LESSON 1

SOIL ANALYSIS: FOUR SOIL SAMPLES

PURPOSE

IN SOIL OBSERVATIONS, STUDENTS WILL:

- Learn that soils can be described by their properties.
- Learn that soils are composed of different kinds and amounts of earth materials and humus.
- Observe and record the results of shaking soil and water in a vial.
- Learn that soils differ in their ability to support plants.

Engineering Practice

- Investigate the composition of soils from four different locations.

BACKGROUND FOR THE TEACHER

SOIL

What is soil? Soil is defined as a mixture of different-sized earth materials, such as gravel, sand, and silt, and organic material called humus. Humus is dark, musty smelling stuff from the decomposed remains of plant and animal life.

The ideal composition of a soil to grow most plants would have the following:

25%	Air
25%	Water
45%	Earth materials (sand, silt, and clay)
5%	Humus

Plants need air and water to grow. A soil with adequate pore spaces allows circulation of air and water to the plants and space for microorganisms.

Geologists classify soils by the amounts and kinds of organic and earth materials that compose them. All life depends on a dozen or so elements that must be ultimately be derived from the earth's crust.

Rocks are assigned names according to their various sizes.

Rock Particle	**Size** *(mm)*	*(in.)*	**Similar**
Boulders	256 and up	10" up	Basketball & up
Cobbles	64-256	2.5-10"	Baseball-grape
Pebbles	2-64	¼-1.5"	Grape - golf ball
Gravel	1-2		Rice-grapes
Sand	0.0625-1		Salt-rice
Silt	0.002		Smaller than salt
Clay	0.002 & smaller		Too small to see with hand lens

TEACHING CHILDREN ABOUT SOIL

The idea of the material in soil getting to that size is an abstract concept. Comprehending the concept that sand found on the playground was weathered down from massive rock structures from mountains carried by erosive forces. It requires students to think what might have happened to transform and deliver a tiny piece of rock to its present location. It requires students to infer. Inferential thinking is an important element of constructing complex explanations for observed phenomena in the natural world. Helping students build bridges between observations and explanations takes tie and experience. The role of the teacher to guide this kind of student thinking is important for science.

How students learn has been the topic of numerous discussions, books, and symposiums. According to Dr. Lawrence F. Lowery, Emeritus Professor of UC Berkeley and creator of FOSS (Full Option Science Systems), students learn through three formats.

THREE FORMATS FOR TEACHING – LEARNING

1. **Concrete** – (Real Stuff): First hand experience or activities. Multi-sensory input. Most powerful of all teaching. Payoff is great. E.g. Riding a real elephant at the circus. See it, feel it, smell it, and hear it's sounds are first hand experiences.
2. **Representational** – (Pictorial): Second hand experiences or activities, advantage is to manipulate variables. Surface, superficial level. Most of your knowledge is second hand – through videos, photos, and TV programs, etc. Payoff is greatly enhanced if first hand experience is present.
3. **Symbolic** – (Text): Last-hand experiences and close reading. You don't read what you don't know. "**Power of Reading"** – You must have something (concept) in your knowledge that brings to the page. Reading comes from experience. It is in the person, it triggers knowledge that you already know. There is nothing on page that is going to teach you unless you have the concepts. Manipulating or shaping the mind can be arranged by excellent and quality writers to get the people on the same frame or ideas. More time is put into text

than any other subject and results have not increased or have not helped other content areas.

Studies show that prior knowledge goes from first hand experience to second hand experience and learning is multiplied enormously. Lastly, symbolic has the least impact if the student does not know the concepts being read.

Having students experience handling a real soil only enhances their learning

CRITICAL COMPETITORS

Having a second object to compare and contrast is where learning happens. Observing the characteristics of the four real soils is key to learning. Make comparisons and contrasts to learn more about each object. A single object does not teach you new knowledge, it will not teach you anything you already know. There must be a critical competitor to be able to retain knowledge of the compared objects. All measurements are best learned through critical competitors, making comparisons of the known and the unknown. Once the concept is established, the clearness of the vocabulary is learned.

