Crop Science Investigation Workshop Series Lesson Plans

Amazing World Under Our Feet

Subject: Crop Production- Intro to Soil **Grade Level(s):** 4th – 8th grades
Lesson Title: What is soil and why is soil important?
Time period: 25-90 minute session (depending on activities conducted and depth of content)
This lesson can easily be adapted to address as few as one learning objective or all. Objectives and corresponding learning activities are numbered accordingly.

These lessons can be adapted for youth of any age depending on level of technical content taught. When working with youth of varying ages, it is suggested to have older youth help the younger ones.

Lesson Objectives:

1. Define soil and understand the importance of soil.
2. Explain why plants need soil.
3. Be familiar with how soil layers are formed.
4. Explain moisture retention capabilities of the three major soil particles.
5. List and describe functions of soil.
6. Describe ways soil can be enriched.

Materials, audio-visual aids:	**Resources**
3-4 soil samples Sealable sandwich or gallon bags for each sample Paper lunch bags for each sample Index cards for each sample Paper Pencils Stopwatch or second hand watch Apple Paring Knife & Cutting Board Paper Towels Optional: Clipboards PREP AHEAD: Find three or four soil samples from different locations (field, pasture, yard, garden, playground, sandbox, etc.). Obtain samples at least 2 inches below the soil surface keeping all soil particles from that sample together. Each sample should fill about a sandwich bag or half of a gallon bag. Label each bag (A,B,C, etc. with instructor keeping track of which is which) 3 jars with sand, silt, & clay (1 cup each) 3 cups of water	University, North Carolina A & T, (2002). Down-To-Earth Enriching Learning Through Gardening. In B. Williamson, & E. Smoak, pgs. 33-38. *USDA Natural Resource Conservation Services*. (n.d.). Retrieved August 2010, from http://www.nrcs.usda.gov/feature/education/squirm/skQstns.html **Handouts** -Checking for Understanding (Following lesson plan) -Amazing World under Our Feet Review Sheet (Following lesson plan)

Solving the Problem	
Interest Approach/Attn Focusing Activity	▪ How much soil is on the Earth? Let's do this demonstration to show how much soil is on the Earth and how much is available for ag production.

	APPLE DEMONSTRATION HOLDING UP THE APPLE: Imagine that this is the earth. We all have the responsibility of taking care of our planet. It will be up to your generation to make sure that we continue to take care of our land, and also come up with creative ways to feed everyone in the world. Now, I'd like to demonstrate how very little of the earth's surface is available for us to use to grow all the food we need to stay healthy and strong for one year. Imagine that this apple is the earth. How much of the earth is land vs. water? (ANSWER: 3 PARTS WATER, 1 PART LAND) I will start by cutting this apple into 4 parts. I will set aside three parts which will represent the oceans, lakes, rivers, and all waterways of the world. Other than seafood we harvest from the waters, we really don't grow any food in these three parts. That leaves us with ¼ (or 25%) of the earth's surface. (HOLD UP ¼ PIECE OF APPLE.) I will now cut this into 2 pieces. (CUT LENGTHWISE.) One of these pieces will be set aside to represent the areas of the earth's surface where no man or animals can live and where no plants grow… places like Antarctica, the desserts, and mountain tops, etc. HOLD UP 1/8 OF THE APPLE That leaves up with 1/8 (or 12.5%) of the earth's surface. Of this 12.5%, 40% represents places that are too rocky, too dry, too wet, or too rough. (CUT 40% OF THE APPLE.) HOLD UP THE 10% REMAINING. That leaves us with 10% of the earth's surface available for humans to use. If we peel that, it leaves 3%. (CUT THE PEELING OFF THE APPLE, HOLDING THE PEEL AND APPLE PEEL.) This peel represents what is available for agricultural land. The 1/32 apple piece represents areas of the earth's surface where we built cities, houses, factories, roads, etc…places where we live but don't grow crops. So, remember that 10% of the world's entire land is available for agricultural production and what we depend on for the world's food supply. This portion of the Earth competes with all other human needs – houses, cities, schools, hospitals, shopping centers, etc. Ask youth the following:

