Pre-Classroom Activities

5-8 Activity #1

NASA Landsat 7 Educational Activity

Activity Summary, Lesson Plans, and Resources for this Activity found at this url:
http://craters.gsfc.nasa.gov/index.htm

Finding Impact Craters with Landsat
-Lesson Plan-

Step 1 . Use students' interest in the highly dramatic, explosive to introduce the activity.

Show students an aerial photograph of Barringer Meteor Crater (also known as "Meteor Crater", and located in Arizona). Tell them this landform is about 1300 meters (0.8 mile) in diameter and 174 meters (570 ft) deep. Ask them, what do you think could have made a hole this big in the land? Discuss as a class.

Show an artist's rendering of an impact event. Two are provided.

1. "One Minute After the End of the Cretaceous" by William K. Hartmann

Please be aware that anyone reproducing this painting for uses other than this classroom activity, "Finding Impact Craters with Landsat" must contact William K. Hartmann for his permission, at: <hartmann@psi.edu> or by using information at this URL:
http://www.lpi.usra.edu/publications/books/CB-954/CB-954.intro.html

2. Impact Painting by Don Davis

Tell students that many objects much smaller than a planet orbit the Sun, and sometimes the Earth's path crosses theirs. When that happens, there is an impact event of enormous force, with profound effects on rocks and soil, atmosphere, water, and living things.

Ask students to imagine hitting a dust particle or a fleck of paint in the air with their finger. They will understand that such a collision would not leave any lasting mark. Tell them that NASA engineers working on the Space Shuttle have found that even tiny flakes of paint floating in space (from earlier missions) can make craters one centimeter in diameter in Space Shuttle windows when they hit them, because of the speed of impact. Emphasize that there is a lot of energy in an object traveling fast. It has been calculated that the energy required to produce the Barringer crater was equivalent to the explosion of 15 million tonnes of TNT.

Have a discussion about what students may already know about impact events. Ask students if any of them have visited Barringer Meteor Crater. Students who have done so can describe their experience.

Do the following either in the classroom or as homework the night before you wish to conduct the bulk of the lesson:

Distribute the Student Worksheet for Step 1, "When an Extraterrestrial Object Hits the Earth".

On the worksheet, students read a short description of what happens during an impact event. Based on that reading and on their existing knowledge, they describe the effects such an event might have on the land, air, and living things, and evidence of these effects that might remain for thousands or millions of years.

In the classroom:

Step 2. Distribute Student Reading for Step 2: Known Effects of Impact Events, and have students read quietly alone or aloud together.

Step 3. Show either of the following, both of which are provided with this activity:

(a) the movie, "Iturralde Movie" ~or~
(b) the series of three still images from the Iturralde movie, which is provided with this activity.

Explain to students that the movie is comprised of Landsat images of a location in Bolivia, as the movie progresses the data are displayed in various way so that the impact crater becomes more visible to the viewer. The movie and the series of still images taken from it show very clearly how satellite technology helps us see landforms hidden in the Earth's surface that we cannot see with our eyes alone.

Step 4. Organize students in small groups (of three to five students). Distribute the following:

(1) One set of seven satellite images to each group

(2) One copy for each student of the Student Worksheet Sheet for Step 4: Describing Satellite *Images of Possible Impact Craters*

Given what students know about the evidence left by impacts, ask student groups to determine whether or not the landforms in all seven of the images *appear to be* impact craters.

Guidance questions are provided on the Student Worksheet.

Monitor the student groups as they discuss their analyses of the satellite images.

1. Make sure students understand that they should come to agreement as a group about their satellite images based on their analysis of the evidence in the images.

2. The Student Worksheet provides instructions about sharing their thoughts about the evidence before coming to agreement as a group. As groups discuss their analyses of the images, make sure they are discussing the evidence constructively with each other.

3. If students do not follow these instructions in the worksheet, direct them to choose one or two of the satellite images they find most interesting to interpret for the class, and to designate a spokesperson for the group.

Step 5. Have each spokesperson interpret the group's images. Make sure that all of the images in the set provided are covered in the class discussion.

Whether or not students believe each image shows an impact crater, their spokesperson must explain their group's thinking clearly and convincingly.

For positive identifications of the landforms as needed, use the *Teacher Reference for Step 5: The Landforms Identified*.

Either in the classroom or as homework:

Step 6. Distribute Student Worksheet for Step 6: Questions You Would Ask on a Field Expedition to a Possible Impact Crater

Ask students to write a set of questions for researchers going on a field expedition to an unidentified landform. The questions should serve well as guidance to determine whether or not the landform could be positively identified as an impact crater.

