Activity 31: Determining a Soil's Textural Classification

Maine Geological Survey

Objectives:

To use particle size analysis as a tool to determine a soil's texture. To understand the role of sand, silt, and clay sized particles in a soil.

Time:

This activity is designed to last two (2) class periods.

Background:

The generic soil names such as sandy loam, silty clay loam, sandy clay, and others are not mere descriptive terms, but are derived from quantitative analysis of the soil particles. The names have specific meaning in terms of the percent mass composition of the three specific particles, sand, silt, and clay. These particles have very specific size ranges and a change in the amount of any one can greatly affect the characteristics and hence the use of a given soil. The size ranges are as follows:

Sand	Any particle smaller than 2 mm and greater than $1/16^{th}$ mm
Silt	Any particle smaller than $1/16^{th}$ and greater than $1/256^{th}$ mm
Clay	Any particle smaller than $1/256^{th}$ mm

Particles in excess of 2 mm are called gravel; many Maine soils will contain some gravel-size fragments; these should be removed at start of the activity. It should be noted that sand, silt, and clay are PARTICLE SIZES only; any attributes they have are due to size/space/surface area relations and are NOT due to some innate chemical property of the substance we call sand.

The ideal mixture for agriculture is called loam and has roughly 40% sand, 40% silt and 20% clay. The texture of a soil determines its capacities and limitations. Many clay-rich soils are notorious for having poor drainage, high water retention, and substandard building surface potential. Because of the severity of drainage problems in certain soils, Maine law requires a percolation test prior to any construction involving the discharge of sewage or other wastes into the soil. Soils that do not pass this test must have leach fields constructed on them from sand and gravel imported from other areas; these leach fields can be very expensive, adding considerably to construction costs.

The texture triangle (Figures 1 and 2), sometimes referred to as the tertiary soil diagram, is used to plot the soil texture class.

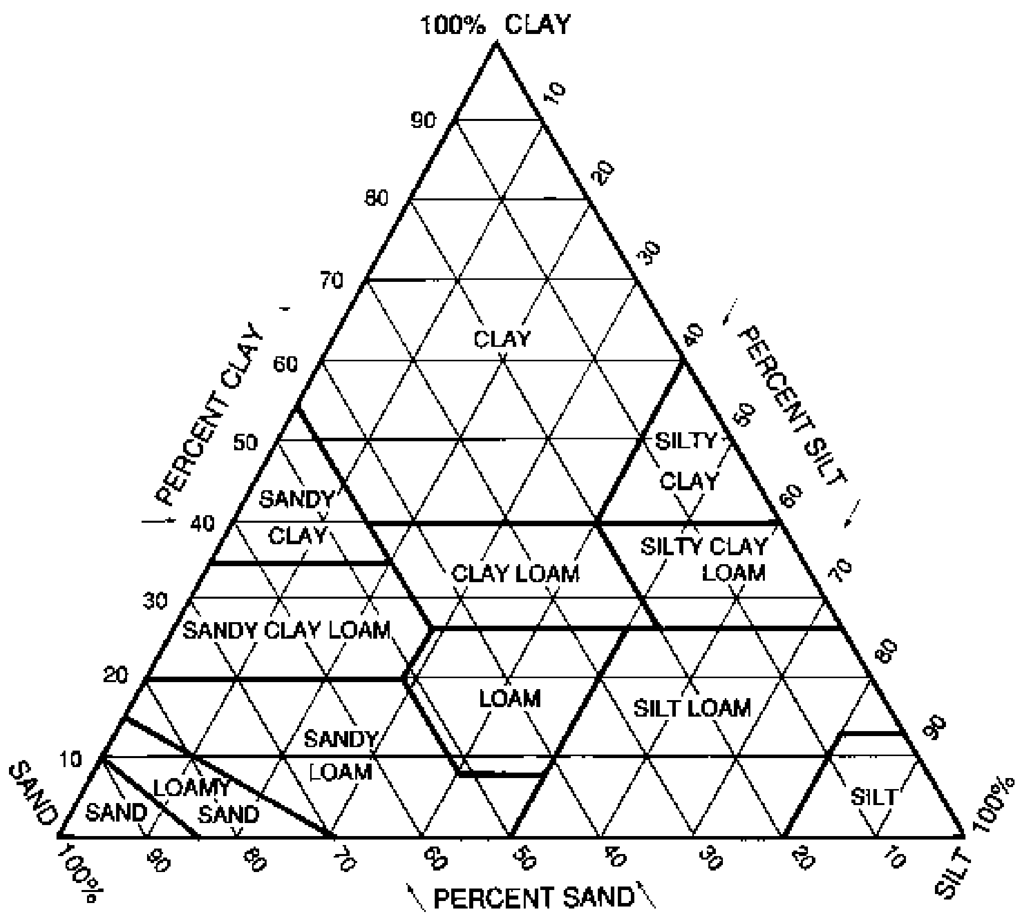

Figure 1. The texture triangle, sometimes referred to as the tertiary soil diagram. Notice that if you plot a soil with the following percent values- sand 50%, silt 22%, and clay 28%- the point of intersection of the three lines lands in the sandy clay loam area of the chart. Also notice that any soil with over 50% clay will almost invariably be referred to simply as a clay soil.

