National Aeronautics and Space Administration

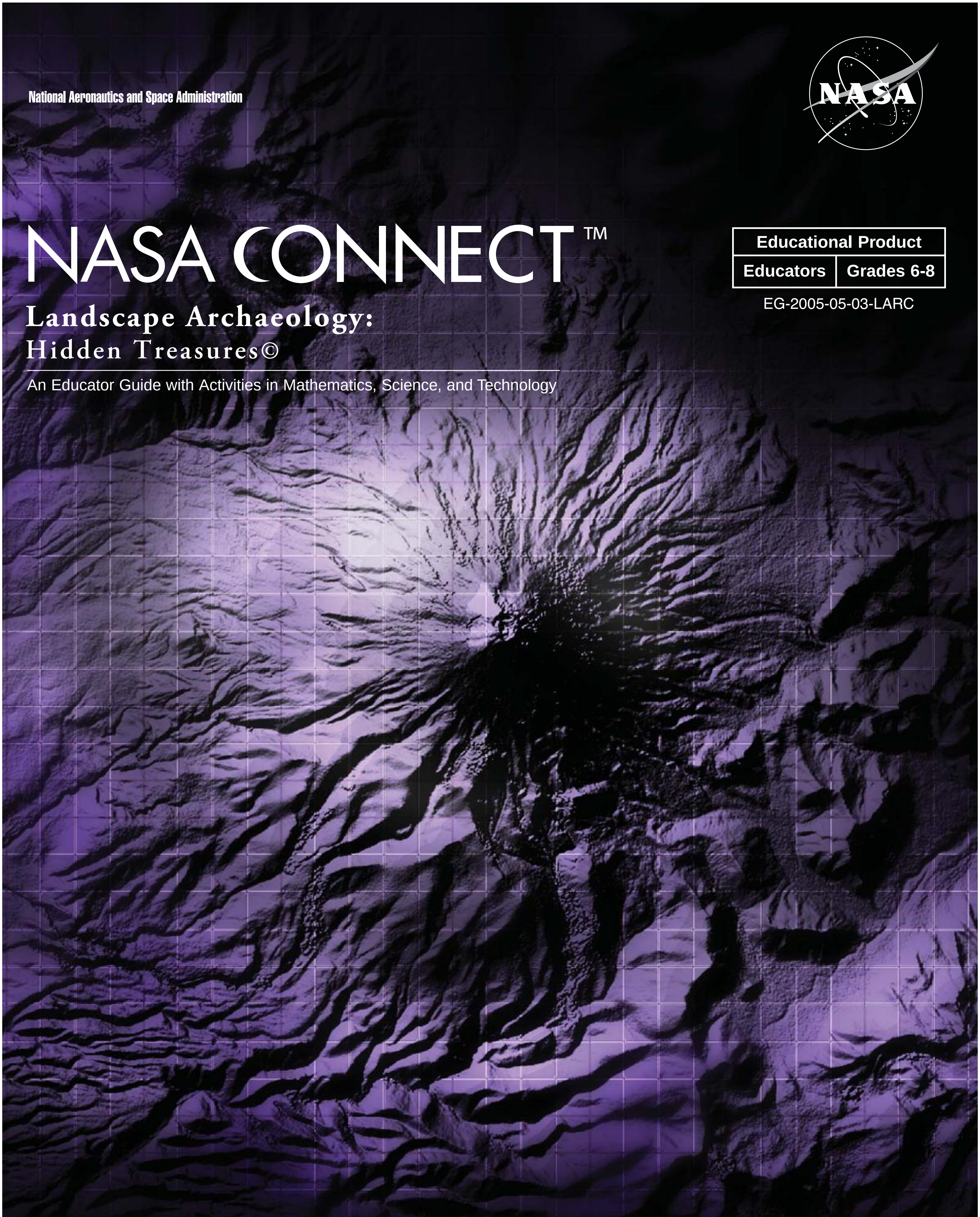
NASA CONNECT™

Landscape Archaeology: Hidden Treasures©

An Educator Guide with Activities in Mathematics, Science, and Technology

Educational Product	
Educators	Grades 6-8

EG-2005-05-03-LARC



NASA CONNECT™: *Landscape Archaeology: Hidden Treasures* is available in electronic format. Find a PDF version of the educator guide for NASA CONNECT™ at the NASA CONNECT™ web site: **http://connect.larc.nasa.gov**

NASA CONNECT™ is produced by the NASA Center for Distance Learning, a component of the Office of Education at NASA's Langley Research Center, Hampton, VA, and is a collaborative endeavor of NASA with the organizations below. The NASA Center for Distance Learning is operated under cooperative agreement NCC-1-02039 with Christopher Newport University, Newport News, VA. Use of trade names does not imply endorsement by NASA.

