Lab: Settle that Soil

FOR THE TEACHER

Summary
In this lab, students will learn about what properties constitute soil and how it is different than “dirt.” Students will also be able to distinguish the difference between sand, silt, and clay.

Grade Level
Elementary School

NGSS Alignment
This lab will help prepare your students to meet the performance expectations in the following standards:

- **2-PS1-1**: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

Objectives
By the end of this lab, students should be able to

- Differentiate between sand, silt, and clay.
- Determine (roughly) how much sand, silt, and clay make up the different soil samples used.
- Classify and distinguish between materials based upon their observable physical properties.

Chemistry Topics
This lab supports students’ understanding of

- Separating Mixtures
- Mixtures
- Physical properties
- Soil properties
- Observations

Time
Teacher Preparation: 30 minutes
Lesson: 90 minutes (and will need to record observations the following day as well)

Materials (per group)

- Jars or clear bottles (with wide mouths)
  - They need lids or caps that are tight as you’ll be shaking the containers
  - Enough jars or bottles for each soil sample
  - Mason jars work well as do large juice bottles with the labels taken off
- Several cups of different soils:
  - One from the schoolyard, a garden, playground, etc. It would be ideal to have one very obviously sandy soil so the students can see the difference between particle sizes.
  - 2-5 soil samples are ideal. You can assign students to collect their own samples from their yard or playgrounds. They could fill up a quart Ziploc bag with their soil and that would be plenty.
- Water
- Stopwatches
- Labels for each sample
- Metric ruler (optional)
Safety
- Always wear safety goggles when handling chemicals in the lab.
- Students should wash their hands thoroughly before leaving the lab.
- When students complete the lab, instruct them how to clean up their materials and dispose of any chemicals.

Teacher Notes
- You can do this activity as a demonstration or give each group their own soil sample.
  - 3-5 students per group is suggested.
  - If using as a demo, students can still fill out the data form and record their observations.
- You can change the number of minutes or hours for the students to observe their soil layers, depending on your class schedule.
- *Dirt is not synonymous* with *soil*, something that many people do not know. Soil is *vital to humans* (not just farmers!) and is made up of minerals, air, water, and organic matter.
- After the students have recorded all of their data, and you don’t mind cleaning it up, you can have them feel the difference between the sand, silt, and clay layers.
  1. Use this [video](#) (for kids!) to teach about the basics of soil and plants, including what makes up soil.
  2. This [short video](#) of a soil scientist determining the soil profile in the field using colors can also be helpful to show students.
  3. Another helpful [video](#) to consider using is about the importance of soil and things that live in soil.
- The students can investigate one soil sample at a time, and after 5-minutes, they can move on to the next sample. Using stopwatches and recording the time when each sample is started is a good way to keep everything on track. Once the groups are finished with all of their samples, they can answer their analysis questions while they wait for the one hour mark to record their new observations.
- Update the data table given on the student document based on how many soil samples you plan to use.
- Answer Key for Pre-Lab Questions:
  1. Soil: minerals, air, water, organic material
  2. You could find: nematodes, worms, roots of plants, dead plants, bugs and insects, rocks, garbage/trash, fossils, etc. You could find a lot in soil and you can encourage your students to really think hard about what else could be in soil!
  3. It is important for soils to have different size particles so that air, water, and nutrients can flow through. Worms and other animals/insects can help aerate the soil, but they can only do that if there is already space: if a soil is mostly clay, it is virtually impossible for anything to flow through. Plant roots need space and they can’t grow through mostly clay soils. If the soil is too sandy, water and nutrients will slip right through and roots will not have anything to hold on to. You can encourage students to think about the beach of the ocean or a lake: are the plants on the beach itself? Why or why not?
  4. a. Sand
  5. c. Clay
  6. No, because if the sample has a significant amount of clay in it there won’t be enough space for plant roots, nutrients and water to move through it. Clay becomes very compact and tight due to its small size which makes it difficult for plants to grow or survive.
  7. Sand will settle first at the bottom since it’s the heaviest and biggest particles.

- Two additional elementary school lab resources available in the AACT Resource Library that are focused on the chemistry of soil investigations are The pH of Soil and Soil Permeability.
Settle that Soil!

Background
Soil is made up of minerals (from rocks), air, water, and organic material (dead plants and animals). Soil is one of the major things plants need to survive: it has the nutrients and water plants need to grow. Soil is formed by the breakdown of rocks. These rocks can either be very far down below the soil, called bedrock, or from rocks hundreds of miles away that breakdown and are carried away by wind and water. Some of Hawaii’s soil is from the Gobi Desert in China!

Sand particles in soil are .05-2mm in size and are the heaviest. If a soil has a lot of sand, there is a lot of open space and air and this soil cannot hold a lot of water. Soils near beaches and the ocean have a lot of sand.

Silt particles are .002-.05 mm in size and is often blown away by winds because it is lighter than sand. Soils with a lot of silt can be very muddy.

Clay particles are smaller than .002 mm and there is very little air space in soils with a lot of clay. When clay is dry it as hard as concrete, and water may pool on top of clay because it can’t be absorbed because of the lack of space between particles.

Pre-lab Questions
1. What is soil?
2. What are some things you can find in soil?
3. Why is it important that soil has different particle sizes?
4. Circle which has the biggest particle size:
   a. Sand
   b. Silt
   c. Clay
5. Circle which has the smallest particle size:
   a. Sand
   b. Silt
   c. Clay
6. Can plants survive in soils that have a lot of clay? Why or why not?
7. Which (sand, silt, or clay) do you think will fall to the bottom first?

**Objective**
By observing the different layers of your soil samples, you will be able to determine how much sand, silt, and clay there is in the soil of a garden, your school yard, and your neighborhood.

**Safety**
- Always wear safety goggles when handling chemicals in the lab.
- Wash your hands thoroughly before leaving the lab.
- Follow the teacher’s instructions for cleanup of materials and disposal of chemicals.

**Procedure**
1. Label each jar with where the soil sample came from.
   a. One jar per sample.
2. Fill the jar half way with soil.
3. Fill the rest of the jar with tap water (almost to the top).
4. Put the lid on the jar – *make sure it is on tight* (get your teacher to double check!)
5. Shake the jar vigorously for a full minute (You can take turns so that everyone in your group gets a chance).
6. Record your observations one minute after you’re done shaking, 5 minutes after, 30 minutes after, etc. in the table below. Be sure to look for multiple layers of soil in your jar!
   a. Use your stopwatch for the one minute observation.
   b. Have one member in your group be the timekeeper and write down what time you need to check your jar to record your other observations.

<table>
<thead>
<tr>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Which layers do you see after:</strong></td>
</tr>
<tr>
<td>1 minute</td>
</tr>
<tr>
<td>5 minutes</td>
</tr>
<tr>
<td>30 minutes</td>
</tr>
<tr>
<td>1 hour</td>
</tr>
<tr>
<td>24 hours</td>
</tr>
</tbody>
</table>

**Analysis**
1. Was there a noticeable difference in the number of layers after 5 minutes compared to after 1 minute? Why or why not?
2. Was there a noticeable difference in the number of layers between 12 hours and 24 hours?
3. Can you clearly see the separate layers of sand, silt, and clay?
4. Which soil sample had the most sand?
5. Which soil sample had the most clay?
6. Which soil sample had the most silt?

**Conclusion**
What did you learn about soil that you did not know previously? Do you think it is important to know how much sand, silt, or clay is in the soil? Who may benefit from knowing the type of soil in the ground?