ART BY SERGEY IVANOV

The Art

DURING A TEACHER WORKSHOP CONducted by our state geologic survey, I learned that geologists often use specific colors and patterns to enhance their graphical depictions of sedimentary rock sequences. For example, blue is used to represent limestone, green for shale, yellow for sandstone, orange for siltstone, and purple for the clay sometimes found under coal beds. I also learned that sections of an outcrop are often covered over by vegetation or talus slopes. In this case, geologists use white to indicate concealed, and therefore undescribed, rocks.

Several months later, the art teacher at my school and I took a class called "Energy and the Environment," sponsored by the American Electric Power Company. In the class, we studied coal as an energy source and its effect on the environment. Our final assignment was to develop a classroom activity related to the workshop. While I felt it would be relatively easy to develop an activity for my science classroom, the art teacher wondered how to develop an activity on coal for the art class. For several days we sought ways to combine art and geology until a colored sand art souvenir provided us with inspiration.

We received permission from the course instructors to conduct a cooperative project using both art and science to construct model geologic columns. The art teacher emphasized the construction of scale models and the use of color to enhance visual design and understanding. I concentrated on the accurate representation of the rock layers and the application of the model in my Earth science lesson on local mineral resources.

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COLUMN CONSTRUCTION

I have incorporated the construction of sand art geologic column models into my Earth science class. Students work in groups of three to construct sand art geologic columns, and these groupings are maintained in the art

DEBRA ROCKEY

# of Geology

Creating sand art geologic columns

class. To ensure that the scales of the columns are calculated with accuracy, each group has one student with a strong math background.

Students understand concepts best when they develop and apply them in realistic situations. To relate this activity to the work of geologists, students use real data from rock descriptions and drilling records found in geologic publications to construct their models. Because some of these records are quite old, many of the measurements are in the English units still preferred by the coal mining industry, but we convert them to metric.

A class of 21 students takes three 50-minute class periods to complete the project, but it can be modified to fit any schedule. To build the columns, we use plastic tubes cut to 37.5 centimeters in length and end caps purchased from a commercial company. We use glue to permanently seal one end of each tube. Tempera paint-dyed sand provides brilliant colors that do not fade when exposed to light. The white sand and nontoxic powdered tempera paints are premixed with water to enhance their color and eliminate the problem of dust. To color 2 kilograms of sand, we mix 50 grams of paint with 50 to 75 milliliters of water. Used sand can be placed in cheesecloth and rinsed with water to remove the coloration. After drying, this sand can be redyed for future use.

During the first class period, each group is given a plastic tube with end caps, a dowel rod, masking tape, and small paper cups for handling sand. Large containers of dyed sand are placed in a central area of the classroom, and the students obtain the sand as needed for their model. They examine the clear plastic tubes that will hold their column models, making sure that the bottom end cap is properly sealed. On a piece of masking tape attached to the outside of the tube, students note special features of each rock layer, such as the presence of fossils.

Each group is given a published diagram of a local outcrop or roadcut. Before constructing their model, students use colored pencils to shade this illustration in the specific colors used to represent the different rock types present. This work familiarizes students with rock sequences, and the shaded illustrations are guides for the construction of their dyed sand models (Figure 1).

During the second and third class periods, students complete their models. First, they determine the appropriate scale for their model by dividing the total thickness of the rock measurement taken from the diagrams of the sites by the length of the tube. These calculations are transferred to the tape strip.

Each group member has an assigned role. One gets the colored sands as needed; another steadies the tube and fills it with sand. The third student makes sure the sand is filled to the appropriate thickness for each layer. As each layer is poured, it has to be compacted

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with a dowel rod. If the layers of colored sand do not completely fill the tube, the remainder is filled with undyed sand.

Each completed tube is capped and labeled with the site location and the scale used for the model. Students then use a series of handouts and rock unit labels to identify and name three rock layers, including one coal bed, on their completed model.

Accurate replication of the paper diagram into a useful colored-sand model is emphasized. If students make an error they are allowed to acknowledge it on the tape strip and continue the model with the proper rock sequence. However, most groups prefer to start over rather than have an error.

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MODELING REALITY

As students use the models, they realize that changes in rock type are related to changes in early geographic environments. They are amazed to find that several limestones containing crinoids and brachiopods can be found throughout the northern panhandle of West Virginia, and they examine their models for evidence of sea level changes. Sedimentary rock samples from many sites are put in the classroom to help distinguish the rocks.

Students complete a written summary of their model and its rock types. The lab groups give verbal presentations on their models to share their information with the class. They relate present rock types to their ancient environment of deposition, and this emphasizes the truth in the phrase, "The present is the key to the past." Using their knowledge of modern depositional environments, such as beaches and stream channels, students list various environments in which sedimentary rocks, and specifically coal deposits, form.

After completing the analysis of their own models,

FIGURE 1.

Sample shaded illustrations.