Problem statement What is soil and why is soil important?	▪ What comes to mind when you heard the word, "soil"? *Is it organic matter, water, air, sand, silt, clay, worms, plant roots, etc?* ▪ Why do some plants grow better in some areas? *Climatic factors such as temperature, moisture and sunlight are important, but small differences in soil also enable a plant to grow more successfully in one area than in another.* ▪ Why is soil important? *It is the basic element of life.* *Soil is the foundation for life on Earth.* *Without it, we could not survive.* Today, you'll all be soil scientists and discover the Amazing World Under our Feet! We'll examine different types of soil and even have you understand some basic soil terms by the end of this session.
1. **Objective 1**: Define soil and understand the importance of soil.	Soil, the foundation for life on Earth, needs to be rich and fertile if plants are to grow healthy and strong. What is soil made up of and what do plants use that is in the soil? The underground environment for the roots of plants living in adequately watered garden soil contains nearly 50 percent solids, 25 percent air, and 25 percent water**.** Through their roots, plants take in air (oxygen), water (moisture), and nutrients (minerals). Plants use these vital ingredients to survive.
2. **Objective 2:** Explain why plants need soil.	How does soil help plants? Plants need support, oxygen, ions, and liquid to survive. There are plants which live in water or other conditions without soil, and there is an agricultural production process, hydroponic production, which makes it possible to grow plants without soil. But the vast majority of plants which humanity depends on for food and fiber depend on soil.
3. **Objective 3:** Be familiar with how soil layers are formed.	How do soils form? Soils are formed by a slow weathering process that takes place above and below the Earth's surface. This weathering process begins with the physical breakdown and chemical decomposition of rock. Above ground, weathering can start with wind and rain blowing against mountains. Boulders become loosened, and freezing

	rain cracks the smaller boulders into even smaller pieces. Below ground, rock becomes soil through decomposition. During decomposition, both above and below the ground, rock chemically reacts with water and other acidic solutions to produce "rotten" rock that falls apart more easily. Chemicals released during rock decomposition are sources of the nutrients that help plants grow. The list of nutrients includes nitrogen (N), Phosphorous (K), potassium (P), and many others. Although wind and water reduce rock into sand, silt, and clay, these particles alone do not produce fertile soil. The particles mix with organic matter - the decayed remains of plants and animals. Decay keeps the soil fertile, able to nourish plant growth, by recycling nutrients. Soil is a temporary storehouse for nutrients. Soil has distinct layers called "horizons." Separate layers of a soil differ from one another in various physical and chemical characteristics. Top layers of soil (A horizon) consist mostly of organic material. Subsoil layers (B horizon) have many fine clay particles. The lower subsoil layer (C horizon) contains partially decomposed pieces of solid rock. Beneath the three layers is the parent rock from which the soil originated. **ACTIVITY:** Have youth draw the layers of soil horizons and label the characteristics of each horizon.
4. **Objective 4:** List and describe functions of soil.	Rain, decay, and living organisms form the web of life that produces fertile soil. Thus, fertile soil is a renewable resource. Litter and surface soils are full of microscopic life, such as bacteria and fungi. When a leaf falls or a field mouse dies, living worms and bacteria feed on those organisms and make them part of the soil. Decayed organic matter, called "humus," helps keep the soil moist by soaking up rainwater. As rain seeps through, the humus removes chemical elements, and the water leaches them into the soil. Then, the roots of growing plants absorb calcium, zinc and other elements. Most of the soil layers provide homes for a variety of animals: ants, beetles, grubs, spiders, mites, springtails, millipedes, snails, worms, and small rodents such as mice and shrews. As these animals burrow and tunnel beneath the soil, they mix and break soil into tiny fragments. Their passages also allow air, water and nutrients to penetrate beneath the soil surface.

5. **Objective 5:** Explain moisture retention capabilities of the three major soil particles.	What are the major soil particles? Small particles of **sand, silt, and clay** give soil its structure. A sand particle is much larger than a silt particle, while clay particles are, by far, the smallest. The ratio of these particles is the key to soil classification. Loam (the most desirable soil) is a mixture of nearly equal parts of sand, silt and clay. If the soil has more silt than loam, it is silty loam; more sand than clay, it is sandy clay; more clay than loam, it is clay-like loam, and so forth. **ACTIVITY** Take each jar with the sand, silt and clay. Slowly pour 1 cup of water into each jar. Ask youth if they noticed any differences of how the water reacted to each soil sample. (Clayey container should have had water pool on top and not absorb as readily.) (Silt container should have slowly absorbed the water.) (Sandy container should have had water go through quickly.) Why did these samples react differently? Different types of soil hold different amounts of water, minerals, and air. Sandy soils drain well because they have large air spaces. Water is lost more quickly from the large spaces between sand particles, as the force of gravity drains the water out. Also, sandy soils have little capacity to hold plant growth minerals. **Sandy** soil is made up of large round particles with relatively large spaces of air between them. Though sandy soil contains a lot of air, or space it cannot hold water well and tends to lose soil and nutrients quickly. **Silty** soil is intermediate in texture between clay and sand. It feels smooth and is slippery to the touch when wet. **Silt** prevents water and minerals from the leaching, or draining out of the soil. **Clay** soil is made up of microscopic, flattened mineral particles. These tiny particles pack closely together, becoming sticky when wet and leaving little space for air and water. Clay soils have poor drainage and air holding spaces. Because of this, clay and other heavy soils