INQUIRY/SCIENCE PROCESS SKILLS

Learning the science process skills is essential for scientists. These are the tools that scientist use in conducting investigations. In most investigations, the sense of taste is not often used. However, in this investigation of observing oranges, students will get a chance to taste their science experience. The following are the most used inquiry/science process skills used today:

1. **Observe** – Use the 5 senses and combination of senses. Multi-sensory methods are most important. Most powerful and only way to reach the brain is through the five senses. Teach kids to observe for details, carefully, and the use of habit of mind. Kids naturally observe. Tools and apparatuses (microscopes, telescopes, Mars Rover) extend the human senses.
2. **Communicate** – Humans are special in transferring information from one person to another. For students, teach them how to communicate in a fruitful manner.
    - Describing, speaking sound.
    - Formulating operational definitions.
    - Recording, tabling, writing.

- Researching the literature, reading, referencing.
- Picturing, drawing, illustrating,
- Graphing.
- Unique to humans-We can communicate through generations. E.g., The writings of Newton communicate to us today and future generations. Humans span generations. Animals only communicate with their present generation (only their lifetime). In one hour, 500 books have been created. Publications are important, not often done in education.

3. **Compare** – All measurements, mathematics, are comparison and critical competitors.
   - Making general comparisons or comparisons from different points of view.
   - Making numerical expressions.
   - Estimating
   - Weighing,
   - Measuring areas, volumes, and pressures.
4. **Organize** (Categorizing) – Although these are hard-wired since birth, however, these need some concepts or details to be used properly.
   - A1 Seriating: has order, in a linear fashion based on the object itself, built in the properties of the materials, content in science is seriated; E.g. sharp to dull, rough to smooth, Moh's Scale, Beaufort Wind Scale.
   - A2 Sequencing: linear order but has time in. E.g. Water cycle, Rock cycle; not all cycles are circular, many are linear. Life Cycle is linear - the adult butterfly does not go back into the egg.
   - B1 Grouping – put things together by one single property.
   - B2 Classifying: 2 or more properties are grouped. Comparisons are made when classifying. It is deeper, use of multiple properties. Grouping and Classifying are not synonymous. They each have a different brain operation.
   - Ordering, Sorting, matching, grouping: is putting things together by one property.
5. **Relating** – The grand ideas in science and math is how facts, words, and concepts (must have) relate to each other. E.g. Insects, mosquitoes, locusts; Medical students, doctors, and grave

robbers; rain, snow, precipitation; vertebrates, mammals, frogs; fish, sharks, whales.

- Identifying a problem, formulating questions.
- Hypothesizing.
- Controlling and manipulating variables, testing.
- U.S. Teaches facts not relationships. Other countries teach both. **"Quality of the Argument (Story)"** on your understanding of your concepts - Time of reference determines how to place something in a Venn diagram. All graphing is relationships. Interpret the graphing. Quality of the story in the relationships. E.g. Animals – 2 colors. Zebras - To be seen, they advertise; Lioness – Hidden, hide.
- Relational stories in science are most remembered and beautiful.

6. **Inferring** –
   - Generalizing, synthesizing, evaluating.
   - Using indicators, predicting.
   - Using explanatory models, theorizing.
   - Inferences are distant from you, remote in time and space. Making wise judgments based on evidences and detail observations. Requires a detail of knowledge of the person or subjects background. The human mind can go to places we cannot see or touch. For example, Dinosaurs lived a long time ago. How do we know? 6^{th}, 7^{th} grade inferences kick in students.
7. **Apply** – General plan. A team of experts is needed.
   - Using knowledge of technology.
   - Inventing, creating.
   - Constructing.
   - Growing, raising.
   - Collecting.
   - Used more in the adult level. This is more complex.

These seven are needed for inquiry science.

MATERIALS

LESSON 1: SOIL ANALYSIS

FOR EACH STUDENT

- 1 *Soil Observation Worksheet*
- 1 *Soil In Vials Worksheet*
- 1 Set of colored pencils or crayons
- 1 Science notebook or science journal

FOR EACH GROUP

- Prepared Soil (4 mixtures)
- 4 Vials with caps
- 8 Self-stick notes
- 4 Paper plates
- 1 Syringe 50mL
- 4 Hand lens
- 1 FOSS Tray
- 1 1/2 Liter Container
- Water

FOR THE LESSON

- Chart paper for Vocabulary and Concepts
- Markers
- LCD Projector

GETTING READY

LESSON 1: SOIL ANALYSIS

1. **Schedule The Investigation**

   The lesson will take about 30-45 minutes to complete.