AIAA FOUNDATION
www.aiaa.org

ITEA International Technology Education Association
www.iteawww.org

CHRISTOPHER NEWPORT UNIVERSITY
www.cnu.edu

AECC Aerospace Education Coordinating Committee
www.nasa.gov

NCTM
www.nctm.org

Knowitall.org
http://knowitall.org

NSTA National Science Teachers Association
www.nsta.org

NEC
NEC Foundation of America
www.nec.com

NASA CONNECT™

Landscape Archaeology: Hidden Treasures

An Educator Guide with Activities in Mathematics, Science, and Technology

Program Overview

Hands-On Activity

AIAA FOUNDATION Registered users of NASA CONNECT™ may request an American Institute of Aeronautics and Astronautics (AIAA) classroom mentor. For more information or to request a mentor, e-mail **nasaconnect@aiaa.org**.

Acknowledgments: Special thanks to Summer 2004 Educators in Residence, Chris Giersch, Ellen Holmes, and the National Council of Teachers of Mathematics (NCTM).

program overview

educator guides

SUMMARY & OBJECTIVES

In NASA CONNECT™: *Landscape Archaeology: Hidden Treasures,* students will learn how researchers and scientists use data collected through remote sensing to study hidden features on the Earth's surface and from ancient cultures. Using the coordinate plane and ordered pairs, students will map the surface of a "mystery planet" landscape and make predictions about it. Students will see how archaeologists are trying to solve current world problems by looking at clues from the past. By conducting inquiry-based and web activities, students will make connections between NASA research and the mathematics, science, and technology they learn in their classrooms.

STUDENT INVOLVEMENT

Inquiry-Based Questions

Host, Jennifer Pulley, and NASA engineers and scientists will pose inquiry-based questions throughout the program. These questions allow the students to investigate, discover, and critically think about the concepts being presented. When viewing a videotape or DVD version of NASA CONNECT™, educators should pause the program at the designated segments so students can answer and discuss the inquiry-based questions. During the program, Jennifer Pulley and NASA engineers and scientists will indicate the appropriate time to pause the tape or DVD. For more information about inquiry-based learning, visit the NASA CONNECT™ web site, **http://connect.larc.nasa.gov**.

Teacher note: : It is recommended that you preview the program before introducing it to your students so that you can become familiar with where the pauses occur.

Hands-On Activity

The hands-on activity is teacher created and is aligned with the National Council of Teachers of Mathematics (NCTM) Standards, the National Science Education Standards (NSES), and the International Technology Education Association (ITEA) Standards for Technological Literacy. Working in groups, students will create 3-D mystery landscapes. Using a coordinate grid system to plot 50 different data points, other groups will create 2-D topographical maps of the mystery landscapes.

Web Activity

Students can explore a powerful set of activities that use similar concepts to those of GIS software at **http://earthobservatory.nasa.gov/**.

Using the Squeak Challenge, students and teachers will assist Norber and Zot who are on a mission from Norbania to create a Geographical Information System (GIS) for forests on planet Earth. You will use sensors to to gather information from the maps to create graphs as a way to visualize the data.

The activity is aligned with the National Council of Teachers of Mathematics (NCTM) Standards, the National Science Education (NSES) Standards, and the International Technology Education Association (ITEA) Standards for Technological Literacy.

RESOURCES

Teacher and student resources enhance and extend the NASA CONNECT™ program. Books, periodicals, pamphlets, and web sites provide teachers and students with background information and extensions.

hands-on activity

BACKGROUND

BACKGROUND

The technology of modern remote sensing began with the invention of the camera more than 150 years ago. Although the first, rather primitive photographs were taken as "stills" on the ground, the idea and practice of looking down at the Earth's surface emerged in the 1840s when pictures were taken from cameras secured to tethered balloons for purposes of topographic mapping. Perhaps the most novel platform at the end of the last century is the famed pigeon fleet that operated as a novelty in Europe. In the First World War, cameras mounted on airplanes proved invaluable in military reconnaissance because they provided aerial views of fairly large surface areas. From then until the early 1960s, the aerial photograph remained the single standard tool for depicting the surface from a vertical or oblique perspective.