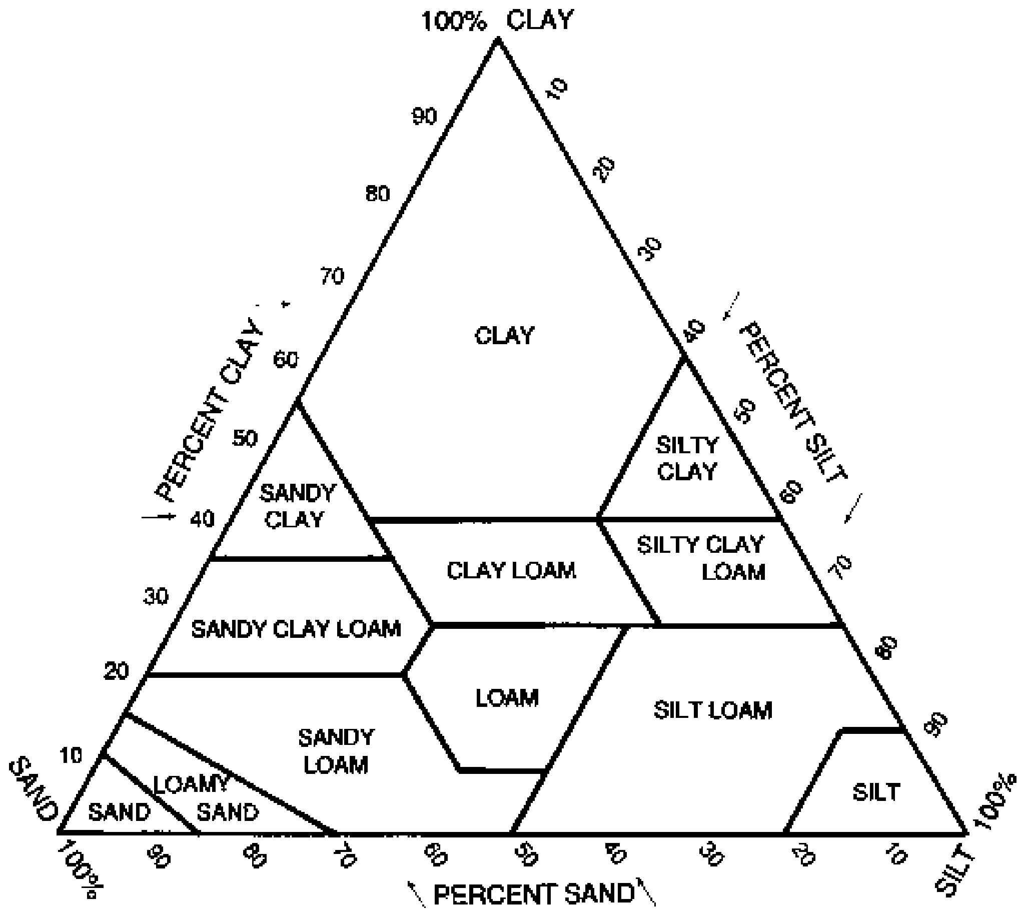

Figure 2. The texture triangle, sometimes referred to as the tertiary soil diagram. This second chart is included to show ONLY soil texture boundary lines leaving the plotting guidelines out.

Materials:

Each group of students will need two soil sieves, numbers 3 and 4, from Activity #29 (Constructing a Set of Soil Sieves), a soil sample collected from their lawn or garden, access to a balance, a 400 ml beaker, a copy of the tertiary soil diagram, and a copy of the local county soil survey map. Sheets of newspaper (for use in rug areas) are optional.

Procedure:

Have the students record the weight of a clean, dry 400 ml beaker. Fill the beaker almost full with soil from their sample and weigh again; subtract the weight of the empty beaker to obtain the weight of the soil. Place the sample in the soil sieve (#3) that will retain the sand. Sieve the sample until all the material that will pass through the sieve has done so; the material remaining in the sieve is the sand fraction. Repeat this process with the finer silt sieve (#4); the material that has passed through this sieve is the clay fraction. The remains in the sieve are the silt fraction. Place each fraction, BY ITSELF, back into the beaker and weigh it, subtract the weight of the beaker, and record the weight of the fraction. Divide by the weight of the total sample to obtain the percent of each fraction.

