



FORENSICS AND DIRT

QUICK PEEK

In this lesson, students become forensic geologists as they perform various tests to analyze soil samples and determine which suspect was at the “Crime Scene.”

SUGGESTED GRADE LEVELS: 9-12

ILLINOIS STATE LEARNING GOALS

SCIENCE

11.A, 13.A

MATH

6.A, 7.A., 10.A, 10.B

LANGUAGE ARTS

1.C, 3.A, 4.A

OBJECTIVES

- ★ Students will perform various tests on soil, compare soil samples and match them to an “unknown” sample.
- ★ Students will construct data tables that can be used to organize the data they collect.
- ★ Students will accurately record data in a table.

PACE YOURSELF:
100 MINUTES



PREPARE YOURSELF

1. You will need to collect soil from 4 different locations. You may want to “doctor” the samples by adding chemicals, small plastic pieces, animal & plant debris, etc.
2. Dry each sample of soil in the oven for an hour at 212°F (or 100°C).
3. Decide which of the four samples you want to call “CS” (the sample from the crime scene) and place part of that sample in a plastic bag labelled “CS.” Label the other four bags as 1, 2, 3, and 4. Fill each with a different soil sample.
4. You will need a LaMotte soil testing kit (available at: <http://www.biconet.com/testing/LaMGarden.html>) for each lab group as well as a LaMotte soil texture kit (Available at: <http://www.acornnaturalists.com/store/SOIL-TEXTURE-TEST-KIT>). Easy to follow directions are included with the kits. (**NOTE:** you may use another soil test if you do not wish to purchase these suggested.)



MATERIALS

Per Group:

- 5 petri dishes
- 5 soil samples (in labeled plastic bags)
- Stereomicroscope (or magnifying lens)
- LaMotte soil testing kit(s) (cost: \$59.95)
- LaMotte’s soil texture test kit (cost: \$54.00)

Per Student:

- Copy of *Data Table 1* and *Data Table 2*
- Writing utensil



WHAT YOU NEED TO KNOW...

What exactly is dirt or soil? The definition of soil can vary depending on whom you ask. Farmers consider soil to be the top 6 to 12 inches of the earth's crust where plants grow. Geologists, scientists who study the earth's surface, define soil as the organic (carbon-containing) and mineral matter composing the earth. Engineers look at soil as material that can be removed from an excavation site.

Forensic geologists consider soil as earth material that has been collected accidentally or on purpose and is related to the matter they are investigating. When a forensic geologist is investigating a crime, all natural and artificial objects that are on or near the surface of the earth are considered part of the soil. This includes rock, minerals, vegetation, glass, paint, asphalt, etc. The presence of these objects in that area helps to make that area of soil unique from other areas.

In most forensics cases, only about one cup of the top layer of soil needs to be collected. The sample should be allowed to air dry to prevent further decomposition of the material in the soil. Before observing the color, all samples are further dried at 100° Celsius for one hour because wet soil has a different color than dry soil.

Once dry, the soil is transferred to the crime lab to compare with the soil sample found on the suspect or on his or her belongings.

The famous story-book detective, Sherlock Holmes, presumably had an amazing grasp of forensic geology, being able to tell exactly where a person had been by looking at the splashes on their trouser.



WARM UP!

Monica's house was robbed last night while she and her family were out for dinner. The police discover a torn window screen and a broken window latch on the back bedroom window. They believe this is how the burglar entered the home. Heavy rain that night washed away any trace of footprints.

The crime scene investigators think the burglar might have a lot of dirt and debris caked on his shoes. They take a soil sample from outside the window and send it back to the lab.

Early this morning, police bring in four suspects who cannot account for their whereabouts last night. The police scrape the bottom of each of their shoes and send these scrapings to the crime lab for comparison with the soil outside the window of Monica's house.

Your job is to determine if the soil from any of the suspects' shoes matches the soil at the crime scene. Each soil sample has been dried for 1 hour at 100 degrees Celsius.



THE HOW TO

PART I:

1. Label five petri dishes with the following letters:
 - CS: Crime scene (this is the known sample from Monica's house)
 - S1: Soil from Suspect 1
 - S2: Soil from Suspect 2
 - S3: Soil from Suspect 3
 - S4: Soil from Suspect 4
2. Sprinkle enough of each soil sample in the appropriate petri dishes to cover the bottom of the dishes.
3. In Data Table 1, record the following about each soil sample:
 - a. Colors
 - b. Odors
 - c. Textures (grainy, smooth, hard, etc.)
 - d. Presence of plant or animal debris
 - e. Presence of inorganic (nonliving) material
4. Repeat step 3 using the stereomicroscope (or magnifying lens). Record your findings on Data Table 2. This time, give a more detailed description of each sample.

Forensic Geologists

study evidence relating to minerals, soil, petroleums, and other materials found in the Earth used to answer questions raised by the legal system.

PART II: TESTING PH, NITROGEN, PHOSPHORUS AND POTASSIUM LEVELS

1. Follow the directions as illustrated in the LaMotte Soil Testing Kit to test all 5 labeled soil samples.
2. Create your own data table to record the testing information.

PART III: SOIL TEXTURE UNIT

1. Follow the directions as written with LaMotte's Soil Texture Test Kit to test all 5 labeled soil samples.
2. Create a data table to record your test information.

Students complete the first portion of the lab on the first day, and the second two portions on the second day.



WHAT'S GOING ON HERE?

Many scientists agree that no two places on Earth have precisely the same soil. Soil from one area will be identifiably different from the soil collected in another location. The presence of certain minerals in the soil can give it a characteristic color. For example, the presence of copper minerals appears green while black minerals point to the presence of manganese and iron. Odor and texture of soils are also examined during the initial observation.



DID THEY GET IT?

You may decide to grade students by analyzing how completely and accurately they fill out their data tables.

SCORING

Data tables 1 and 2	20 (10 points each)
Chemicals in soil data table	20
Soil texture data table	20
Questions	30
Total score:	90 points

POSTLESSON QUESTIONS (*can be answered in a whole group discussion or individually*):

1. Compare samples from Suspects 1 through 4 with the sample from the crime scene and determine if you have a match. Which suspect may have committed the crime?
2. What is soil?
3. Why were the soil samples dried before observations were made?
4. Did any of your soil samples have the same data results when testing for pH, nitrogen, phosphorus or potassium? If so, which ones?
5. Did any of the soils end up having the same percentage of sand, silt and clay? If so, which ones?
6. Why do you feel you had to perform so many different tests on these soils to determine a match?

You may have the group turn in one of each data table instead of each individual completing their own.



ET CETERA

Have students learn more about Forensic Geology at one of these websites:

<http://www.apsu.edu/oconnort/3210/3210lect08b.htm>

<http://www.geoforensics.com/geoforensics/fgeology.html>

**DATA TABLE 1
INITIAL DESCRIPTIONS**

Sample	Color	Odor	Texture	Plant or Animal Debris	Inorganic Debris Present
CS					
S1					
S2					
S3					
S3					

**DATA TABLE 2
OBSERVATION WITH MICROSCOPE**

Sample	Color	Odor	Texture	Plant or Animal Debris	Inorganic Debris Present
CS					
S1					
S2					
S3					
S3					