

In what ways are soil and sand similar and how are they different?

Teaching and Learning Focus

It is important that your students begin to understand that soil is a mixture of mineral particles and organic matter of varying size and composition. They need a general understanding that particles and matter make up about half of the soil's volume and that air and/or water occupy the remainder. Your students may need help in learning that a mature, fertile soil is the product of centuries of physical and chemical weathering of rock, combined with the addition and decay of plants and other organic matter. In the investigations that follow, students examine and experiment with soil, and other material samples, to gain a better understanding of what soil is.

In these first investigations, your students will use their senses to investigate properties of soil and a similar natural medium, sand. The two media will be introduced with photos to show that soils often sustain abundant vegetation and sand, generally much less. This initial contrast will serve as an invitation for students to question and investigate the properties by which soil and sand differ.

Materials Needed

- Photographs showing a forest scene, beach scene, farm-crops scene, and desert sand dune (Copy Master 1).
- Newspaper (to cover surfaces)
- Half-cup of soil in a baggie or clear plastic cup (one for each group of up to four students)
- Half-cup of coarse sand in a baggie or clear plastic cup (one for each group of up to four students)
- Hand lenses (enough for everyone or two sharing)
- Tongue depressors or wooden stirrers (enough for everyone or two sharing)
- Plastic spoons (enough for everyone or two sharing)
- Letter-size white paper (one per group)
- Letter-size black paper (one per group)
- Small flashlight (one per group)
- Dropper bottle of water (one per group)

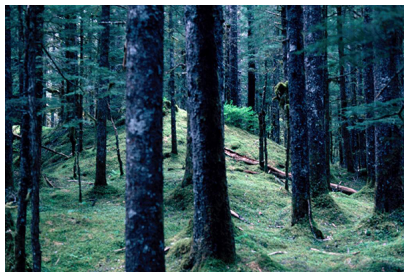
Safety

This investigation is considered generally safe to do with students. However, you must ensure that students do not allow sand or soil traces to inadvertently enter their mouths from their hands. Make sure everyone understands this from the beginning. Students should wash their hands after handling soil or sand. Please also review the investigation for your specific setting, materials, students, and conventional safety precautions.

Setting the Scene

To introduce students to ideas about soil, they first need to realize that soil is similar to, yet different from, other materials that can be found on solid Earth's surface. This first part of the investigation is designed to introduce them to soil as a mixture of materials and get them interested in learning more about soil.

Begin by distributing copies of the photos to your students (*see LAND SURFACE PHOTOGRAPHS – Copy Master 1*). Ask them to describe what they see in each photo. If they notice that there are more living things, particularly plants, in two of the photos, ask them why they think this is so.



Forest © Bruce Molnia, Terra Photographics; Beach © Marcus Milling, AGI; Crop Field © T. Loynachan; Desert © T. Loynachan

- Copy Master 1 Word Document (169 KB)
- Copy Master 1 Adobe PDF (33 KB)

They may suggest that rainfall (climate) is a key difference, and they will be partially correct.

Presenting the Investigation Question

After the scene is set, introduce your students to the investigation question: *“In what ways are soil and sand similar and how are they different?”*

Tell your students that they will be investigating this question and at the end of their investigations they will be able to provide reliable answers.

Have your students brainstorm ideas about how this investigation question could be investigated.

1. Design an experiment that could be used to test the investigation question.
2. What materials would be needed?
3. What would you have to do?
4. What would be measured?
5. How long would the experiment take?

Assessing What Your Students Already Know

Here are some initial questions that your students can discuss, in pairs, groups and as a whole class:

- What materials are in soil?
- How is soil different from sand?
- Do plants grow easily in sand?

Have your students report out their ideas and make a list of them. Start a list called “Questions we have about soil.” This list will provide further insights into what your students know, and also what they would like to know. By the end of the investigation, most of these questions will probably be answered.

