SOIL TEXTURE

Wake Forest University

Natural Hazards Engineering Research Infrastructure (NHERI)

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Lesson Details

Grades This lesson has been designed for a high school level (9 – 12), but it can be adapted to lower grades by simplifying the information provided.

Key Words Clay, Texture, Large-Scale Mobile Shaker, Sand, Silt, Subsurface

Topics Soil Texture

Objectives

Students will be able to:

- Classify soils
- Identify the different particles of soil and how proportions of each one can affect the soil

Essential Questions

- What are the particles that make up soil?
- How is soil classified through textures?
- How can the soil triangle be utilized to determine the type of soil?

Materials (per group)

- Soil in a Bottle worksheet
- Soil triangle worksheet
- Ruler (cm graded)
- Bottle (one per group)
- Local soil sample

Introduction

The soil is the outermost layer of the crust and is one of the most important resources of the world. Every living being that lives on land is connected to it in a direct or indirect way. From nutrients that help producers develop, or the hardness/softness of its consistency, which limits what grows on it and the buildings that can be made, this component of nature is a major factor when identifying the potential of a specific place.

In this lesson we will explore the particles that build up the soil, how their specific amount affects the characteristics of the soil, and how to classify a soil sample.

The Lesson

The soil is made up of three particle types:

- Sand: Small particles of weathered material that are easily identified by sight. Water can easily run through it, the amount of organic material is poor, and because of its size, tends to precipitate fast if mixed with water.

- Silt: Tiny particles of weathered material and organic matter that are not identified by sight. A sample of it would feel like flour on the hand. Water tends to take longer to go through it, since it works like a sponge. The amount of organic material in it could be from non-existent to high. Due to its size being bigger than that of Clay, it tends to precipitate earlier.

- Clay: Microscopic particles of weathered material and organic matter that are sometimes too small to be seen in a microscope. Water and clay have a special relationship, you see, clay particles are so small that water can't go through, but clay particles are negatively charged as well. Since water is polar (it has a positive and a negative charge), it will bond to clay particles. Having this in mind, if clay is mixed with water, it grows in volume (new bigger space required for the clay-water bonding), but if clay dries out then it reduces its size. Clay will tend to always have an amount of organic material, so, since organic material is less dense and clay particles are so tiny, it precipitates last when mixed with water.

Any given spot will have these three particles making up the soil (organic matter will change). Depending on the ratios, specific soil textures are identified.

Sandy soils will tend to be dry, unstable, and poor in nutrients. Silty soils are actually really good for agriculture but depending on their moisture their stability changes. Finally, clayish soils are either unstable or supremely hard. This will change depending on their moisture.

Knowing that each particle tends to precipitate differently in water solution, we could take a sample from any soil, mix it with enough water, and shake the recipient, which will result in specific layers of each of the particles after the mixture has settled. Using these layers, a soil texture can be identified.

The procedure is explained below. Templates are included in the appendix section or as independent PDF files.

Procedure

Image 1. Sample of Soil with Layers (*Taken from Soil Jar Science, 2020*)

1. Before class, select a spot where you can collect a sample of soil. Students will be assigned to make groups, so make sure there is enough soil for each group.
2. Using one bottle, have students collect a sample of soil by digging down and ensuring there is no grass in it.
3. Have students fill the bottle approximately ½ of the way full. (it is important to leave enough room for water.)
4. Return inside (if you were outside), and have students fill the bottles to approximately one inch from the top.
5. Once the water is added, ensure lids are put on tight, and have students shake until the water has completely mixed with all the soil.
6. Bottles will need to be placed to the side to settle for approximately 24 hours to be able to make measurements. Explain to students that they must be very careful not to shake the bottles, so the sample won't get mixed again.
7. Ensure students have both the bottle worksheet and soil texture worksheet (both provided below).

