

Soil texture

Focus questions	What is soil texture? How is it determined? What geologic history contributed to soil texture?
Vocabulary	Sand, silt, clay, gravel
Learning target	Students will follow a flow chart to determine soil texture, measure the amount of each soil particle to determine soil texture, and compare their results using the two methods.

MS-ESS3 Earth and Human Activity

Performance expectation MS-ESS3-1	Classroom connection: Students test soil texture to determine the relative percentage of sediment types in each.
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Science and engineering practices

Constructing Explanations and Designing Solutions	Classroom connection: Students compare the results from two different testing methods on the same sample of soil.
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Disciplinary core ideas

ESS3.A: Natural Resources	Classroom connection: Defined by the location of the soil sample, students <i>construct an explanation</i> for the amount of sand, silt and/or clay that they find in their sample based on geologic history of the area.
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Cross-cutting concepts

Cause and Effect	Classroom connection: The geologic history had an effect on the amount of each soil sediment found in the sample.
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Background

Soil is composed of particles that are categorized into groups according to their size, as shown in the table below.

Clay	< 0.002 mm (2 microns)
Silt	0.002 mm – 0.06 mm (2–60 microns)
Sand	0.06 mm – 2.0 mm (60–2000 microns)
Gravel	> 2.0 mm (2000 microns)

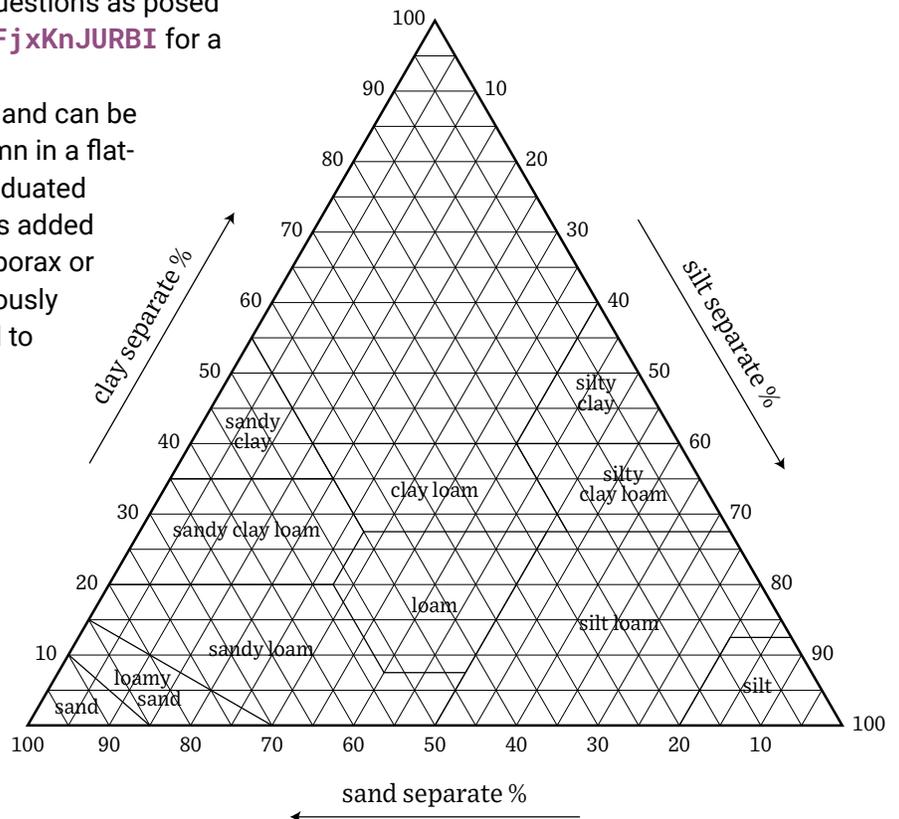
The sediment sizes and percentages of each in a sample are determined by the history of geologic and climatic events in an area.

One method of classifying soils is to measure the relative amounts of sand, silt, and clay in a soil sample, then use a soil triangle to determine the soil type. In this lab, the textural classification of a soil sample will be determined by measuring the relative amounts of sand, silt, and clay particles, then using a soil triangle to determine the soil type. The comparative volumes of sand, silt, and clay will be determined since the different-sized particles will settle out of the soil/water mixture at different rates and different levels with the largest particles on the bottom and the smallest on the top.