	often hold more water than is good for plant growth. On the other hand, clay soils may be richer in nutrients, because they can hold plant minerals more effectively than soils composed of larger particles. -Why is soil classification [ratio of clay, silt, and sand] important? Farmers, gardeners and anyone else growing plants need to know what kind of soil is present. For example, sandy soils require less fertilizer and more frequent applications of water than clay soils. **ACTIVITY: SOIL IN A SACK** -Set up an observation station for each soil sample collected. At each station place a bag of soil, one paper bag, a stack of index cards (at least one per team member), pencils, and one sheet of construction paper. -Divide the group into as many small teams as there are soil samples. Explain that each team will spend a few minutes at all of the stations exploring the soil. -When you say “Start”, teams will have 30-60 seconds (depending on time frame) to examine the soil at the station, write at least one descriptive word about the soil on an index card and place the card into the bag. -When you say “change”, they will rotate to the next station. Repeat to as many stations as time permits. -After youth have had a chance to look at each (or as many stations as time allows), go over the descriptive words in each sack that best describe that soil. After reading the descriptive word, have youth guess where that soil sample came from. *-If time permits, or for an extra project, based on the descriptions from each soil, youth will write a small report explaining what that soil would be best suited for (i.e. garden, field, playground, construction site, etc.)* What would you do if you had one of the soil samples that was not necessarily suited for a field, but was the intended purpose? (use it for a field by modifying the soil or if it is just not meant to grow crops, use it or sell it for something else) Lead into next section on how people can enrich soil.

6. **Objective 6:** Describe ways soil can be enriched.	How can people *enrich* soil? The composition, moisture-holding capacity, drainage, and fertility of soil can be changed by using soil enrichers. -Adding organic matter improves the water-holding capacity of soils. Animal manure, peat moss, and sawdust are good sources of organic matter. Chemical or natural fertilizers can also be used to provide important plant nutrients. Adding organic matter to the soil can: • Make a heavy soil lighter, more crumbly, and friable. This is especially important in areas where the soil is high in clay. • Hold light soil particles together and help anchor them against erosion. This increases the water-holding capacity of soil in sandy areas. • Provide some of the nitrogen needed by plants. • Release nutrients already in the soil by turning them into soluble compounds that can be absorbed by the roots of the plants. • Permit growth and functioning of micro-organisms. • Furnish a small quantity of all elements essential for plant growth. -Spreading mulches, such as wood chips and straw, on the soil surface helps to retain soil moisture, reduces runoff, and allows more rainwater to drain into the soil. Mulches keep soil cooler by reducing evaporation loss. -Planting windbreaks and plants on the soil can help prevent erosion from occurring.

Summary (Closure) – Conclusion to the Problem:
What is soil and why is soil important?

1. What is soil? Why is it important?
2. Why do plants need soil?
3. How are soil layers formed?
4. What are the three major soil particles? How do they affect moisture retention of soils?
5. What are functions of soil?
6. How can soil be enriched?

Performance Assessment:

1. Youth are able to successfully describe different soils using appropriate soil terminology.
2. Youth are able to explain the importance of soil, soil properties, and what soil is composed of.

Checking for Understanding

Amazing World under our Feet Questions

What percent of our earth's land is available to produce the world's food supply?

a. 20%
b. 30%
c. 10%
d. 75%

What is soil?

a. Organic matter, water, air, sand, silt, clay, worms, plant roots
b. The foundation for life on Earth
c. Created by the weathering of rocks and other elements make the minerals in soil.
d. All of the Above

What is soil made of?

a. 50 % solids/organic matter, 25 % air, and 25 % water
b. 50 % water, 25% air, 25% solids/organic matter
c. 50% air, 25% water, 25% solids/organic matter
d. 100% organic matter

How does soil help plants?

a. Plants take in air with its roots.
b. Plants take in water with its roots.
c. Plants take in nutrients, as plants use these vital ingredients to survive.
d. All of the Above

What are the three major particles of soil?

a. Humus, air, sand
b. Water, humus, air
c. Sand, silt, and clay
d. Clay, sand and water

Answers: 1) C, 2) D, 3) A, 4) D, 5) C

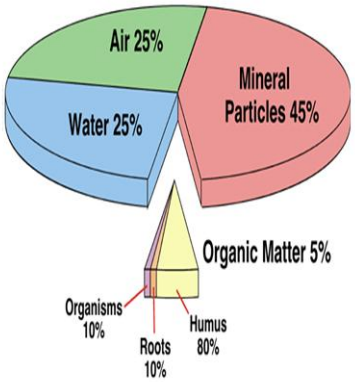
Lesson Plan: Crop Production- Intro to Soil
Lesson Title: What is soil and why is soil important?

