

Soil Lessons



Instructional Value

Soil Physical Properties

Grade Level: 2-5

Type of Lesson

Initial demonstration

Materials Needed

Quart jar with lid, large mouth

1-2 cups of soil

Water

Calgon/non-sudsing soap (optional)

Marking pen or whiteout

Time

Teacher prep time:

20 minutes to gather materials

Student class time:

30 minutes initially and then observation over a day or two

Student Learning Objectives

- To explain the different sizes of soil particles.
- To demonstrate that soil particles settle based on particle size
- To understand how the soil texture triangle works

Keywords

Texture, sand, silt, clay, nutrients



Soil Texture Analysis

Overview

Pick up a handful of soil and you can feel how fine or coarse it is. That feel comes from the size and relative proportion of mineral particles in the soil, and is known as soil texture. The particles that make up soil are categorized into three groups by size: sand, silt, and clay. Sand particles are the largest and clay particles the smallest. (Fig.1) The relative percentages of sand, silt, and clay are what gives soil its texture.

The soil texture triangle is used to determine the name of the soil texture. There are 12 soil textural classes. (Fig.2a) This triangle is used so terms like “clay” or “loam” always have the same meaning. Each texture corresponds to specific percentages of sand, silt, or clay.

Although a soil could be all sand, all clay, or all silt, that is rare. Instead most soils are a combination of the three. A clay loam texture soil, for example, has nearly equal parts of sand, silt, and clay (Fig.2b) and a soil with 15% clay, 20% silt, and 65% sand has a sandy loam texture. (Fig.2c)

When referring to loam one is only indicating that the soil has a given percentage of sand, silt, and clay; there is no mention of whether or not that soil has any organic matter in it or not. Knowing the texture helps us manage the soil.

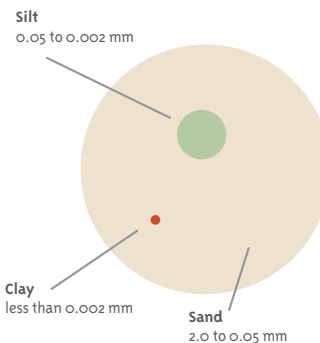
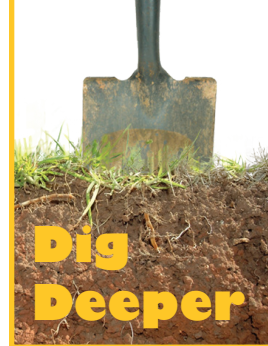


Fig. 1. Relative sizes of sand, silt and clay particles.

