BOUNCING BACK: USING GROUND-PENETRATING RADAR TO LOCATE BURIED OBJECTS

LAB FORENSICS.2

From *TI Classroom Activities,* Texas Instruments, 2006

Case File 2

Locate Mrs. Holloway's car and help solve this cold case.

To: Detective Sergeant Ashanti
Re: Possible new evidence in Holloway case

We have just received new information on this unsolved, high-profile case from several years ago. On May 6, 2000, the wife of billionaire oil tycoon Donald Holloway drove away in her car and never returned. As we never found any evidence of foul play, we believed that Mrs. Holloway left her husband and changed her identity. Recently, Mrs. Holloway's California vanity license plate, OIL GIRL, was found outside a remote gas station along the Desert Highway. This particular gas station happens to be quite close to lands owned by the Holloway oil empire. Also uncovered in recent weeks have been several documents detailing the purchase of some large properties along the road. It now looks like Holloway may have killed his wife and buried her and her car at one of the properties. Sample email is attached.

From: jwinchester@ ZongoReelEstayt.com
Date: May 8, 2000
To: dholloway@hollowayoil.com
Subject: RE: your needs

Mr. Holloway –

Per your request, I have identified four abandoned sites along Desert Highway that would suit your needs. The following locations are very remote and have been untouched for years:

- the old Two Tree golf course
- the 1960s government rocket-testing site (now deserted)
- the construction site on 31st and Desert
- the abandoned Bright Days housing development

Good luck with your latest endeavor.

Forensics Objective

- explore the use of ground-penetrating radar (GPR) to find buried materials

Science and Mathematics Objectives

- detect the presence of an object, using a range finder
- distinguish between different-shaped objects, using a range finder

Materials (for each group)

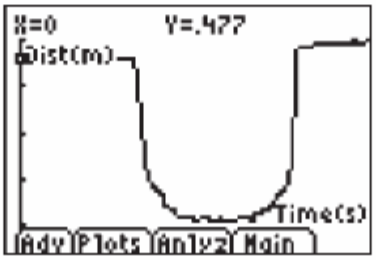
- TI-83/TI-84 Plus™ Family
- Vernier EasyData™ application
- Calculator-Based Ranger™ 2 (CBR™ 2)
- USB cable
- small box or block of wood
- several large boxes, each containing an unknown object

Procedure

1. Attach the USB cable to the CBR 2. Connect the other end of the cable to the calculator's USB port. The EasyData App should self-load. If it does not, press APPS and select **: EasyData**.

2. Set up the CBR 2 to collect one data point every 0.05 seconds for 200 seconds.
   a) Select Setup. Select option **2: Time Graph**.
   b) Select Edit to change the experiment parameters.
   c) Press CLEAR and type **0.05** for the time between samples.
   d) Select Next, press CLEAR, and type **200** for the number of samples.
   e) Select Next. Confirm that the experiment parameters are correct (sample interval = 0.05 seconds, number of samples = 200, experiment length = 10 seconds), and then select OK.

3. Get to know how the CBR 2 displays its data.
   a) Place a block of wood or a small box on your desk. Make sure that there is nothing else on the surface of your desk.
   b) Hold the CBR 2 about a meter above your desktop and toward one end of your desk. Select Start. You will hear a rapid clicking sound from the detector. Slowly move the motion detector, at a constant height above the desktop, from one end of your desk to the other end. Make sure that the light-gray part of the detector is facing the desk and that it passes over the top of the block or box on your desk.
   c) After 10 seconds, the clicking will stop. The screen will say that data are being transferred. Then you should see a display like the one shown below. (Note: It may take a few seconds for the data to transfer. Be patient!)



d) Your display will look like the one shown above only if you have moved the detector slowly, at constant speed, and at a constant height. If you turn your calculator upside down, the image looks more like something sitting on the desktop.
e) Using the arrow keys, you can see how far the desktop and the top of the box were from the CBR 2. (Note: If you do not get a graph like the one on the previous page, repeat step 3b. Make sure that your desk is clear, that the light-gray part of the detector is facing the desk, and that you maintain a constant speed and height above the desk.
f) Select (Main) to return to the Main screen. Repeat steps 3a–d with the box in a different orientation, such as on one of its ends. If you get a message about overwriting stored data runs, select (OK). Explore the graphs until you are comfortable with how the graph shows the location and shape of the object on your desk.

4. Your teacher will direct your group to move to one of the suspected "burial sites" for the car. Record the location of the site in the Evidence Record.

5. Without looking inside the box, probe each of the suspected burial sites.
   a) Rest the CBR 2 on the top edge of a flap that runs the length of the box, with the light-gray part of the detector facing the bottom of the box.
   b) Practice slowly moving the CBR 2 along the flap at a constant height. You need to move the CBR 2 at a speed that will let you move from one end of the box to the other in about 10 seconds. Practice this until you can move the detector at the correct speed and at a constant height.
   c) When you are ready, select (Start). If you get a message about overwriting stored data runs, select (OK). Begin moving the detector just after you begin to hear the rapid clicking noise.
   d) Once the data are transferred, examine the shape of the graph.
   e) Repeat step 5c to see if you get a similar shape again. If not, repeat step 5c until you get a consistent shape. If you are having trouble, ask your teacher for assistance.
   f) Sketch the display shown on the screen into the Evidence Record.

NAME: _____

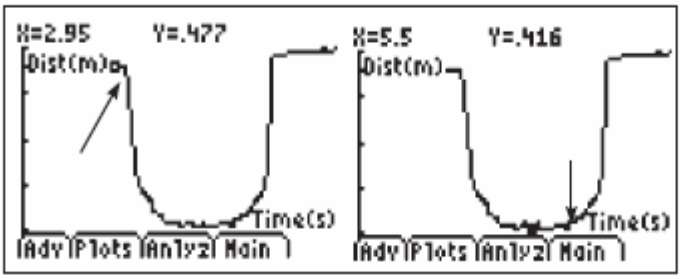
DATE: _____

Evidence Record

Site Probed by Detector	Sketch of Shape Found by Detector

Case Analysis

1. Analyze the sketches that you have made. Which site contains the buried car? Explain your reasoning.
2. Using the screen captures shown below, determine the height of the object. The **X=** is the time in seconds, and the **Y=** is the distance from the CBR 2 in meters. The cursor location is indicated by an arrow. The **X=** and **Y=** values are shown for the cursor location.



3. Why is it important to move the CBR 2 slowly but at a constant speed? What would happen if you didn't move it at a constant speed?
4. What can make the CBR 2 image (or a real GPR image) of an object look different from the actual profile of the object?
5. How could someone get a more complete image of the object if they used real GPR?