

K-12 IYS Activity



Summary

Students will rotate through stations (or “centers”). At each station, students will examine a unique soil and record their observations. Students will see that soils are different and have many components. Students will also learn that soils contain air and water in addition to solid components.

Learning Objectives/Outcomes

- To name and identify the four components of soil (mineral, organic matter, water, and air)
- To understand that soils are complex, diverse, and have living components.

Age of Audience

Elementary

Recommended group size?

20-50

Where could you offer this?

Local school

What type of room do you need?

Lab/work benches or classroom group tables

What's in Soil?

Materials (per student, group etc.)

- One soil for each station (about four). Each soil should have different properties, such as color or texture. One way to obtain soils of different properties is to collect them from different landscapes (wetlands, beach, yard, garden, forest), as long as they are not from soil-less media such as potting mixtures. You may have students collect them and bring them to school.
- Plastic zip bags (one per pair of students)
- Newspaper or disposable table cloths
- Hand lenses (magnifying glasses, recommended one per pair of students)
- Paper towels (in case of spills)
- Journals, notebook paper, drawing paper, or printouts of the attached worksheet (per each student per each station)
- Colored pencils, crayons, or markers (per each group)
- Water at each station
- 2-cup containers (plastic or paper cups, soup cans, or beakers) (one per each station, group, or pair)
- 1-cup measuring cups (one per each station, group, or pair)
- One Soil Pie attachment, for display (see reference #1)
- One piece of yarn, cut to fit the radius of the Soil Pie display
- You may need a parent or teacher assistant for each station

Type of Lesson

1. Hands-on (participants touch the stuff)
2. Indoor
3. Demonstration (scientist or teacher demo, outside professional)
4. Small group exercise/discussion critical thinking

Time Needed

1. Scientist prep time + cleanup time:
Collection of soils = varies
Classroom setup = 10 minutes
Classroom cleanup = 10 minutes

2. Participant/class time = 50 minutes, varies. The teacher can decide how much time to allot for each station in order to keep a balance of depth and active engagement.

Background

ANALOGY 1

Soils are not made of a single substance. Like a cake, they are made up of a mixture of different ingredients. There are many different types of ingredients possible, as well as different ways of combining these. One of these “ingredients” or components of a soil “cake” includes life forms—organisms such as bacteria, nematodes (microscopic worms), fungi, insects, plant roots (and the rest of the plant!), and even small animals like gophers and moles.

ANALOGY 2

There are four components of soil: mineral, organic matter, water, and air. Minerals are the bricks of the soil “house,” which are cemented together by the organic matter “mortar” or “cement” to produce soil structure, much like a housing structure built out of bricks and mortar. Similar to a house, there are spaces or “rooms” and “hallways” in the structure of the soil—pores and tubes, often connected in a network. These pores in the soil are open spaces, and as a result can be filled with air or water, depending on the conditions in the soil. For example, rainfall will lead to an increase in the number of soil pores having water instead of air; as the soil dries, water leaves these pores and they are filled with air. Different soils have different proportions of these four components, which makes them better for different purposes.

Methods/Procedures

SETUP

1. Set up classroom into stations (“centers”) for each unique soil type. We recommend four students per group. If your class size is large, each station could accommodate multiple groups of students (2 or 3 groups of 4 students each).

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Celebrating the



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What's in Soil?

- Lay out newspaper to cover the tables, desks, or other surfaces.
- Each station should house a different soil. At each station, divide the single soil into plastic bags, one for each pair of students. With groups of four, this will be two plastic bags per group. Depending on the number of groups per station, there will be 2-6 plastic bags per station. Decide on these numbers based on your class size and the number of soil types.
- Provide at least two hand lenses (magnifying glasses) for each group.
- Station a parent or teacher assistant at each center.
- Divide students into pairs, groups, and stations for the first rotation.

ACTIVITY 1: THE MINERAL AND ORGANIC MATTER

(this activity has been adapted from reference #1)

- Ask each pair of students to pour their sample out onto the newspaper.
- Have students use their senses (don't taste!) to examine the soil. Record their observations with writing and drawing. If prompting is needed, the station assistant can ask the following questions.
 - Smell: What does the soil smell like?
 - Feel: Does the soil feel gritty? Smooth? Sticky? Hard or soft? Wet or dry? How wet or dry?
 - Listen (optional): Does the soil sound gritty? Smooth? Sticky? Wet or dry?
 - Look: Using a hand lens, ask each pair of students to observe and write a description of the moisture in their sample. Have them draw something they see in the soil. What do they see? Is there a rock? A clump? A stick? What color is the soil? Does it contain many different colors? What colors? You may want to let them know that the small, grain-like, particles they see are called mineral matter. Depending on the samples, they should see mineral pieces (little rock-like pieces), organic matter (live or decomposing leaves, roots, sticks, straw, worms, beetles, etc.), water (moisture, unless the soil is totally dry), and air (which they will probably not mention, because they cannot see it).

- Encourage the students to ask questions about soil. Have them record their questions on paper, like a scientist.
- Show the students the "Soil Pie: Components of the Soil" display (see reference #1). All of the items they have inventoried should fit into one of the four soil component categories. Define the four components.

ACTIVITY 2: SOIL WATER AND AIR

(this activity is from reference #1)

- Ask each student group or pair to place 1 cup of dry soil into a 2-cup container.
- Students should slowly pour 1 cup of water into the soil container until the soil is saturated or all the dry soil is turned to "mud." While they are pouring the water, they should take note of the air bubbles that are rising to the surface. Students should stop pouring the water once the sample is totally saturated and no more air bubbles emerge.
- Students should measure the amount of water left and subtract it from 1 cup.
- Lead students to infer that the amount of water added to the soil sample was approximately the amount of air that was displaced.
- Have students compare the amount of water that they were able to pour into their soil samples. There will be differences depending on the soil texture and organic matter. What is the percentage of air in the soil sample? If they were able to add 1/4 cup of water, the sample contained 25% air.
- Tape one end of the yarn to the center of the "Soil Pie: Components of the Soil" display (see reference #1). Take the loose end and move it up or down around the outside of the circle to show how the percentage of water and air changes depending on climatic conditions.

Discussion Questions

- What are the components of soil?
ANSWER: Mineral, organic matter, water and air
- Which two components are the most variable? Why?
ANSWER: Water and air. They can flow into, within, and out of soil quickly, unlike mineral and organic matter, which change much more slowly. Soil water and air are inversely proportional (if you add more water to the soil there will be less air in the soil)
- What might change the total amount of air?
ANSWERS: Rain, watering or irrigating, snowmelt
- Why do worms come up to the surface after a drenching rain?
ANSWER: The pores that were filled with their breathing air get filled with water so they have to go to the surface to breathe.
- Given this, do you think plants are at risk of 'drowning' in very wet soils?
ANSWER: Yes
- (Extra) Why are air and water two components that are important for soil function from a biological standpoint?
ANSWER: Organisms need air (oxygen) to live—this includes plants roots, which do not perform photosynthesis (not green), and water for plants to take up

References

Lesson modified from the Utah State University Cooperative Extension program *Agriculture in the Classroom*: https://utah.agclassroom.org/teachercenter/index.cfm?controller=main&action=lpsearch&lpID=509&searchGrade_gradeID=5&searchSub.subjectID=2

A PDF of the "Soil Pie: Components of the Soil" chart may be found here.

Additional Resources

Dig It! The Secrets of Soil Media Library, Videos and Interactives from the Smithsonian National Museum of History Forces of Change: http://forces.si.edu/soils/04_00_00.html

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