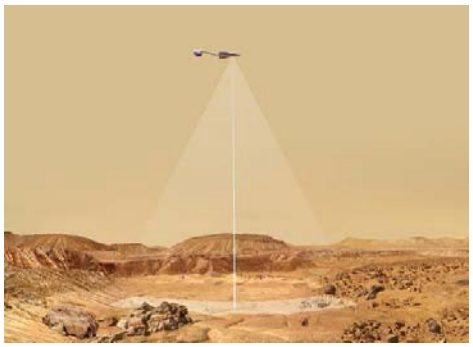
Civil Air Patrol's ACE Program

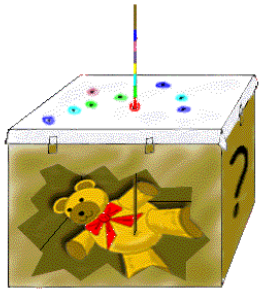


What's Hidden Below?
Grade 6 Academic Lesson #6

Topics: remote sensing, imaging radar, topographic maps (science, math)

Lesson Reference:
NASA SpacePlace lesson: Rising Above the Problem

Length of Lesson: 50 minutes



Objectives:

- Students will gather information using measurement and observation.
- Students will make predictions, collect data, analyze, and make a conclusion.

Next Generation Science Standards:

- MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

CCSS Math:

- 6.G.4 - Solve real-world and mathematical problems involving area, surface area, and volume.

CCSS ELA:

- SL 6.1 - Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
- SL 6.2 - Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.
- SL 6.4 - Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

Solve real-world and mathematical problems involving area, surface area, and volume.

Background Information:
We can use technology called imaging radar to help create a picture of the terrain on Earth – or any other planet (such as Mars). Imaging radar instruments are either flown over the surface of the planet in an airplane or launched into orbit around the planet. Imaging radar works by bouncing a radar signal off the ground, then measuring the strength of the signal that comes back and how long it takes.

For an introduction to NASA's remote sensing programs, you may wish to watch this video (or share it with your class): "NASA | Getting the Big Picture".

Materials:

- box (such as a Styrofoam carryout box) that includes a top
- an object, such as a small teddy bear or other simple-shaped object (or incorporate geometry by securing a distinct 3-D geometric figure inside the box)
- sharp, straight stick, such as a wooden skewer or knitting needles (Safety: Be sure to instruct students on safe use of the skewer and perhaps attach an eraser or piece of clay to the end of the sharp skewer). If you add an end that will not stick into the paper on the top of the box, you may have to pre-cut holes in the box for use in surveying the object.
- markers
- ruler
- grid paper (a copy for covering the object and a "Grid Data Sheet" are included)

NOTE: Secure an easily identifiable object inside a box. If using a light-colored Styrofoam carryout box, line the bottom of the inside of the box with black paper (or use black spray paint to make the inside surface dark). Consider using a dark-colored object to make it harder for "peepers" to see it. Place a lid on the box. Tape a piece of graph paper on top of the lid (copy provided). If using a box that makes it difficult to insert the skewer, poke holes through the dots on the grid paper covering the object prior to conducting this lesson. To correctly place measurements on the skewer, place the skewer vertically into the box. Make a mark on the skewer indicating the top of the box. Make a ring around this mark in a color of your choice. <u>The measurement of the top colored ring will be "0" to indicate surface level</u>. Now, move down the skewer stick about 1 cm and draw another colored ring. This ring represents 1 cm. Move down 1 more cm and draw another colored ring. This ring represents 2 cm above surface level. Continue this method. It is wise to put your object into the box, insert the skewer vertically at the highest point of your object in order to determine the "lowest" colored ring needed on your skewer. This lowest colored ring indicates the highest point of the object in the box. (You may wish to omit the measurements and simply allow students to make different bands of colors on the skewer.)

You can either conduct a whole class activity using the one hidden object in the box, or you can prepare enough hidden object boxes for students to work on in small groups.

Lesson Presentation:

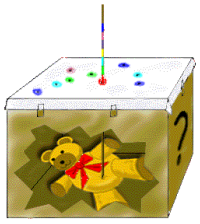
1. Show students a box that you have prepared that has a hidden object inside it. Ask students how they might be able to determine what is in the box without pressing or shaking the box and without looking inside. Listen to student ideas.

2. Tell students that they will conduct a remote sensing activity to simulate a process called radar imaging in order to help determine what is in the box. Explain remote sensing and radar imaging.

   Think about the words "remote sensing." Remote refers to something located at a distance, far away or hidden away. "Sensing" may cause us to think of our five senses. When we use any of our five

senses, it provides us with information. So, remote sensing actually means gathering information about something from a distance, without having any physical contact with the object we want to study. Airplanes and satellites can conduct remote sensing. One way to obtain information about something without actually coming in contact with it is by using radar. Imaging radar instruments are either flown over the surface of the planet in an airplane or launched into orbit around the planet. Imaging radar works by bouncing a radar signal off the ground and then measuring the strength of the signal that returns and how long it takes to return.

