Soil Scientists
5th & 6th grade

Students will examine the soil composition, testing for texture, nutrients, and structure. Students will examine soil, describe important soil attributes for farming and list things farmers do to improve the soil.

Lesson Objectives:
- Students are able to identify the 4 components of soil
- Students describe the 3 important plant nutrients and how they are important for plant growth and development
- Students can identify the 3 soil texture particles

What You Need
- Nutrient Test Kit
- 3 Strainers
- Examples of Clay, Sand, Loam Soils
- Pitcher of water
- Magnifying glasses
- Trays/plates
- Soil Pie Chart
- White Board (optional)

What To Do
Ask students “What is Soil” and “What is soil made of?” List the answers on the white board.
Tell students that soil is composed of water, air, organic material (living and dead plant and animal matter), and minerals (sand, silt, clay). Show the pie chart and indicate the percentages of each. We will be exploring three elements of soil today: texture, structure, and nutrient composition. Texture has to do with how the soil feels, structure has to do with how the soil stays together, and nutrients are the food in the soil that plants need. We will be measuring and/or describing each of these characteristics.
What Vegetables Want:
Explain to the group that each plant has specific nutrient needs and some are more picky than others, however in general, to have a successful garden or farm your soil needs to have a texture and structure that allows roots to penetrate, and water and air to circulate—most vegetables call for “well drained soil”. It needs to have a large amount organic matter that provides the nutrients needed by plants, most importantly Nitrogen, Phosphorous, and Potassium (N-P-K).

- N helps produce green leafy growth of stems and leaves
- P helps stimulate roots, flowers, and seed production, and
- K helps overall health and disease prevention.

Usually you want a ratio of (5-2-2). Organic matter not only provides nutrients to help plants grow, but is acts as a sponge, soaking up water and letting plants access it as they need to.

First we will test for one of the three nutrients, then we will examine the soil texture.

Testing Nutrients
You will test for N, P, K and pH, one with each rotation of students. Introduce the nutrient you will be testing, reviewing what it provides the plants.

Info on pH: Ask if anyone knows what pH refers to? pH measures how acidic or alkaline a soil is. Generally, plants require near neutral pH (slightly on the acidic side, around 6), however some plants, like blueberries, like acidic soils. pH is measured on a scale of 1-10. 1 is most acidic, 10 is most basic or alkaline. Soil pH is determined by the minerals present in the parent material (rocks) that made the sand, silt, and clay.

Walk the students through the steps in performing the tests from the kit. Make sure all safety equipment is used:
1. Show the kit and explain the parts
2. Make a circle – each student has a partner
   - 1st student holds the test tube, partner performs the action
   - Teacher or another student reads the instructions
   - Continue passing the test tubes and supplies and instructions around the circle until everyone has had a chance to participate
   --optional 😊 When it comes to the ‘cap and shake for 1 minute step’ have each student do a ‘soil shake dance’ for 5 seconds and pass to the next student.
The pH test tube must rest for 10 minutes before reading the results, so set it aside and, move on to texture.

Testing for Texture
Soil texture is determined by the presence of different particles that come from rock being broken down over time. Sand is the largest particle, silt is smaller, and clay is the smallest. Hold up examples of each particle, ask students to guess which one holds water the best, which one holds air the best? Sand does not hold water well, but does allow for air circulation, silt holds more water and clay holds so much water that it can suffocate plants by not allowing any air to come in.

| Clay and silt soils are made of very small particles. They feel slick and sticky when wet. Clay and silt hold moisture well, but resist water infiltration, especially when they are dry. Often puddles form on clay or silt soils, and they easily become compacted. | Loam soil is a mix of sand, silt or clay, and organic matter. Loam soils are loose and look rich. When squeezed in your fist, moist loam will form a ball which crumbles when poked with a finger. Loam soils normally absorb water and store moisture well. Loam soils can be sandy or clay based, and will vary in moisture absorption and retention accordingly. | Sandy soils contain large particles which are visible to the unaided eye, and are usually light in color. Sand feels coarse when wet or dry, and will not form a ball when squeezed in your fist. Sandy soils stay loose and allow moisture to penetrate easily, but do not retain it for long term use. |

Have strainers with each type of material available and have students pour water through. Plants need a balance, they need water, but not so much that they drown or suffocate from lack of oxygen. Have students spread out and dig up a trowel full of soil from somewhere on the farm and place it in a tray. Hand out forks and magnifying glasses, ask them to examine the soil.

