

Soil Lab

Part I: Soil Texture

Soil is composed of particles that are categorized into groups according to their size, as shown in the table below. 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 based upon the fact that the different sized particles will settle out of a mixture at different rates.

| | |
|--------|-----------------|
| Clay | < 0.002 mm |
| Silt | 0.002 – 0.06 mm |
| Sand | 0.06 – 2.0 mm |
| Gravel | > 2.0 mm |

Materials

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|---|--|--------------------------------------|
| <input type="checkbox"/> safety goggles | <input type="checkbox"/> distilled water | <input type="checkbox"/> Soap |
| <input type="checkbox"/> lab apron | <input type="checkbox"/> 100-mL graduated cylinder | <input type="checkbox"/> soil sample |
| <input type="checkbox"/> 250-mL beaker | <input type="checkbox"/> rubber stopper for cylinder | |

Procedure

- Bring in approximately 200 grams (1 cup) of soil from around your home. Do not take soil in such a way that it will negatively affect the aesthetic appeal of your home's landscaping.
- In a group of four make and share a 5% soap solution as follows. Dissolve 10 g of soap in 200 mL of distilled water to make approximately 200 mL of 5% soap solution.
- Add approximately 25 mL of soil to a 100-mL graduated cylinder. Add 5% soap solution to fill the cylinder to the 50 mL mark. Mix well (until all of the soil has been moistened) and allow the mixture to stand for 15 minutes.
- Insert a rubber stopper in the graduated cylinder, wrap a paper towel around the stopper, and by inverting the cylinder, mix the solution for 10 minutes. Keep a hand over the stopper to secure it while mixing. Do not force the stopper into the cylinder to prevent leaking, as the cylinder may break; some of the mixture will leak out of the cylinder this is unavoidable.
- Label the cylinder and leave it undisturbed for 23 hours.
- After 23 hours, the lines that divide the sand, silt, and clay columns will be visible. Sand will be on the bottom, silt in the middle, and clay on the top. Measure and record the volume of the sand column, the volume of the silt column, the volume of the clay column, and the total volume of soil in the cylinder
- Calculate and record the percent sand, silt, and clay in the soil sample.
- Use the soil textural triangle to determine the texture of the soil sample.

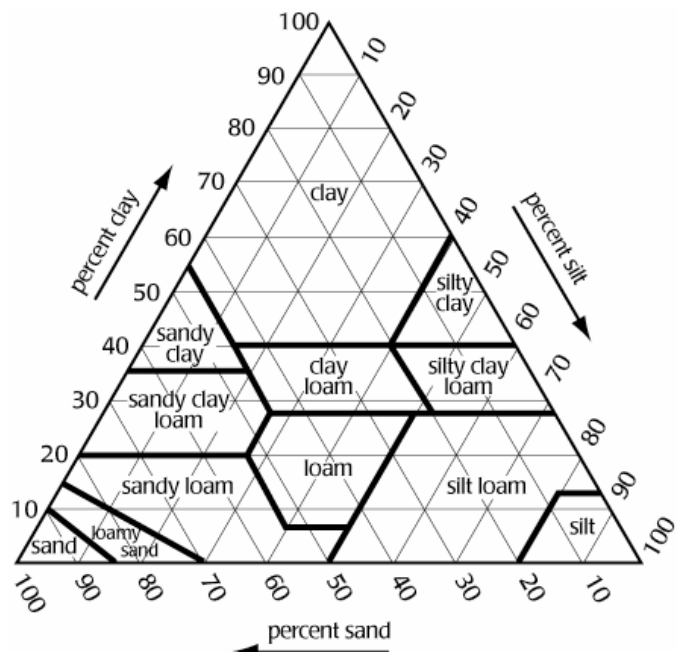
Procedure for Use of the Soil Triangle

The soil triangle is used to determine textural classes of soil from the percentages of sand, silt, and clay in the soil.

To determine soil texture using the soil triangle, the lines from each side must be extended in the correct direction. Proceed as follows:

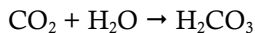
- ☒ Clay—extend line horizontal from the percent clay (parallel with side labeled sand)
- ☒ Silt—extend line downward from percent silt at 60° (parallel with side labeled clay)
- ☒ Sand—extend line upward from percent sand at 120° (parallel with side labeled silt)

For example, if a soil is 40% sand, 30% silt, and 30% clay, the texture is clay loam.



Part II: Soil pH

The pH of soil is an important factor in determining which plants will grow because soil pH controls which nutrients are available for plants to use. The actions of plants, animals, and microbes that inhabit soil, along with physical factors, especially the characteristics of rainfall in the area, affect soil pH. Contrary to popular belief, rainwater does not have a pH of 7.0. As raindrops fall through the troposphere, carbon dioxide (CO₂) is absorbed and dissolves in the rainwater, as a result the raindrops become acidic as CO₂ reacts with water to form carbonic acid (H₂CO₃), as shown below.



Since air has always contained CO₂, rain has always been acidic. Today, the pH of rain can be 5.0 or lower if it is contaminated with oxides of sulfur and nitrogen which can form sulfuric and nitric acids respectively. In this lab activity, the pH of a soil sample will be determined.

Materials

- | | | |
|---|--|--------------------------|
| <input type="checkbox"/> safety goggles | <input type="checkbox"/> 100-mL beaker | pH probe |
| <input type="checkbox"/> lab apron | <input type="checkbox"/> balance | <input type="checkbox"/> |
| <input type="checkbox"/> plastic fork | | |

Procedure

1. Mass out 20g of soil in a 100-ml beaker.
2. Add 40 mL of distilled water and stir for 30 seconds every 3 minutes for 15 minutes.
3. During the intervals between stirring the soil mixture, connect a calculator to the LabPro and prepare the pH probe for measurement using the stored calibration.
4. After the final stir of the soil mixture, remove the fork, and allow the mixture to settle for 5 minutes.
5. Carefully, measure and record pH of the liquid phase of the soil-water mixture using the pH meter.
6. Rinse the pH probe thoroughly with distilled water.
7. Rinse and return the plastic fork.

Postlab Questions—Write out and respond to the following questions.

1. Use the soil triangle to determine the type of soils with the following particle sizes
 - a. 20% silt, 10% clay, 70% sand
 - b. 30% sand, 10% clay, 60% silt
 - c. 10% silt, 50% sand, 40% clay
 - d. 30% clay, 30% sand, 40% silt
 - e. 40% sand, 10% silt, 50% clay
2. List and describe three ways in which soil pH affects an ecosystem.
3. What types of vegetation does soil of the type and pH you sampled best support?
4. What would be the ideal type and pH of soil to have around a home?
5. What would be the ideal type and pH of soil for agriculture?
6. How do farmers adjust the pH of soils?