2. **Develop (or Obtain from Science Center) Soil Samples**

   Develop the soil samples that students need for observing and comprehending their compositions. The following samples are as follows:

	Soil Mixture					
Soil	**Clay** *(mL)*	**Sand** *(mL)*	**Gravel** *(mL)*	**Pebbles** *(mL)*	**Humus** *(mL)*	**Simulated environment**
1	300	210	210	0	0	river delta
2	60	60	300	300	60	mountain
3	60	300	360	0	60	desert
4	30	60	210	30	450	forest

3. **Practice Using The Hand Lenses**

   Hold the lens in one position about 2 cm from the eye and move the plate with soil closer until it comes into focus.

4. **Prepare Vocabulary Chart And Concept Chart**

   Have charts ready for new vocabulary and concepts concerning the soil compositions and rock size classification.

5. **Have A Materials Station Set Up**

   Have a central materials station where designated students can retrieve and return needed materials.

6. **Copy Worksheets**

   Have worksheets ready for each student and group.

GUIDING THE LESSON

LESSON 1: SOIL ANALYSIS

1. **Accessing Prior Knowledge**

   Ask students, “Have they ever played in the mud? Have they ever made mud pies? Have they ever played on the sand at the beach? Can they describe the differences in the various types of earth material? You may record student answers on the board rather than on chart paper. (Optional) Take a tour outdoors to look for soil. Some questions to ask while touring the area:

   - *Where should we look for soil?*
   - *What kinds of material do you see in the soil?*
   - *Is anything growing in the soil?*
   - *Are there soil areas where nothing is growing?*
   - *How is this soil the same as the soil we saw over there? How is it different?*
   - *Do you think there is soil underneath this lawn, this pavement, or this building?*
   - *Where is there not any soil?*

   Return to class and discuss their observations and findings.

2. **Focus Question: What Is Soil?**

   Some students will say, “It is dirt!” The focus question guides the students in making their observations and understanding the physical properties of soil samples.

3. **Arrange Students Into Their Project Groups**

   The project groups can help each other when making observations and recording relevant data for their presentation to the city council about their park.

4. **Dry Soil Observations**

Have groups gather the materials needed (See materials needed for groups and individuals) for making their observations and record their data about the four (Vials DS1, DS2, DS3, DS4) soil samples.

- Have students label and match the plates with the vials.
- Pour out the soils on to the plates and make observations of each dry soil (DS) sample.
- Students should record on their worksheet, *Soil Observation,* the properties such as color, shape of materials, particle size, and texture of each vial.

5. **Discuss Dry Soil Observations**

Call for attention and share observations. Ask the following questions:

- *What different kinds of earth materials did you find in your soil?*
- *What different sizes did you observe?*
- *Use the chart on the wall to use scientific language to describe the sizes of the rock.*
- *What different shapes did you observe?*

6. **Wet Soil Observations**

Have groups get a syringe, ½ liter container, and water

- Pour soils back into the appropriate vials
- Add 25 mL of water to each vial using the syringe
- Cap and shake the vial for 2 minutes
- Set the vial on the table and let it settle
- Record observations on worksheet *Wet Soil Observations*

7. **Wet Soil Observations and Share**

Call for attention and share observations. Ask the following questions:

- *Which materials settled out first after shaking the vials?*
- *Where is the humus?*

- *Did you observed bubbles when you added water to the soil in the soil?*
- *Do all the vials contain the same amount of soil?*
- *Are all the layers of similar earth materials the same size (depth) in all the different soils?*
- *Do all the vials have the same number of layers?*

Let vials settle over night for further observations and recording data.

8. **Clean Up, Review Vocabulary, And Concept Charts**

Have students answer the Focus Question in their science journals. For scaffolding, sentence frames work well. For example,

- "Soil is composed of _____."
- In our soil investigation, we found out _____."

