Layer Away- A Lesson on the Importance of Soil

AUTHOR:
The original lesson, first developed by Michigan Department of Agriculture, was modified by Michigan Water Stewardship Program.

OVERVIEW:
In this lesson, students will explore the many components of soil.

Michigan Grade Level Content Expectations (GLCEs):

- Identify the living (biotic) and nonliving components of an ecosystem (L.EC.06.31).
- Explain how physical and chemical weathering leads to erosion and the formation of soils and sediments (E.SE.06.11).
- Explain how waves, wind, water, and glacier movement, shape and reshape the land surface of the Earth by eroding rock in some areas and depositing sediments in other areas (E.SE.06.12).
- Describe how soil is a mixture, made of weathered eroded rock and decomposed matter (E.SE.06.13)
- Compare different soil samples based on particle size and texture (E.SE.06.14).

GRADE: 6

SUBJECT(S): Science

DURATION: Two class periods

GLCSs: L.EC.06.31, E.SE.06.11, E.SE.06.12, E.SE.06.13, E.SE.06.14

MATERIALS:

- "Soil Texture Triangle" handout (click here for a printable version)
- "Soil Composition" worksheet (click here for a printable version)
- "Soil Triangle" worksheet (click here for a printable version)
- Clear quart size or gallon size jar with lid (1 per group)
- Soil sample (1 per group)
- Ruler (1 per group)
- Water
- Containers to get water (1 per group)
- Paper
- Tape
- Chalkboard and chalk

OBJECTIVES:
Students will be able to:

1. Understand that soil is important and needs to be taken care of.
2. Recognize that there are many living and non-living ingredients in soil.
3. Explain the different components of soil and the characteristics of each component.
4. Understand why farmers and individuals need to test their soil.
5. Recognize that human impacts can cause soil erosion to degrade water quality and wildlife habitat.

BACKGROUND INFORMATION:
One of the most important natural resources that cover much of the earth's land surface is soil. Most life on earth depends upon the soil as a direct or indirect source of food. Plants

are rooted in the soil and obtain nutrients (nourishing substances) from it. Animals also get nutrients from eating the plants in the soil. Soil is home to of many organisms such as seeds, spores, insects, and worms. The contents of soil change constantly and there are many different kinds of soil. It forms very slowly and is destroyed easily, so it must be conserved in order to continue to support life.

Biotic factors are the living things that shape an ecosystem, specifically living components that affect another organism, e.g. animals which consume a living organism, and the living food that the organism consumes. In contrast, abiotic factors are the non-living components of an organism's environment, such as the quality of light and water, range of temperatures and soil composition.

Physical and chemical weathering leads to erosion and the formation of soils and sediments. Weathering is the breaking down of Earth's rocks, soils and minerals through direct contact with the planet's atmosphere. Two important classifications of weathering processes exist — physical and chemical weathering.

Physical weathering involves the breakdown or disintegration of rocks and soils through direct contact with atmospheric conditions, such as heat, water, ice and pressure, without chemical change. Chemical weathering involves the direct effect of atmospheric chemicals or biologically produced chemicals in the breakdown of rocks, soils and minerals. Chemical weathering changes the composition of rocks, often transforming them when water interacts with minerals to create various chemical reactions. Chemical weathering is a gradual and ongoing process.

The materials left over after the rock breaks down combined with organic material creates soil. The mineral content of the soil is determined by the rock from which it was formed, thus a soil derived from a single rock type can often be deficient in one or more minerals for good fertility, while a soil weathered from a mix of rock types often makes more fertile soil.

Soil is made up of four parts: air (abiotic), water (abiotic), minerals (abiotic), organic material (abiotic), and living organisms (biotic) that help break down soil including worms, soil microorganisms, and other living creatures in the soil. Air and water provide nutrients to plants so they can make food for themselves. Organic matter, also known as humus, is made of plant and animal remains in various stages of decay. Minerals are the clay, sand, and silt particles. The mineral content determines the soil type. Sandy soil has mostly has mostly sand and no organic matter. Sand is the largest of the soil particles, feels gritty, is the heaviest, and allows water and air to move easily through it. Clay soil has mostly clay, a little organic matter, and sand. Clay particles are very fine and are the smallest of the three soil particles. Clay is sticky when wet and hard and brick-like when dry. Silt is the soil particle that falls between sand and clay in texture. It is considered a medium-sized soil particle. It feels like flour and is very smooth when you rub it in your hands. Silt particles keep the soil rich and loose.

