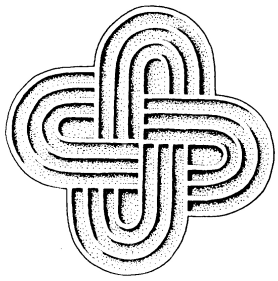
Lesson 2.10

ARCHAEOLOGICAL SOILS

Subjects: science, mathematics.
Skills: analysis, evaluation, knowledge.
Strategies: computation, observation, scientific inquiry, classification.
Duration: 30 minutes one day, 30 minutes on the following day.
Class Size: any.



Stamped decorative motif on pottery vessel from Montgomery County, North Carolina, AD 1200–1400.

Objectives

In this lesson about archaeological soils, students will:

- determine components of a soil sample;
- evaluate how archaeologists use soils to interpret sites.

Materials

For the teacher, a large box of crayons and a sheet of paper divided into four blocks. For each student, copies of "What is My Soil?" instruction and activity sheets, and an "Archaeological Soils Triangle" activity sheet; a baby food jar, a colored pencil or marker, and a soil sample in a plastic bag. For each four or five students, a pitcher of water, a magic marker, and a ruler.

Vocabulary

Clay: a type of soil whose particles are too small to be seen or felt. When wet, clay is sticky and plastic.

Geomorphologist: a scientist who studies the characteristics, origins, and development of landforms, including soil.

Loam: a rich soil containing a relatively equal mixture of sand and silt, and a smaller proportion of clay.

Munsell Color Chart: a book whose pages contain color chips that are used to determine soil color.

Proportion: the amount of a portion or a constituent in relation to the whole.

Sand: a type of soil whose particles are large enough to be easily seen and felt. Sand particles do not adhere or stick to one another, and grate against each other when rubbed together.

Silt: a type of soil whose particles are too small to be easily seen with the naked eye. Particles of silt are intermediate in size between those of clay and sand.

Soil triangle: a chart used by archaeologists and geomorphologists to determine soil texture.

Suspension: a state or condition where particles of a substance are mixed with a fluid, but are not dissolved.

Background

When archaeologists excavate, they dig through soil layers formed by people's activities. The artifacts that archaeologists recover from the soil layers provide clues about what happened at

that site, but the soil itself is also an important source of information for archaeologists. Through soil analysis, archaeologists can help date sites, learn about the environment at the time the soil layers were formed, and discern how soil layers were formed. Studies of soil fertility, for example, help archaeologists understand how efficient ancient agricultural systems were.

Accurate descriptions of soils help archaeologists understand what happened in the past at their site. Archaeologists use a special book called a *Munsell Color Chart* to help them describe the colors of the soil layers they are excavating. This book has pages filled with color squares, like the paint chips or samples you may have seen at a hardware store. By comparing the color of the archaeological site's soil with the color chips, archaeologists can determine soil color and name it in a standardized way. This is important because what one person calls brown, another person might see as gray. Calling the same soil layer two different colors could cause confusion later when archaeologists try to understand the site and write a report about their findings.

In addition to describing the color of the soil, archaeologists also need to characterize the texture of the soil layers on their sites. Soil is made up of three components: sand, silt, and clay. Particles of each component are different sizes, with sand the largest and clay the smallest. It is unusual to find a soil composed entirely of *sand*, *silt*, or *clay*. Generally, a combination of these three types of particles is found in most soils. The percentages or relative *proportions* of each particle type in a particular soil determine what type of soil it is. For example, a sandy *loam* contains approximately 50% sand, 30% silt, and 20% clay.

Geomorphologists and archaeologists who study soil use a *soil triangle* to help them determine what type of soil they are examining. Just as using a Munsell Color Chart ensures that everyone describes soil color in the same way, using a soil triangle guarantees that people describe soil texture consistently. To use a soil triangle, archaeologists first determine the percentages of sand, silt, and clay in each soil sample. They do this by thoroughly mixing the soil sample with water in a glass container and letting the different soil types settle out. The heaviest particles, those of sand, will sink to the bottom of the container first and form a layer. All of the silt particles will settle on top of the sand, forming a second layer. Particles of clay, which are the lightest component of soil, will be the last to settle and will rest on top of the silt.

