TALKING *Science*, MODELING *Scientists*

A website allows fourth-grade students to share investigations, findings, and questions—and model the experience of scientists.

By Elizabeth Edmondson, William H. Leonard, Chris Peters, and Anna O. Baldwin

Do you want your students to share their investigation findings in a meaningful way? Or to communicate like real scientists do—beyond conducting investigations in the classroom? Of course you do!

Fourth-grade students in the Upstate of South Carolina are doing just that as they log onto the Experimental Reflection Portal, or *XRePort*, an online system that pairs students and teachers from different schools and allows them to "talk" about their common science investigations (see Internet Resources). In this way, students communicate their science knowledge *and* experience firsthand the benefits of the collaborative nature of science.

The XRePort system was developed as part of a project to engage students in meaningful writing opportunities initiated by the *Science and Math to Go!* Program (a regional science materials support program) and the Center of Excellence for Instructional Technology Training, both based at Clemson University in South Carolina.

The XRePort system was created with funds from the U.S. Department of Education as a part of a Preparing Tomorrow's Teachers to Use Technology (PT3) grant, which was designed to assist university schools of education with the development of skill and comfort in the use of instructional technology. One of the goals of the XRePort project was to provide teachers and students the opportunity to collaborate online. Teachers only need computers with internet access to take part.

We participated in the design and implementation of the system with five fourth-grade classes as they worked with the Science and Technology for Children curriculum unit *Electric Circuits* (NSRC 2002) and would like to share our experiences. While our article highlights the experiences of students using the same curriculum, the XRePort system is not limited by topic or location. Teachers and students in any location can connect with other groups studying the same topic and talk about their shared science experiences (see "Try XRePort," page 31).

Preparing for XRePort

Prior to beginning the electric circuits unit, teachers introduced their students to the XRePort system, explaining that they were going to use the online system to share the findings of their electric circuits investigations with students in other schools—just as scientists make their findings and ideas public.

The electric circuits unit contained many hands-on investigations for students to discuss, such as lighting a bulb with a battery, bulb, and wire; constructing a flashlight using a series or parallel circuit and switch; and designing and wiring a simple cardboard house.

To provide students with a focus for their writing, we developed writing prompts for each lesson. The prompts were varied so that students would have opportunities to discuss their investigation in many ways—from investigation design to writing about results, conclusions, questions, and any problems they had. Prompts were also developed to help students respond to their partners' entries. Examples of both types of prompts are presented in Figure 1, page 30.

A good writing prompt will enable students both to share their ideas and discover that in some situations others will obtain the same results, while in others the results may be very different. These discoveries will likely lead to meaningful classroom discussion of whether they should have all obtained the same results and whether scientists always obtain the same results and how different results should be handled.

One of the lessons in the electric circuits unit requires students to light a light bulb in as many ways as they can, using a battery, bulb, and wire. Students typically record their successes and failures in drawing form. With persistence, they find that either end of the battery works and that two different connections are necessary on the bulb. The students generally will draw four or five different strategies. A class discussion of the configurations that light the bulb allows the students to add additional drawings to their page.