5-8 Activity #2

What Color Do You See?

Teacher Sheet(s)

Objective:	To understand why sensors of different wavelengths can only see and produce certain colors.
Level:	5-8
Subjects(s):	Physics
Prep Time:	Less than 10 minutes
Duration:	One to two class periods
Materials Category:	Special Requirements

Materials:

- Red, blue, and green pipe cleaners (two per color for each student)
- 10-15 sheets of green, blue, and red acetate or colored cellophane paper
- One set of glasses per student (see pattern at end of Teacher Sheets)
- Construction paper
- Scissors
- Tape

Related Links:

Remote Sensing Images

Supporting Article(s):

High-Tech Fire Firefighting

Pre-Lesson Instructions:

- Divide the class into three equal groups—one group for the red, one for the blue, and one for the green glasses.
- Prior to the start of this activity spread out the pipe cleaners on a grassy area outside. They should **not** be hidden.

Background Information:

None

Guidelines:

1. Read orally with the class the 5-8 article, "High-Tech Fire Fighting."
2. Hand out the Student Sheets, and read orally with the class the Background Information. Show examples of different types of remotely sensed images. You can download images from web sites in the Related links section.
3. Draw a long wavelength (radio wave) and a short wavelength (x-ray) on the chalkboard. Ask students to describe the difference. Encourage students until they generate the concept of wavelength. The distance between the crests of the radio wave is greater than for x-rays. A radio wave has a wavelength of a kilometer. An x-ray has a wavelength of 0.000000001 centimeter. The longer the wavelength, or speed of vibration (frequency), the less energy it has. The shorter the wavelength (frequency), the more energy it has.
4. Show students how to pick out the different wavelengths on the diagram in the Background Information on the Student Sheets.
5. Explain that the energy is transferred from one point to another without matter carrying it. The transfer of energy by electromagnetic waves is called radiation. Light is a form of energy called electromagnetic radiation, made up of electrically charged particles.
6. Explain to the class that the group activity they are going to do will be dealing with the visible portion of the spectrum. It is a very small group of wavelengths that make up the visible light.
7. Hand out a different color of the acetate or cellophane paper to each group of students.
8. After groups have made their remote-sensing glasses and you have gone over all the Procedures on the Student Sheets, take the class outside to the grassy area where the pipe cleaners have been distributed. Be sure to have the students place the glasses on before you reach the area where the pipe cleaners are located.

Discussion/Wrap-up:

- After the students have collected the pipe cleaners discuss why they were only able to see certain colors through their glasses. *Explanation: Each color has a different wavelength. The lenses in the glasses act like filters. The filters are transparent for one or more colors of light. The colors pass through the filters, but the other colors are absorbed. The color of the filter is the color of light that passes through it. Your glasses absorb certain colors of light and allow other colors to pass through. Everything you observe through your glasses is seen in the colors of the light that passes through them.*
- If time allows, have the groups exchange glasses with each other, and repeat the activity.
- Once students are back in the classroom, ask them to explain remote sensing and how it is connected to the electromagnetic spectrum.
- Explain that the activity they participated in should have helped them understand why sensors of different wavelengths can only see certain colors and that they can only produce certain colors on pictures.

- Ask the class why we use remote sensing for obtaining information about areas or objects.

- Write the following electromagnetic waves on the board and have the students arrange them in order of their wavelength (frequency) from the lowest to the highest using the electromagnetic spectrum diagram from the Background Information on their Student Sheets.

X-rays **Radio Waves** **Ultraviolet Waves**

Infrared Radiation Microwaves

Extension:

- Have students keep a record of the different kinds of electromagnetic energy they use in 1 day.

Background Information

Remote sensing is receiving information about an object without coming into direct physical contact with it.

The Earth's surfaces reflect incoming energy from the Sun. When you see a blanket of snow or the surface of a lake on a sunny day, they are so bright that it almost hurts your eyes to look at them. These objects are clearly reflecting the Sun's energy. On the other hand, the surface of a road that's been tarred or the black top of a roof is not too bright. They absorb more of the Sun's energy than they reflect.

Most of the remote-sensing satellites carry scanners that record the amount of reflected light energy from the Earth's surfaces. Specifically, these scanners record this reflected energy within specific parts of the electromagnetic spectrum (EMS). They record energy from any surface: natural objects like water, or man-made things like buildings.