By looking at the thickness of each layer, the archaeologist can determine the proportions of sand, silt, and clay in each soil sample. After deciding on the proportions, the archaeologist uses the soil triangle to determine soil texture. Each side of the soil triangle is marked with a different soil texture. For example, if the soil sample has 30% sand, 60% silt, and 10% clay, he would locate each of these numbers along the sand, silt, and clay sides of the triangle. Following the lines from each number to the point where they all meet or intersect shows that the soil in the sample is a silty loam.

Here's how you read the soils triangle: Each vertex of the triangle represents 100% of a particular constituent—sand, silt, or clay. As you move away from a vertex toward the opposite side of the triangle, the percentage of that constituent decreases to zero. Thus, each combination of three percentages (which must add up to 100%) uniquely defines a single point within the triangle where those percentages converge.

Setting the Stage

Prior to beginning the lesson, select four crayons representing different shades of blue. On a sheet of paper divided into four sections, color each block with a different shade. Number the blocks. Show the colored sheet to students and ask them to assign a color name to each block. (Be sure to keep the shades' "official" color names secret.) Have students share the color names

they chose. How many of them picked names for each square that matched the color name written on the crayon wrapper? How many different names of blue surfaced? If an archaeologist called an ancient bead turquoise blue, would everyone know what color he or she means?

Procedure

1. Several days before the exercise, ask each student to bring a small plastic bag of soil obtained from or near home. Encourage them to be creative when deciding where to gather the soil. One person may want to sample the soil from a flower bed; another the bottom of a creek. Other possible places include the eroded side of a road bank, a child's sandbox, etc. Students should describe where they gathered the soil by writing the location on the outside of the bag with a magic marker or placing a label inside the bag.

2. On the day of the exercise, distribute to each student an empty baby food jar, a ruler, a copy of the "Archaeological Soils Triangle" activity sheet, and the "What Is My Soil?" instruction and activity sheets. Be sure to tell students to have adult supervision when collecting their soil samples so they do not dig in inappropriate or dangerous places.

3. Go over the "What Is My Soil?" activity sheet and have students follow instruction numbers 1 and 2. After marking a horizontal line one inch from the bottom of the jar, the students should pour in soil up to the mark. Ask them to write the soil source on the jar lid with a magic marker or tape the label to the jar lid. The jar should then be filled halfway with water and the jar lid tightly closed.

4. While holding the jar securely, the student should shake the jar up and down to completely mix the soil and water. Then, the soil jar should be placed on a level surface in a location where it will not be disturbed over the next day.

5. Instruct students to fill in questions 1 and 2. After about 10 minutes, have them observe the soil in the jar without touching or disturbing the jar. Have different soil layers formed? How many? Is there a layer of clay visible on top of the silt layer yet? (It usually takes 12 or more hours for the clay to completely settle out of *suspension*, since the particles are so small and light.)

6. On the following day, project the "Archaeological Soils Triangle" transparency and, using the example provided on the "What Is My Soil?" instruction sheet, show students how to determine soil texture. Instruct them to get out all three activity sheets from the previous day. Distribute a colored pencil or marker to each student.

7. Instruct students to, again without touching or disturbing the jars, observe the soil in the bottom of their jar. How many different soil layers have formed? Have them use a ruler to measure the soil in the bottom of the jars. What percentage of their sample is made up of sand? Of silt? Using proportions of sand to silt to clay for their individual soil samples, have the students determine the soil texture of their soil sample. Using a colored pencil or marker to highlight each of the three lines will help the students see where the lines intersect.

8. Instruct the students to answer questions 3 and 4 on their "What Is My Soil?" activity sheet.

Closure

Ask students to think about whether they see any patterns in the class's soil samples. For example, were soil samples collected from gardens more often in the loamy sand or sandy loam category than soil samples collected from stream beds or road cuts? What might it mean for archaeologists to find patterning in soil textures? You may want to guide students into thinking about soil fertility, plant growth, and where ancient peoples might have chosen to settle.

Evaluation

Have students turn in their activity sheets for evaluation.

