

The Case of the Vanishing Gnome

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Time Frame 200 minutes; 4-5 periods

Essential Question(s)

- How can soil evidence be used to link people, objects, and locations in a forensic investigation?

Summary

Students explore how soil functions as trace evidence in forensic investigations. Through observation, hands-on soil analysis, and case-based reasoning, students learn how soil characteristics such as color, texture, and composition can link suspects and objects to specific locations.

Learning Goals

Standards

ACT College and Career Readiness Standards - Science (6-12)

SIN401: Understand a simple experimental design
EMI502: Determine whether presented information, or new information, supports or contradicts a simple hypothesis or conclusion, and why

College and Career Preparation Standards 6–12 (6th -12th)

9.6 (S): Students will foster curiosity, inquisitiveness, wonder, and imagination by applying scientific reasoning and engineering practices to investigate, analyze, and explain phenomena in the natural and designed worlds, demonstrating an understanding of scientific relationships and patterns. (Clarification Statement: To achieve this standard, instruction should align to grade-level state standards for science and engineering.)
10.6 (S): Students will foster curiosity, inquisitiveness, wonder, and imagination by applying scientific reasoning and engineering practices to investigate, analyze, and explain phenomena in the natural and designed worlds, demonstrating an understanding of scientific relationships and patterns. (Clarification Statement: To achieve this standard, instruction should align to grade-level state standards for science and engineering.)
11.6 (S): Students will foster curiosity, inquisitiveness, wonder, and imagination by applying scientific reasoning and engineering practices to investigate, analyze, and explain phenomena in the natural and designed worlds, demonstrating an understanding of scientific relationships and patterns. (Clarification Statement: To achieve this standard, instruction should align to grade-level state standards for science and engineering.)
12.6 (S): Students will foster curiosity, inquisitiveness, wonder, and imagination by applying scientific reasoning and engineering practices to investigate, analyze, and explain phenomena in the natural and designed worlds, demonstrating an understanding of scientific relationships and patterns. (Clarification Statement: To achieve this standard, instruction should align to grade-level state standards for science and engineering.)
9.13.1: Students will join or initiate at least one school- or community-based organization aligned with their personal or social identities (e.g., cultural clubs, service groups), documenting how participation strengthens their sense of self and fosters connections with mentors and like-minded peers.

Attachments

- Activity Slides—The Case of the Vanishing Gnome.pptx
- Career Presentation Guide—The Case of the Vanishing Gnome.docx
- Career Presentation Guide—The Case of the Vanishing Gnome.pdf
- Claim, Evidence, and Reasoning (CER)—The Case of the Vanishing Gnome.docx
- Claim, Evidence, and Reasoning (CER)—The Case of the Vanishing Gnome.pdf
- Detective's Letter—The Case of the Vanishing Gnome.docx
- Detective's Letter—The Case of the Vanishing Gnome.pdf
- Field Notes—The Case of the Vanishing Gnome.docx
- Field Notes—The Case of the Vanishing Gnome.pdf
- Soil Investigation Lab Guide—The Case of the Vanishing Gnome.docx
- Soil Investigation Lab Guide—The Case of the Vanishing Gnome.pdf

Materials

- Activity Slides (attached)
- Field Notes handout (attached; print two-sided; color recommended; one per student)
- Detective’s Letter handout (attached; one per student)
- Soil Investigation Lab Guide handout (attached; print two-sided; stapled; one per student)
- Claim, Evidence, Reasoning (CER) handout (attached; one per student)
- Career Presentation Guide (attached; two-sided; stapled; one per student)
- Soil (three different samples per group; see Prep Notes)

- Magnifying glass (one per student)
- Forceps (one per group)
- Petri Dish (four per group)
- Ruler (one per group)
- Distilled Water (50 mL per group)
- Vial (50 mL) with cap and flat bottom (four per group)
- Test tube with stopper (four per group)
- pH Test strips (four per group)
- Nitrate tester strips (four per group)
- Phosphate tester strips (four per group)
- Digital scale
- Stopwatch (one per group)
- Ziplock bags (one per soil sample per group)
- Clorox Wipes (optional; 1-2 per group)
- soil test kits (optional)

20 minutes

Activity 1

Use the attached **Activity Slides** to facilitate the activities. Display **slide 2** to introduce students to the lesson's title.

Pass out a copy of the attached **Field Notes** handout to each student. Move to **slide 3** and explain to students that they will be investigating a crime scene. Explain that a crime has taken place and a beloved gnome has disappeared from the client's garden. Pass out a copy of the attached **Detective's Letter** handout to each student. Display **slide 4** and show students the crime scene. Read the Detective's Letter out loud and have students follow along. They should record observations about the crime scene and the scenario on the field note side of the handout as you read. Repeat information as needed so students have detailed notes.

Possible Student Observations

"Wolfgang is suspicious because he hates gnomes."

"Gnorman is a likely suspect as he is starting a revolution."

Display **slide 5** to introduce the suspects and the pieces of evidence collected. Have students add the new information to their field notes.

Use **slide 6** to provide students with information about the soil and trace evidence. Have students record what they learn in the Supplemental Notes column of their handout. Explain how soil gets transferred from one location to another. Transition to **slide 7** and go over the types of tests that need to be done to compare soil types.

Move to **slides 8–9** and go over the essential question and learning objectives.

45 minutes

Activity 2

Move to **slide 10** and explain to students that they will be analyzing the soil samples from three different suspects. Pass out a copy of the attached **Soil Investigation Lab Guide** handout to each student. Display **slide 11** and explain that they must sign out the evidence to maintain chain of custody. Ask students to select a group member to retrieve their evidence packets.

