SUPER SPECIAL SOILS

Soil is not just "dirt." Soil is one of the basic elements required for all life on earth: soil sustains the plants that give us our food, clothing and shelter. Soil is alive with microorganisms, insects, fungi, plants and other living matter working to build healthy soil. As the plants and animals on earth die, organisms in the soil break down the dead and decaying organic matter and turn it into nutrients that plants need. In addition to the organic matter and nutrients, soil contains air, water and minerals. Plants absorb all these materials through their roots and use them to grow. The healthier and more alive the soil, the better our plants will grow in it. Below are two activities that let students explore different elements of soil: (1) understanding soil composition and (2) improving soil composition.

Activity 1: Understanding Soil Composition

Objective: Students will understand that soil is made up of different sizes of rock particles that make some soils better than others for growing plants.

Activity: Students first explore different soils by feel to predict what their composition is. Then they combine soils with water and let them settle into layers to see actual composition.

Grades: K-8

Materials:

- Soil with varying textures from multiple locations around school or community—students may be sent out to dig samples direct from garden or instructor may provide soils in buckets or bags. Best if each group has a different type of soil to sample. At least one sample should be from their school garden planting area.
- Large jars with lids—enough for one jar for every 4-6 students
- Tape and marker to label jars
- Trowels
- Water

Location: Outside—students are working with soil and water so it can be messy and muddy.

Lesson: Soil is made up of different types and sizes of rock particles. Soil is generally classified by the different sizes of rock particles it contains. The three basic soil classifications are sand, silt and clay. If you want to demonstrate the relative size of the rock particles, sand is a basketball, silt a baseball and clay a marble.

- Sand is the largest rock particle. Because the particles are so big, very sandy soils do not hold water well. Water is not available to the plants and also can wash away the soil nutrients.
- Sandy soil feels rough to the touch and falls apart easily even when damp.
- Silt is the middle-sized rock particle and the best for promoting plant growth. Silt can hold water and nutrients sufficiently for plants to use them, but it is also porous enough for the roots to be able to grow and to get the air they need.
- Silty soil feels smooth and soft. It clumps together when damp, but then crumbles apart easily.
- Clay is the smallest rock particle. It melds together tightly and can prevent both water and roots from getting through. So the plant can not grow the roots it needs, and the water can not drain out so the roots get no air. However, clay soils usually are high in mineral nutrients so they have benefits.

- Clayey soil is slippery and sticky. When damp it will stick together tightly and can even be molded, which is what we do when we create with clay.

Depending on where you live, your soil will have a different mixture of these soil particles. If you live near a beach, you are likely to have soil high in sand. Clay sands are very common throughout the US. The ideal soil mix for gardening is called loam, which is 40% sand, 40% silt and 20% clay.

Directions:

1. How does it feel? Students use hands to feel different soil samples and guess their content.
    a. Divide students into small groups of 4-6 students.
    b. Assign each student group a location for sampling soil or provide them with a bucket, 1-gallon pot or bag of soil.
    c. Have students dig up soil or reach into their container of soil and grab clumps in their hand. Have them explore soil visually and by feel to answer these questions with their group:
        i. Is it rough, smooth or sticky?
        ii. If they squeeze it, does it clump together a lot or a little?
        iii. Have students mix in some water with their clumps—how does it feel now and how does it react to squeezing?
    d. Using what they know about the different soil particles, have each group decide what is the primary soil in their soil sample (sand, silt, clay). *Older students can predict relative % of each particle type.
    e. Have students rotate soil "stations" so that they all can explore the different varieties. *Older students can use their findings to create graphs or data charts.
2. Soil Separation. Students shake up jar full of soil and water and let sit 24 hours to observe soil composition as illustrated by settlement. Because of particle size, soil separates in water. After 24 hours, you will have visible layers in jar with large particle sand sinking to bottom, silt in the middle and smallest particle clay on top.
    a. Have each student group select one soil sample to test.
    b. Each group labels its jar with group name and the location from which their soil sample came.
    c. Students fill their jar ½ with soil and ½ with water. Close jars tightly with lids
    d. Have students shake up their jar and set it some place where it can be easily observed, but not disturbed, for 24 hours. Instruct students NOT TO DISTURB JARS.
    e. After 24 hours and WITHOUT DISTURBING JARS, have students evaluate the settlement in their jars. How close is it to the ideal loam composition—40% sand, 40% silt, 20% clay?
    f. Have students compare what they found from separation activity to what they predicted based on feeling and seeing the soil the day before. *Older students can determine relative % for each soil separation jar. They can also compare that data to their personal exploration data, using a graph or data chart.

Activity #2: Improving Your Soil

Objective: Students will understand that they can improve the health of their soil to make it better for growing plants.

Activity: Students add amendments to their soil sample to improve soil composition.

Grades: 2-8

Materials:

- Soil with varying textures from multiple locations around school or community—students may be sent out to dig samples direct from garden or instructor may provide soils in buckets, 1-gallon pot or bags. Best if each group has a different type of soil to sample. At least one sample should be from their school garden planting area.
- Magnifying glasses—one per student or pair of students
- Trowels
- One bucket, 1-gallon pot or large bowl per group of 4-6 students
- Cup or small pot for holding "before" soil sample
- Soil amendments: compost, sand and clean topsoil
- Optional: seed flats or 4" pots and seeds

Location: Outside—students working with soils

Lesson: Balanced, healthy soil is the key to a healthy garden. As per lesson above, soil has to have a beneficial combination of sand, silt and clay. It also has to have plenty of organic matter. Organic matter is made up of living and/or dead and decaying plants and animals. Organic matter improves soil composition by helping soil maintain proper levels of air and water. Soil also needs organic matter to support a living community of microorganisms and insects that can break down the organic matter to release nutrients into soil.

Gardens rarely come with perfect soils. The native soils in an in-ground garden may have too much clay or sand or not enough organic matter. Container gardens that use store-bought planting mixes eventually use up much of the organic matter in the planting mix so they too need regular improvement. Gardeners can improve soils by adding or replacing the missing elements elements. This is called amending your soil. The goal is to create a loamy soil, rich in organic matter. Good soil holds water, clumps together easily if moist but also breaks apart easily, and contains lots of brown organic matter to provide nutrients.

Directions:

1. Divide students into groups of 4-6 and assign each group a soil sample location or provide them a soil sample in a bucket, 1-gallon pot or bag.
2. Direct students to explore their soil by feel, sight and smell (please no taste tests!) to determine what is its consistency.
3. Set aside small amount of soil in cup or pot for use later to compare against their amended soil.
4. Working together, have students add experiment adding ingredients to improve its structure. Here are some suggestions:
    a. If too sandy, add topsoil and organic matter.
    b. If too clayey, add sand, topsoil and organic matter.
    c. If not rich and dark brown, add organic matter.
5. Have students take notes and write their "recipe" for improving their particular soil.
6. Bring the groups back together to share their soil creation. Each group can show their before and after amendments soil and describe their soil amendment process and recipes.
7. Optional: have students plant seeds in pots filled with their newly amended soil. *Older students can turn this into an experiment by also planting seeds in pots filled with the non-amended soil. Have students measure growth rates over time to determine if their soil amendments worked to create a better soil that grew healthier plants.