Weathering occurs with no movement. In contrast, soil erosion involves the movement of rocks and minerals by water, waves, ice, wind, and gravity which shape and reshape the land surface of the Earth by eroding rock in some areas and depositing sediments in other areas. Soil can be detrimental to water resources when the nutrients it contains are carried with it into waterways, degrading water quality. Soil erosion can also lead to degradation of aquatic wildlife habitat.

Farmers have very important jobs growing the food and fiber for the world. If we did not have farmers, we would have to grow our own food and materials for clothing. However, a farmer's job consists of many more responsibilities than growing food or fiber. They must also take good care of our soil so we can continue to grow enough food to feed everyone. Soil testing must be done so the farmer knows what type of soil he or she has and can make sure the proper nutrients and the amounts of these nutrients are present. If the proper nutrients aren't present, the levels of these nutrients need to be adjusted so the farmer can grow a healthy crop. By adding fertilizers and rotating crops, farmers replace nutrients that leaching and growing plants have removed. Farmers also make sure there is a high level of organic matter in cultivated soils.

VOCABULARY:
Abiotic, biotic, soil texture triangle, sand, silt, clay, loam, soil erosion, sediments, soils, physical weathering, chemical weathering, soil particle size, texture.

PROCEDURE:
Warm-Up (Anticipatory Set):
Prior to this lesson, have the students form groups with three to four students in each group. Have one of the students bring a soil sample in a jar with a lid or a resealable plastic bag. The soil sample needs to be enough to fill a quart size jar or gallon size jar (whichever you choose) about half way. Make sure the students understand their soil sample needs to come from their yard or garden. They should not bring in a container of potting soil.

Activities:
Day One:
1. Write the four components of soil on the chalkboard for the class to see. Discuss each component with the class. When discussing minerals, write sand, silt, and clay on the board. Discuss the characteristics of each type and write the characteristics on the board.
2. Explain to the students that the farmers have many responsibilities with their job. One of these responsibilities is to maintain the quality of their farmland. Farmers test their soil to determine what type of soil they have and what nutrients are in the soil. The soil test also tells farmers if any nutrients need to be added.
3. Divide the class into groups of three or four students each (if not done previously). Hand out a quart or gallon sized jar with a lid to each group.
4. Have the groups pour their soil sample into their clear jar until the jar is half full. Then have each group fill their jar three-fourths full of water. Place the lid tightly on the jar.

5. Have the students in each group take turns shaking their jar for one minute each.
6. When done shaking, have the groups put their names on a piece of paper and tape it to the jar. Set all the jars out of the way where they will not be disturbed.

Day Two

1. Start the second process of this lesson by asking students why they think you had them put water in the jar with the soil and shake it up. Let students make some guesses.
2. When the students are done guessing, explain to them that all of the soil samples put into the jars were soil that was all mixed up. Each sample has different amounts of minerals (sand, silt, and clay) in it, but we did not know the amounts by simply looking at the soil. By putting water in with the soil, shaking the jar, and letting the soil settle, we are able to see the different types of minerals in the soil. This occurs because of the heaviest particles (sand) settle first on the bottom of the jar. The next layer of soil is the silt because it has medium size particles. Silt is not as heavy as sand but is heavier than clay. The last layer to settle on the top is the clay. Clay particles are he lightest of all.
3. Have the students get back into their groups and get their jar of soil. Remind them to carefully carry their jar back to their group so the particles will not be disturbed. Hand out the "Soil Composition" worksheet and the "Soil Triangle" worksheet to each student. The "Soil Texture Triangle" handout can also be passed out to each group or can be made into an overhead for all to see.
4. Next the groups should conduct the measurement of their 'Soil Composition" worksheet. Have the groups use their ruler to measure the total height of the soil in their jar. Record this number in centimeters on the worksheet.
5. Then have the students measure the heights of the sand, the silt, and then the clay. Record these numbers on the worksheet.
6. Now the students will change their measurements into percentages. The students should then compute what percentage of sand is in the sample, what percentage of silt is present, and what percentage of clay is present.
7. When students complete this worksheet, have them follow the directions on the "Soil Triangle" worksheet. The students will need to use their percentages figured on the "Soil Composition" worksheet to complete the "Soil Triangle" worksheet.
8. The “Soil Triangle” worksheet will tell the students what type of soil their group has.

