How can you separate a soil mixture?

Teaching and Learning Focus

You can help your students investigate methods of separating soil.

Materials Needed

For each group of four students:

- A clear cup of soil sample, dry
- A plastic spoon
- Forceps
- A small scoop, about ¼ cup capacity
- 2 tall clear plastic tumblers
- Water supply
- Paper towels
- Safety goggles for all

Safety

This investigation is considered generally safe to do with students. However, please review it for your specific setting, materials, students, and conventional safety precautions.

Setting the Scene

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Ask students to look at the picture of the soil samples to the left. Ask the students: *Do all of these types of soil look alike? In what ways are they the same? Different? How could you separate the different parts of the soil mixture?*

Presenting the Investigation Question

Introduce students to the investigation question: "*How can you separate a soil mixture?*" Tell students that they will be investigating this question and that at the end of their investigations, they will be able to provide reliable answers.

Have students brainstorm ideas about how to investigate this question:

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

Your students should be familiar with many types of mixtures, but may not have thought of different ways of separating these except for picking them apart manually (as people do with snack mixes or mixed nuts). They may need your help in coming up with ways of separating their soil mixture.

Exploring the Concept

1. Give each student group a set of the materials. Ask the groups to come up with a plan for how they can separate their soil mixtures using the tools you have provided. [Some plans they might think of can be: picking apart the soil with forceps; shaking the soil between two tumblers; putting the soil into a tumbler of water or pouring the soil through air.]
2. Ask student groups to share their plans. Make a list of these plans on the board. Ask students to comment on the plans – which do they think will do the best job of separating the soil mixture and why? When you finish the discussion, ask students to try out their plans. Remind everyone to put on safety goggles first.
3. Circulate around the groups, helping those who are struggling. Remind students to record their observations as they try to separate the soil sample.

4. When everyone finishes, ask students to share their results. If your classroom setting allows it, you might want to take the class from group to group to "visit" students as they demonstrate their soil separation methods and explain what they did and why.
5. Remind students to wash their hands at the end of the investigations.

When everyone has shared his or her results, ask the class: *What method seemed to work the best to separate the soil?* [Pouring soil into water will result in different layers. More dense particles sink to the bottom, while less dense particles end up on the top.] *Which method took the least work? Why was that?* [Pouring into water is less work than picking the soil mixture apart by hand. Pouring through air and shaking the sample up really doesn't separate the particles much.]

Applying Students' Understanding

Have students recall that in the first investigation, they compared soil to sand. Sand, they observed, was made of particles that appeared to be very similar. Use this experience to measure their understanding of separating a soil mixture by asking: "Is sand a mixture?" (No, all of the particles appear to be very much the same.) "What do you think would happen if we tried your separation methods with a sample of sand?" Ask them for the reasoning behind their predictions. (If students understand the concepts behind separation of mixtures, they will predict that sand, with its similar particle sizes, will fail to separate by the soil separating methods.)

Revisiting the Investigation Question

Complete this investigation by asking your students to reflect on the investigation question and how their answers may have changed as a result of what they have learned. Ask them *why they think it's important to know what is in a soil mixture*. [Knowing what's in soil is important for planting crops, preventing erosion, having water move through soil and supporting structures, among many other things.]

Digging Deeper

It's important to recognize a common misconception that most of us share about falling objects, whether through air or water:

It seems perfectly natural to us that in air, an object like a bowling ball with its large mass and size falls to the Earth faster than a feather. Both objects are falling toward the Earth's center because of the pull of gravity. But the explanation for one falling faster than the other is complicated.

It's hard to believe it, but if both were released from a given height above the surface of the moon, they would reach the surface in exactly the same amount of time! The reason for our very different result on the Earth's surface is explained by the atmosphere—air—through which they fall. In air, the object that exposes the most surface area contacts the most air. And that contact produces a braking effect called *friction*. So why don't a bowling ball and a balloon inflated to the same size reach the Earth at the same time? The mass of the bowling ball gives it momentum to counteract the force of friction to a much greater extent than the mass of the much lighter balloon.

In these investigations, the friction was between the various soil particles and the medium through which they were poured. More dense elements reached the bottom of the container faster than less dense elements. And the effect was more marked in methods that used water because the force of friction is greater between objects and water than between objects and air.