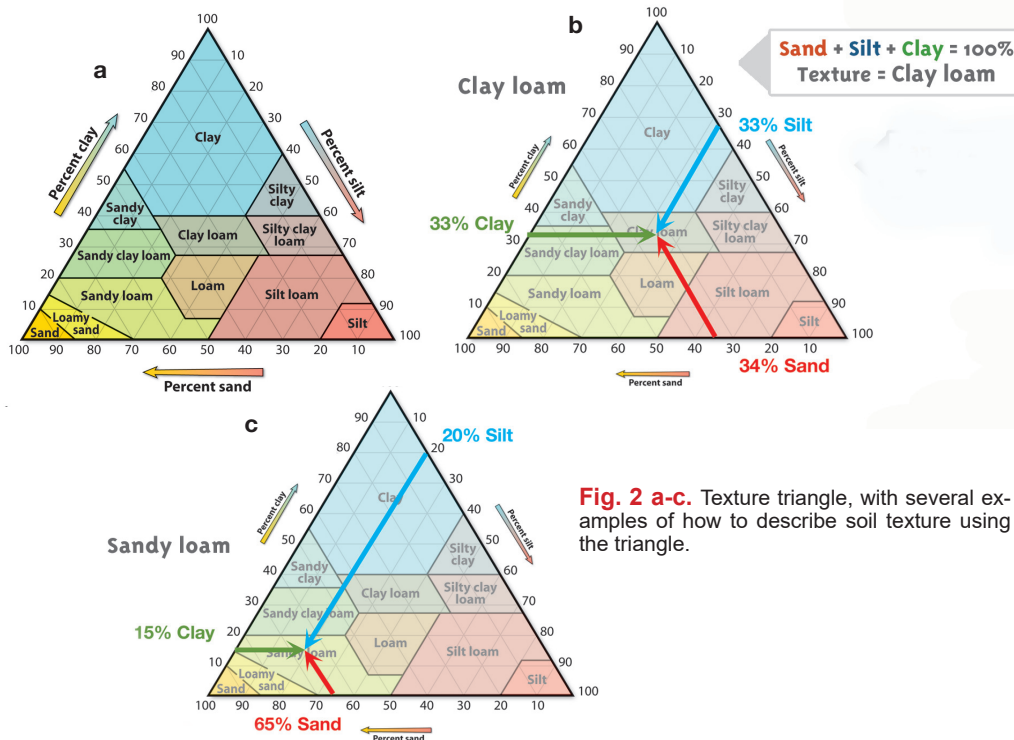


Fig. 2 a-c. Texture triangle, with several examples of how to describe soil texture using the triangle.



Soil Texture Analysis

Adapted from an experiment developed by Ted Sammis
at New Mexico State University

Summary

Soil texture is one of the most important measures of a soil because fine soil particles (clay and silt) have a greater surface area than coarse particles (gravel or sand). This is important in chemical reactions, soil fertility (nutrients), and the retention of moisture.

Method

A simple method to estimate the percent sand silt and clay in a soil and determine its texture.



1. Get a quart jar from the supermarket with a lid or use any jar with a large mouth.
2. Gather soil. If the soil has a covering of organic matter (compost, plants) scrape that off digging the soil. Remove roots. Fill the jar half full of soil.
3. Wet the soil to a mud consistency and tap the jar to settle the soil.
4. Mark the level of soil on the jar with a marking pen or whiteout.
5. If you have some Calgon/non-sudsing soap put a teaspoon full in the jar
6. Add water to the top of the jar and shake the soil water mix until the soil is all mixed up in the water
7. Turn the jar on a table and let the soil settle out for 40 seconds, mark the level of soil on the jar. This is sand portion in the soil.
8. Wait 6 hours and mark the level of the soil in the jar. The difference between the bottom mark, which is the sand, and the second mark-up is the silt portion of the soil. The total sand plus silt is the distance from the bottom of the jar to the second mark.

9. Calculate the percent sand, silt and clay by measuring the depth of the soil by measuring the distance from the bottom to the first mark up in inches which is the sand fraction, the distance from the first mark up to the second mark up which is the silt fraction and the distance from the bottom to the third mark up from the bottom which is the sand plus silt plus clay fraction.

Sometimes, when all the sand silt and clay has settled, the height of the soil is higher than when you marked the jar after making a mud solution. This is because there may be more pore space after mixing and the particles tend to settle. This can only be determined by letting the jar sit for several days. If you have the time to do this, then a more accurate calculation of % sand silt and clay can be determined based on this new measured total height.

Also, the percent sand, silt, and clay is a volume percentage. The soil triangle and table below for soil classification is in percent by weight. You need to correct this problem by converting from percent volume to percent weight by multiplying the percentage of sand by 1.19, the percentage of silt by 0.87 and the percentage of clay by 0.94. These numbers are the weight ratios of bulk density compared to average bulk density of the material.

10. The percent sand is the depth of the sand divided by the depth of the total soil.
11. The percent silt is the depth of the silt divided by the depth of the total soil.
12. The percent clay is 100 minus the percent sand plus silt.
13. To determine the soil texture knowing percent sand silt and clay using the table below

Soil classification	Clay Soil	Loam soil	Sandy soil
percent clay	40-100%	7-27%	1-10%
percent silt	0-40%	28-50%	1-15%
percent sand	0-45%	23-52%	85-100%



14. A more precise determine of soil texture can be determine from percent sand silt and clay using the soil triangle.