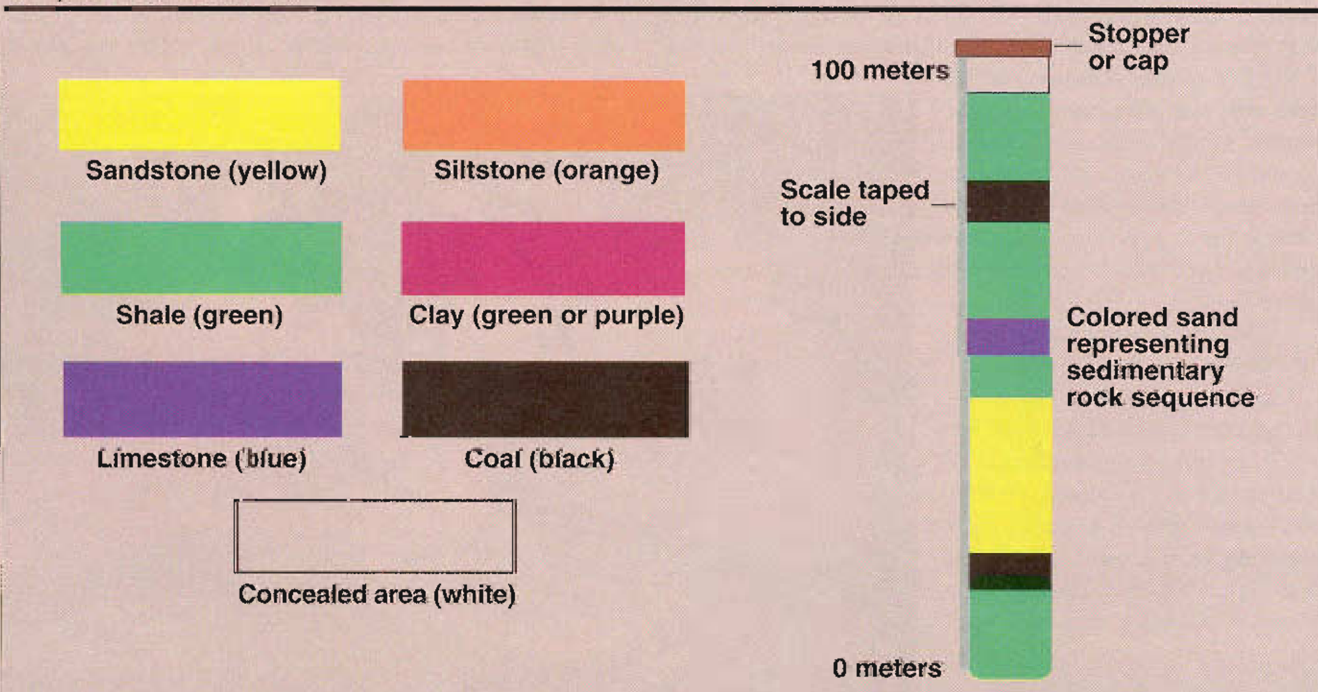

FIGURE 2.

Geologic columns rubric: This will be used to assess your group's model of a stratigraphic sequence of sedimentary rock.

Topics	Scores			
	4	3	2	1
Stratigraphic model	Model site and scale labeled properly Accuracy in measurements Rock layers are in proper sequence	Model site and scale identified properly Few errors in measurements Rock layers in proper sequence	Model site and scale identity incomplete Measurements inaccurate Error in rock sequence	Does not identify site and scale Measurements are inconsistent Inaccurate rock sequence
Cooperative effort	Student actively participates in task Assumes an active role within group	Student needs encouragement to participate Accepts role within group	Student requires prompting to work with the group Accepts role within group	Student is uninvolved in group effort Refuses to accept role within group
Collaborative effort	Stays on task	Briefly distracted from task	Reminded to remain on task	Does not remain on task
Conceptual ideas	Identifies rock strata Relates rocks to ancient environments Responses are given in clear, coherent manner	Identifies rock strata Difficulty relating rocks to ancient environments Communicates responses in an understandable manner	Difficulty identifying rock strata Unable to relate rocks to ancient environments Poor attempt to communicate discussion questions	Does not identify rock strata Does not relate rocks to ancient environments Does not respond to discussion questions

the groups exchange models and compare and contrast them by considering rock types and ages of the rocks in each. In an extension of this analysis, students use the models as a data platform to enhance classroom discussion of geologic and environmental issues relevant to our locality. This includes topics such as slope failures and acid mine drainage.

IT'S NOT ALL BLACK AND WHITE

The sedimentary rocks of our northern Ohio River Valley are mostly brown and gray. This makes distinguishing one layer from another difficult for the novice. Having students construct geologic columns using dyed sand provides them with a more visual, and therefore more useful, interpretational tool.

Formal assessment of the students' efforts is done with a rubric (Figure 2) to assess model construction in the art class and application work in the science class. The rubric provides students with known expectations for their roles within the group and for the completed models (Jensen, 1995).

The activity generates interest in geology, and students become more observant of local outcrops and roadcuts. When asking questions about these rocks, their verbal responses include descriptive terminology such as thin-bedded or massive sandstones. Students also begin to notice and refer to prominent rock units by their official geologic names: "It's not just a limestone, but the Ames marine limestone." What began as a colorful model using colored sand to replicate rocks has evolved into a learning tool that brings a new respect for the geology of our area. ✧

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REFERENCES

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