This can be accomplished in two different ways, one by feel and the other by volume. It is best to have students attempt both methods on the same soil, then compare their results. Texture by feel is subjective or qualitative following steps in a flow chart (see flow chart).

Students will begin with a sample of soil that covers the palm of the hand, that has had organic material and foreign debris removed. Wet the soil by pouring 3–5 ml of water on top in the cupped palm. The soil should be kneaded to work in the water; add more water as kneading to make a ball. It should feel like putty. Answer the questions as posed on the flow chart. (See youtu.be/2FjxKnJURBI for a demonstration of a soil ribbon).

Texture by volume is quantitative and can be accomplished by creating a soil column in a flat-bottomed container with a lid or a graduated cylinder in which a quantity of water is added to soil, along with a small amount of borax or non-foaming dish soap, shaken vigorously for at least two minutes, then allowed to settle for 24–48 hours¹. See: youtu.be/7p1pyBDNPJE for a step-by-step demonstration. The layers of soil will settle out with sand on the bottom, silt in the middle, and clay on the top. Students then measure the height of each level, then add the heights together to get a total soil column height. Divide each layer by the total to determine the percentage of each soil particle in the column. Use the soil texture triangle to find out what soil type you have.



1. The lines that divide the sand, silt, and clay columns should be visible in the container.

Materials

- 500 ml of soil (a flower bed will work—dig under the mulch layer)
- 100 ml graduated cylinder or flat bottomed clear jar with a lid.
- Borax
- Parafilm (or plastic wrap)
- Ruler
- Trowels or shovels for collecting soil (soil core samplers are not necessary, since the goal is to determine texture, not test for nutrient levels).
- Bucket or gallon bags for soil

Prior knowledge

Students should know the three different sediments in soil: sand, silt and clay. They need to be able to calculate percentages. Students are expected to construct an explanation for the texture that they find, so they need to have studied geologic history to help them understand how soil texture is a result of a geologic event (i.e. if a shallow ocean once covered the region, a soil may be expected to have a large amount of sand, etc).

Teacher preparation

- Determine where students can collect soil samples or ask students to bring in samples from home.
- Have students dig below the root zone of a flower bed or grassy area to collect soil. They will not need more than a gallon bag full.
- Once samples have been collected, find a space in the room for soil samples to be spread out so organic material, roots, and debris may be removed.
- Provide clear, flat-bottomed containers (spice jars work) or large graduated cylinders for soil columns. (Jars are recommended because it is difficult to get soil out of graduated cylinders after settling occurs.)
- During one class, students can prep the soil columns, then complete the soil texture by feel flow chart. The following day, students can measure the height of each layer in the column, complete the calculation to determine the percentage of each to the total, then use the soil texture triangle to identify the soil texture.
- Keep soil samples so students can use for nutrient testing and soil stability.

Differentiation

Other ways to connect with students with various needs:

- **Local community:** Students may investigate the soil types for their local community by visiting websoilsurvey.nrcs.usda.gov/app/.
- **Students with special needs (language/reading/auditory/visual):** Watching the videos listed: youtu.be/2FjxKnJURBI for a demonstration of a soil ribbon; youtu.be/7p1pyBDNPJE to see a demonstration of setting up a soil column; youtu.be/4hW59WZ0EQI for a soil texture triangle tutorial.
- **Extra support:** see above videos.
- **Extensions:** Students compare different soils to determine texture differences. Students brainstorm then research ways to amend soil texture.

Assessments

Rubric for assessment

Skill	Developing	Satisfactory	Exemplary
Texture by feel flow chart	Student did not complete all aspects of the chart.	Student completed all the portions of the chart and identified a soil texture.	Student worked with multiple soil samples to determine texture using the flow chart.
Texture by volume and soil texture triangle.	Student determined percentages of each soil particle, but did not successfully identify the texture of the soil using the triangle.	Student completed the texture by volume and successfully used the soil texture triangle.	Student was able to accurately identify the soil texture and matched them using both methods.
Construct an explanation for soil textures	Student was unable to construct an explanation connecting recent land use and soil texture.	Student constructed an explanation using one past land use or geologic event to support the soil texture results.	Student constructed an explanation using more than one land use or past geologic event to support the soil texture results.

Rubric for self-assessment

Skill	Yes	No	Unsure
I was able to complete the texture by feel flow chart and determine the texture of my soil sample.			
I was able to determine the texture by volume, read the soil texture triangle, and compare it to the texture by feel.			
I researched the recent land use of the area to construct an explanation of why my soil sample had the texture it does.			