Exploring the Concept

1. If you have not already done so, divide your class into groups of about four students with each group sitting around its table or work area.
2. Cover each group work table with newspaper, and distribute the soil and coarse sand samples to each group. *(You may be able to do this ahead of time. If not, have your students do it under your direction.)*
3. Before your students begin, tell them how much time they will have to complete their investigation. *(Group learning strategies often call for appointing a group time keeper who keeps the group on track.)*

4. Provide your students with the following tools for investigation:
 - Hand lenses (enough for everyone or two sharing)
 - Tongue depressors or wooden stirrers (enough for everyone or two sharing)
 - Plastic spoons (enough for everyone or two sharing)
 - Letter-size white paper (one per group)
 - Letter-size black paper (one per group)
 - Small flashlight (one per group)
 - Dropper bottle of water (one per group)
 5. Tell your students that they may use four of their senses to investigate the soil and coarse sand samples (*looking, feeling, smelling and listening – or: sight, touch, odor and sound.*)
 6. Emphasize that it is NOT SAFE for your students to TASTE the samples. Forewarn them that they will need to wash their hands at the end of the investigation, after handling the samples.
 7. Tell your students that their job is to find out how the two materials, sand and soil, are alike and how they are different. They can use all the tools they have been given to do this. Have them first study the samples through the baggie or clear plastic cup. Next, have students pour their samples into the paper plates and continue their observations. (*If your students are new to this type of investigation, it might be a good idea to begin by thinking of what we can describe when we (a) touch and feel (sticky, wet, gritty, soft, springy, crumbly, cool, etc). (b) see (colorful, shiny, big, little, shapes, fuzzy, smooth) (c) smell (odorless, sweet smelling, sour smelling, smells like...) (d) hear (drop a spoonful and it sounds like....).*)
 8. Suggest that each group appoints someone to be the “recorder” for all the observations made about the samples. They should focus on the similarities and the differences as the investigation proceeds. (*You can use the template SOIL AND SAND OBSERVATION TABLE - Copy Master 2 provided, or have students design their own.*)
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(Groups may need your help getting started. Circulate among them helping your students to notice an interesting similarity or difference. Then assist the recorder to note the observation on a table or on a graphic organizer with which the students have had practice).

9. When the time for the investigation is up, ask the groups to clean up the materials according to your directions. Everyone should wash their hands after handling these sample materials.
 10. Allow a short time for the “recorder” to work with the rest of the group to complete the record of its findings.
 11. Have each group report its findings in turn and construct a class record for all to see. (*An effective method for sharing a wide ranging variety of findings from a large group is to allow each group to report on one similarity or difference before moving to the next group. You can organize this sharing using one of a number of effective cooperative learning strategies, each designed for equity among the participating groups. You might act as the recorder for the entire class as you complete a large posted graphic organizer. A Venn diagram is particularly well suited to this activity – see: SOIL AND SAND OBSERVATION VENN DIAGRAM -Copy Master 3)*)
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Applying Students' Understanding

Ask the students to help you summarize how soil is like sand and how soil is different from sand. Older students might be given this as a writing prompt. Using information recorded on a graphic organizer or Venn diagram as a tools in forming a paragraph is an excellent skill-building activity.

You might want to return to the initial photos and the point made about plants growing more abundantly in soil than in sand. Although Activity 5 will return to this contrast, you might want to initiate a plant growth investigation in the two media. Initially, seeds such as bean seeds will germinate perfectly well in either moist medium. It will take at least two weeks of growth before features of the maturing plants will show soil to be the more favorable medium, all other factors being equal.

You might take one more look at the Venn diagram and say, “So...it seems that some of the particles in soil are like those we found in sand. But I see that soil has many other things as well. What other things does it have in it?” This question prompts students to see that soil is actually a mixture of several media. Tell students that in the next activity, they will devise and use ways to separate this mixture in order to describe its composition.

Revisiting Investigation Question 1

Complete this investigation by asking your students to reflect on this question and how their answers may have changed as a result of this investigation. Sand is a collection of particles which are roughly similar. Realizing that soil is different because it is a mixture of many materials and particles will help your students begin to understand its organic nature.

Digging Deeper

There are many kinds of soil. A group of soil scientists from the U.S. made up a way of grouping soils that is used around the world. This grouping has hundreds of named soil types! All soils, however, are made of just a few main things. Soil consists of fine particles of minerals and rocks, decaying plants, and living plants and animals. You can easily see the larger plants and animals. There are even more tiny plants and animals that you can only see with a microscope.

Soil Unit Sections

Introduction

Comparing Soils

Soil as a Mixture

Water and Soil

Chemicals in Soil

What Lives in Soil?