Links

Lesson 1.3: "Observation and Inference."
Lesson 2.2: "Stratigraphy and Cross-Dating."

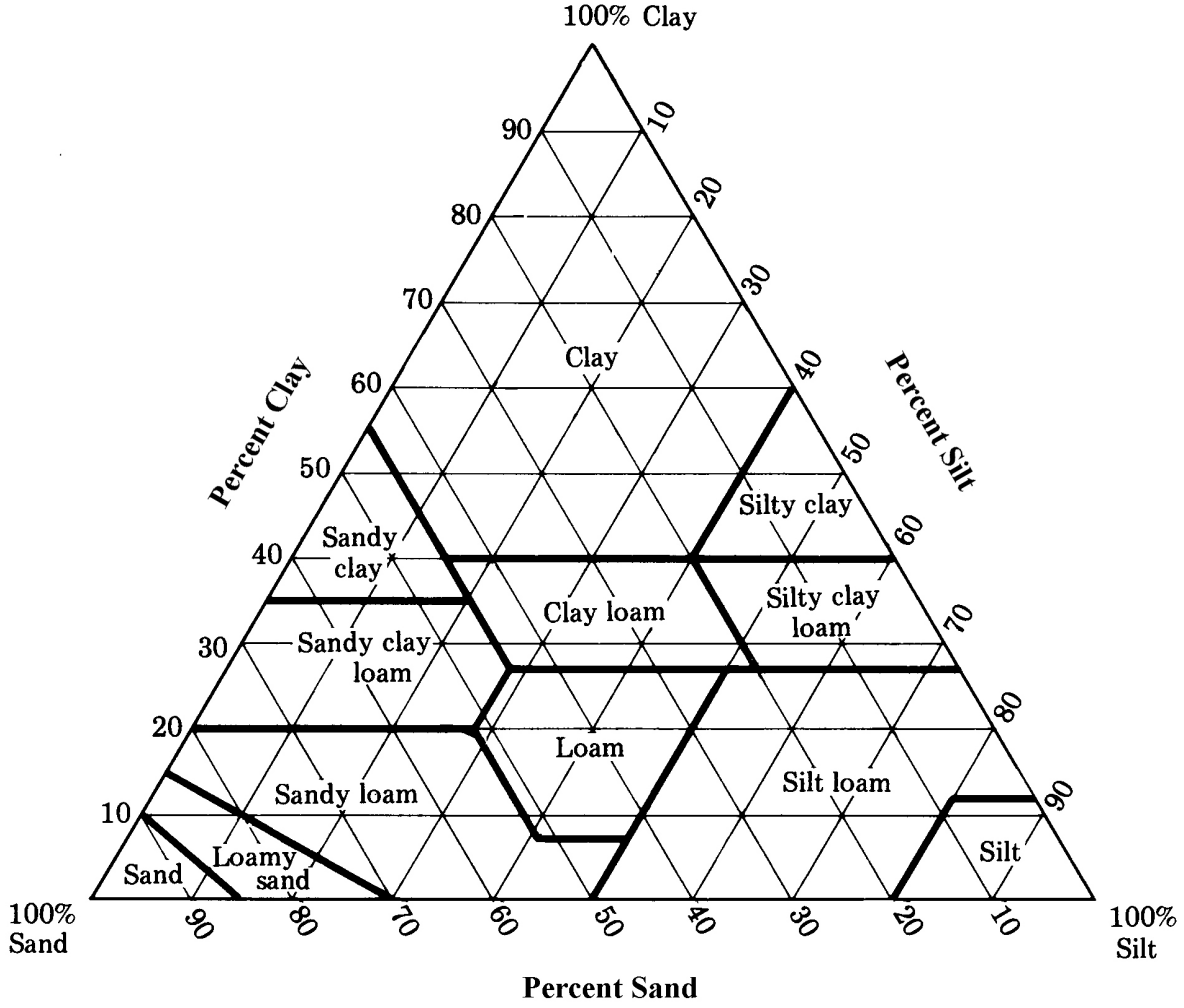
Sources

Birkeland, Peter W. 1974. *Pedology, Weathering, and Geomorphological Research.* New York: Oxford University Press.