Wrap-Up (Closure):

1. Why is soil important?
2. What are the components of soil?
3. What are the three types of minerals in soil?
4. How are these three minerals different?
5. Why do farmers test their soil?
6. What type of soil settled first in your jar? Second? Third?
7. What type of soil did your group have?

ASSESSMENT OPTION:

Farmers are not the ones responsible for taking care of soil, preventing soil erosion, and getting soil tested before fertilizing. Individuals also have these same responsibilities. What can individuals do to help manage soil properly? What impact do soil nutrients have on water quality? How can soil erosion impact habitat of aquatic wildlife? What happens when soils become compacted?

What happens if you take one of the components of soil out (e.g. remove sand, silt or clay). What will happen to the composition of soil? Could you still grow plants in this kind of soil? How would this affect the way water drains from this type of soil?

EXTENSIONS:

1. Have the class keep track of where each soil sample came from and compare what types of soil they are?
2. Invite a farmer into the classroom to discuss what he or she does to protect their farmland from soil erosion.
3. Have a conservationist come to the classroom to talk more about soil and its importance.
4. Research how an individual can get their soil tested through a local MSU Extension office.
5. Explore your community (home, school, neighborhood, etc.) for examples in which soil is not being managed properly. Develop a plan to help manage soil responsibly.

RESOURCES:

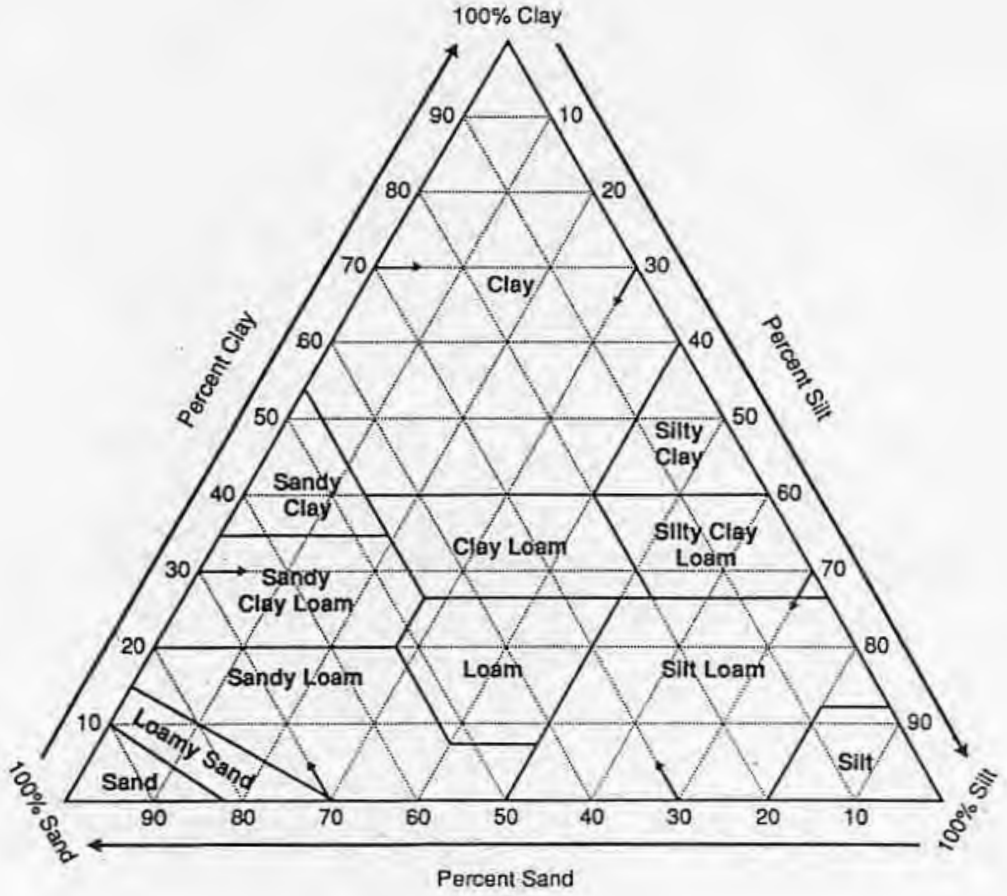
1. Michigan Farm Bureau Ag in the Classroom, "Soil. . . It's More than Just Dirt" lesson, Science Section.
2. The Dirt on Soil, Discovery, Discovery Education, Discovery Communications, LLC:
   http://school.discoveryeducation.com/schooladventures/soil/down_dirty.html

