NIEHS Teaches by Example

There was a child went forth every day
And the first object he look'd upon, that
object he became,
And that object became part of him for the day
or a certain part of the day,
Or for many years or stretching cycles of years.
–Walt Whitman

It's never too early to introduce a child to the wonder of science, especially when that introduction involves plenty of muddy, gooey, thought-provoking, fascinating hands-on experiences. That's the philosophy behind the NIEHS's array of programs aimed at making environmental health science not only fun but meaningful for students in kindergarten through twelfth grade (K–12).

The programs are part of the NIEHS's efforts to convey findings in basic, clinical, and epidemiological research to the public in understandable terms, says Allen Dearry, chief of the Chemical Exposures and Molecular Biology Branch and a key player in getting the K–12 programs off the ground. "As members of the public," he says, "we're challenged to be involved in health-related decision making, but we don't always have a good understanding of what that involves. K–12 was developed as one mechanism to address that gap." The NIEHS commitment to improving science education at both local and national levels is important, says Fred Tyson, program administrator for extramural K–12 projects, because if students are interested in and knowledgeable about environmental health science, they'll be better-educated consumers and possibly more health-conscious adults. "And," he says, "we might turn some kids on to pursue a career in environmental health science."

A Nationwide Lesson

The institute's Division of Extramural Research and Training is midway through a three-phase grant process to develop instructional materials, educate science teachers, and track the results of exposing kids to environmental health science in school. Phase one, begun in 1993, involved developing instructional tools that could be incorporated into existing curricula. For younger children, some materials took the form of books featuring cartoon characters teaching about the relationship between people and the environment. For instance, My Health My World, a project by researchers at the Baylor College of Medicine, comprises three storybooks for children in kindergarten through fourth grade: *Mr. Slaptail's Secret*, which features a beaver who lives in a dusty, allergen-rich home, *Mystery of the Muddled Marsh*, in which the residents of Beaver Pond fight fertilizer runoff, and *Mr. Slaptail's Curious Contraption*, in which the inventive title character builds a solar water heater. Older students are targeted with CD-ROM and Web-based programs such as Project Greenskate, developed by researchers at the University of Washington Department of Environmental Health, in which students must gather key documents from Web sites for the fictitious Lakeview city government to help them determine whether it is safe to build a skating park on a former industrial site. The students not only learn how to obtain facts and information but are also introduced to such basic toxicology concepts as dose–response relationships, routes of exposure, thresholds for toxic effects, biotransformation, and risk assessment.

Phase two began in 1996 with the funding of seven grants to provide teachers with the skills and support necessary to implement an environmental health science curriculum. The grantees used strategies such as summer workshops, hands-on lab and field experience, and networks of science teachers and science clubs to further science teachers' knowledge and skills. For instance, the Environmental and Occupational Health Sciences Institute at Rutgers University in New Jersey and the Southwest Environmental Health Sciences Center at the University of Arizona teamed up to create the ToxRAP network, a train-the-trainer project in which teachers who were taught a special toxicology/risk assessment curriculum go on to train other teachers within their school district or region. Originally intended only for New Jersey teachers, the network has since gone nationwide, reaching 27 school districts in 11 states.

With phase three, eight new seven-year grants will be awarded this summer for projects to investigate whether the use of environmental health science an an integrative context for learning can actually enhance student achievement in nonscientific areas such as language arts and social studies. "These projects are really different," says Tyson. "What they will do is use an environmental health science issue such as asthma or lead poisoning as a focus for doing multidisciplinary teaching." At least three courses will revolve around the chosen topic, allowing students to develop diverse skills while being introduced to different facets of the topic. So, for instance, in one course they may perform a statistical analysis of lead poisoning, while in a second course they may learn what makes lead toxic to humans, and in a third they may write a term paper about the public health importance of lead poisoning. The effectiveness of such multidisciplinary teaching will be gauged by comparing students who do and don't take the courses in terms of standard criteria such as in-school grades and standardized test scores, as well as measuring the students' performance before and after implementation of the projects.