The Amazing World under Our Feet

What Is Soil?

What is Soil Made Of?

- Soil is made up of:
- Minerals
- Air
- Water
- Organic Matter
  - Humus
  - Roots
  - Organisms



Why do some plants grow in better in some areas?

Climatic factors such as temperature, moisture and sunlight are important, but small differences in soil also enable a plant to grow more successfully in one area than in another.

Why is soil important?

It is the basic element of life. Soil is the foundation for life on Earth. Without it, we could not survive.

SOIL STRUCTURE

O-horizon: leaf litter, organic material

A-horizon: plough zone, rich in organic matter

B-horizon: zone of accumulation

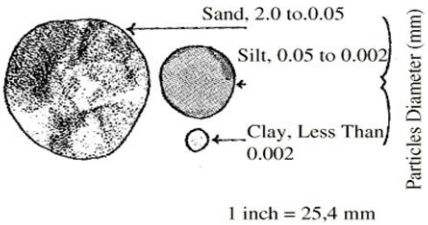
C-horizon: weathering soil; little organic material or life

R-horizon: unweathered parent material

What is Soil Made Of?

- Soil is made up primarily of three different particles.
- Clay, Silt, and Sand

Relative Size of Soil Particles



Soil helps plants:
Take in air, water and nutrients with its roots.

What are some ways humans can help enrich soil?

-Adding organic matter improves the water-holding capacity of soils. Animal manure, peat moss, and sawdust are good sources of organic matter. Chemical or natural fertilizers can also be used to provide important plant nutrients.

-Spreading mulches, such as wood chips and straw, on the soil surface helps to retain soil moisture, reduces runoff, and allows more rainwater to drain into the soil. Mulches keep soil cooler by reducing evaporation loss.

-Planting windbreaks and plants on the soil can help prevent erosion from occurring.

Graphics from: U.S. Department of Agriculture's *Natural Resources Conservation Service*. Worksheet Compiled by UNL Extension

The Amazing World under Our Feet
Review

Lesson Plan: Crop Production- Intro to Soil
Lesson Title: What is soil and why is soil important?

What is soil made up of?

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List and describe the three major soil particles?

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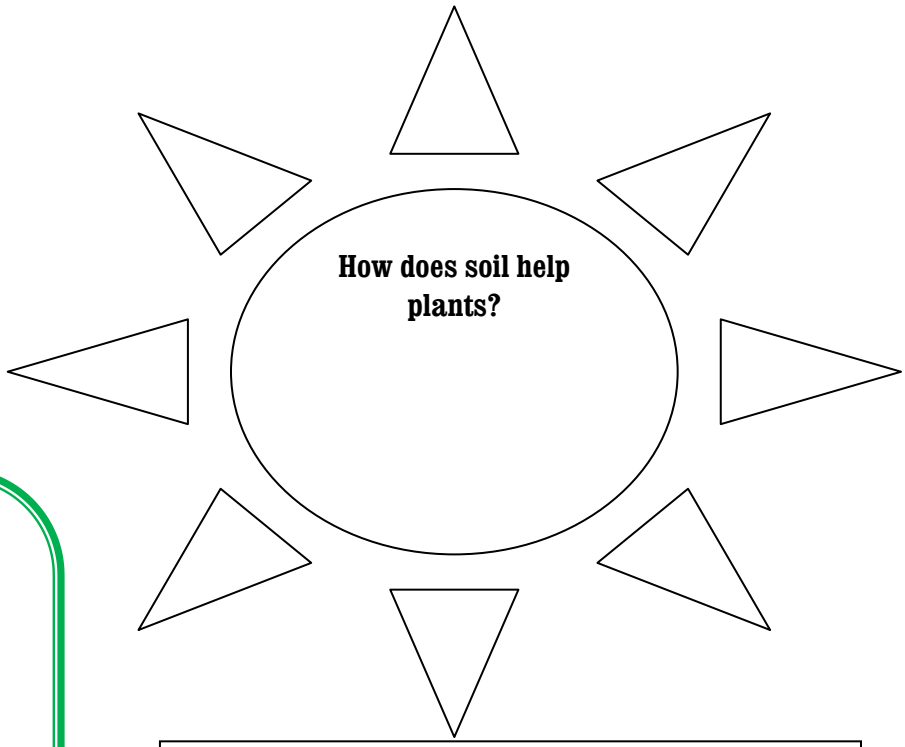
What Is Soil?

Soil is dynamic .... Meaning it changes daily, hourly and even every minute. How does it do that?

- Soil is constantly changing its form and properties because of microorganisms that live in it, water being added or removed, and by the plant roots that are growing in the soils pores.
- These changes are happening microscopically and are hard to see.



How can we enrich the soil?

Why is soil important to us?

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