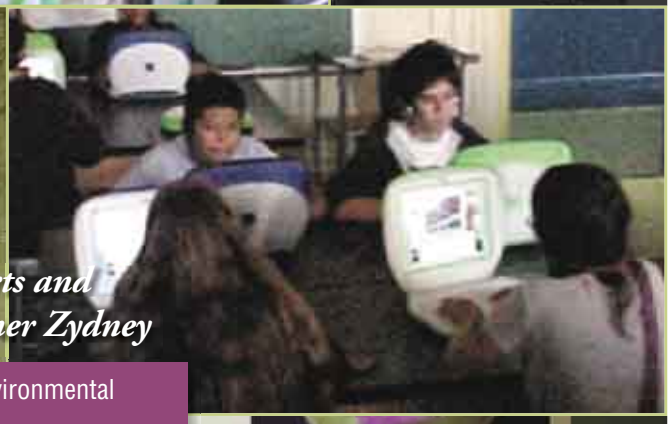
Students as Environmental Consultants

Simulating Life Science Problems



By Megan Roberts and Janet Mannheimer Zydney

Subject: Biology, environmental science

Grades: 9–12 (Ages 13–18)

Technology: Video, Web

Standards: *NETS•S* 3–5; *NETS•T* II, III (http://www.iste.org/standards/). *NSES* Content Standards Grades 5–8 C (http://books.nap.edu/html/nses/html/).

PHOTOS BY MEGAN ROBERTS

As an eighth-grade earth science teacher, I (Megan) take every opportunity to incorporate the idea that Earth is a dynamic orb, constantly undergoing irreversible change. Of the myriad subjects that encourage students to contemplate environmental change, perhaps the most consistently thought-provoking topic is pollution. My students at East Side Middle School are amazed to find out that New York City, where we live, is home to one of the world's largest landfills or that U.S. drivers produce trillion of tons of carbon dioxide by driving SUVs.

I met Janet in fall 2001, when she was a doctoral student at New York University and was developing an interactive multimedia program called Pollution Solution. Her goal was to bring a real-world problem into the classroom that would challenge and motivate students. Janet came up with the idea for the program while reading the front page of the November 4, 1999, issue of the *New York Times.* She came across the article, "7 Utilities Sued By U.S. on Charges of Polluting the Air." She thought about how relevant this issue was to the topics students were studying in earth science. This article became the basis for the software, which presents students with a sticky environmental problem and challenges them to investigate the possible causes and probable effects and, ultimately, to recommend a viable solution. This problem seemed like a perfect fit for my students. We began our planning, and in spring 2002, we introduced my students to the project.

Assigning Students to Be Environmental Consultants

East Side was fortunate enough to have received a technology grant, and as a result, each of our students

had his or her own laptop computer to use each day in class. Pollution Solution puts students to work at a fictional environmental consulting company. The consultants are given a client, a utility company, which is being sued by the U.S. Justice Department on behalf of the Environmental Protection Agency (EPA) for violating the Clean Air Act. Students are asked to research what caused this problem and how best to fix it. After several weeks, they prepared their culminating project: a recommended, viable solution for the utility company. The various aspects of this environmental problem were presented to the students from multiple perspectives, thereby encouraging them to draw their own conclusions.

Introducing the Problem

The challenge was how to bring this problem to life for students. Janet cleverly decided to videotape her husband, who acted in the role of vice president of the utility company that was being sued. He addressed students directly, explaining the problem as if they were actually in his office.

> In the middle of a phone conversation, the vice president of the company looks up from his desk and waves you and the other consultants into his office. As you take your seat, he abruptly ends his phone call, slamming down the receiver. He immediately launches into his explanation of the problem his company is facing. "I assume you've been reading the papers lately," he says. "My company is being sued by the Justice Department on behalf of the EPA for violating the Clean Air Act." He gives the details of the lawsuit and his reasons for needing consultants to advise him on what to do. He then asks you to recommend a plan of action: Should the company fight the lawsuit and risk paying possible fines? Or should it make a settlement with the EPA and agree to find alternative solutions to reduce emissions?

Janet and I were excited by the students' enthusiasm for the project. The video clip of the vice president of the company is a powerful hook. To see if they understood their role and the nature of the problem, I asked students to tell us whom they would need to speak to first in order to give their client the best advice on how to fix its pollution problem. One student said she would like to visit a similar factory to see if it operates differently. Another added, "I want to speak to a scientist to find out how to prevent acid rain." Some students said they would need to speak with the EPA to hear its side of the case. Others felt that talking with engineers would help them to learn how the utility plant operates. Clearly, the class was beginning to get a sense of the complexity of the problem.

Developing a Research Plan

Over the next several classes, students researched the problem using the computer program and the Internet. Their virtual office included a filing cabinet with important documents about the company and reference manuals full of valuable information regarding environmental science issues, such as relevant technologies, environmental laws and policies, and basic economics. The information students needed was either embedded in the program or made available through links to the Web sites of various organizations, including the EPA, Department of Energy, National Park Service, and the Center for Renewable Energy and Sustainable Technology. To introduce students to these resources, I demonstrated a few of the sites. Using the LCD projector, I displayed a map of the United States from the U.S. Geological Survey that depicted the acid rain levels of various cities across the country. (***Editor's note:*** Find this and other URLs under Resources on p. 25.) As a class, we hypothesized why the acid rain levels differed. One girl in the back of the class noted that the Northeast had higher levels of acid rain. The girl next to her noted that the wind might carry pollution from one part of the country to the other. To demonstrate this point, I showed an animation of the jet stream from the *Baltimore Sun's* Web site. This animation clearly shows how the pollution can travel across the country.

