IYS Soils Activity

Soil Science Society of America

Soil Forensics in Everyday Life: An Outdoor Activity for the Community

Materials Needed

All materials can be household items. If you have access to pH meters or strips, Munsell color charts (some pages can be printed in color from the internet), soil sieves, or a microscope, feel free to incorporate those into your activity and add the data to the data tables. You can also extend the activity by teaching participants the "feel method" for determining soil texture.

- Plastic sandwich bags

  Larger size for the CS and S1 samples (each participant will take some from these two)

  Smaller size to give 5 to each participant for samples
- Garden spades
- Wax paper, paper plates, or aluminum foil
- Paper towels
- Magnifying glass or microscopes
- Copies of the data table and pens or pencils
- 5 Soil samples (see Procedures for details)

Learning Objectives:

1. To learn how to analyze soil in order to compare soil samples and match them to an "unknown" sample.
2. To construct data tables that can be used to organize and record the data they collect.
3. To have a better understanding of the importance of soil in forensic cases.

Celebrating the 2015 International Year of Soils

soils.org/IYS

Ages

All ages

Recommended Group Size

Unlimited

Where could you offer this?

University, local school, library, or picnic

What type of room do you need?

Outdoors activity, table needed

Type of Lesson

Hands-on, Outdoor

Summary

Forensic soil analysis is the use of sciences and other disciplines (e.g., geochemistry and geology) to aid in criminal investigations. Because every soil possesses unique properties, soils can be traced and matched with each other. While participants have fun "solving" a crime, they will gain experience in making and comparing soil analyses.

Time Needed

Scientist prep time: Must take time to scout out the locations and look for different soils

Participant/class time: approx. 1 hour

Summary: While participants have fun "solving" a crime, they will gain experience in making and comparing soil analyses.

Activity Background

Forensic soil analysis is the use of soil science and other disciplines (e.g. geochemistry and geology) to aid in criminal investigations. Since each soil possesses unique properties that serve as identification markers, soils can be traced and matched to each other. For example, clay embedded in the sneaker of a criminal can be traced back to a specific clay type found along a lake where a murder victim was discovered.

Each soil type has unique characteristics that provide important clues about its history, formation and location of origin, such as *color, texture and structure*. For example, the color of a soil indicates its history as well as the compounds present in the soil. White or gray soil may contain lime or have been leached, while black or gray soil indicates the soil contains organic materials and/or moisture.

Forensic soil scientists 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 soil scientist 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. In an actual forensics laboratory, soil samples are further dried at 100° C for one hour before observing the color of the soil because wet soil has a different color than dry soil. At the crime lab, the forensic soil scientist compares the soil samples from the crime scene location with the soil sample found on the suspect or on his or her belongings.

Preparation for Lead Scientist

You will play the lead soil forensic scientist and lead a team of community members or students through an exercise using soils as key evidence in a robbery case. Your main purpose is to involve community members of all ages to better understand the importance of using soils to help solve forensic cases due to their uniqueness. Soils are very variable and diverse, even on a local scale.

When leading this activity, have people break into groups of 3 or 4, in which they are the "community soil forensics team" and you are the lead scientist. At the end of the activity, they should show you their observations and results and in addition you should guide them along the way.

You will need to determine a crime scene location near a house or building. Typically a garden bed is a good crime scene given its distinct colors and minerals. Then take some of the soil from the crime scene location and put it into the sandwich bags labeled as "crime scene evidence- CS." If you want the suspect to be found guilty, also place some

Soil Forensics

CS soil in the plastic bag labeled S1, evidence from the suspect. To have the suspect found innocent, the S1 soil should be from one of the alibi locations. Alternatively, you can also have participants go back to the crime scene and collect their own evidence.

Now choose three alibi locations for the participants to go to and collect soil samples from. Label these as L1, L2, and L3. Choose one that resembles the crime scene so it's not completely obvious that the S1 soil is the CS soil (if the suspect is guilty). Soils from nearby construction sites, eroded areas, or playground sand are all good options. Clearly mark or describe the alibi locations so the participants can find them.

If you wish to be more creative you can take hair from your brush, or a pet, or flour or other "pieces of evidence" and put them in the CS soil and S1 soil or even the alibi locations. This adds "clues" to the samples so participants have more traits to observe. Another option would be to make an alibi location and crime scene the same soil but place something like rubber or hair or quartz grains in the suspect soil and crime soil to make them slightly different so that the participants really have to try to find the differing factors.

The Activity

Set the Scene:

Sally's townhouse was robbed last night while she and friends 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 have a suspect in custody but he says he was in three other locations that night that would not put him at the crime scene. The investigators were able to take his shoes and pants and remove different layers of soils from them, indicating different places he may have been. Now that they have collected the soil from his clothing, they need to go back and gather soils from the crime scene and alibi locations then compare them to the locations.

Your job as the community soil forensics team is to determine if the soil from the suspects' shoes and clothes match the soil at the crime scene or his alibi locations. Because your budget was tightened over the past years, you don't have the high-tech equipment used in forensic investigations seen in movies and shows. However, being a true soil forensic scientist, you know that you can use every day items and comparison techniques to match the suspect to the crime scene or his alibi locations. Time is crucial because there is a storm coming, so you get on your way and start collecting soil from all locations.

Soil Samples to Analyze:

CS: Crime scene (this is the known sample from Sally's townhouse)

S1: Soil from the suspect

L1: Soil from alibi location 1

L2: Soil from alibi location 2

L3: Soil from alibi location 3

Procedures

1. Label five sandwich bags with the following letters: CS, S1, L1, L2, and L3. The soils from the crime scene (CS) and suspect (S1) were already bagged, so you can take a small scoop from those bags.
2. Go out and collect soil from the alibi locations using a cleaned garden spade to scoop the soil into the labeled bag. Place enough of each soil sample in the appropriate bag to cover the bottom two inches of the bag. Normally, you would oven dry the samples at 100°C but since you don't have access to your lab you can let the samples dry outside or note that the color is for wet soil.
3. Once you get back to your outdoor lab (find a picnic table or a table your lead scientist has set up for you), lay out paper plates, wax paper, or aluminum foil to place your samples out on. Make sure not to mix your samples and to keep the labeled bags with your samples so you know which ones are which. In Data Table 1, make initial observations to familiarize yourself with the samples and briefly 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 a magnifying glass or microscope (since your stereomicroscope is also in the lab that you can't get access to). Record your additional findings on the data table. This time, give a more detailed description of each sample.
5. Compare your observations of the soil from the suspect with the soils from the crime scene and alibi locations. Compare with your team and determine if the suspect is guilty! Show your lead scientist your observations and results for confirmation.

References

This activity was modified from the *Forensics and Dirt* activity created by the Museum of Science and Industry.

The background information was borrowed from *Forensics and Dirt* and the *Forensic Soil Analysis* by Forensics World.

Forensics World. 2011. *Forensic Soil Analysis*. From the 11th Annual CSI Challenge. Smithtown, New York.

Museum of Science and Industry. *Forensics and Dirt*. Museum of Science and Industry. Chicago, Illinois.

Additional Resources on Soil Forensics

https://www.soils.org/discover-soils/story/got-crime-solve-call-soil-scientists

http://www.forensicgeology.net/science.htm

http://www.clw.csiro.au/publications/cafss/Soil-Forensic-Analysis-Encyclopedia-fsa096Ref.pdf

Soil Forensics

DATA TABLE 1: INITIAL OBSERVATIONS

Date:

Observations made by:

Sample	Color	Odor	Texture	Plant or Animal Debris	Inorganic Debris Present
CS					
S1					
L1					
L2					
L3					

Conclusion: _____