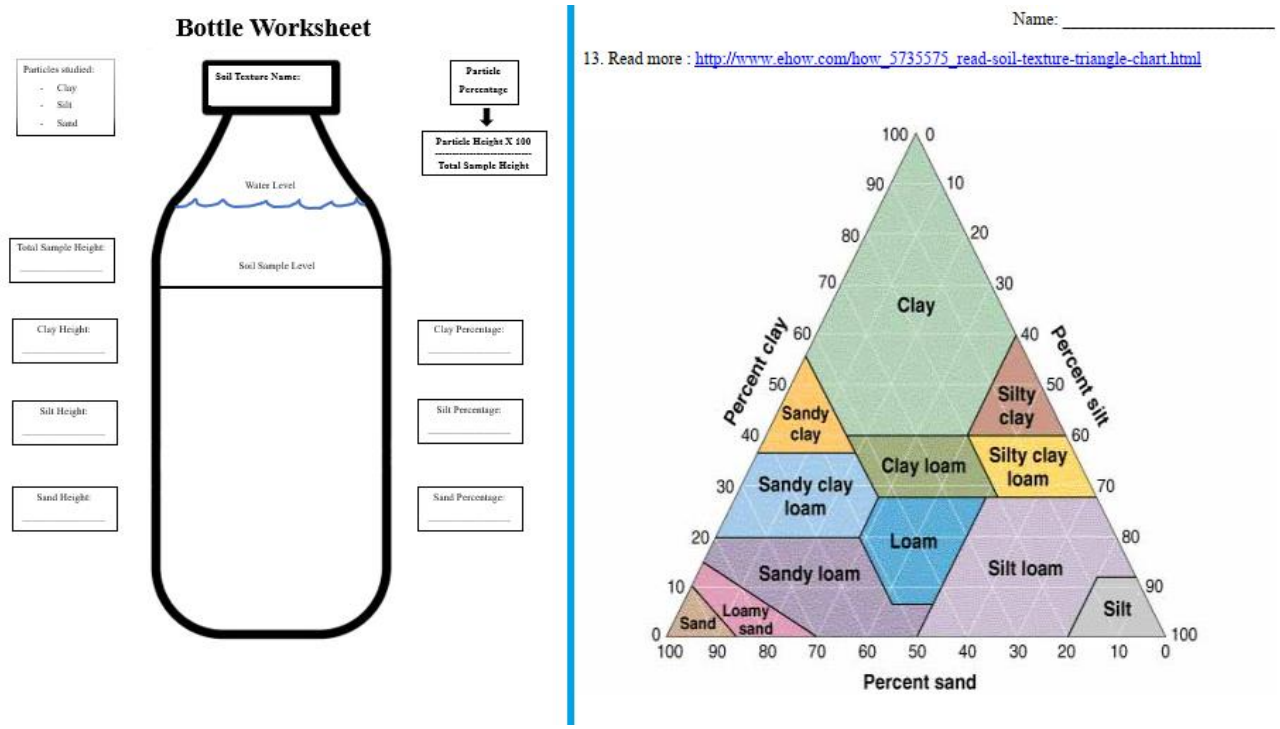

Image 2. Bottle and Soil Texture Triangle Worksheets

8. On the bottle worksheet and using a ruler, have students divide the space below the line labeled "Soil Sample Level" in three spaces (spaces don't have to be the same. In fact, it's better if they are not).

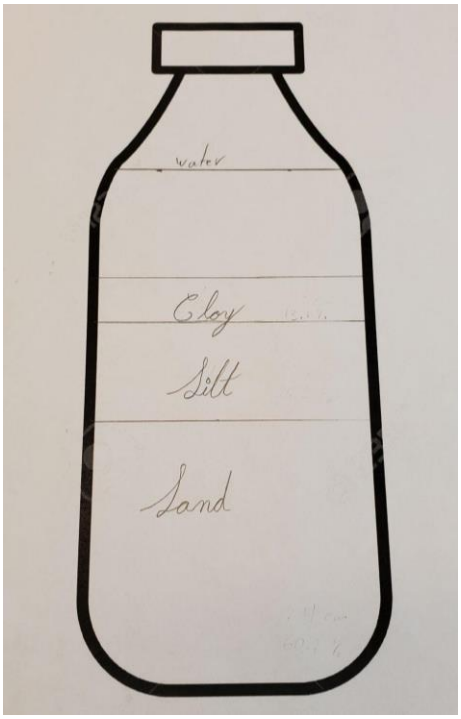

Image 3. Bottle Worksheet Divided

9. Make students label the top space as "Clay", the one below "Silt", and the one at the bottom "Sand".

10. Using the ruler, have them measure the height of each particle sample (clay, silt, and sand) and record their measurements at the left side of the template in the spaces provided.
11. Using the equation labeled "Particle Percentage" at the top right of the template, make students calculate the percentage of each particle in this theoretical sample.
12. Once the percentages of each layer of soil have been identified, have students utilize the soil triangle and write the type of soil texture in the space provided at the bottle cap of the bottle diagram.
13. Once students are able to properly identify the type of soil texture on the worksheets, students will be able to replicate the procedure with the real sample. This will only be possible if the content has settled, if not, it is important to wait.

    It is possible to find that more than three layers are identified. In that case, all layers in which particles are easily identified (most probably at the bottom of the bottle) will be labeled as sand. The top layer will be identified as clay and most of the time it will have a specific color, if there are different layers with different tones of the same color, it is safe to classify them as clay as well. Finally, silt will be easily identified in the middle of these layers. It may have more layers as well, so identifying the top and bottom layers will define the layers of silt.

    Another way is to simply watch the way each layer precipitates. Sand will not take long to precipitate, and the layer will form fast. Silt will take longer but it will gradually build its layers. Finally, clay will take the longest and is probable to give the sample its color.

There will be some material floating at the top of the layers and at the top of the water. This will be classified as organic material. Most of the time, black samples of soil will have a lot of organic material.

Assessments

-Provide students a prefilled bottle worksheet and have them individually complete the same procedures as the initial bottle worksheet but using the prefilled worksheet.

Appendix

Appendix 1. Soil Texture Format

This template has been made without layers. You will be able to use the format several times and define the thickness of the layers, so that each time you could get a different type of soil texture. It is useful as well to be able to make students define the layers and then get them to identify their corresponding texture.

Percentages are calculated using the rule of three (here is a video that explains how it works https://www.youtube.com/watch?v=nJcCk0lAdRM). If you know a better way to calculate them, it is OK to do so.

Appendix 2. Soil Texture Triangle

To use the tool, follow the lines that each axis shows. You will find that there are two directions for each, so wherever the three meet, that is the type of texture of the sample assessed. If you find that is confusing to use, you could watch this video The Soil Texture Triangle - YouTube.
This soil texture triangle has been taken from Ryczkowski, 2009.

References

- Ryczkowski, A. (2009, December 11). How to Read a Soil Texture Triangle Chart. EHow.com; eHow.com. https://www.ehow.com/how_5735575_read-soil-texture-triangle-chart.html

- Soil Jar Science – Ithaca Children's Garden. (2020, July 3). https://www.ithacachildrensgarden.org/soiljarscience/