3. Local Michigan State University Extension (MSUE) office:
   Visit "Your Local Resources" section, Michigan Water Stewardship Program web site or http://www.msue.msu.edu.
4. Local Conservation District:
   Visit "Your Local Resources" section, Michigan Water Stewardship Program web site.
5. Kids Gardening web site (Classroom Projects):
   http://www.kidsgardening.org/

1.

To be used with:
Layer Away

Soil Texture Triangle



To be used with:
Layer Away

Name _____

Soil Composition

Conduct the following measurements to find out what type of soil you have. Record all heights in centimeters.

1. Measure the total height (amount of soil in your jar). Total Height: _____ cm

2. Measure the amount of sand (bottom layer). Sand: _____ cm

3. Measure the amount of silt (second layer). Silt: _____ cm

4. Measure the amount of clay (the top layer). Clay: _____ cm

Now take measurements for the sand, silt, and clay and turn them into percentages. The percentages will tell you how much sand, silt, or clay is present compared to the total amount of soil in the jar. To figure out the percentages of each, take your amount of sand (or silt or clay) and divide the number by the total amount of soil in the jar. Then multiply this number by 100 to get the percentage of sand in your jar. Round your percentages to the nearest whole number.

Here is an example:

You have 2.5 cm of sand in your jar. The total amount of soil in your jar is 7 cm.

Step 1: Divide the amount of sand by the amount of soil.
2.5 cm ÷ 7 cm = .357

Step 2: Multiply the number by 100 to figure the percent.
.357 x 100 = 35.7

Step 3: Round your answer
35.7 rounded = 36% sand

5. Sand: _____ cm

cm = _____ x 100 = _____ % Sand = _____ %

6. Silt: _____ cm

cm = _____ x 100 = _____ % Silt = _____ %

7. Clay: _____ cm

cm = _____ x 100 = _____ % Clay = _____ %

8. Now add your three percentages together. They should equal 100%.

_____ % Sand + _____ % Silt + _____ % Clay = _____%

To be used with:
Layer Away

Name _____

Soil Triangle

Use the **Soil Texture Triangle** to determine what type of soil your group has. Look over the soil triangle to familiarize yourself with it. The bottom line represents the percentages for sand. The slanting left line represents the percentages for clay and the right slanting line represents the percentages for silt.

1. Transfer your percentages of sand, silt, and clay from the "Soil Composition" worksheet.

   Sand: _____ % Silt: _____ % Clay: _____ %

2. Take your percentage for sand and find it on the sand line (bottom line). From this point, draw a line upwards and to the left through the triangle. (This line should be parallel to the right slanting line.) This line marks your percentage amount for sand.

3. Next, take your percentage amount for silt and find it on the silt line (the right slanting line). From your percentage on the line, draw a line slanting downward and to the left, through the triangle. This represents your percentage amount for silt. (The sand line and the silt line should cross over one another.)

4. Now take your percentage for clay and find it on the clay line (the left slanting line). Draw a line from your percentage point directly across the triangle (horizontally). Once you have drawn this line, all three lines should intersect at the same point.

5. Draw a circle around the intersection of the three lines. It will fall within one of the soil types on the grid. This is the type of soil that your group has.

   The type of soil we have is: _____