

# What

## Can University Scientists Offer to K-12 Schools?

by Nancy Trautmann

*"I believe that the worst thing that has happened to science education is that the great fun has gone out of it... Very few see science as the high adventure it really is."* —Lewis Thomas<sup>1</sup>

The contemporary movement for science education reform calls for the teaching of science to more closely reflect the way science is practiced. In other words, students should learn not only science facts but also the processes through which scientific discoveries are made.

To help meet this mandate, universities across the country have begun partnering with local schools to bring real scientific research into the classroom. These university/school partnerships take a number of forms, including developing research-based curricula and providing university students as classroom teaching fellows.

### Curriculum development

In a project funded by the National Science Foundation, scientists and science educators at Cornell University have teamed up with middle and high school teachers to create the Cornell Scientific Inquiry Series, a collection of student and teacher manuals that enable students to design and conduct their own environmental science experiments. Through these research experiences, students begin to view science as a continuous process of discovery rather than a static collection of facts to be memorized in time for an exam.

The first book in the Cornell series, *Assessing Toxic Risk*, provides protocols for testing the toxicity of chemical solutions or environmental samples by using organisms such as lettuce seeds, *Daph-*



ALAN FIERO

Alan Fiero's students in bug house they built to raise *Galerucella* beetles for biological control of purple loosestrife.

*nia*, and duckweed in the same sorts of bioassays used by professional scientists. The idea for this book developed out of school water-monitoring programs because students often wanted to address questions that couldn't be answered using test kits. Chemical tests for specific contaminants generally require equipment that is too expensive or reagents that are too hazardous for school use, but bioassay experiments provide a wonderful chance for students to learn about toxicology in a way that integrates concepts in biology, chemistry, environmental sciences, and human health.

*Invasion Ecology*, the second title in the series, incorporates ideas for designing and conducting experiments related to invasive species. For example, Alan Fiero's seventh-graders at Farnsworth Middle School near Albany, New York, are raising and releasing *Galerucella* beetles. These beetles, native to Europe, specialize in eating purple loosestrife, a non-native invasive species that is crowding out native wetland plants across the United States. Fiero learned about *Galerucella* during a summer of working side-by-side with Cornell scientist Bernd Blossey, who has spent over a decade studying these beetles and evaluating the viability of introducing them to North America for biological control of purple loosestrife. After teaming up with Cornell scientists and educators to write classroom instructions for raising *Galerucella* and studying their impact on local loosestrife populations, Fiero piloted this project with his classes. He concluded, "Students are excited about being part of an authentic

Students at all grade levels and in every domain of science should have the opportunity to use scientific inquiry ... including asking questions, planning and conducting an investigation, using appropriate tools and techniques, thinking critically and logically about the relationships between evidence and explanations, constructing and analyzing alternative explanations, and communicating scientific arguments."

— National Science Education Standards, 1996

<sup>1</sup> Presentation at the Sloan Foundation's "Conference on New Dimensions of Liberal Education," Key Biscayne, Florida, 1981.

research project. They like the idea that what they are doing may make a difference by improving the ecology of our area.”

The Cornell series will conclude with two books to be published in the coming year. *Decay and Renewal* will focus on natural processes of biodegradation, and how humans can harness these processes to prevent or clean up pollution through composting, wastewater treatment, and bioremediation. *Watershed Dynamics* will include techniques for stream habitat assessment and for modeling impacts of human activities on stream water quality and stormwater discharge.

### Graduate students as teaching fellows

At the launch of the National Science Foundation's (NSF) Graduate Teaching Fellows in K-12 Education Program in 1999, NSF Director Rita Colwell said, "We cannot expect the task of science and math education to be the responsibility solely of K-12 teachers while scientists, engineers and graduate students remain busy in their universities and laboratories. There is no group of people that should feel more responsible for science and math education in this nation than our scientists and engineers and scientists- and engineers-to-be." Today, this program provides fellowships that enable graduate and advanced undergraduate students at over 70 universities across the United States to work as teaching partners in local schools.

