Soil Texture and Composition

Overview: Students explore ways to determine the texture of soil samples.

Grade Level/Range: Grades 3-6

Objectives: Students will learn about the different components of soil and ways to determine soil texture and composition.

Time: 1 hour

Materials:

- soil samples
- water
- a clear, plastic container
- a ruler

Background Information:

Although many factors contribute to a thriving garden, any seasoned gardener will stress the importance of good soil. In addition to anchoring roots, soil provides life-sustaining water and nutrients. Plants in poor soils will struggle to grow, even if optimal water and light are available. In contrast, plants in good soils will grow to their fullest potential and experience fewer problems with insects and disease.

Soil is composed of minerals and organic matter. Sand, silt, and clay are the mineral particles derived from rock broken down over thousands of years by climatic and environmental conditions (rain, glaciers, wind, rivers, animals, etc). The largest, coarsest mineral particles are **sand**. These particles are 2.00-0.05 mm in diameter and feel gritty in your fingers. **Silt** particles are 0.05-0.002 mm and feel similar to flour. **Clay** particles are extremely fine – smaller than 0.002 mm – feel sticky in your fingers when wet, and clump to the point that you can't see an individual particle without a microscope. The proportion of these three minerals in a soil determine its texture or they way it feels. Organic matter is the decayed remains of once-living plants and animals. Good plant growth and development depends on the mineral and nutrient content of soil, as well as its structure.

Soil is teeming with life, including microorganisms like bacteria and fungi (billions in a single teaspoon!) and larger animals such as worms and sowbugs. Many of these underground inhabitants feed on remains of plants and animals, breaking down their tissues. In the process, they create pore space and release nutrients that plants need and the cycle begins again.

Pore space – the arrangement of soil particles in relationship to each other – is an important component of soil structure. In an optimal situation about 50 percent of the volume of the soil would be pore space, with half of that filled with water and half filled with air. The other 50 percent would be sand, silt, clay, and organic matter. Roots need air as much as they need water; plants can actually suffocate or drown if they are completely submerged in water for extended periods of time.

The proportion of these different-sized particles affects the amount of air, water, and nutrients available to plants, and how the soil "behaves." The smaller the soil particles, the more they stick together when wet. Thus clay soils can be sticky and difficult to work. With fewer air spaces, they drain poorly, and roots may suffer from a lack of oxygen. However, clay soils can be rich in minerals. In contrast, sandy soils can drain water too quickly and be low in nutrients, but they are easier to work. Adding organic material can offset many of the problems associated with either extreme.

While there's no such thing as a perfect soil, particular plants grow best in particular soils. In general, common garden plants prefer **loam** – soils with a balance of different-sized mineral particles (approximately 40 percent sand, 40 percent silt, and 20 percent clay) and ample organic matter and pore space, but some common plants grow better in sandy conditions, while others are well adapted to clay soils.

Laying the Groundwork:

Ask students to bring in soil samples from home or collect samples from your schoolyard. Give them a chance to investigate the soil with a plastic spoon and a hand lens. Ask: *What is soil? Can you identify different components of the soil? What does it look, smell and feel like? Do all of our samples look identical? How are they the same? How are they different?*

Exploration:

1. Share information about the components of soil and how the amount of sand, silt and clay present effects growing conditions for plants.
2. Use the ribbon test to estimate the amount of each component in your soil samples. First, take a small clump of soil and add water until it makes a moist ball.
3. Rub the soil together between your fingers. If the soil makes a nice, long ribbon, then it has a lot of clay in it (thus sticks together well). If it crumbles in your hand, then it has a lot of sand. If it is somewhere in between, then you probably have a good mix (a soil with a good mix of all 3 components is called a loam).
4. Ask students to estimate what percentage of each component they think is present. Explain that the ribbon test may not be exact, but scientist may use it in the field to create a general description of a soil since it is very easy to implement (all you need is a little water).

Making Connections:

Follow up with a more concise texture test. Explore soil components by creating "mudshakes" and watching components settle out. To create a "mudshake:"

1. For each soil sample, have students fill a clear container about two-thirds full of water; then add enough soil to nearly fill the jar. You can also add a pinch of laundry detergent to help the soil components separate well. Shake the jar vigorously; then observe the jar over the next couple of days as the particles settle into layers. The larger particles, sand, are heaviest and will settle at the bottom, followed by silt, with the last full layer being clay. The clay may stay suspended and cloud the water for a long time. Organic matter will float on or just below the water surface.
2. Once the jar has settled, compare the results to your ribbon test. Measure the height of each layer and then translate that into percentages for each component (height of each component divided by height of the sample). How accurate were your estimations from the ribbon test?

Branching Out:

Science – Learn about the macro and micronutrients needed by plants. Where do the nutrients come from? How do plants use the nutrients? Test the nutrient content of your soil samples through a do-it-yourself soil test kit or a soil test kit from your local Cooperative Extension office.

Science – Explore the soil map data available from the USDA Natural Resources Conservation Service at: *http://websoilsurvey.nrcs.usda.gov* Contact your local USDA office or College/University and invite a soil scientist to come speak to the class about their job and the importance of their work.

Science – Find out how plants grow in different types of soils. For instance, fill one pot with heavy clay soil, another with sand, and a third with loam. Plant bean seeds in each pot. Provide equal amounts of water, fertilizer, light, etc., to each pot and chart the resulting growth. Students might also find out how worm castings or compost affects plant growth.