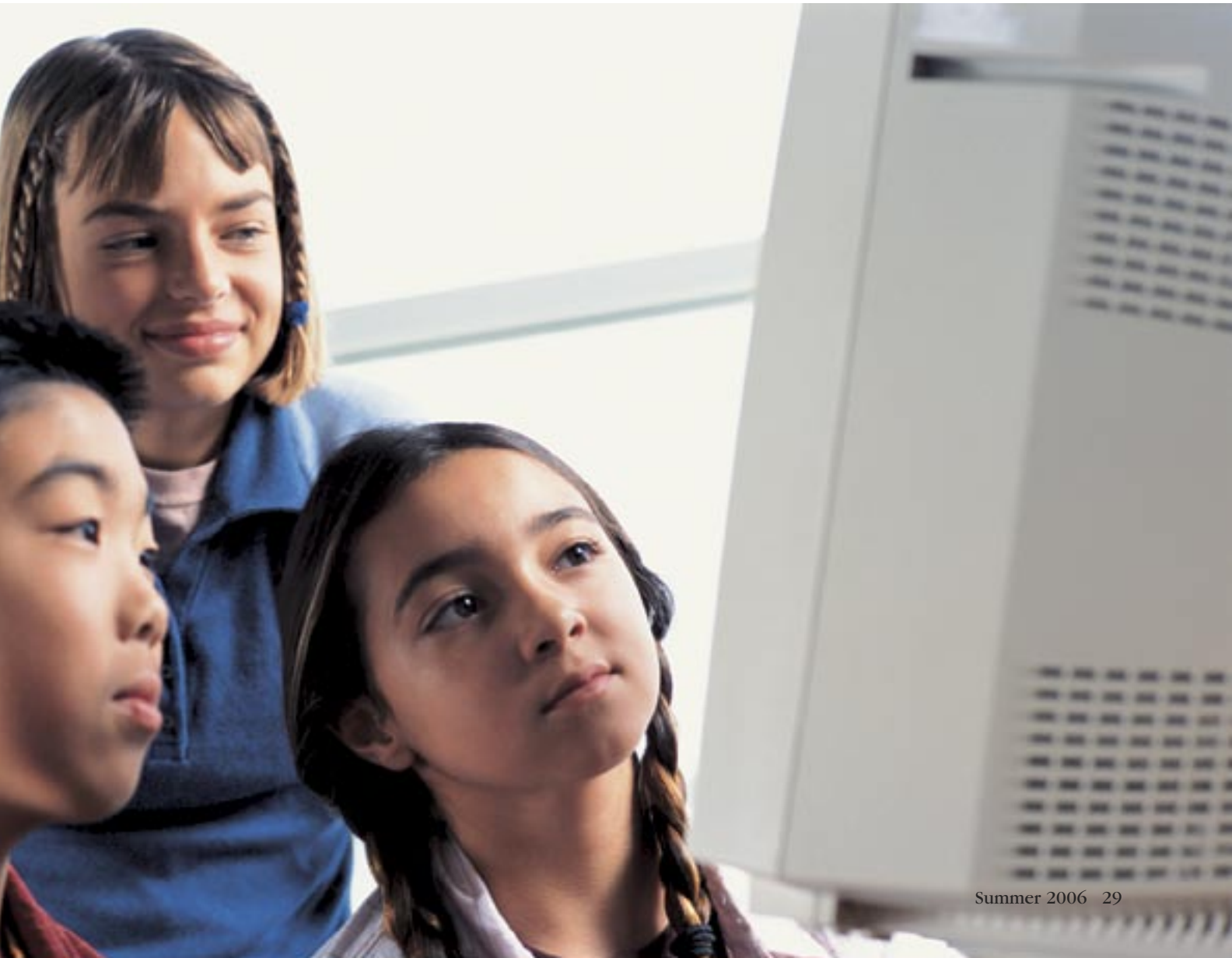


Figure 1.

XRePort writing prompts.

Student Writing Prompt	Hints for Response to Partners
Share your prediction for how many batteries you thought it would take to light the bulb. Why did you think it would take that many? Explain what actually happened.	Compare your results to those of another student. Ask them questions to understand their findings better.
Name one of the materials that you found was an insulator. Explain how you determined that it was an insulator. Describe one of the materials that you predicted would be a conductor. Were you correct? Why did you think it would be a conductor?	Compare your response to those of others. Respond and ask questions.
Describe the challenges in designing and building your flashlight.	Read another students' entry. Did they experience the same challenges that you did?

Next, students are prompted to describe in writing one of the ways they were able to light the bulb and share their explanations with an in-class partner or the entire class by reading them aloud. This allows students to begin creating explanations and sharing their ideas. The in-class partner reads the explanation to determine if it makes sense to them. If the explanation does not seem clear, the in-class partner asks questions and if time allows, tries to build the circuit based on the directions. How well the partner is able to build the circuit based on their in-class partners' explanation helps students clarify their written explanations. Because it is early in the process of learning about circuits, the teachers do not yet formally assess students' explanations; however, they do help students clarify their explanations and correct spelling and grammar.