V-2 Rocket

Satellite remote sensing can be traced to the early days of the space age (both Russian and American programs) and actually began as a dual approach to imaging surfaces by using several types of sensors from spacecraft. In 1946, V-2 rockets acquired from Germany after World War II were launched to high altitudes from White Sands, New Mexico. These rockets, while never attaining orbit, contained automated still or movie cameras that took pictures as the vehicle ascended. Then, with the emergence of the space program in the 1960s, Earth-orbiting cosmonauts and astronauts acted much like tourists by taking photos out the window of their spacecraft.

The term "remote sensing," first used in the United States in the 1950s by Ms. Evelyn Pruitt of the U.S. Office of Naval Research, is now commonly used to describe the science—and art—of identifying, observing, and measuring an object without coming into direct contact with it. This process involves the detection and measurement of the radiation of different wavelengths that are reflected or emitted from distant objects or materials, by which they may be identified and categorized by class/type, substance, and spatial distribution.

One method of remote sensing uses the spectrum of sunlight reflected by Earth's surface that contains information about the composition. of the surface. It may reveal traces of past human activities, such as agriculture. Since sand, cultivated soil, vegetation, and all kinds of rocks each have distinctive temperatures and emit heat at different rates, sensors can "see" things beyond ordinary vision or cameras. Differences in soil texture are revealed by fractional temperature variations, so it is possible to identify loose soil that had been prehistoric agricultural fields or was covering buried remains. The Maya causeway was detected through emissions of infrared radiation at a different wavelength from surrounding vegetation. More advanced versions of such multi-spectral scanners (Visible and infrared (IR)) can detect irrigation ditches filled with sediment because they hold more moisture and thus have a temperature different from other soil. The ground above a buried stone wall, for instance, may be "a touch" hotter than the surrounding terrain because the stone absorbs more heat. Radar can penetrate darkness, cloud cover, thick jungle canopies, and even the ground.

Remote sensing can be a discovery technique because the computer can be programmed to look for distinctive "signatures" of energy emitted by a known site or feature in areas where surveys have not been conducted. Such "signatures" serve as recognition features or fingerprints. Such characteristics as elevation, distance from water, distance between sites or cities, corridors, and transportation routes can help predict the location of potential archeological sites. Remote sensing allows scientists to gather a great deal of information without ever disturbing the site being observed.

INSTRUCTIONAL OBJECTIVES

The students will

- Measure, collect, and analyze data in order to predict
- Use coordinate plane geometry to create a topographical map

NATIONAL STANDARDS

NCTM Mathematics Standards

Geometry

- Specify locations and describe spatial relationships by using coordinate geometry and other representational systems.
- Use coordinate geometry to represent and examine the properties of geometric shapes.

Measurement

- Understand measurable attributes of objects and the units, systems, and processes of measurement.
- Understand both metric and customary systems of measurement.
- Apply appropriate techniques, tools, and formulas to determine measurements.
- Select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels of precision.

Representation

- Create and use representations or organize, record, and communicate mathematical ideas.
- Use representations to model and interpret physical, social, and mathematical phenomena.

NSES Science Standards

Content Standard A: Science as Inquiry

Ability To Do Scientific Inquiry

- Use appropriate tools and techniques to gather, analyze, and interpret data.
- Develop descriptions, explanations, predictions, and models by using evidence.
- Think critically and logically to make the relationships between evidence and explanations.

Content Standard E: Science and Technology

Ability of Technological Design

- Identify appropriate problems for technological design.
- Understanding About Science and Technology

Content Standard F: Science in Personal and Social Perspectives

Science and Technology in Society

- Science and technology in local, national, and global challenges

ITEA Standards for Technological Literacy

Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.

NASA RELEVANCE

NASA scientists are using remote sensing to gain information about the topography of Earth and its effects on human activity. Topographical data are used to learn about the history of the Earth and to predict upcoming changes in the Earth's atmosphere, land (surface and subsurface), and sea that are caused by nature and human activities. NASA is also using remote sensing to gain a better understanding of the topography of other planets and objects in our solar system. For example, the topography of Mars is being studied by using a remote sensing technology called the Mars Orbiter Laser Altimeter (MOLA), which is carried on the Mars Global Surveyor. Using MOLA, NASA scientists are able to build a fuller picture of Mars and its interactive systems. Remote sensing has widespread applications that will provide us with key information needed to help us understand the bodies of mass in our solar system, including our own environment on Earth.

