



Interactions of Energy and Matter: Dawn Instrumentation

CSI: Student Activity

STUDENT ACTIVITY

Part 1

In this activity, you and your classmates are members of a crime scene investigation team that are investigating vandalism (graffiti on park property) that was committed on the sandy shore of a lake at a local park. You have taken a soil sample from the site where vandalism took place. When two suspects were brought into the police station for questioning, one was wearing a shirt with patches of dried soil and the other had some partially dried mud on his/her jeans. Use the *Police Photo Log* to observe images of the scene of the crime and evidence obtained.

1. What additional information do you know by observing the photos?
2. What remaining questions do you have?

Samples of the soil from each of the suspects' clothing were analyzed by CSI technicians using an **infrared spectrometer**. The first step in the **spectroscopic analysis** was to determine whether or not the water content of soil samples on the suspects' clothes matched that of the soil sample taken at the crime scene. When the CSI scientists check their reference books, they find that near-infrared (NIR) bands, with wavelengths that range from about 750–1940 nm, are suitable for determination of water content of the soil. They decided to compare the soil samples on the basis of two well-known water **absorption** bands, found at 1470, and 1940 nm. (For a review of units and their conversions, check out the [Wavelength Conversion Factors chart](#).)

Your assignment is to compare the infrared spectrograms of the samples taken from the suspects' clothing with the spectrum analysis of the soil sample you took from the crime scene. These are shown in *Briefing CSI: Activity Data Sheet 1*.

After you have studied *Briefing CSI: Activity Data Sheet 1*, answer the following questions.

1. The Y-axis of these spectral graphs are labeled "percent **reflectance**." How is reflectance related to absorption?
2. Why do you think that the dry soil sample from Suspect #1's clothing showed the most reflectance of the three samples?
3. Do the results of this water content test lead to any conclusions regarding whether or not either of the suspects were in the location where the vandalism occurred? Why or why not?
4. Would you feel comfortable holding either of the suspects for further questioning based on the results in *Briefing CSI: Activity Data Sheet 1*? What other information might you need to make the decision about the suspects' involvement in the vandalism?

Part 2

Since the crime scene was a sandy shore, CSI scientists decided to test the three soil samples to determine their mineral content. **Quartz** (silicon dioxide) is the major constituent of sand and has distinctive infrared absorption bands between 8 and 10 μm and between 12 and 13 μm , so the team decided to compare the silicates present in the soil samples found on the suspects' clothing with that collected from the crime scene. The results of these tests are found in *Briefing CSI: Activity Data Sheet 2*.

After studying *Briefing CSI: Activity Data Sheet 2*, answer the following questions:

1. The Y-axis of these spectral graphs are labeled "percent **transmission**." What is the relationship between transmission and absorption?
2. Based on these spectra, can you determine whether either of the suspects should be questioned further? If not, what do you need to know?
3. Why is it important to use more than one method of detection and analysis to confirm the constituents of a sample of matter?
4. How are these various methods of detection and analysis similar to how the Dawn spacecraft is collecting data on the surfaces of Vesta and Ceres?