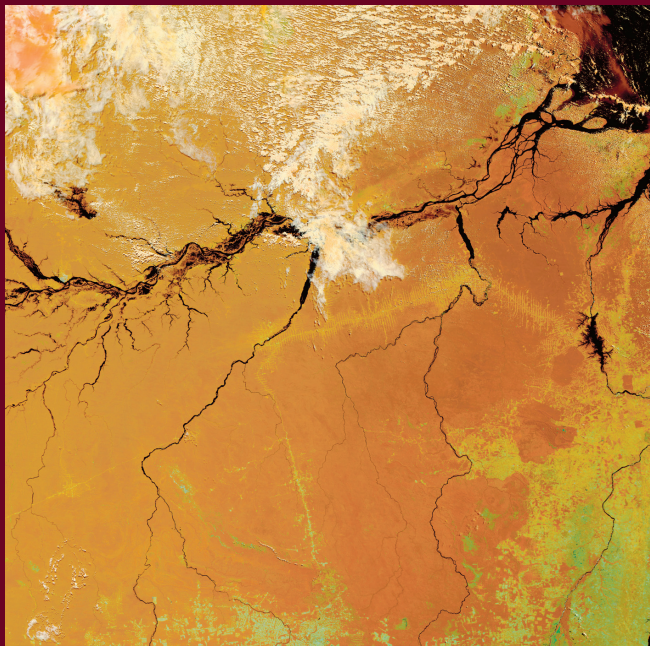


Earth View

NASA VISIBLE EARTH



ORIGINAL ARTWORK BY
LYDIA DAMBEKALNS

Art View

Lydia Dambekalns

The study of satellite Earth images provides an interdisciplinary science/art platform

Educational practice today encourages interdisciplinary teaching as teachers address important basic themes from a variety of angles. One of my successful projects focuses on “sense of place” as one such theme, with the more specific charge of viewing Earth from both scientific and artistic perspectives. The project combines satellite imagery and the technique of silk painting in batik, which allows students to record their geospatial understanding in a visual way (Figure 1, p. 44).

Students of all ages and abilities have the potential to succeed with this medium and these concepts. High school students do particularly well with this project because they have usually had at least minor exposure to art classes and have attained a level of scientific understanding that allows them to explore sophisticated visual solutions. As a teacher of all levels of students, I constantly try to pilot new instructional strategies that allow students to better grasp content, in this case remotely-sensed images of Earth. Lee Shulman writes that “. . . the key to distinguishing the knowledge base of teaching lies at the intersection of content and pedagogy, in the capacity of a teacher to transform the content knowledge he or she possesses into forms that are pedagogically powerful and yet adaptive to the variations in ability and background presented by the students” (Shulman 2003, p. 119). What follows is an explanation of how geospatial technology can help students visually investigate Earth’s surface and how art can become a vital aid in that understanding.

Content understanding as a foundation

The idea of “sense of place” is one example of a potentially rich interdisciplinary theme through which in-

structors can emphasize a number of related issues. These include the understanding of Earth processes and geological features, map interpretation, and artistic elements and principles of design in looking at a two-dimensional representation of Earth’s surface.

Embedded in this theme is the science and art of geospatial technologies. Perhaps the most familiar to readers is Global Positioning System (GPS), the gadget that allows hikers to mark trails, wildlife biologists to define boundaries, and so on. The second form of geospatial technology, Geographic Information Systems (GIS), consists of software analysis tools that allow users to ask geographical questions and compare data in multiple layers. Scientists use GIS for tracking major fire outbreaks, planning migratory corridors for wildlife, and locating oil drilling patterns in the desert. For a good example of high school students using both GIS and GPS, see “The GIST of GPS” by Kelly Lane in the May 2004 issue of *The Science Teacher* (www.nsta.org/highschool#journal). The third type of geospatial technology is remote sensing, which consists of various types of satellite imagery of the Earth’s surface. NASA is one of the leaders in remote sensing technology with its Landsat series of satellites. Environmental scientists and mapmakers are ulti-