PREPARING FOR THE ACTIVITY

Student Materials *(per class)*

- lunch size paper bags (1 per student)
- mystery object (same one for each student)
- shoebox
- graph paper
- heavy-duty foil
- skewer sticks
- Materials to put in box (*foam material, rocks, sand, clay, straws, empty milk cartons, food, and others*)

Teacher Materials

- A copy of the video NASA CONNECT™: *Landscape Archaeology: Hidden Treasures*

Time for Activity

- 60 minutes (watching the video and discussing the inquiry-based questions)
- 90 minutes (the activity)
- 45 minutes (the extension)

Vocabulary

Remote Sensing is the technique or process of obtaining data or images from a distance, as from satellites or aircraft.

Topography is the detailed, precise description of a place or region, including the elevation.

THE ACTIVITY

Remote Sensing

Lesson Description

Brief Description

In this lesson, students will learn to use a coordinate plane system to create a topographic map of a mystery planet landscape. Working in groups, students will decide what data points they will need to choose to best create their map. Students will measure, record and analyze their data.

ENGAGE

Show students the NASA CONNECT™ program, *Hidden Treasures: Landscape Archaeology*. Working in groups, have students answer and discuss all inquiry-based questions that are presented in the program.

Give each student a closed, brown paper bag with the same mystery object inside. **Safety Note: Please no sharp objects**. The mystery object should require several words to fully describe and yet be difficult to identify by touch alone. Some examples are a golf ball, a marshmallow, and a foam ball. With eyes closed or blindfolded, each student will reach into his/her bag and suggest attributes of the object while someone records the comments on the board or overhead projector. The objective is to list as many descriptors as possible without naming the object. Explain to students that like remote sensing, they are using senses other than vision to determine what something looks like. Discuss with students that scientists often have to use a variety of methods and forms of technology to describe something.

EXPLORE

Students working in pairs will create model environments for imaginary planets that they name. In shoeboxes, they will create a variety of landscapes that include rivers, lakes, mountains, cliffs, and flatlands by using objects of their choosing (rocks, food, sticks, foam objects, clay, sand, and so on). Students will cover their shoebox planets with heavy-duty foil marked with a grid so that no one will be able to see inside. Trade the shoebox environments with another group. The goal will be for students to determine what each other's planet environments look like without looking inside the shoeboxes. Students will determine and record the elevation and any other observations at 50 cells in the shoebox environment.

EXPLAIN

Without looking in boxes, groups will explain to each other what they think the shoebox environment that they mapped looks like and how they went about choosing which cells to measure. They will point out any significant landscapes (mountains, valleys, and so on) and any areas in the shoebox about which they are uncertain. Students will make maps of the shoebox environment they used for taking data.

EXTENSION

Go to **http://ltpwww.gsfc.nasa.gov/tharsis/Mars_topography_from_MOLA/**. This web site contains a topographical map of Mars taken by the Mars Orbiter Laser Altimeter (MOLA). Looking at the entire picture of Mars, ask students to find the highest and lowest elevations on Mars. Click on a section of the topographical map to zoom in on that area. Either print pieces of this map or allow students to view the web site. By using words and pictures, have students describe the topography of the area they (or you) have chosen. This activity will require that students understand how to use the color key to determine elevation.

EVALUATE

Students will unveil the environments and compare their maps to the actual environments they used to take data. They will write a paragraph explaining the similarities and differences in their maps and the actual environments and a paragraph explaining how they could have improved their data collections to get more accurate maps.

Student Handout

Remote Sensing

Materials *(per 2 to 3 students)*

shoebox, graph paper, heavy-duty foil, skewer sticks, and materials to put in box *(foam material, rocks, sand, clay, straws, empty milk cartons, food, and others.)*

Activity Setup

1. In groups of 2 to 3, build an environment inside your shoebox that is from an imaginary planet that you create and name. Include several different landscapes that possibly include lakes, rivers, mountains, rolling hills, cliffs, valleys, and so on. Examples could be (1) using a lid filled with water to represent a lake or (2) using a rock to represent a mountain. Be sure to glue all objects placed in the box to the bottom so they do not shift. Note: Be sure not to let other students see your shoebox environment.
2. Cut a piece of heavy-duty foil large enough to fit over the top of your shoebox.
3. On the foil, use a permanent marker to draw a grid that will fit over the top of the box. Make each of the grid squares 2 cm by 2 cm and label the columns with letters and the rows with numbers.
4. Secure and tape the foil grid over the top of your shoebox, covering the planet's environment. Note: Tape the edges of the foil as tightly over the shoe box as possible to keep the foil from sagging and align the grid so that the corner of cell A1 is over the corner of the box as seen on figure 1.