Have the students answer the following questions:
- What is the color of the soil? (Dark brown, light brown, reddish-brown, etc.)
- How does it feel? (Gritty, sandy, smooth, etc.)
- What kinds of things can be seen in the sample? (Leaves, small twigs, rocks, etc. What do they represent: organic material, minerals?)
- What is the texture of the soil? Is it soft, or does the sample have hard lumps in it?
You can have the students add a bit of water and feel the soil and make observations about its texture and structure.

Remind them that soil is a mixture of organic material such as leaves and twigs that have decomposed, and pieces of larger rocks that were broken down by the process of weathering. Ask the students which kind of soil they think would be best for plant growth?

Explain that few gardens start with the "rich sandy loam" that gardening books recommend for planting. The soil improvement and planting practices outlined below can help plant roots do better in any soil:

Break Up Compacted Soil -- Soils that are compacted inhibit drainage and root growth. Compacted soil must be broken up using a shovel, pick or Rototiller. For maximum root spread cultivate new garden and turf areas one foot deep, not just where individual shrubs and trees are to be placed. Break through compacted layers so roots can penetrate into looser soil below.

Add Organic Material -- Organic materials, such as compost, improve every soil type. Organic materials bind sandy soil particles so they retain moisture and nutrients better. They also break apart clay and silt particles, so that water can infiltrate and roots can spread. Amend soil by mixing 4-6" of compost or other organic material into the top 6-12" of soil in new garden and turf areas. Annual beds should receive an additional 1-2" each year. Composted yard waste or barnyard manure are the best soil amendments, because the nutrients are ready for plants to use.

Mulch to Retain Moisture -- Mulch is any material that is spread on the soil to slow moisture evaporation, keep the surface loose and porous, and keep down weeds. Organic materials such as wood chip, ground bark, and compost are excellent mulches that allow air and water to enter the soil, and add nutrients as they decompose.
SOIL TEXTURE—BY HAND

Follow the procedure below to determine the texture of a soil:

1. Take a soil sample the size of a small chicken egg (2 Tbs.) and add enough water to moisten it. The soil should form a ball when squeezed. If it crumbles, add some more water, and it gets too wet, just add some more dry soil. If the soil sample will not form into a ball, regardless of the moisture, you have Sand.

2. Place the ball of soil between your thumb and forefinger and gently push the soil forward with your thumb, squeezing it upward into a ribbon. Try to keep the ribbon uniform in thickness and width.

3. Does soil form into a ribbon? If yes, go on to #4. If no, you have Loamy Sand.

4. If soil forms a weak ribbon, less than 1” before breaking, you have Loam.
   a. Does soil feel gritty? If yes, you have Sandy Loam
   b. Does soil feel equally gritty and smooth? If yes, you have Loam
   c. Does soil feel smooth? If yes, you have Silt Loam.

5. If soil forms a medium ribbon, 1-2” before breaking, you have Clay Loam.
   a. Does soil feel gritty? If yes, you have Sandy Clay Loam.
   b. Does soil feel equally gritty and smooth? If yes, you have Clay Loam.
   c. Does soil feel smooth? If yes, you have Silty Clay Loam.

6. If soil forms a strong ribbon, 2” or longer before breaking, you have Clay.
   a. Does soil feel gritty? If yes, you have Sandy Clay.
   b. Does soil feel equally gritty and smooth? If yes, you have Clay.
   c. Does soil feel smooth? If yes, you have Silty Clay.
NOTES AND EXTENSIONS

1.) Soil particle test  *you can do this ahead of time to share with the groups*
This simple test allows students to see the different sized particles in the soil. Simply place a few handfuls of soil in a glass mason jar fill nearly full with water and have students vigorously shake. Then set the jar aside and allow it to settle. Depending on the amount of clay in the soil it will take longer to settle, even if the clay is still in suspension, they can usually see the sand and silt within an hour. Do this at the beginning of the lesson and revisit the jar at the end.

2.) You can add the science inquiry experiment to this lesson if the class is returning to the farm another day

3.) You can facilitate a discussion about organic/sustainable agricultural ways of adding nutrients and conventional agricultural methods

4.) Do the Soil Texture By Hand—or “Ribbon Test” that is attached

5.) Show the examples of how farmers add different nutrients to the soil