Jonathan Sharpe, Center for Ecogenetics and Environmental Health

Teaching the teacher. Teachers participating in the 1998 Environmental Health for Educators program, part of the Community Outreach and Education Program at the University of Washington Center for Ecogenetics and Environmental Health, tour a former industrial site in Seattle.

Each project will be a cooperative effort between environmental health scientists, teachers, and individual state departments of education, which will be called in to ensure that state educational standards are being adhered to with the innovative programs. If all goes as planned, state education departments could conceivably adopt such programs for whole school systems. Tyson adds that these programs are not geared toward specialty groups such as gifted or disadvantaged students. "We're looking for programs that can be put into any classroom," he says.

Meanwhile, each of the Environmental Health Sciences Centers, Marine and Freshwater Biomedical Sciences Centers, and Developmental Centers supported by the NIEHS sponsors a Community Outreach and Education Program (COEP) that addresses the educational needs of students, teachers, and other members of the surrounding community. Many COEPs specifically target school-age children with activities ranging from bringing students into the center to show them how research is conducted to preparing educational presentations to take to the schools. In Boston, Massachusetts, for example, staff from the Kresge Center for Environmental Health at the Harvard School of Public Health go into local schools to teach K–12 students about environmental health issues pertinent to the students' lives. "We try to teach them about their bodies and the environment and how the two are interrelated," says Marshall Katler, a research specialist and director of the center's Environmental Health Education Program. Students experience hands-on learning, handling real bones and lungs to learn about how they grow, collecting and measuring pollutants in their school, and using lead detection kits to test the paint in their homes.

The NIEHS is also teaming up with other science, government, and educational organizations to coordinate education and dissemination efforts. For instance, for the past five years the institute has cosponsored a one-day seminar during the annual Society of Toxicology conference for area teachers to learn basic concepts of toxicology, receive some training in teaching toxicology, and then attend some of the scientific sessions at the conference. The teachers are later matched up with scientist mentors who advise them on bringing environmental health science into their classrooms. The NIEHS is also involved in a two-year project to develop standardized educational materials addressing all the areas represented by the National Institutes of Health (NIH). In collaboration with the NIH Office of Science Education, each member institute is developing a curriculum packet reflecting its field of expertise targeted at the grade level it chooses. The NIEHS is now field-testing an environmental health science packet in print and CD-ROM formats aimed at middle school students.

Science in My Own Backyard

In a program closer to home, participants in the Summers of Discovery program, including high school through graduate-level students, high school science teachers, and science faculty, are placed in research internships in an NIEHS lab for 2–3 months during the summer, where they receive one-on-one mentoring with an institute scientist. They also attend weekly seminars, where they discuss current research being conducted at the institute with the scientists in charge, and participate in a summer's-end poster session of their own work at the institute. Mike Hogan, associate director for planning and policy for the institute's Division of Intramural Research and coordinator of the Summers of Discovery program, says, "I promise [the participants] four things when they start: that I'll work 'em to death, that they'll work with people who love going to their jobs in the morning, that I'll put them two years ahead of the rest of their class in technology skills, and that they'll know at the end of the summer whether this is something they'll want to do with the rest of their lives."

Although participants receive as much mentoring as they need, they are pushed to work as independently as possible, becoming full-fledged productive members of the research team. "I feel it's our responsibility as scientists and members of the federal government to make science available and interesting to as many kids as possible," says Hogan.

Each summer, about 100 participants are accepted to the program, which is open to any student, although participation by women and minorities is encouraged since these groups are traditionally underrepresented in the sciences. The program reaches students at a point when they are beginning to make career choices, offering them a taste of life as a scientist, and benefits teachers by giving them training in the latest environmental health science technology that they can take back to their classrooms. Hogan points out, "It makes the classroom much more meaningful to the students if the teacher isn't just lecturing about science but is living it as well."

