ESSAYS ON SCIENCE AND SOCIETY

The Spirit of Discovery

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Science education, like science, is an ever-evolving experiment. Teachers are beginning to reform old classroom practices by engaging learners in actual research projects and using inquiry-based methods of teaching At the heart of this transformation are partnerships between scientists, educators, and students. "Doing science"—conducting actual research side by side with researchers—is perhaps the best way to achieve scientific literacy.

Many organizations, such as NASA Quest, the GLOBE Program, the Earthwatch Institute, and the JASON Foundation for Education (JASON), have been working hard to bridge the gap between the scientific and educational communities. These collaborations provide students with role models, infuse current research into the curriculum, and make science relevant to learners. They also challenge researchers to engage the public in the scientific process and to demonstrate how their ongoing research serves a larger purpose.

Along with these benefits come additional challenges for the educational community. Economic and logistical barriers prevent every student from actually going on scientific expeditions or having a one-on-one relationship with a scientist. Even if these experiences were possible, they are not by themselves sufficient. Collaborations need to be enhanced by a learning framework that can give students the skills they need for lifelong learning and can provide teachers with the methodologies to continuously improve their teaching.

In this essay, we focus on our own experience with JASON by describing our tenth expedition (JASON X) to the Peruvian Amazon. In doing so, we describe how JASON is using communication technologies and partnerships between leading corporations, government, and nonprofit organizations to tackle these challenges, and helping to bring the spirit of discovery to students and educators all over the world.

JASON, founded by scientist and explorer Robert Ballard, conducts year-long learning expeditions that involve middle-school students and teachers. In 1999, after selecting the theme of rainforests, we chose the Amazon Center for Environmental Education and Research (ACEER) Foundation, located 3 hours upriver from Iquitos, Peru, as our host partner. We then identified a diverse group of scientists who conduct ongoing research at the ACEER Foundation's facility in the Peruvian Amazon and could communicate the excitement of their work to students and teachers: Roger Mustalish, an aquatic ecologist and the president of the ACEER Foundation, uses Geographical Information Systems (GIS) to study land use and vegetation patterns; Meg Lowman, Executive Director of Selby Botanical Gardens and a canopy biologist, conducts research on herbivory and bromeliad communities; Randy Morgan, an entomologist and curator of the Cincinnati Zoo's Insectarium, collects and studies arthropods; Lily Rodriguez, a Peruvian herpetologist, conducts audio transects to identify frog species; and Jim Duke, a preeminent ethnobotanist, partners with Don Antonio Montero Pisco, an Amazonian shaman, to record indigenous knowledge of medicinal plants.

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Our staff traveled to Peru to gather oral histories, songs, and maps for a print curriculum; produced video footage of students and researchers working in the rainforest; collected GIS data and photographs for a set of online tools; and coordinated logistics and technical details to produce a live satellite broadcast.

To bring these multimedia tools to educators and students throughout the world, JASON relies on its collaboration with an international network of universities, science and technology museums, aquariums, school districts, education centers, partner companies, and state and regional educational networks. Each partner site offers local professional development for teachers, hosts live satellite broadcasts, and provides ongoing support to classrooms throughout the year. Each site adapts our standards-based materials to its particular local educational needs. Teachers in Monterrey, Mexico, may emphasize field studies to meet local curricular requirements, whereas educators in Philadelphia tailor Internet projects to better reach students with below average academic skills.

Teachers begin the school year by participating in professional development workshops. Teachers then guide students into the expedition by discussions and classroom activities about the geography, history, and culture of the expedition site. Through readings, videos, and Internet chat sessions, students make personal contact with host researchers and observe how they work. Then, through a series of inquiry-based exercises, including local field studies, gathering and analyzing data,

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designing experiments, and building models, students emulate the field research conducted at the expedition site and conduct their own investigations.

During expeditions, students solve scientific problems. This learning environment helps students master scientific concepts, vocabulary, and skills. For JASON X, students compared tropical, temperate, and fossil rainforests; measured quantities of water and arthropods in artificial bromeliads; designed new insect traps; studied the relation between leaf margin and mean annual temperature; transformed school hallways into rainforest canopy walkways; and compared watershed data from their local site with data from sites from around the world. Students from several sites developed a common name for a new species of canopy beetle (now known as the "nutmeg canopy beetle").

