CSTA Conference 2004 Special: SAMPLE SATELLITES & EDUCATION LESSON – Grades 5-8

Interpreting Landsat Images

For GRADES 5-8. The following teacher resource ideas and lesson are from NASA's Goddard Space Flight Center. These are free and available to educators from Goddard or through the web at http://imagers.gsfc.nasa.gov.

Content Standard: As a result of this lesson, students will understand how satellite images are created, interpreting numbers into pictures.

Product Standards: Upon completion of this activity, students will be able to: 1) create a numerical code to represent colors of light; 2) identify a color by a numerical value, and 3) describe how satellites use numbers to create satellite images.

Materials needed: Small flashlights (3 per group); red, blue, and green theatrical gels or color disks (available at teacher resource stores) or cellophane; tape; white paper; or access to the www at http://imagers.gsfc.nasa.gov/color/

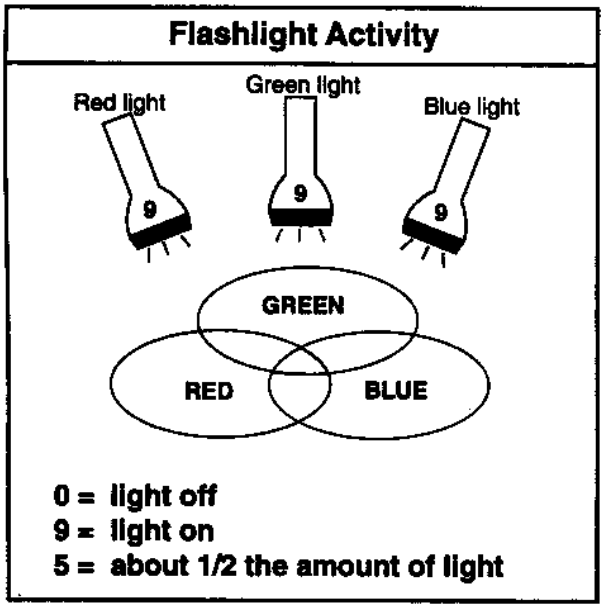
Also needed: copies of the Color mixing & Digital Picture worksheets and colored pencils.

How do we get pictures of Earth from satellites in space? When astronauts travel on the shuttle, they take pictures out the window – just like you and I taking pictures out the window of a tour bus. They have to wait until they get home to get the pictures developed. What about satellites that orbit Earth day after day, year after year without any astronauts there to take the pictures and bring them home? Yet, we get images from satellites every day. You see them on the evening news showing us that there will be thunderstorms during Saturday's game. How did they get those images?

Background. A satellite in orbit around Earth has a sensor which scans Earth's surface measuring the amount of light reflected. One part of the sensor records only the amount of blue visible light reflected. Another part of the sensor records the amount of green visible light reflected. A third part of the sensor records the amount of red visible light reflected. (Landsat 7 also has bands which record the near infra-red and mid-infra-red bands of light, not discussed in this activity). These data are recorded as a series of numbers. The data collected about Earth's surface are sent to a receiving antenna at a ground station. Computers process the data amounts of blue, green, and red light reflected off Earth's surface creating a satellite image. This process is called "remote sensing" and scientists use these satellite images to study Earth.

Color Mixing Activity:

1. Divide students into groups of four.
2. Provide each group with three flashlights – a red, green, and blue color theatrical gel or color disks – and tape. Have students tape the gels around the face of the flashlight so that no white light leaks out.
3. One student acts as the recorder and the other three operate the flashlights.
4. Have students shine their flashlights onto the white paper so that the colors overlap.
5. As the students discover colors of light, the recorder describes the color in the Color Mixing Table.
6. Students create the code by recording a number "9" in the column of the color used and a "0" value in the column of the color not used.
7. Challenge the students to investigate how many colors they can create. ASK: *What happens if you pull one colored flashlight further away from the paper than the other flashlights?*



Explanation:
After students complete the table, as a class discussion, ask them to describe the colors they created. Make a list on the board. Review the following combinations and give students the "proper names" for them. Refer to Color Mixing Table for color names and answers.

Yellow = Red + Green
Magenta (pinkish purple) = Red + Blue
Cyan (turquoise) = Blue + Green
Brown = Red at half strength + Green at quarter strength (and no Blue at all)
White = Red + Blue + Green
Black = the absence of light

Color Mixing Table

Color Created	Red	Green	Blue
Yellow	9	9	0
Magenta	9	0	9
Cyan	0	9	9
White	9	9	9
Black	0	0	0

Ask students why red, green, and blue are so unique. Explain that red, green, and blue mix to make all colors. When we watch TV, use a computer or even play a video game, we are looking at colors that were created by only three colored light sources. With different amounts of these three colors of light (red, green and blue), millions of colors can be created. Lead them to understand that these three colors are the primary colors of light.

Internet Alternative Activity – Color mixing web site.
If the materials required for the flashlight activity are not available, students can use the internet to access the color mixing page at
http://imagers.gsfc.nasa.gov/color/

Do the same sequence of steps to create a "Color Mixing Table".

Digital Picture Activity
If we lived on a space station orbiting Earth and wanted to know about how Earth looked on the surface, we might send down a sensor to collect information. This sensor could transmit numbers back to us on the space station. Color in the "Digital Picture" to see what the sensor is looking at one planet Earth.

1. Use the recorded codes to label the colors on top of the "Digital Picture" worksheet.
2. Color the squares on the digital picture according to the corresponding color code.

Assessment Rubrics:
For an acceptable level of demonstration of competency, the student will list the 3 primary colors of light, state the numerical value of the primary colors of light and give a basic description of the use of numerical codes to create an image.

For an above acceptable level of demonstration of competency, the student will list the 3 primary colors of light as well as 3 secondary colors, state the numerical values of the primary and secondary colors of light, give a basic description of the use of numerical codes to create an image and tell what the "Digital Picture" completed worksheet shows.

For an outstanding level of demonstration of competency, the student will list the 3 primary colors of light as well as *more* than 3 secondary colors, state the numerical values of the primary and secondary colors of light, give a detailed description of the use of numerical codes to create an image, tell what the "Digital Picture" completed worksheet shows and how that information could benefit a farmer, and evaluate a way that the farmer could save money if a satellite image could show the location of sick and healthy plants.