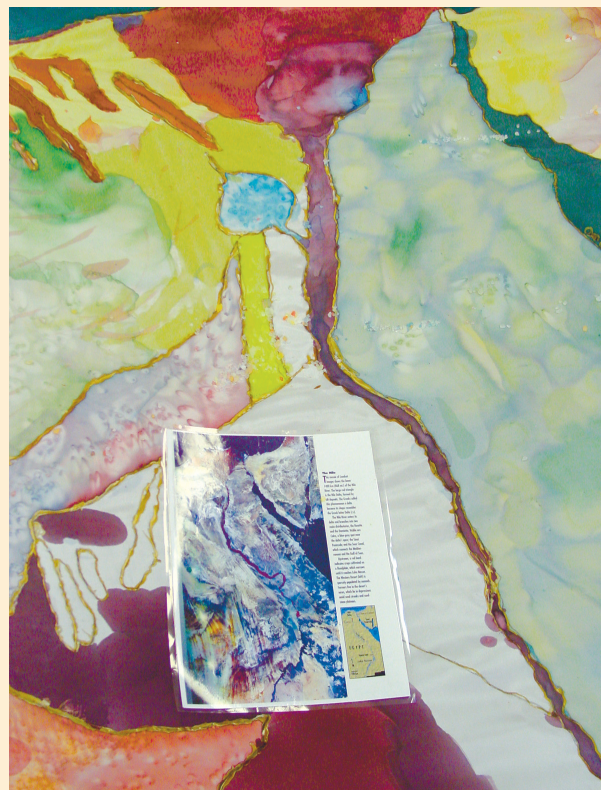
FIGURE 1

Silk batik painting of the Amazon Basin.



FIGURE 2

Student interpretation of the Nile Delta.



mately the people who help the general public understand these images as they interpret them through assigned color and enhanced feature presentation. The United States Geological Survey (USGS) makes many of these images available to the public, a number of which are free (see www.usgs.gov/pubprod/aerial_satellite.html).

While all three of these technologies have interesting applications for use in art as well as science, the Landsat images hold the most potential visual impact for art projects. Many students become fascinated at the discoveries that can be made of subtleties in the Earth's surface using this technology. For instance, by studying the properties of reflected infrared waves, students can detect patterns of healthy versus stressed vegetation because vegetation tends to appear red where healthy chlorophyll production is taking place. The Nile River delta shows this dramatic contrast between plant life and nearby desert (Figure 2, p. 44). Thus, such images taken from space portray a fresh relationship among features on Earth. The satellite or aerial photographic imagery provides data that in turn inspire both scientists and artists to ask questions and seek to portray interpretations from this data. For an example of how high school students at the Pennsylvania Governor's School for Agricultural Sciences used these images in their mapping batiks, see Dambekalns (1997).

Technique to aid interpretation

Once students have been introduced to Landsat imagery, it is time for them to focus on a particular area of interest for their project. A sample goal might be better comprehension of surface structures. For example, watershed patterns are particularly striking from space, showing up as snakelike features that follow topography in interesting ways. The waterways may exhibit a progression in size and complexity as they progress from point source toward larger bodies. What a beautiful project for artwork analysis. As students create their batiks of the remote-sensed imagery, they employ the techniques of scale, abstraction, emphasis, and use of color.

Batik is a method with roots in Indonesian fabric decoration and design. In its traditional form, hot wax is applied to cloth before colored dye is applied. Wherever there is a wax line, it resists the color. When the color has been set and washed out, the fabric eventually has layers of color and lines from repeated applications of wax and dye.

Fortunately for classroom use, there is a much easier method. Gutta (a thick substance made from latex that is found in art stores) can be used as a substitute for wax because it penetrates the cloth, hardens, and does not allow the color to adhere (Figure 3).

If applied to white cloth (typical in our work) the resist lines at the end of the project will all turn out to be white. As for dyes, instead of the natural products used by traditional Indonesians, a wide variety of well-made, reasonably priced synthetic fabric dyes and paints are available. I recommend "flowable" paints not dyes, because they are easier to heat set. The pigment suspension is so light in flowable paints that they flow as freely as a thin, watery dye would.

Most dyes require steaming, which is impractical in a classroom. Flowable paints can be set with just a hot iron. Silk is the cloth of choice because its fine weave allows easy penetration of gutta and color, it is strong, and it gives off a magnificent sheen that enhances the final work. Surprisingly, when purchased from a fabric art supplier by mail, silk is quite reasonable in price. However, if a budget is extremely tight, thin, used bedsheets with 50–100% cotton also work well.

Making the batik

Students first choose an image and crop it to focus on the most interesting geological features. Next they enlarge the image and draw it on practice paper

FIGURE 3

Gutta resist lines and flowable paint application.



FIGURE 4

Students create a sampler. Note the stretched silk.



(newsprint works well) with a dark marker. This creates a pattern for them to follow for the final piece. Students then attach the silk to the frame with safety pins, rubber bands, or bands cut from pantyhose. (Note: Any sort of rough lumber pieces can be used to construct a frame. Formal silk painting frames can be purchased, but those tend to be expensive. Turning tables or chairs upside down and stretching the silk between the legs is another alternative.) This is very important for both the resisting and painting stages. If the material touches anything else, the resist smears and the colors run together. The practice paper image is put underneath the suspended silk, and students trace the image onto the silk using vine (soft) charcoal. The charcoal lines will wash

out in the end. Next, students gently squeeze gutta along the lines from a small squeeze bottle with a pinprick opening and allow the lines to dry which can take (between 10–30 minutes).

