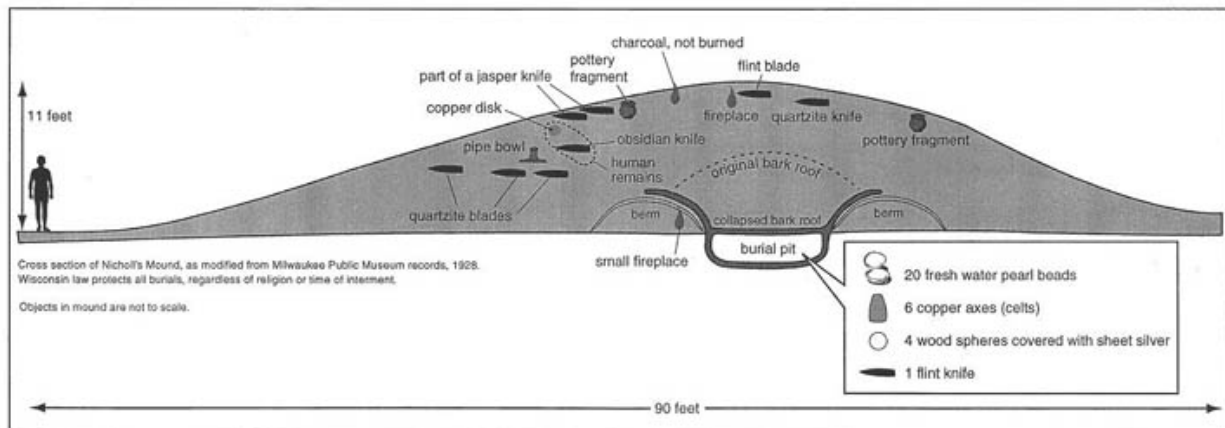**Excel Exercise**
**Numbers and Operations**

In the early part of the 19th century, prior to extensive farming and development in Wisconsin, archaeologists estimate that there were over 15,000 earthen burial mounds in the state. They represented a major investment of labor and energy for the pre-contact Native populations, and were important social, ritual, and religious monuments. One example of a mound is Nicholls mound, in Trempealeau Wisconsin.  There is information on the MVAC website about this mound, and about the people who built it and buried their dead there.
http://www.uwlax.edu/mvac/SpecificSites/Trempealeau.htm#Hopewell



Cross section of Nicholl's Mound, as modified from Milwaukee Public Museum records, 1928. Wisconsin law protects all burials, regardless of religion or time of interment.

Objects in mound are not to scale.

Archaeologists think these mounds were made by piling basketloads of dirt.  In Nicholls, we can see some of the outlines of the different basketloads, as each load of soil came from a slightly different place and looks just a bit different.
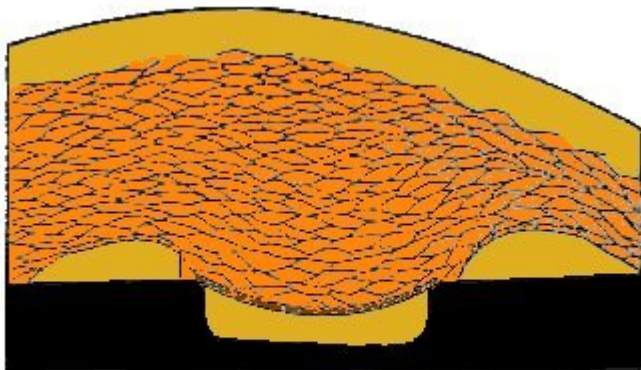


Adapted from a drawing in " A Wisconsin Variant of the Hopewell Culture', W. C. McKern, 1931.

**YOUR TASK:**

You have several questions about the mounds:

How long did it take to build a mound the size of Nicholls mound, and how many people could it have taken to build it?

How long would it take you to build a scale model of the mound (not including any of the artifacts) in your school yard? How much soil would you need to use?

To answer these questions, you need to do some calculations about the mound. Do these in an Excel spreadsheet.  Record all of the information and label it appropriately.

**Dimensions:**
Use the attached profile of Nicholls mound to estimate the diameter and height of the mound. Record this in a table in the spreadsheet, for example:

|  | Diameter | Height |
|---|---|---|
| Original Mound: | | |

**Volume:**
Think of at least two different mathematical ways to estimate the volume of Nicholls mound, and calculate the mound volume by each method.  Discuss your assumptions in using each method.

**Time estimates**
You would like to know how long it took to build these mounds. You decide to do an experiment with your class.  You discover that one person can carry about 1 cubic foot of soil at a time, and that one person can gather about 5 cubic feet per hour.

*For these next calculations, choose the volume estimation method  that you think most accurate, and use that one.*

How many person-hours did it take to build Nicholls mound?
Assuming a group of 50 people working together, how many 8-hour days did it take?

**Scale models**
You would like to build a scale model of the mound in your school yard, using soil that you will buy from the local garden store.  You decide to make it a 1/10 scale model.

Based on your original estimates of time, how long do you think it will take to make the replica? (Take a guess here, you'll calculate it later)

How big will your replica mound be? Diameter?          Height?