Writing XRePort Entries

After the explanation critiques, the students were given their username and password and were led step by step through the creation of their first entry: a description of how to light a bulb. Later that day, students would look to see if their partner had created an entry for that lesson, and if so they prepared to respond to their partner's entry. In the beginning, the teacher and students discussed what the partners wrote and what types of things students might write in response.

Initially, it took 50–60 minutes for students to access XRePort, enter their response to a lesson prompt, check their prior lesson entries for responses, respond to these entries, and finally respond to their partners' lesson entries. After several lessons, this process took significantly less time.

As the classes completed subsequent lessons, the students would again access the XRePort to create an entry for this lesson and also check to see if their partner had responded to them. The dialogue on another lesson has now begun. Students would revisit previous lesson

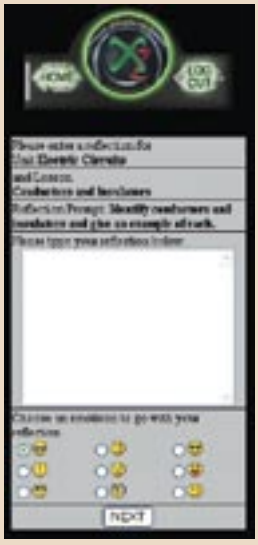
Figure 2.

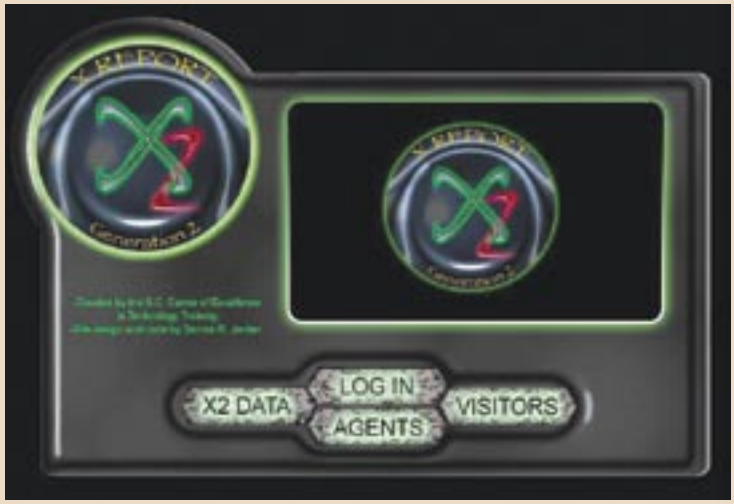
XRePort conversations.

M15 wrote	"I got one of the wire ends and put it to the + side and got the bulb and put the bottom of it on the – side and put the other end of the wire on the metal part of the bulb."	
s46 wrote	"That is exactly what I did in class."	
M15 wrote	"That is very easy to do. If someone says that is hard they're crazy."	
s46 wrote	"Good information!"	
M7 wrote	"I got the light bulb to light when I put one end of the wire to the negative side of a battery and the light bulb on the top. Then I then put the other end of the wire to the light bulb."	
s60 wrote	"Where on the light bulb?"	

Try XRePort

Teachers who are interested in participating can first go in as a guest to review the writing of participating students. Because the XRePort system was designed to protect student identity and to prevent nonclassroom participants from engaging in dialogue, guests can view students' writing and see what is happening but they are not able to comment on entries posted. If teachers are interested in participating with their class, the XRePort staff will send them a user id and password, which allows them to add their students, units of study, and lesson prompts.





The XRePort staff can also introduce them to other participating teachers so students can then be paired up with partners. The teachers involved in our test project all used the same curriculum, which ensured that the students had similar experiences to discuss. This, however, is not essential if writing prompts are developed that unify the experiences and focus the students' writing. The teachers may communicate with one another to develop and then post prompts for their students to discuss. This approach opens up student discussion to the different approaches that are possible for the same concepts, such as habitats, ecosystems, land formations, motion, and many others.

entries as time permitted. Two examples of the dialogue from this lesson are shown in Figure 2.

Soon after making the first entry, the teachers also discovered it was important for students to have multiple XRePort partners at different schools. This prevented any disappointment if a partner was not able to respond due to absence or had completed the lesson on a different day. With multiple partners, students had more opportunities to engage in dialogue and get the feedback they desired.