Once all students have their materials, display **slide 12** and invite students to start with the sedimentation test. While the sedimentation test sits, have students complete the physical test display **slide 13** and have them start the physical characteristics of their sample: color, odor, texture, presence of plant material, and presence of inorganic material. Have students use the steps on the Soil Investigation Lab Guide and record their results in the table. Remind them to leave the crime scene column blank as they will test that soil separately. Once students have finished their physical characteristic observation, move to **slide 14**. Invite students to complete chemical characteristic observations using the Soil Investigation Lab Guide. Have students record their results in the table. Transition to **slide 15** and invite students to return the remainder of their evidence and clean up their station. Have students return their materials and wipe down their lab area. Display **slide 16** and facilitate a discussion about what information they found and how it will help them determine who the thief is.

Teacher's Note: Sediment Test

Even if it has not been one hour since the students started their sediment test, have them finish the activity before they leave for the day.

Teacher's Note: Chain of Custody

If the activity goes beyond the designated time, have students sign their evidence back in and then sign it back out when they return to the activity.

45 minutes

Activity 3

Display **slide 17** and explain to students that they are going to be testing the soil from the crime scene. They will use the same Soil Investigation Lab Guide as they did in the previous activity. Inform students they will now be recording their information in the last column for the crime scene. Move to **slide 18** and have students collect the crime scene evidence. Remind students that they will be conducting the same investigations as they did the previous day. Display **slide 19** and invite students to start the sedimentation test. While the sedimentation test sits, display **slide 20** and have the students start the physical characteristics of their sample: color, odor, texture, presence of plant material, and presence of inorganic material. Once students have finished their physical characteristic observation, move to **slide 21**. Invite students to complete chemical characteristic observations. Remind students to record their results in the table. Transition to **slide 22** and invite students to return the remainder of their evidence and clean up their station.

Teacher's Note: Sediment Test

Even if it has not been one hour since the students started their sediment test, have them finish the activity before they leave for the day.

Move to **slide 23** and ask students to compare the results of the crime scene analysis to the samples from the suspects. Invite students that they need to decide who they are going to accuse of the crime. Move to **slide 24** and introduce students to the Claim, Evidence, Reasoning (CER) strategy. Invite students to state who they believe committed the crime via the fill-in-the-blank statement on the slide, provide 2–3 pieces of evidence (specific pieces of evidence from the physical and chemical characteristics that matched), and a reasoning or justification for the claim (explanation of trace evidence and what it means and how it applies to this situation). Pass out a copy of the attached **Claim, Evidence and Reasoning (CER)** handout to each student.

Ask students to share their CER with a partner. Then invite students to share their CERs with the whole group. Move to **slide 25** and inform students who the criminal really was! Progress the slide deck once to reveal the thief on slide 25.

Teacher's Note: Thief

If you change who the thief is you will need to adjust slide 25 to show the thief you chose.

45 minutes

Activity 4

Move to **slide 26** and invite students to create a presentation about soil investigating and two careers. Inform students they are going to look for one forensic career to present on as well as one career that involves testing soil (which does not need to be forensics-related). Pass out a copy of the attached **Career Presentation Guide** handout to each student. Referencing the handout, briefly walk students through requirements for their presentations. Encourage students to use the provided rubric on the Career Presentation Guide as creating their presentations. Provide students with the following link: aafs.org/careers-forensic-science.

Teacher's Note: Sharing the Forensic Website

Consider adding the AAFS link for careers in forensic science in your classroom's LMS.

Provide students time to search for a career that involves soil.

Teacher's Note: Career Presentation

Encourage students to use images in their presentation. Additionally, suggest that students use fonts and font sizes that are large and easy to read. Students should also keep in mind color contrasts to have a visibly appealing presentation.

Consider sharing the rubric featured on the Career Presentation Guide for students to use when creating their presentation. If needed, adjust the rubric to fit your class needs.

To save time on the next activity, consider pairing students up who have chosen careers that are the same.

Optional Activity: Career-Focused Video

To share with students an example of a professional in the forensic science field who regularly works with soil, consider unhiding **slide 27** and showing the video *Lorena Dawson on Forensic Soil Science*.

45 minutes

Activity 5

Display **slide 28**, and inform students that as their peers present their presentation they need to take note on the back of their Career Presentation Guide handout about two careers they learned about. Introduce a modified version of the SIT (Surprising, Interesting, Troubling) strategy. Inform students they will write down one surprising, interesting, and thought-provoking thing they learned about each of the careers they choose to record.

Optional Activity: Extended Soil Investigation

Consider using the Physical and Chemical Properties of Soil-Student Laboratory Kit has a two part investigation to help students continue exploring physical and chemical properties of soil.

Research Rationale

See the "Career Exploration Through Experiential Learning - Forensics" Evidence in Action document.

Resources

- Careers in forensic science. American Academy of Forensic Sciences. https://www.aafs.org/careers-forensic-science
- Flinn Scientific. (n.d.). *Physical and chemical properties of soil: Student laboratory kit*. https://www.flinnsci.com/physical-and-chemical-properties-of-soil---student-laboratory-kit/ap7184/
- K20 Center. (n.d.). Claim, evidence, reasoning (CER). Strategies. https://learn.k20center.ou.edu/strategy/156
- K20 Center. (n.d.). S-I-T (Surprising, Interesting, Troubling). Strategies. https://learn.k20center.ou.edu/strategy/926
- Lorna Dawson on forensic soil science. (2017, January 13). YouTube. https://www.youtube.com/watch?v=EC7Mq835aYQ