What will be the volume of your scale-model mound?
Calculate how long it would take one person to build your 1/10 scale model mound?

You wonder if you can make a still smaller mound for your classroom, and a much larger one for the city park? Assuming you do a 1/20 scale model, and a 1/2 scale model-what are the diameter and heights of each of these mounds, and how do the volumes change?

|  | Diameter | height | volume |
|---|---|---|---|
| 1/20 scale model: | | | |
| ½ scale model | | | |

What is the ratio of your scale model replica to the original mound diameter?
To the original mound height?
To the original mound volume?

What pattern do you observe in the way that the ratios for diameter and height differ from that for volume?

How long would it take one person to build the 1/20 scale model?
The ½ scale model?


**Math investigations**
How does the volume vary in relation to the diameter and height?  In other words, in a 1/10 scale model, where height and diameter are 1/10 of the original, what is the ratio of the volume of the scale model to the original mound?

How can you use ratios and formulas to calculate the volume of any scale model?


**Extensions:**
For your budget you need to know how many cubic <u>yards</u> of soil you will have to purchase?
How does your 1/10 scale model mound volume estimate translate into cubic yards of soil?

**Assessment framework topics addressed:**
Addresses use of fractions, decimals, and ratios, and addresses calculation of volume of irregular objects.

Apply proportional reasoning to a variety of problem situations (eg comparisons, rates and similarities)
Use all operations in everyday situations to solve single or multi-step word problems
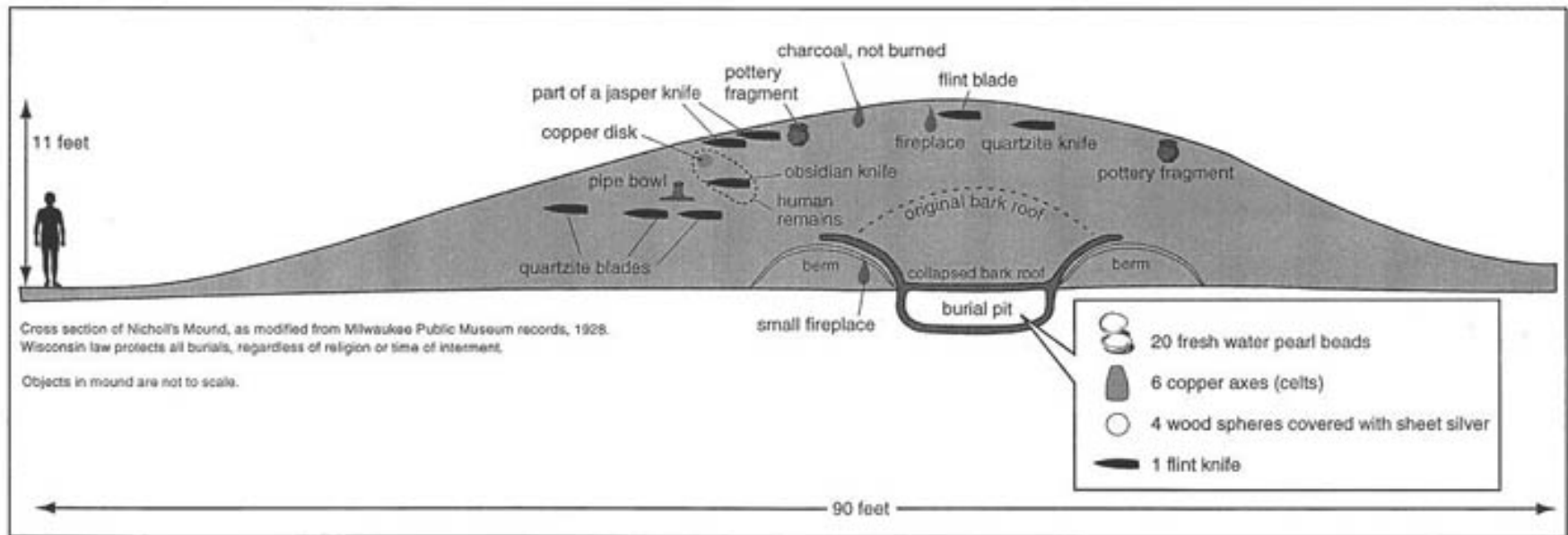
From Geometry:
Identify, describe, and compare properties of 2 and 3 dimensional figures
Determine perimeter and area of irregular shapes when given a reference tool such as a grid
Draw similar figures in any shape using a scale factor (e.g. enlarge/shrink)
Identify three-dimensional shapes from two-dimensional perspectives
Use geometric formulas to derive lengths, areas, volumes of common figures

Cross section of Nicholl's Mound, as modified from Milwaukee Public Museum records, 1928.
Wisconsin law protects all burials, regardless of religion or time of interment.

Objects in mound are not to scale.

Cross-section of Nicholls Mound, as modified from Milwaukee Public Museum records, 1928
The above box is 90 feet from end to end (so you need to estimate just how big the mound itself is)
The mound is 11 feet high

Objects in mound are not to scale.

http://www.uwlax.edu/mvac/SpecificSites/Trempealeau.htm#Hopewell

(Wisconsin law protects all burials, regardless of religion or time of internment)