While students worked on their computers, Janet and I maneuvered our way through the consultant teams to address questions, offer ideas, or provide technical assistance. At one point during the first week of our project, Janet asked me to check out the problem statement that a student had typed. It said, in part: "The activists have protested that the company is burning massive amounts of fossil fuels and therefore creating more sulfur dioxide. Then, when the sulfur dioxide reacts with water, it forms sulfuric acid mist. Eventually this acid is rained out of the atmosphere and falls to the ground. This sulfuric acid destroys our environment by destroying trees and killing fish." Impressed, Janet whispered with a smile, "I couldn't have said that better myself."

Playing Roles

In the second phase of this work, students were challenged to become experts on one of four perspectives related to this problem: an environmen-

PROJECT TIME LINE

Week 1	*The Problem* An electrical utility plant is out of compliance with the Clean Air Act and is being sued on behalf of the EPA because the plant is releasing dangerous amounts of emissions. The company needs to make decisions about how to handle this problem. Should it fight the lawsuit or settle? In the long run, would it be better for the company to convert to a different type of energy source? And if so, how do the company's executives decide what type of energy will be best for both the environment and their ability to make money? The company has hired you, an environmental consultant, to find a viable solution to the problem. Students discussed and researched the causes and effects of acid rain, the details of the Clean Air Act, the government's economic policies, and similar legal cases.
Week 2	*Developing a Research Plan* Using the Pollution Solution program and the Internet, students worked individually to develop their own problem statement, hypothesis, plan of research, and list of resources they planned to use in order to research their problem.
Week 3	*Comparative Analysis* Each group of four students was assigned a type of alternative energy source to research from various perspectives. Each student in the group chose to become an expert in one of the four categories: an environmental scientist, a lawyer, an economist, or an engineer. Each student was challenged to research all the pros and cons of that energy source from his or her perspective. The groups presented their analyses of their energy solutions to the class.
Week 4	*Final Report* Based on their presented analyses, the students discussed which solution would be the most viable for the company. The students wrote up their final recommendations for the company.

tal scientist, an economist, a lawyer, or an engineer. Each consultant team (made up of each of the four experts) was assigned an alternative energy source to research and then present to the class their analysis of that alternative from the four different perspectives. To do this, the team members needed to understand the economic, technical, legal, and environmental effects of one possible energy solution, so they could scientifically argue the pros and cons of it.

Each consultant team discussed the problem quietly. In one team, a girl leaned over, pulling her computer earphones away from her ear and asked the girl sitting across from her, "How much money can the company afford to pay?" Her partner, who had slid her earphone back, answered, "It says here that the company makes a profit of $6 million per year." Another student who was listening in pointed out, "But they spent $10 million last year to repair their plant." The first girl responded, "Well, if they spent $10 million to fix their plant, why couldn't they have installed something to reduce their emissions in the first place?" Students were clearly coming to their own conclusions

about how this problem began and, as budding scientists, were eagerly seeking solutions.

Reporting Their Findings

As their final project, the expert groups wrote up recommendations for the utility company based on their research. Afterwards, the class discussed which energy source was the most viable solution for the company to choose. As we watched them discuss and share their opinions, it was clear to Janet and me that students were not only becoming interested in the effects humans are having on the environment but also becoming vested in making a difference.

Looking at the Benefits of Problem-Based Learning

This type of learning atmosphere is student centered and allows each child to navigate through the Internet as he or she seeks to learn about a specific environmental problem. With regular benchmarks of student performance and individual and group assignments made clear at the beginning of the project, students were able to move at their own pace. Although all had the same end goal of finding an energy solution, each student was encouraged to be driven by his or her curiosity and self-interest as he or she sought to learn about how pollution affects the environment. In the end, we found that students learned a great deal about the scientific concepts, such as the cause and effects of acid rain, the cause and effects of the carbon and water cycle, and the effects different types of energy have on the environment. But possibly of the greatest importance, they also became more aware of how the way we live affects the natural world.

In talking with teachers of other disciplines, we realized that this type of project could be created for a variety of curricula. With relatively simple technologies such as video and the Internet, problems that we see in the newspaper can be brought to life in the classroom. Teachers could videotape their relatives or willing friends to introduce the problem or perhaps have their class create a newscast about the problem. This can provide a wonderful hook to motivate students and really bring the problem to life in the classroom. Teachers can also adapt the project that we did by using the Pollution Solution Web site, which provides information about the case as well as the necessary resources to research the problem. When given the opportunity to solve real issues, students rise to the challenge and clearly benefit from becoming personally involved with these issues and seeing the effects humans are having on the environment.

Resources

"7 Utilities Sued by U.S. on Charges of Polluting Air" By David Stout (Abstract): http://query.nytimes.com/gst/abstract.html?res=F10D11F73A5F0C778CDDA80994D1494D81

Baltimore Sun Weather Maps: http://weather.sunspot.net/maps.asp

East Side Middle School: http://www.eastsidemiddleschool.com

Pollution Solution: http://mypollutionsolution.com/

U.S Geological Survey: http://www.usgs.gov

Megan Roberts taught earth science at East Side Middle School in New York City, where she is now the regional instructional supervisor for science. She was a research fellow at both The Woodrow Wilson Foundation and the Fulbright Memorial Foundation. Currently, she is a doctoral candidate at Teacher's College, Columbia University.

Janet Mannheimer Zydney recently graduated with a PhD in educational communication and technology from New York University. This fall, she starts a post-doctoral fellowship with Dr. Ted Hasselbring at the University of Kentucky in special education technology. For more information on Janet's research on problem solving or the development of Pollution Solution, send a letter to the editor at letters@iste.org.