VOCABULARY *The following key science terms are developed in this investigation:*

Soil Humus Pebble Gravel Sand Clay Silt Earth material

CONCEPTS: *The following are key concepts of both oranges:*

- *Soils can be described by their properties.*
- *Soils are composed of different kinds and amounts of earth materials and humus.*

9. **Discuss Where The Soils Came From**

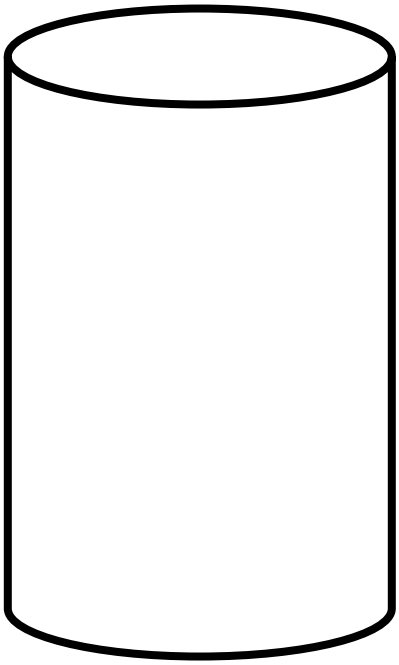
Have students try to guess where the four soils represent or where they might have come from. See the simulated environment on the Soil Mixture chart.

10. **Internet Connection: Textual Reading "What is Soil?"**
https://www.soil-net.com/legacy/schools/index.htm

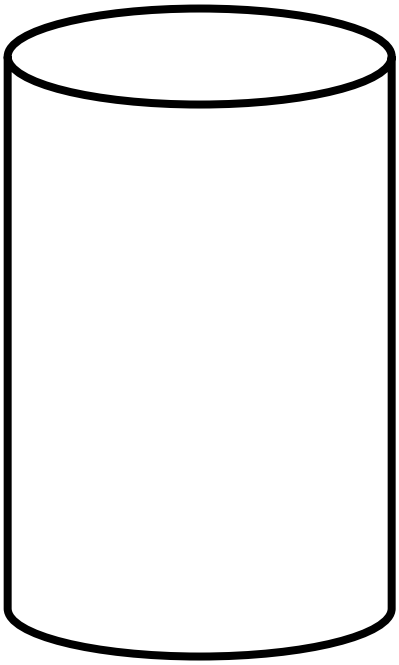
Name: _____ Date: _____

WET SOIL OBSERVATIONS

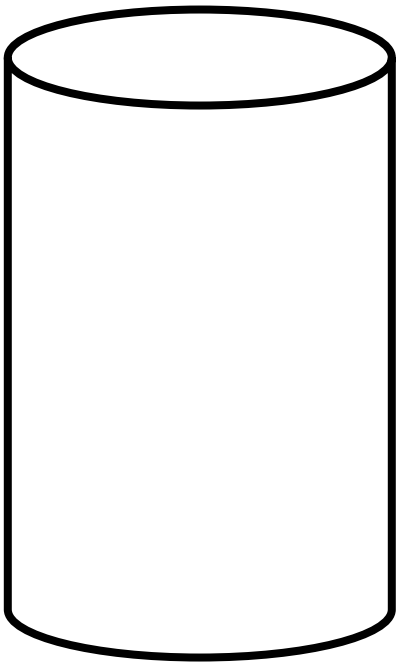
SAMPLE WS1



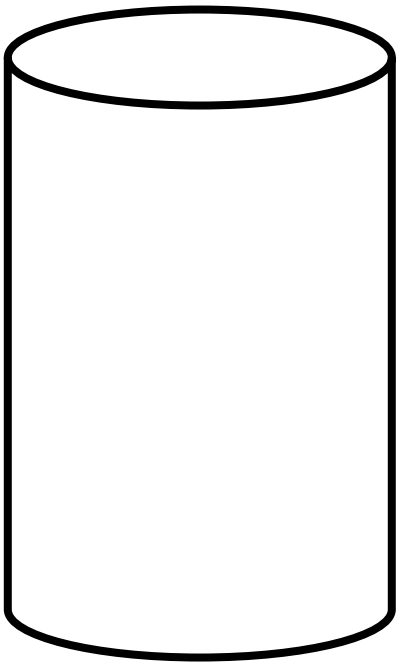
SAMPLE WS2



SAMPLE WS3



SAMPLE WS4



Name: _____ Date: _____

SOIL OBSERVATIONS

SAMPLE DS1	SAMPLE DS2
SAMPLE DS3	**SAMPLE DS4**