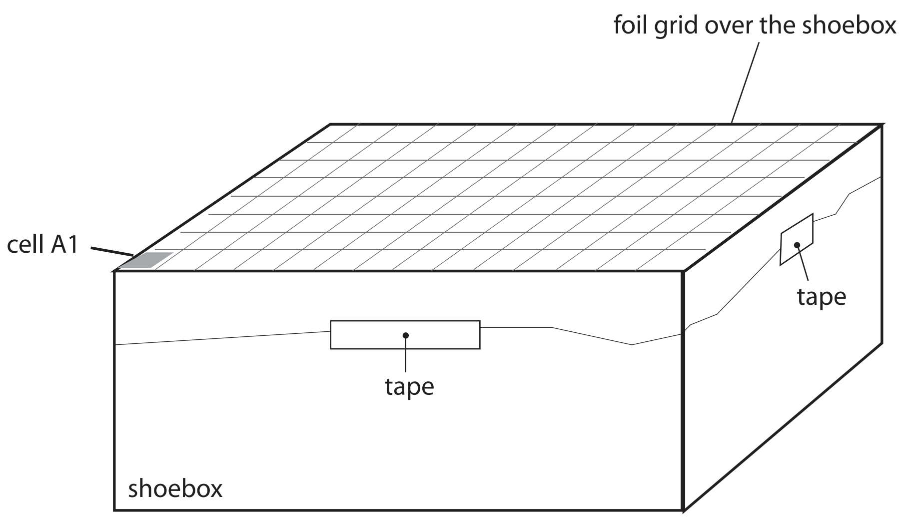


Figure 1

Student Handout

Remote Sensing

Measure and Predict

1. Trade boxes with a different group, making sure not to look inside the boxes.
2. Your mission is to make a map of each other's environments without looking inside the boxes.

   a. To do this activity, first measure and record the height of the box.

   b. Next, choose a cell on the foil and poke a skewer stick through the foil grid and continue straight down until you hit something. Note: Do not try to look through the hole. Refer to figure 2.

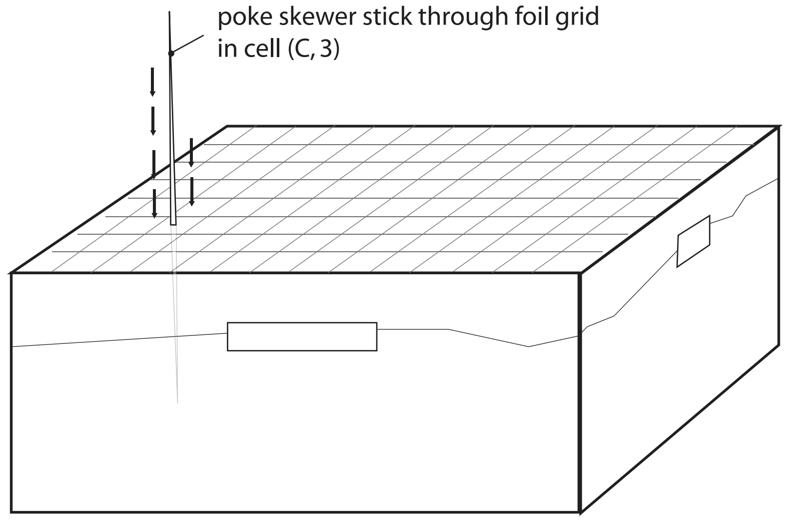


Figure 2

   c. Measure the length of the skewer stick that is inserted into the box by holding the spot with your fingers where the foil meets the skewer stick and measuring from that point to the end that was inserted, as seen in figure 3.

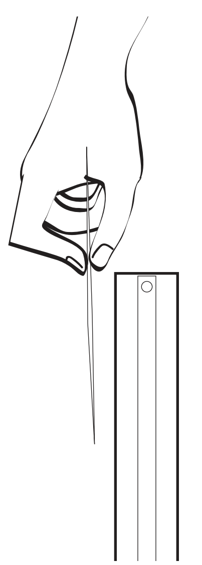


Figure 3

Student Handout

Remote Sensing

d. Subtract the length of the part of the skewer stick that was inserted from the height of the box to give you the elevation of the landscape at that cell.

e. Find the paper grid cell that correlates with the foil grid cell that you poked (*example: "C3"*). Record the elevation of the landscape and any other observations that may tell you more about that cell (*example: wet, soft, hard, sandy, and so on*). Refer to figure 4.