The projects undertaken by teaching fellows from Cornell are wide-ranging, based on their own individual expertise as well as on the interests of the participating classes. Last year, fellow Dave Warner worked with a high school environmental studies class designed to help struggling students succeed in science. For one of Dave's projects, the students used remote sensing technology and lake zooplankton levels to predict alewife populations in the Great Lakes. In the course of another project, students used nitrate test kits and noticed that they sometimes got different

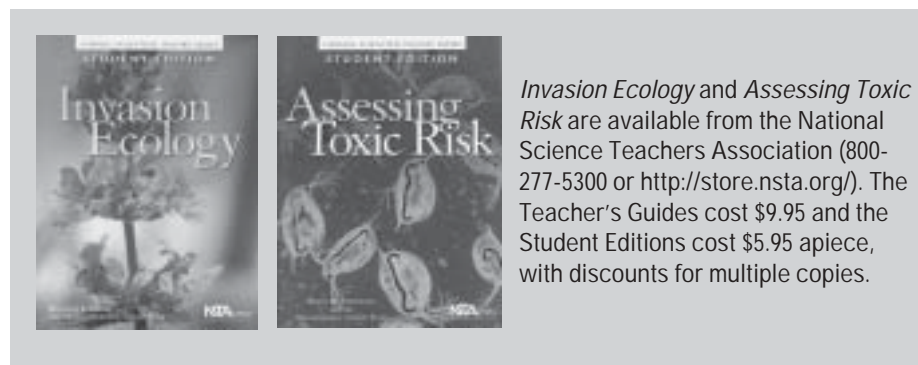
readings for the same water sample. Seeing a "teachable moment," Dave led them through an investigation of the types of error involved in scientific measurements. After discussing accuracy, precision, and the role of bias, the students drew conclusions about these factors in their own water monitoring data. Their teacher, John Signorelli, says, "Dave brings real science into the classroom. Most kids don't realize that science is numbers, crunching numbers, and not just the gee-whiz stuff that they see on TV. But they also see his excitement about his own research and about what we are doing in class."

For more information about the publications and programs discussed in this article, see <http://ei.cornell.edu>.

Curriculum resources developed by Cornell's teaching fellows are downloadable at <http://ceirp.cornell.edu>. These resources include lesson plans and project descriptions designed to help teachers try new ideas in teaching high school or middle school science.

Universities interested in applying for funding to participate in the NSF Graduate Teaching Fellows in K-12 Education Program can find grant proposal information at: [www.ehr.nsf.gov/dge/programs/gk12/](http://www.ehr.nsf.gov/dge/programs/gk12/).

*Nancy Trautmann is Program Leader for Cornell's Environmental Inquiry Program at the Center for the Environment, Cornell University, Ithaca, NY; [nmt2@cornell.edu](mailto:nmt2@cornell.edu); 607-255-9943.*



*Invasion Ecology* and *Assessing Toxic Risk* are available from the National Science Teachers Association (800-277-5300 or <http://store.nsta.org/>). The Teacher's Guides cost \$9.95 and the Student Editions cost \$5.95 apiece, with discounts for multiple copies.

### LAKEWATCH, continued from page 11

While frozen water samples might not be acceptable for certain types of research work, Dan Canfield, the lead author on the paper, says the study shows that "frozen water can be used any time you're interested in broad trends." He adds, "The use of frozen samples has enabled us to collect more data, on more lakes, in a more cost-effective way."

The authors of the paper conclude that "volunteer monitoring provides a source of credible data." Apparently others agree, at least as far as LAKEWATCH is concerned. Mark Hoyer, a coauthor on the paper, points out that local, state, and federal agencies regu-

larly use our data for their reporting purposes and also that some two dozen manuscripts based in whole or in part on LAKEWATCH data have been accepted for publication in peer-reviewed scientific journals. He says, "This is a clear indication that the scientists reviewing these articles have accepted the integrity of LAKEWATCH water quality data."

*Note:* Other volunteer monitoring groups who may be interested in freezing water samples for nutrient analysis should be sure to conduct their own comparison studies first, as results may differ from

region to region depending on characteristics such as water hardness or nutrient concentrations.

*Amy Richard is Information Specialist for Florida LAKEWATCH, University of Florida, Gainesville, Florida; 352-392-9617, ext. 228; [arich@mail.ifas.ufl.edu](mailto:arich@mail.ifas.ufl.edu).*

### Reference

Canfield, D. E., Jr., C. D. Brown, R.W. Bachmann, and M. V. Hoyer. 2002. Volunteer lake monitoring: Testing the reliability of data collected by the Florida LAKEWATCH program. *Lake and Reservoir Management* 18(1):1-9.