Types by Texture
Soil Isn’t a Dirty Word

Background

Remember that soils are made of tiny pieces of rock or minerals, but not all of the particles are the same size. Gravel particles are greater than 2.00 mm, sand is classified between 2.00 and 0.05 mm, silt is a particle that is between 0.05 and 0.002 mm, and clay is any mineral particle less than 0.002 mm.* To determine a type of soil, particles are analyzed. Most soils are a mixture of sand, silt, and clay and are said to be loams. If the sample has more sand it is a “sandy loam,” more silt is a “silty loam,” and more clay is a “clay loam.” Depending on the amounts of sand, silt, and clay, the soil type may be further classified as a “sandy clay loam,” “silty clay loam,” “silty clay,” etc.

Activity 1 is a “hydrology test” that, with the use of water, simply separates the soil particles. Sand is the largest particle in a soil sample (gravel is not small enough to be considered soil) and is a heavier, denser, particle that will settle out in the water within 1 minute. Silt (the next largest particle) will settle out in 3 to 4 hours and clay will take a few days or as long as a week to completely settle. Scientist will shake soil samples in water for 24 hours. This is to ensure that “tightly” bound clay particles are thoroughly separated, but for the classroom experiment the 2 minute shake will work. Organic matter will be the “debris” floating on top of the water, if the sample was dry. This usually is a very small amount that can’t be measured. Measuring the sand, silt, and then surmising what the clay will be will help to determine the type of soil in the jar. For example, if a sample size is two inches inside a mason jar and measures one inch in the bottom after settling for 1 minute, the sample is 50 percent sand and is considered a sandy type (probably sandy loam) soil.

Within 2 days the students should be able to see the different layers easily. The layers may be easy or difficult to see, depending on the color of the minerals in a given soil sample. Soil color is determined by the minerals in the soil, not the texture. Red soil can be sandy or made of clay.

When texturing soil samples by hand students should follow this criteria. Sand feels gritty; silt feels smooth, soft, somewhat slick, like the smooth silkiness of baby powder; and clay feels sticky and often stains the fingers. Soil samples containing a lot of clay will also be able to be pressed together through the thumb and forefinger to create a “ribbon” of soil. Clay soils stick together. Most of us have worked with potters clay. Potters clay is not quite as sticky, but a truly clay soil will hold together is a similar fashion. You cannot determine soil texture by color or where it is found in the soil profile. The touch method and hydrology tests determine soil texture.

Activity Procedures

Soil samples of sand, silt, clay, and loam can be obtained from Utah Agriculture in the Classroom (see Materials list). Soil samples can be used over and over if allowed to dry after each use. In each subsequent use, the samples can be moistened to a paste and textured as explained. If you would like students to see what the soils look like dry, expose the sample to air to dry thoroughly. Then, using a motar and pestle (a wooden dowel or carriage bolt and plastic bowl will work), pulverize the sample to its original dry, loose state.

*Note: To demonstrate the difference in particle sizes, see the “What’s in Soil” lesson plan, available through Utah Agriculture in the Classroom.
Activity 1 - Dirt Shake

1. Divide the students into groups of three or four. Provide each group with a soil sample or instruct each group to use one of the samples brought from home. **Note:** This activity will not work with most potting soil. Potting soil is made up of mostly organic matter. This activity is designed to determine soil texture by evaluating soil (mineral) particle size.

2. Place 2 inches of soil into a 1-quart jar. Add water until the jar is \( \frac{2}{3} – \frac{3}{4} \) full. Add one teaspoon of alum (optional water softener, found on the spice aisle of most grocery stores; it does help the soil settle faster, but is not necessary) Be sure the lid is tight. (You may use 3 or 4 inches of soil if you would like to see “larger” layers. This may facilitate measuring. Be sure to record the depth you start with so you can accurately estimate percentages.)

3. Shake the jar vigorously until all the particles have been sufficiently wet and separated by the water, about 2 minutes. Set the jar down and allow the soil to settle.