Both students and researchers host the live satellite broadcast. Roger Mustalish and two student argonauts, Hillary Lehr and Stephanie Sverdup, discuss aquatic characteristics of a tributary of the Amazon River.

Throughout the year, teachers and students use online tools, such as teacher workshops, message boards, simulations, and journals to facilitate yearlong interactivity between classrooms and scientists. A highlight of the JASON expedition is a live, 2-week satellite broadcast, during which a small group of researchers, teachers, and students present their discoveries from the expedition location to sites all over the globe. During last year's live satellite broadcast, students learned how JASON transformed two local barges from Iquitos into a state-of-the-art production studio and towed them upriver to the ACEER Foundation's remote field location.

When students investigate the work of researchers, such as monitoring volcanoes in Hawaii, studying the impact of El Niño or La Niña on ocean ecosystems, or observing the technical challenges of building an international space station, they learn about science "as it happens." This experience not only is exciting and relevant to students' lives, but also fosters critical thinking skills and helps students understand and evaluate current science news. As students work side by side with researchers, they meet positive role models: real, diverse people doing interesting work.

Introducing current research into the science curriculum transforms the traditional role of educator. The ongoing support of a global, intellectual community encourages teachers to learn new pedagogies and try new curricula. Teachers cannot rely on textbooks to instruct their students about cutting-edge research, but must constantly learn in their classrooms.

Partnerships with the educational community are beneficial for researchers, too. Dr. Lowman partnered with entomologist Randy Morgan to identify arthropods that she collected with students and teachers as part of her bromeliad tank ecosystem research. She also worked with an artist to illustrate the new species of canopy beetle she discovered at the ACEER Foundation's field station and posted the illustration on JASON's Web site. Dr. Lowman is currently working with a teacher, Donna Krabill, to develop curricular materials on research methods for the classroom.

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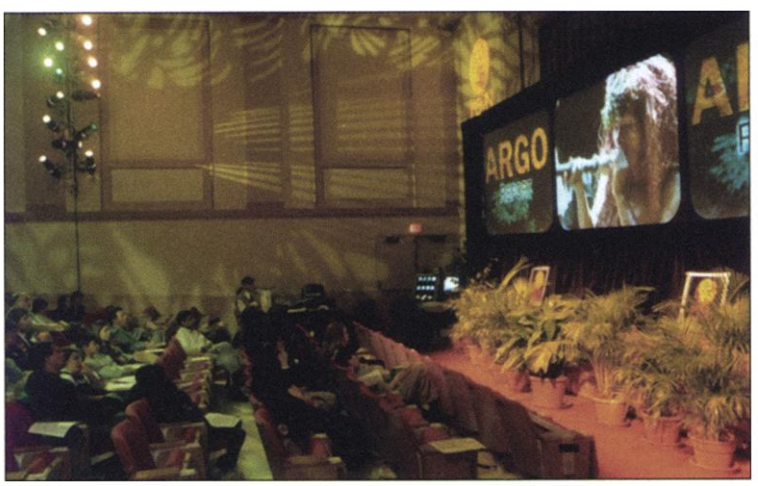
Although many teachers are finding innovative uses for technology in the classroom, others are still not fully capitalizing on technology's power. Continued professional development for teachers in both science education and using educational technology is an international need. We believe that technology taught in a research context has a far greater chance of being incorporated into a teacher's repertoire of strategies than technology training alone. Programs such as the Virtual High School, Light Span's Global School House, and various electronic field trips are offering teachers new ways to use technology while at the same time focusing on academic content. We are spearheading a new initiative, the JASON Academy, to offer teachers online courses on a variety of core science topics. The Academy will provide educators an efficient way to obtain advanced certification in science education and a set of skills that they can apply immediately in the classroom.

Even in ancient times, explorers crossed continents to make new discoveries. Yet they could not easily share their findings with the world. Advanced communication technologies and innovative partnerships are transforming the face of science education, allowing the experience of scientific discovery and the excitement of learning to reach further than ever before. If classrooms in the heart of the Amazon rainforest can now exchange cultural and scientific data with scientists and students throughout the world, we can only imagine where science education will be in another 10 years.



A live, 2-week satellite broadcast of a JASON expedition brings researchers, students, and teachers together. Here, they participate in the broadcast at a partner site, Case Western Reserve University.

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