Painting begins as soon as the gutta is dry (Figure 4). A soft watercolor brush works best. A container of clean water is necessary for washing the brush between colors. Ice cube trays make excellent cheap palettes and allow students to mix a variety of shades. When the whole design is finished and dried (on silk this usually takes less than 30 minutes to dry), the fabric is removed and ironed with a hot iron *before* washing. The key to setting the color is that the heat from the iron must penetrate the fabric and color before the piece is washed in room temperature water. Teachers must make sure that students know how to use the hot iron properly, and provide a light-weight presscloth (such as a thin teatowel or old thin bedsheet) on top of the silk piece. The iron's cord must also be in a safe location to prevent accidental tripping. Students hang the silk to dry and lightly press it with a cool iron to remove small wrinkles. Student work space may be small or large depending on how much silk is available. This project also lends itself particularly well to a group effort in making banners with a dowel sewn to the top for easy display in a school hallway.



Assessment of learning

A key to the success of this project is to take time to process the results with students. I organize a gallery

FIGURE 5

Final group critique assesses learning.



at the end where all students hang their projects, and we talk about what they have created and what they have learned (Figure 5). Again, Shulman (2003) reinforces the idea of interdisciplinary teaching: “Multiple forms of representation are desirable. . . . Instructional selections occur when the teacher must move from the reformulation of content through representations to the embodiment of representations in instructional forms or methods” (p. 121).

Teachers can discuss both the content of what students portrayed in terms of scientific inquiry, observation, accuracy, and interpretation and the artistic style they employed in terms of painting technique, observation, and use of elements and principles of design. The science and art aspects feed off and enhance each other. Students achieve greater understanding of geologic features by spending time looking at the images carefully and trying to represent the features graphically. They also come to understand that assigned colors from satellite imagery provide keys to interpreting vegetative patterns. As a technology, these images rely on familiarity with the properties of light waves, additive color mixing principles, and subtractive color understanding of the spectrum.

Standards in both subject areas are covered as well. For example, the National Science Education Standards emphasize science as inquiry, including an understanding of how “new techniques and tools provide new evidence to guide inquiry” (NRC 1996, p. 176). Also, students in this project use a model (the painted batik) to help evidence their investigation of the Earth’s surface and report their findings (NRC 1996, p. 175). The National Geography Standards emphasize the importance of learning “to use maps and other geographic representations, tools, and technologies to acquire, process, and report information from a spatial perspective” (AGS 1994, p. 184). With respect to the National Art Standards, beyond learning the technique of batik painting, students “conceive and create works of visual art that demonstrate an understanding of how the communication of their ideas relates to the media, techniques, and processes they use” (NAEA 1994, p. 22). In addition, this project also clearly meets the sixth National Art Standard, which calls for “making connections between visual arts and other disciplines [by comparing] the materials, technologies, media, and processes of the visual arts with those of other arts disciplines as they are used in creation and types of analysis” (NAEA 1994, p. 24). In sum, this is a true interdisciplinary look at the theme of “sense of place” or “Earth view” where several subject areas can enhance each other.

Possible extensions

The focus of this article has been on satellite views of Earth, silk batik to record observations, and analysis

of those satellite images. However, the medium of batik lends itself to all sorts of extensions and use in other science-related areas. In June 2004 I presented these techniques at the Wright Center for Science Education at Tufts University for two workshops. These workshops drew a select group of teachers from across the nation for an intensive week of study and application. Teachers in the workshops used batik techniques to create interesting artwork related to the themes of science fiction or astronomical features such as galaxies and nebulae. The teachers varied greatly in their artistic backgrounds and confidence levels. Many struggled to find ways of visually representing their scientific understanding in the batiks.

As curriculum theorists Theodore and Nancy Sizer (2003) posit, when teachers allow students to “grapple” with complex inputs that do not offer patent answers, some of the most meaningful education takes place. And while science might be conceived of as an objective search for universal laws and art as a subjective exploration of personal understanding of phenomena, the truth is much closer to a blending of the two disciplines. Each provides students a different way of seeing and responding to gathered data, which returns us to Shulman’s suggestion that true masterful teaching seeks adaptive pedagogy. Some students gravitate to a visual, artistic mode of thinking while others are most comfortable with scientific logic. As we teach, we must attempt to reach all students by matching content with innovative instructional practice. ■

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