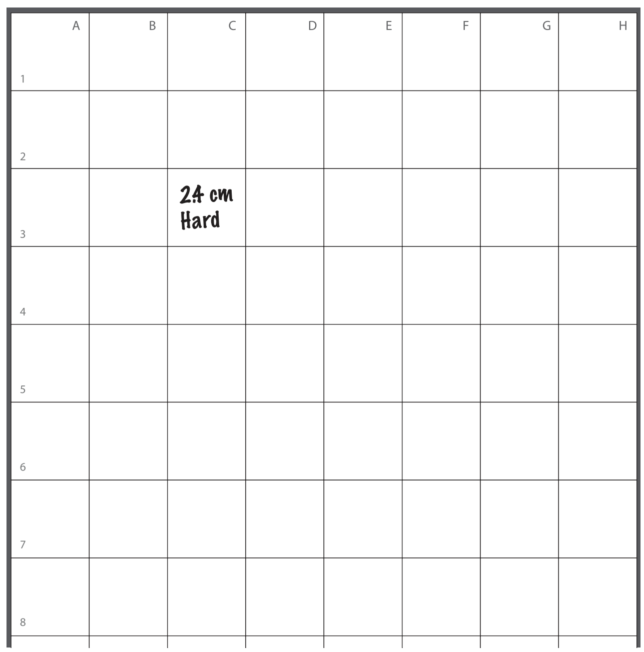


Figure 4

f. Repeat steps b through e until you have 50 observations completed. Choose your cells wisely because you only have 50 cells to help you determine what the entire surface looks like.

g. After you have determined the elevations of 50 cells, use a different color pencil or pen to estimate and record on the paper grid what you predict the entire landscape will look like (elevation and material). When you are finished, you should have an elevation recorded in each cell.

Student Handout

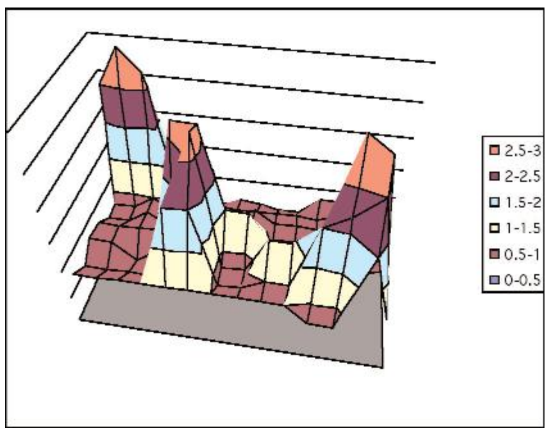
Remote Sensing

Map Your Data

1. Using crayons, markers, and/or pencils, draw a map of the environment on a new grid sheet. Show mountains, valleys, rivers, lakes, flatlands, and other geographical features in the correct cells. Label the heights at significant high points and low points.

2. If available, use Microsoft Excel or a similar spreadsheet program to make a topographical map. Type the numbers on the program's grid that correlate with the elevation measurement in each cell. Highlight the data you typed and insert a 3-D surface chart. On Microsoft Excel, once you have a 3-D chart, you may alter the view by clicking on "Chart" at the top of the page and clicking on "3-D View." You will be able to alter the viewing perspectives of your 3-D map by clicking on the arrows.

Example of a Graphical 3-D Map



Analyze Your Results

Answer the following questions in your student journal.

1. After you have made at least one map of what you believe the environment looks like, take the foil off the box and compare your map to the actual environment.

2. Write a paragraph describing the similarities and differences between your map(s) and the actual landscape.

3. Write a paragraph about several ways you would change this activity to create a more accurate topographical map.

student handout

Remote Sensing: *Student Handout Grid*

A	B	C	D	E	F	G	H
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							

Resources

BOOKS

Goldberg, Jan: Earth Imaging Satellites: Rosen Publishing Group, Incorporated, 2003.

Stefoff, Rebecca: Finding the Lost Cities: Oxford University Press, 1998.

WEB SITES

http://observe.arc.nasa.gov/nasa/exhibits/learning/learning_0.html

http://rsd.gsfc.nasa.gov/rsd/

http://rst.gsfc.nasa.gov/Front/tofc.html

http://seawifs.gsfc.nasa.gov/reefs/

http://www.ghcc.msfc.nasa.gov/archeology/