Follow the direction arrows on the soil texture diagram, draw lines for each of the sieved soil fractions to the opposite side of the diagram. The point where the three lines intersect is the textural name of your soil. Notice when plotting your lines that the sand fraction value runs parallel to the silt side, the clay fraction value runs parallel to the sand side and the silt fraction value runs parallel to the clay side. Once the students have found the general soil class name, have them use the county Soil Survey Maps.

Use the locator map to find the specific map that shows where the sample was collected. Then use this map to determine the exact point where the sample was collected. Using the soil contours find the symbol for this soil type, look it up in the text of the booklet, and obtain the SPECIFIC soil name (i.e., Adams fine sandy loam). A brief description in the text will describe the characteristics of this soil. Students should copy the pertinent information.

Follow-Up:

You may wish to save the sand, silt, and clay fractions of these separations for a percolation rate demonstration prior to Activity #32 (The Percolation Rate of a Soil). You may wish to separate a subsoil and demonstrate how this differs significantly from a topsoil. Experiment with soils from other parts of the country/state.

References:

Activity developed by Kevin Godsey, in conjunction with the 1991 CREST intern program.

Name___________________________

Activity 31: Determining a Soil's Textural Classification

Maine Geological Survey

Student Sheet

Purpose:

To determine the percentages of different particle sizes in a sample of soil so that it may be classified according to its texture.

Materials:

You will need a set of soil sieves, a self-collected soil sample from your lawn or garden, access to a pan balance and a calculator. You will also need a tertiary soil diagram, a copy of your local county soil survey maps, pens, notebook, and possibly sheets of newspaper.

Procedure:

Sort through your sample and remove any roots, rocks, or pieces of organic debris larger than 0.5 inches before starting.

1. Weigh and record the weight of a clean, empty 400 ml beaker.

Weight of Beaker: ________________________ grams.

Fill the beaker at least 3/4 full of your soil sample. Weigh the sample, subtract the weight of the empty beaker and record the weight of the soil.

Weight of soil sample: _______________________ grams.

2. You may wish to spread out a sheet of newsprint before starting this next part, this is especially true if you tend to be a "messy" worker. Place the entire sample from Part 1 into the soil sieve that retains sand sized particles. (If you constructed your own soil sieves, this will be the number 3 sieve). Using a sheet of paper as a cover, shake the sample until no more material passes through the sieve. The material left in the sieve is the sand fraction of your sample; pour this sand fraction back into the beaker, weigh it, subtract the weight of the empty beaker and record the weight of the sand. Remove the sand from the beaker; your teacher will tell you where to put it.

Weight of sand: ________________________ grams.

3. Take all of the materials that passed through the number 3 sieve and place them in a sieve that will retain silt. (If you constructed your own sieves, this will be the number 4 sieve). Sieve the sample and place what is left in the sieve into the empty beaker; weigh the beaker and contents; subtract the weight of the empty beaker and record the weight of the silt. Remove the silt from the beaker and store as directed by your teacher.

Weight of silt: ________________________ grams.

4. Take the materials that passed through the number 4 sieve, place them in the beaker, weigh them, subtract the weight of the empty beaker, and record the weight of the clay. Store clay as directed by teacher.

Weight of clay: ________________________ grams.

5. Using the starting weight of the entire soil sample, calculate the percent value of each fraction as follows:

(Weight of sand x 100) / (Weight of entire sample) = ___________% Sand

(Weight of silt x 100) / (Weight of entire sample) = ___________% Silt

(Weight of clay x 100) / (Weight of entire sample) = ___________% Clay

Add up the three percent values for the respective fractions and see if they approximate 100%; if they don't come close, check your calculations.

6. Using the texture triangle, follow a line in the direction of the arrows for each of the three soil fractions. If you have a soil that has 30% sand for example, your sand line will start at the 30% value on the triangle's base and will connect with the 70% value on the clay side. After plotting the three percent values for your soil sample, locate the point or small triangle where the lines meet. The name in the boundary area of the point of intersection is the textural classification of your soil.

Soil type: ____

7. Now, using the soil survey map for your county, look up the exact location where you obtained your soil sample; there is a general locator map in the back of the soil survey map booklet. If you need help pinpointing your location, obtain assistance from the teacher. Once you have located the spot where your sample was collected, record the SYMBOL of the soil type.

Soil Survey Map Symbol: _________________________

Look up the name that is associated with this particular map symbol and record it. A list of the names and symbols is located on the page(s) just prior to the fold-out maps section of the book.

Soil name: _____________________________________

Briefly summarize the information that the soil survey provides about your soil sample:

Question:

1. How are the textural name and the soil survey name of your soil alike? How are they different?

2. Explain what a SPECIFIC soil survey name indicates about a soil.

3. Does your soil generally match the description provided in the survey book? If not, give some possible explanations why.

4. What special information did you gain from the soil survey description of your soil? What is your soil's slope?

5. For what human development activities is this soil well suited? Is it poorly suited for certain uses?