Aside from an interest in sharing their science experiences, teachers also noticed students were interested in knowing with whom they were corresponding. They wanted to know whether their partner was a boy or girl, what school their partners went to, whether they liked using the computer. The teachers very carefully allowed a minimum of questions to partners about these questions. The next time the teachers created an initial entry, which allowed the students to write "All About Me." This helped the students and gave them a sense of whom they were writing to and hearing from.

Assessing XRePort

During this initial implementation of XRePort, the teachers did not assess the students' online entries for content or structure. They focused on providing students with oral and written feedback as the students created lesson responses and responded to their partners.

Teachers reported significant gains in their students' ability to explain the critical connections in an electric circuit. All of the teachers also rated their students as having a greater appreciation and understanding of the role of communication in science as a result of the online collaboration. The teachers were convinced that using XRePort helped students more deeply understand the presented concepts and gain a deeper appreciation for how scientists approach their work. One teacher commented, "I think some students knew that scientists repeated things but I don't think that was something they had actually experienced. With XRePort, they now know more about that."

In addition, some teachers noted that some students took their writing more seriously because someone else was looking at their writing. One teacher commented, "When students wrote in their journal, I was the only one that would look at it. They figured that I would try to understand what they were saying. When students were writing on the computer, they knew that another student would eventually look at it. At the beginning they didn't understand that, but when other students began to reply to their writing, they understood they had to be very clear or that other student would not have an idea about what they were talking about."

For the students, the sharing of their work publicly made them more aware that others were reading and questioning their ideas. The students began to self-critique their own work and came to realize that other students were looking at their work in a critical fashion as well. In addition to understanding that scientists consider and question each other's work, the teachers believe the students learned additional science content from the exchange: "I think that sharing and asking questions of each other was a big eye opener. Many of them said they had learned something from having read other students questions and entries."

The teachers believed the asking of questions of one another's work was an important skill for the students to develop: "I never had them ask questions of another student before. Responding to each other was really important."

Improvements for the Future

Overall, students created between 10 and 13 lesson responses over a six-week period and responded two to three times a week to their partners' entries. We found this number of entries cumbersome and time-consuming for the students. The number of lesson prompts kept the students so busy that they did not always have time to respond and talk about prior lessons with their partners.

In the future, the teachers plan to use XRePort to focus on four to five key lessons or concepts, which will allow the students to discuss each of the lesson prompts in greater depth, ask questions of one another, and come to a deeper understanding of the lesson concept.

While the students demonstrated in their writing and classroom discussions that they understood that collaboration was more like what scientists do, to truly develop an understanding of the nature of science, the teacher must make explicit connections during their instruction and use of the XRePort (Abd-El-Khalick 2001; Lederman 1999). As opportunities occurred during class, the teachers would mention that they were collaborating in this way to model and experience how scientists work together. The teachers identified this as an area in which they needed support and recommended meeting with colleagues to discuss these ideas and places in their lessons where these discussions would be most effective.

In most classrooms, science inquiry is limited to what goes on in that classroom. This is not how real scientists work or engage in their profession. Through XRePort, students had the opportunity to share their thinking with students in other settings, compare ideas, rethink their understandings, and consider possibilities that do not arise within their classroom. They expanded their understanding of the concepts studied while developing an appreciation for the world at large—just as scientists do when they share their work with their peers. ■

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Resources

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Lederman, N.G. 1999. Teachers' understanding of the nature of science and classroom practice: Factors that facilitate or impede the relationship. *Journal of Research in Science Teaching* 36(8): 916–929.

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academy Press.

National Science Resources Center (NSRC). 2002. *Science and Technology for Children Electric Circuits*. Washington, DC: Smithsonian/National Academies of Science.

Internet

XRePort
http://itcenter.clemson.edu/XRePort

Connecting to the Standards

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

Content Standards

Grades K–4

Standard B: Physical Science

- Light, heat, electricity, and magnetism

Standard G: History and Nature of Science

- Science as a human endeavor

Assessment Standards

Standard C: The technical quality of the data is well matched to the decisions and actions taken on the basis of their interpretation.

Teaching Standards

Standard B: Teachers of science guide and facilitate learning.