4. After 1 minute, measure the amount of soil on the bottom of the jar. Record this information.

5. Allow the sample to settle for three or four hours, then measure again and record the level of the silt. This is your second layer. This would be a good time to explain that soil pieces, which students saw in a previous activity, are comprised of different size particles. Use the background information and Particle Size attachment.

6. The rest of the soil (or clay particles) may take the next couple of days to a week to settle depending on the amount of clay in the sample. However, because you know that each sample started with 2 inches of soil, you can determine the amount of clay because you know the amount of organic matter that is floating on top (this may be difficult to measure), as well as the sand and silt content. To determine these values, you can convert the measurements into percentages (students may need help with this). For example:

- If the first layer measured 1 inch, that would be equal to 50% sand, a 1/2 inch measured in the second layer would be 25% silt, and the remainder would be 25% clay, to make 100%. If the sample has 5% organic matter, you may only have 20% clay.

- If the first layer measured \( \frac{1}{2} \) inch, 25% of that sample would be sand, 1-inch of silt would be 50%; and if there were only a minute amount of organic material at the top, you could surmise that the remaining 25% of the sample is clay.

7. Once you know these percentages, use the Texture Triangle attachment to determine the name of the soil type.
8. Discuss the following questions:
   • Why do the larger particles settle out first?
   • What is the stuff floating in the jar?
   • How does each person’s sample compare?

Activity 2 - Soil Textures By Feel
1. Place at least three different soil types (sandy, silty, clayey, and loamy) into four separate bowls.

2. Introduce the soil “Textural Triangle” to students. Show the students that there are different names for different types of soil. It will be the task of your students to determine the texture of the supplied soil samples.

3. Explain to the students that each sample is different and explain how the different particles feel by reading the background information. Inform them that they will be determining the type of soil in each sample by feeling it.

4. Moisten soils to the consistency of “pasty” mud. Do not get them too wet and soupy.

5. Divide the class into groups of four. Invite each group, one at a time, back to the table where the soil samples are set up in the bowls on newspaper. Note: You may want to have an activity for students to do independently at their desks while they are waiting for their turn with the soil samples. A crossword and word search are attached for this purpose, but other activities may be substituted. The teacher should try to remain with the texturing group as much as possible to guide them through the activity and answer any questions the students may have.

6. Each student should place a teaspoon of the “mud” into the palm of his or her hand. Instruct students to rub some of the soil between their index fingers and thumbs feeling for the presence of sand, silt, and clay. Two notes:
   • Hands must be rinsed between samples to prevent the samples from being contaminated and changing the feel, which will confuse the next students who use the samples.
   • To avoid a large-scale mess, be sure to cover the entire surface with newspaper and place a bucket of water on the table for rinsing hands. The bucket of water should be placed in the middle of the table so muddy hands will not have a chance of being hung out over the floor. Have paper towels available for the final rinse and dry. Before students rinse their hands, as much of the sample as possible should be returned to the sample bowl.

7. As they continue to feel the samples, ask them evaluate how much sand, silt, or clay is present. Students should feel a mixture and then try to determine the relative amounts of sand, silt, and clay. Students should record their analysis of the soil based on the names provided on the Textural Triangle (sandy, silty, silt loam, etc.).

8. After all students have sampled the soils, discuss with them what their analysis should have been. You may want to go over the Textural Triangle as a class and together review the soil types.

9. Discuss the following questions:
   • What is the name of a soil that contains a mixture of sand, silt, and clay?
   • How do sand, silt, and clay feel? How can you tell them apart? What are their similarities and differences?
Dirt Shake

This illustrations show relative particle sizes of sand, silt, and clay. Silt and clay cannot be seen with the naked eye, but sand can.
Soil Textural Triangle

To find the texture of your soil, read percentages of sand, silt, and clay in the direction of the arrows at the sides. For example, a soil with 20% clay and 40% each of sand and silt is a loam.