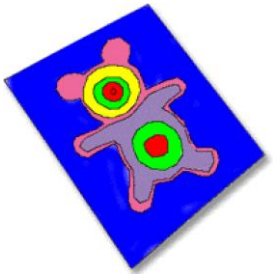
3. Tell the students that their hand will be the aircraft or satellite. The skewer with bands of color will be the radar signal sent to the ground. Explain that students will do the following to obtain information about the hidden object: 1) Push the skewer through the single A-1 box on the grid paper covering the box. 2) See what color on the stick is closest to the opening of the hole. 3) Use that color to color the A-1 coordinate on the "Grid Data Sheet." Explain that the colors represent the height above sea level, or in this case, height above the surface of the box. (With real radar imaging, the time it takes for the signal to return and the strength with which it returns determines the elevation of the point the signal hit.) Tell students that they will continue this process until each box on the loose leaf grid paper data sheet is colored. Ask students how this process will help reveal the object below the cover. (It will reveal the outline as well as any varying heights of the object in the box.)



If conducting this as a whole class activity, distribute a "Grid Data Sheet" to each student. Continue to call volunteers to the front of the room one at a time to "send a signal down to the object below." Have the volunteers call out the coordinate (e.g. A-2, D-5) and the first visible color on the bottom of the skewer. Have the class color in the appropriate coordinate box (e.g. A-2, D-5) on their grid sheet.

If conducting this activity in small groups, distribute a box with a hidden object and a skewer to each group. If skewers are not prepared ahead of time with measurement colors, show students how to make them. Distribute a "Grid Data Sheet" to each student and allow them to work together in their group to reveal their hidden object.

4. Once the class or small groups have completed the radar imaging simulation, ask them to analyze the data sheet(s). Does the image give them a better idea of what the hidden object is? Even if the students cannot tell exactly what the object is, how does a colored picture such as the one they have created help them? (If they know the heights that each color represents, they can imagine how the object might look in three dimensions.) Ask students if they know what they have created on their "Grid Data Sheet." Tell them they have created a topographical map, usually called a topo map. Ask students if they know what a topo map is? Confirm that a topo map shows the elevations in an area.



You may wish to show your class this explanation: Topographic Maps Video.

Summarization:
Ask students to share something they learned today. Confirm that students can define remote sensing and radar imaging.

Character Connection: Remind students that as they go through life, they need to use all their senses to determine if something is good or bad, right or wrong, or useful or not useful. The more we learn, know, and understand about things, the better decision makers we become. "Knowledge is power!"

Assessment:

- teacher observation
- completed "Grid Data Sheet"

Additional activity ideas to enrich and extend the primary lesson (optional):

- Allow students to find a mystery object and mark their own wooden skewers to present the activity to another group of students or their family at home.
- Have students build a robot arm using the lesson "Build Your Own Robotic Arm" from TryEngineering. The lesson focus is to develop a robot arm using common materials. Students will explore design, construction, teamwork, and materials selection and use.
- Another activity called "What shape is it?" from the website Quarked. This activity helps students determine the shape of an unseen object by bouncing a ball off of it.
- A classroom activity from NASA called Robotic Arm Challenge is also available.
- For this activity, you might want to borrow the CAP Robotic STEM Kit. Learn more about the STEM Kits available through the CAP AE office.

Associated Websites:

- "Remote Sensors" - Join Wavie as she leads you through a fun new video designed to help you learn about remote sensing and how the earth is observed by scientists from space. Check out other videos created by the IEEE Geoscience & Remote Sensing Society to learn more about satellite imaging, remote sensors, and orbital rotation.
- Echo the Bat (video reading) and downloadable book
- Engineering in the classroom by Jet Propulsion Laboratories

Tape this grid sheet on top of the lid that is covering the hidden object. (Cut off the excess paper not covering the lid.) The dots on each grid square are provided as an indicator of where to insert the skewer.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
3	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
4	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
5	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
6	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
7	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
8	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
9	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
10	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
11	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
12	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
13	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
14	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
15	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
16	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
17	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
18	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
19	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
20	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
21	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Grid Data Sheet

The colors on the skewer indicate height above “surface” level. When the skewer is held vertically (up and down) the top colored ring will have a measurement of “0” indicating no height above the surface. Rings closer to the bottom will have the highest measurements, indicating greater distances from the surface of the box to the top of the object. Holding the skewer vertically, record measurements for the colors listed below. Remember, the color at the top of the skewer will be “0.” Measure from this color down to obtain correct measurements for the colors below the top colored-ring. Color each grid coordinate below according to the first visible color shown on the skewer after inserting it into the box at a particular coordinate.

Blue=_____cm Red=_____cm Green=_____cm Black=_____cm Yellow=_____cm Brown=_____cm Orange=_____cm

Purple=_____cm Pink=_____cm

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1																
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