The human eye is an excellent reference point for understanding remote sensing. Humans detect only three bands of radiation from the electromagnetic spectrum. It is the part that makes up the visible portion of the EMS. These three bands represent the primary colors: red, green, and blue. The full palette of colors we see is created when the three bands are mixed together in different combinations.

In contrast, remote-sensing instruments can be designed to detect and measure any number of bands from the light and energy spectrum. We see different things (and see things differently) in the various bands depending on the amount and type of the reflected energy from the object. Remote-sensing satellites will record the amount of energy reflected from an object through multiple bands of the EMS.

The Earth looks different through each of the bands of the EMS, and we can use different bands to see specific things on the ground. Looking at them through different bands brings out features that we are often unable to see with the naked eye. For example, pine tree species may appear to be very similar in color when we look at them. However, when we use an infrared band from a remote satellite or aircraft sensor, we can pick out the different pine species much easier.

Procedure

Infrared radiation, radio waves, ultraviolet light, x-rays, and gamma rays are all different forms of electromagnetic radiation. All are waves, but the length of the waves changes depending on the kind of radiation it is. Human eyes can see visible wavelengths. Human skin can feel infrared radiation. Skin (especially fair skin) is also, unfortunately, an ultraviolet "radiation detector" and turns red after exposure. The diagram above shows the wavelengths of the different forms of electromagnetic radiation.

Materials

- Red, blue, and green pipe cleaners (two per color for each student)
- 10-15 sheets of green, blue, and red acetate or colored cellophane paper
- Construction paper
- Scissors
- Tape

1. Follow the directions below to make your remote-sensing glasses.
    - Trace the eyeglass pattern on construction paper, and cut it out.
    - Cut the colored acetate or cellophane paper just large enough to cover the lens area, and tape it on to the glasses.
    - Measure and cut the sides of the glasses to fit your head, and then tape them to the front of the glass frames.
2. You are going to pretend to be part of a remote-sensing scanner.
3. You will be searching for things you can see through your colored glasses.
4. You must only look through your colored glasses to find things.
5. When you see a pipe cleaner, you may pick it up.
6. There will be a time limit.
7. Listen for the teacher to say, "Sensors on."
8. You must stop as soon as you hear, "Sensors off."
9. Take off your glasses and see what everyone picked up. Compare your group's materials with the others.
10. Your teacher will hold a brief discussion. If there is time, exchange glasses with another group, and repeat the activity.

5-8 Activity #3

Materials

- Computer with Internet access

Procedure

1. Inform the class that they are going to look at some of these pictures and learn just how valuable a geography tool they can be. Divide the class into five small groups to perform in teams.

2. The interpretive skills we would like your students to explore are Color, Shapes, and Patterns. What are the observable characteristics that will help your students recognize certain natural and man-made objects and then allows them to interpret the conditions observed in these Images from Space?

   Color – Vegetation, Ocean, River, Lakes, Man-Made Objects (cities, roads, bridges)
   Shapes – Coastlines, Rivers, Lakes, Mountain Ranges, City (homes vs. work buildings)
   Patterns – Man-Made vs. Natural structures and objects.

3. This activity from EarthKAM enables the students to choose different geographical features and become familiar with what they look like in the pictures from space. http://www.earthkam.ucsd.edu/public/students/activities/landformations/

   The students can click through on their own or you can direct them and discuss each picture. During the event with the DLN, similar pictures will be shown and the students will be asked to identify the geographic feature.

4. Other images we would like for your students to work on before the videoconferencing event. The page will have a small thumbnail picture with a description of the picture. Click on the JPEG link to bring up a larger picture for your students to see on the computer monitor or print a hardcopy. The background information is for the teachers to see first and then you can determine how much of this information to give to your students.

   a. Earth's City Lights
      http://visibleearth.nasa.gov/view_rec.php?id=1438

   b. City Lights of Europe
      http://visibleearth.nasa.gov/view_rec.php?id=1513

   c. Chicago, IL

http://visibleearth.nasa.gov/view_rec.php?id=11090

d. Washington D.C. Infrared
http://visibleearth.nasa.gov/view_rec.php?id=1366

5. Once the students have had the opportunity to look at the pictures and analyze them, query the students about what they observed in the photos. Ask questions such as:
    a. What do you think this is a picture of?
    b. Do you recognize any of the features?
    c. What questions come to mind as you look at the picture?
    d. Is there something in the picture that you want to know more about?
    e. After studying the picture, what can you tell me about it?
    f. What do you think a geographer or an early scientist looks for in a picture like this?
    g. Would this be a good place for a city? Why?
    h. Are there problems with the environment in this area?
    i. What types of geographic features are located here?