Activity–What Is In Soil?

Standard III

Objective 3

Standard III
Students will understand the basic properties of rocks, the processes involved in the formation of soils, and the needs of plants provided by soil.

Objective 3
Observe the basic components of soil and relate the components to plant growth.

Intended Learning Outcomes
2. Manifest scientific attitudes and interests.
4. Communicate effectively using science and language reasoning.

Connections

Background

Everything we have comes from the Earth or its elements. The most obvious things that come from the soil are the plants we eat. Trees also give us valuable lumber and the wood can also be used to make paper, paints, and numerous other products. Our animal food also comes from the soil. Cows eat grass, hay, silage, and grain to produce milk, meat, and leather products. Animals supply us with the by-products that are used in paints, camera film, pet food, rubber, crayons, lotions, soaps, medicines, etc. Fish live on insects, plants, and other animals that require dissolved minerals that are washed into the water from soil. Even natural gas, coal, and petroleum-based products (plastics are petroleum-based) come from organic material that grew on the earth ages ago. Minerals used for manufacturing are the parent material of soil. It is important that we recognize our dependence on soil.

Soil is made up of particles of rocks and minerals, dead plant and animal matter, tiny living organisms, gases (air), and water. The particles of rocks and minerals found in soil have broken away from larger pieces of rocks and minerals. Some particles are large chunks of rock and others are tiny mineral particles, which get dissolved by water in the soil.

Soil contains spaces filled with water and gases (air). Water soaks in the ground from rain (and other forms of precipitation). Gases come from the air, plants, and animals. Water in the soil makes minerals available for plants to use.

Soil also contains organisms. Living organisms (such as bacteria, fungi, insects, etc.) are an important part of soil. Living organisms break down nonliving organic plants and animals in the soil, which makes soil rich and healthy for plants to grow in.

Every soil consists of minerals, organic matter, water, and air. The proportions may vary but the following list is the average composition of the major soil ingredients: 45 percent minerals, 25 percent water, 25 percent air, 5 percent organic matter (both living and dead).

Invitation to Learn

Hold up a leather shoe to the class. Brainstorm with the class by asking: Where do you think this shoe came from? Where did it come from before it was there? Write all responses on the board. Try to lead the questioning until students recognize that the original source of the leather was in the soil. (shoe > store > shoe factory > leather > tannery > leather merchant > cow > grass > soil). Model the flow chart on the board or overhead. (You could have students record the flow chart for a leather shoe in their science journal.) Lead students to understanding that everything we eat, wear, build, etc, ultimately comes from soil. So let's see what is in our soil.

Instructional Procedures

Part 1: **Looking for organic (living or once living) and inorganic material (nonliving).**

1. Give each student 1/4 cup of soil, plate, paper towel, lens, tweezers
2. Instruct them to use the hand lens to examine their soil. They are to look for organic matter (living and dead plants, insect parts, living insects) and non-living material (rocks and minerals). Have them make separate piles. They could put living insects in an insect view for better viewing and to contain them.
3. Students should record what they find in their logs.

Part 2: **Water in the soil**

4. Have students place their soil on a paper towel. Fold it in half and gently press. Return the soil to the plate. Examine the towel. Ask them to describe the condition of the towel. They should observe that it is wet. Ask what ingredient was removed from the soil? (water)
5. Place one cup of damp soil in a container. Weigh it. Record weight in science log. Place soil in a sunny window. Weigh it after a few days. Record results and differences in weight. Discuss how much water was in the soil. How can they tell?

Part 3: **Compacted vs. loose soil**

6. Put a cup of wet soil in a container with holes (sieve, can with nail holes punched in bottom). Use a spoon to compact the soil.
7. Ask the question, "Which holds more water– loose soil or compacted soil?"

Materials

- ❑ Scale
- ❑ Garden soil
- ❑ Hand lens
- ❑ Plates
- ❑ Paper towel
- ❑ Tweezers
- ❑ Insect viewers (optional)
- ❑ Measuring cups
- ❑ Containers for soil (preferably clear)
- ❑ Spoons
- ❑ Sieve or can with nail holes punched in bottom

8. Place a cup of soil in each of two containers. Pack the soil tightly in one container.
9. Using two separate measuring cup (filled with exactly 1 cup of water) slowly pour water slowly into each container until the soil won't hold any more and the water starts gathering on top.
10. Observe how much water is left in each measuring cup. Discuss which soil is holding more water. Discuss why plants do not do as well in compacted soil. Record results in log.

Part 4: Air in the soil

11. Give each group of students exactly one cup of loose soil. Have them pack it down as tightly as possible. What does the soil now measure? Ask them how they were able to pack it down? What is now not in the soil? (air)
12. With a spoon, loosen the soil so the top is again at the 1-cup line
13. Give the students another measuring cup of water. Have them pour it slowly into the soil until it starts collecting on the top. Observe the air bubbles rising up. Discuss why they see air bubbles. How much water is left in the measuring cup? How much water did you pour into the soil? How much air was in the soil before adding the water? How do you know? Where did the air go when you added the water? Why do we see lots of worms on the top of the soil after a big rainstorm? Answers to discussion questions should be recorded in science logs.
14. Discuss the soil pie. What percentage of soil is air? Have students convert the information from the pie graph to the mar graph.
15. Here is another way to show air in the soil. Have students loosely fill a measuring cup full of soil. Using a spoon, pack the soil down as tightly as possible. (Who can pack theirs down the most?) Examine the level of soil. Where does the top of the soil come to on the measuring cup? Ask the students if there is less soil. Why did the level go down? If no soil was removed, what was removed?

