The *6-E* Learning Model

The "E-search" adds a modern component to the popular *5-E* learning model.

By Debby A. Chessin and Virginia J. Moore

Most of us are familiar with the *5-E* model of science instruction—Engage, Explore, Explain, Expand, and Evaluate (Trowbridge and Bybee 1990). It is a valuable tool that allows us to structure science experiences so students use the processes of scientific inquiry to construct and connect ideas rather than simply memorize seemingly unrelated facts. I've added a sixth "E"—"e-search"—which ties the five stages together and incorporates the use of technology into the model.

"E-search" encompasses any use of electronic media—Internet research; spreadsheets and databases; programs such as Hyperstudio; CD-ROMs; e-mail; PowerPoint presentations; as well as tools such as data loggers and digital cameras. They can occur in the learning model at different stages, depending on the nature of the activity, student interest, needs, and preference.

This article describes first-grade students' experiences as they investigate properties of rocks through a typical learning cycle but with e-search added to enhance their understanding. A first-grade teacher and I developed and tested the activities with children as part of an effort to show teachers that students can use basic science processes to develop conceptual understanding of a topic—in this case, the characteristics of rocks.

An "Enhanced" Engagement

During the "engage" stage of the instructional model, activities are designed to stimulate thinking and access prior knowledge. An e-search can easily be embedded into this stage of the model, such as having students use the Internet to research uses of rocks and minerals or view a CD-ROM that explains the difference between rocks and minerals.

In our classroom, we "engaged" students using a K-W-L chart to record our students' prior knowledge and experiences with rocks and minerals. It was exciting to listen as many students assured us that they already knew that rocks were, "very heavy," "very hard," and

"very dirty." Some said that rocks have "all kinds of shapes" and "they are cool."

Students were anxious to share their personal experiences as well: "If you put a rock in a rock polisher, you can do cool things, and they get shiny;" "I've been collecting rocks;" "I have a round rock and it has lines on it;" and one student reported, "well, my daddy found one and an Indian made it into an arrow."

From this discussion, we learned that several students had rock collections that they might like to share, and because one child's father collected arrowheads, the students e-mailed him (an e-search) to invite him to class. Without this direct connection, students could conduct an e-mail interview with a geologist as an e-search.

Exploring with Technology

In the "explore" stage of an investigation, students conduct hands-on work and think, plan, investigate, and discuss alternatives with others. The teacher acts as a facilitator and encourages students to work together without direct instruction. Questions are intended to focus students' thinking on their observations and descriptions of their explorations. In this stage of the learning cycle, specific probing questions help redirect students' investigations as needed without giving away answers.

An e-search in the "explore" phase might typically involve visiting teacher-determined Internet sites, viewing CD-ROMs to collect information to answer open-ended questions as they test and refine predictions and hypotheses. Or, if it is appropriate for the topic being studied, students may use databases and spreadsheets to collect and organize information.

In the first-grade rock study, each pair of students chose several rock specimens and received two hand lenses so that they could work individually and then talk about their observations.

As an e-search, students then photographed their favorite specimen with a digital camera, and wrote descriptive words about their rock, which they then shared with their classmates. These photos were later used in extension and evaluation projects.

In addition to the use of the digital camera, for another e-search component, pairs of students took turns using the class's computer to research the topic of rocks and minerals on the Internet (see Internet Resources).

Through their research, students learned that rocks are made of different minerals and that rocks can be classified and identified based on different tests. They were surprised to see the work they did in the classroom was similar to what geologists do in the real world!

Explanations and Reflections

In the "explanation" stage, students are involved in analysis and clarification of their exploration. Students identify patterns, relationships, comparisons, and contrasts and may refer to their graphs, drawings, databases, spreadsheets, or digital images to help them clarify their ideas. The teacher formally provides definitions and explanations, using the students' prior knowledge and experience as the basis for explanations.

In the rock study, after observing characteristics of their specimens with their senses, the students told us what they learned and quickly picked up on the correct terminology for characteristics of rocks.

Students said that they could sort their rocks based on texture (rough or smooth), density (sink or float), color (black, red, yellow, or white), and luster (shiny or not shiny).

The e-search part of the lesson included videotaping the students working, sharing, and discussing their ideas. Students took turns vid-

eotaping other groups to document the learning taking place. When we showed it to the students the next day, they were delighted to relive the excitement of learning. We used the recorded interactions to provide a means of reflection for the students.

Extensions Through E-search

In the "elaboration" or "extension" stage, students solidify their conceptual understanding and apply it to a new and relevant situation. In this stage, the teacher will expect students to use correct scientific terminology and explanations.

Our students worked in groups of four and used at least 10 specimens to play "Guess My Rule." They sorted their rocks into two groups—with and without a chosen characteristic. As other groups tried to guess the sorting characteristic, we circulated and asked students to justify their ideas: "How do you know…?" or "Explain how you decided…." This observation and classification game stretched their communication skills as they justified their choices to each other. As an e-search, students then used the computer to create a set of cards, each with an inserted digital image of the specimen and a description of its properties in correct scientific terms. The cards were laminated for preservation.

Other appropriate e-search suggestions for this learning phase are to research related websites for extension ideas or use e-mail to communicate with students from other schools or regions or with scientists in the field.

Evaluation with an E-search

The "evaluation" stage is the time for teacher, self-, and peer-assessment. The teacher should continue to ask open-ended questions, such as "What evidence do you have to support your idea," or "How would you explain…." Teachers may use traditional means, such as pencil-and paper tests or individual and group observation checklists, along with other performance evaluations.

We used a rubric that assessed both process skills and conceptual understanding. We found that our students had learned a great deal about observing and classifying their rock and mineral specimens and about using the correct terminology to describe and write about them.

Though we did not incorporate an e-search in our evaluation phase, students could create a PowerPoint presentation as a final e-search to demonstrate their new understanding and skills. Slides could include digital images and text to illustrate the items included in the rubric.

"E" is for Excellence

As the rock study showed, the technology-enhanced experiences of the *6-E* model provided another layer upon which students can build further conceptual understanding when they revisit the topic of geology in later grades. In addition, the technology experiences helped students develop their skills of observation, classification, communication, and technical abilities.

The e-searches incorporated into this unit didn't replace the hands-on, minds-on learning experiences but accentuated them—they taught students valuable skills and provided multiple opportunities to extend the learning.

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Resources

National Research Council (NRC). 1996. *National Science Education Standards*. Washington, D.C.: National Academy Press.

Trowbridge, L.W., and R.W. Bybee. 1990. *Becoming a Secondary Science Teacher*. Columbus, Ohio: Merrill.

Internet

Ask-A-Geologist
walrus.wr.usgs.gov/ask-a-geologist

Rocks and Minerals for Kids
library.thinkquest.org/3639

RocksForKids.com
www.rocksforkids.com

Smithsonian Kids Collecting
kids.si.edu/collecting

Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996):

Teaching Standards

Standard B:
Teachers of science guide and facilitate learning.

Assessment Standards

Standard C:
Assessment tasks must be authentic and students must have adequate opportunity to demonstrate their achievements.