Limbrey, Susan. 1975. *Soil Science and Archaeology*. London and New York: Academic Press.

Ward, H. Trawick, and R. P. Stephen Davis, Jr. 1999. *Time Before History: The Archaeology of North Carolina*. Chapel Hill: University of North Carolina Press. [The image in this lesson's main heading is taken from Figure 4.24.]

Archaeological Soils Triangle



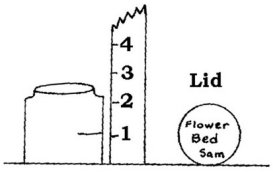
Sand has particles that are easily seen and felt. They grate against one another when rubbed together.

Clay particles are too small to be seen or felt, but when moist, clay looks and feels a lot like modeling clay. When you rub clay between your fingers, it usually leaves a smear on the ends of your fingers.

Silt particles are too small to be seen with the naked eye and have a smooth feel.

What is My Soil?
Instruction Sheet

In this exercise, you will be testing a soil sample to determine its texture. Follow the steps below.



1. Place your jar on the table and, standing your ruler against the side of the jar, draw a horizontal line on the jar one inch up from the bottom. Pour soil from your sample up to the line. Write the location from which you obtained the sample on the jar lid.

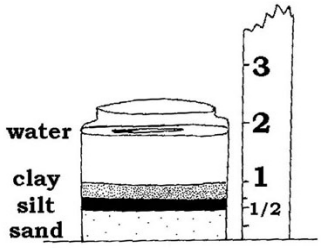
2. Fill the jar halfway with water and screw the lid on tightly. Holding the jar securely, shake the jar up and down to completely mix the soil and water. Then, place the jar on a level surface where it will not be disturbed for the next day.

3. Answer questions 1 and 2 on the "What is My Soil?" activity sheet. Go over the soil triangle with your teacher and learn how to use it.

4. After 10 minutes, observe the soil in the jar without touching or disturbing the jar. Have different soil layers formed? How many?

5. On the next day, use a ruler to measure the thickness of each soil layer. What percentage of the sample is made up of sand? What percentage is made up of silt? Is there a layer of clay visible on top of the silt layer? Using the soil triangle, plot the percentages of sand, silt, and clay to determine the texture of your sample. (See the sample exercise below for an example of how to proceed.) Then answer questions 3 and 4 on the activity sheet.

Sample Exercise

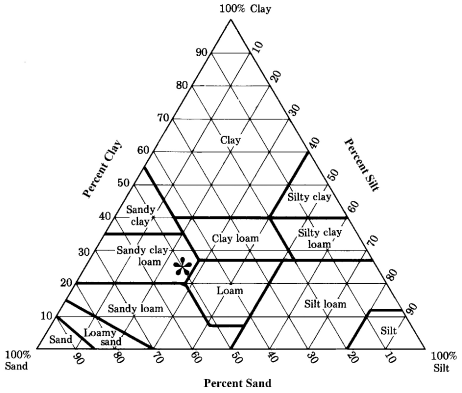


In the soil sample at left:

- the sand layer is ½ inch thick,
- the silt layer is ¼ inch thick, and
- the clay layer is ¼ inch thick.

Therefore, within this sample:

- sand makes up 50%,
- silt makes up 25%, and
- clay makes up 25%.



The asterisk marks the point where these percentages converge on the soils triangle at right. The soil is a sandy clay loam.

What Is My Soil?
Activity Sheet

Name:

Follow steps 1 and 2 on "What Is My Soil?" instruction sheet and then answer the following questions.

1. Where was your soil sample taken?

2. Rub the soil sample between your fingers. Based on the feel and look of the sample, make a preliminary guess (hypothesis) about whether sand, silt, or clay is the major (most abundant) component of your soil sample.

- What is the major component of your soil?
- Why do you think so?

Answer the following questions the day after you begin the exercise.

3. What are the percentages of sand, silt, and clay in your soil sample?

4. What is your soil texture?

Did you guess correctly yesterday the major component of your soil?

Use the space below to calculate the percentages of sand, silt, and clay for your soil sample.