Curriculum Integration

Math/Science—Measure volume using milliliters, liter, cups, and pints. Measure weight using grams, kilograms, and pounds.

Possible Extensions/Adaptations/Integration

Brainstorm other objects that come from soil. Create flow charts that lead back to soil.

Additional Resources

Dirt by S. Tomecek (National Geographic)

Special project of Utah Agriculture in the Classroom in cooperation with Utah lStat

University Extension and Utah Foundation for Agriculture in the Classroom. 435-797-1657 www.agclassroom.org/ut. This is an excellent resource. It includes a video and lesson plans that align with the core.

SURWEB www.surweb.org/ Learning Segments: "Soil—Science"

Pioneer's Online Library pioneer.uen.org/ Choose "Digital Curriculum" There is an excellent video called "Living Soil"

Video: "Earth's Crust - Rocks and Soil" Series in Bill Nye the Science Guy.M6535: Disney, 1995. In the rocks and soil section see how to make crystals, the three basic forms of rock and demonstrate how hot, molten magma could penetrate the Earth's layers through vents.

Name_____

What is in Soil?

Question: What is in soil? Soil Inventory

Use a hand lens and tweezers to examine a small sample of garden soil.

Look for: mineral matter - small pieces of rocks and minerals (the chunks you can't easily break) organic matter - leaves, sticks, insect parts (legs, antennas, etc.), living insects and worms

Make a list under each heading of what you found:

Living and Once Living Organisms Nonliving (rocks and minerals)

_____

_____

_____

_____

_____

_____

Water in the soil.

A. Place your soil sample on a paper towel. Fold the towel in half and gently press. Return your soil to its container. Examine the towel.
Describe the condition of the paper towel._____
What ingredient did you remove from the soil?_____

B. Place a cup of wet in a container. Weigh it. Place it in a sunny window. Weigh it after a few days.

Date: _____ Weight of wet soil sample _____

Date: _____ Weight of dried out sample: _____

Difference in weight _____

How much water was in your soil sample? _____

Which holds more water - loose soil or compacted soil?

Materials: 2 cups soil, 2 containers, 2 cups water, 2 spoons

Procedure: Place a cup of soil in each container. Pack the soil tightly in one container.

Using separate measuring cups, pour water slowly into each container until the soil won't hold any more and the water starts gathering on top.

Which container of soil could hold more soil?

_____

_____

_____

What happened to the water in the container with the compacted soil?

_____

_____

_____

Why would plants not do as well in compacted soil?

_____

_____

_____

Name_____

Air in the Soil

Procedure:

Put 100 ml of sandy soil into a container. Measure 100 ml of water. Slowly pour the water into the soil until it is saturated - cannot hold anymore water. As soon as water starts collecting on top, stop pouring.

Did you notice air bubbles rising up from the soil? Explain why that would happen.

_____

How much water is left in the measuring cup or beaker? _____

How much water did you add to the soil? _____

How much air was in the soil before you added the water? _____

Where did the air go when you added the water?

_____

We often see lots of worms on the top of the soil after a big rainstorm. Explain why.

_____

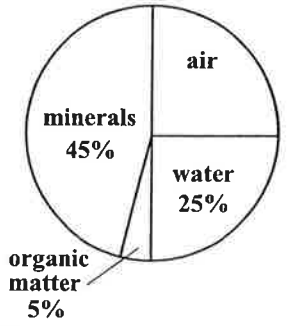
Soil Pie. Components of Soil

The pie graph at the right shows everything that is in the average soil.

The numbers should equal 100 % (percent)

What percentage of the soil is air? _____

Convert the information from the pie graph to the bar graph below.



Minerals					
Water					
Air					
Organic Matter					
	0%	**25%**	**50%**	**75%**	**100%**

What percentage of soil is air and water? _____

Which component of soil is the smallest percentage? _____

Which component of soil is the largest percentage? _____

Where does mineral matter in soil come from? _____

Where does organic matter in soil come from? _____

Name_____

Soil Shake

Put 4 inches of soil into a quart jar. Add water until the jar is 3/4 full.

Make sure the lid is on tight. Shake the jar vigorously for 2 minutes.

Set the jar down and let it settle for 1 minute.

Measure the amount of soil at the bottom of the jar.

After 1 minute: Measurement of bottom layer (sand) _____

After 3-4 hours. Measurement of second layer (silt) _____

After several days. Measurement of top layer (clay) _____

Why do the largest particles settle firs? _____

Why do small sized particles settle last? _____

What is the stuff floating in the jar?_____

How does your sample compare with the others.?_____

_____

_____

Soil Textures

The mineral matter of all soils are made up of tiny particles (pieces) of rocks and minerals. Not all particles are the same size. There are 3 main kinds of mineral matter or soil.

They are sand, silt, and clay.

Rub each soil sample between your fingers - first a dry sample then a wet sample.

Record your observations below.

Traits of Mineral Matter

Type of Mineral Matter	Size Particles	Texture
sand		
silt		
clay		

These are the words you should be using to describe texture: : gritty, smooth and slick, stick

These are the measurements to describe particle size:

Biggest: 2.00-.05 mm Medium .05 -.002mm Smallest: less than .002 mm