Steve McCaw/Image Associates, Inc

Summer school. Summers of Discovery participants present their findings at season's end.

Another local program is the Bridging Education, Science, and Technology (BEST) Program, a collaboration between the NIEHS and Durham, North Carolina, public schools that takes up-to-the-minute technology into the schools, where interested students learn skills that may be used in a future career in environmental health science.

Hillside High School, one BEST partner, is the home of a prototype molecular biology laboratory and training center set up by the NIEHS. In addition to equipping the lab with state-of-the-art equipment for procedures such as polymerase chain reaction and gel electrophoresis, the institute also provided start-up training for Hillside science teachers. "The whole idea," says Marian Johnson-Thompson, NIEHS director of education and biomedical research development, "is to empower the schools and set up a mechanism whereby they are now able to self-sustain by going out and getting other resources." Accordingly, Hillside was recently awarded funding by the private Burroughs Wellcome Fund to establish a molecular biological preparation course in which high school juniors learn to use the lab equipment and perform basic science skills along with other important skills such as how to write a scientific paper and how to present and defend their research findings. As part of the course, each student has the opportunity to do a paid summer research internship at either the NIEHS Marine and Freshwater

NIEHS on the INTERNET

NIEHS Kids Page . . . . . http://www.niehs.nih.gov/kids/home.htm
NIEHS K–12 Program http://www.niehs.nih.gov/od/k-12/k12home.htm

Biomedical Sciences Center at the Mount Desert Island Biological Laboratory (funded by the Burroughs Wellcome Fund) or the NIEHS. In their senior year, the students must write up their findings, participate in a poster session, and present the research they conducted over the summer in such forums as the North Carolina State Science Fair, the North Carolina Student Academy of Science, and, for the past two years, at the American Association for the Advancement of Science annual meeting. According to Kenneth Cutler, Hillside's project director for the Burroughs Wellcome Fund grant, most of the students in the Hillside molecular biology course go on to receive full or partial scholarships for college and are currently majoring in a science or math field. Johnson-Thompson says, "The program has really mushroomed; these kids are starting to get some outstanding recognition."

Not far away, another BEST partner, Durham's elementary-level C. C. Spaulding Biosphere Magnet School, was provided by the NIEHS with two computers as well as speakers, educational reading materials, and supplies, to use in conjunction with its free-standing Life Lab Biostation, which features natural amphibian, reptile, mammal, bird, and insect habitats, pond and river ecosystems, and an observation deck to watch the natural life surrounding the school. The different ecosystems within the biosphere correspond with classroom work at each grade level, so all the students are able to use the lab as a learning tool to complement their classwork, and institute staff act as visiting instructors at the school.

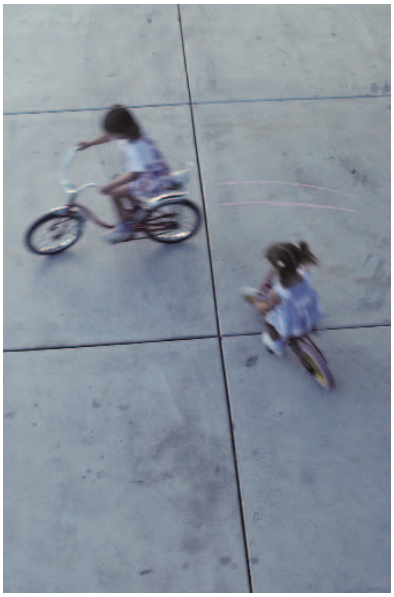
Finally, each year, the Annual Environmental Careers Symposium is held at the NIEHS, drawing around 200 students and teachers from area schools. The event features speakers and exhibitors from nearby universities, other federal agencies, and research organizations, who present information on environmental health science and related fields including public policy, environmental law, and environmental medicine. Participants attend five half-hour talks and have the chance to talk to scientists and find out what's involved in becoming a scientist, including information on summer programs and college degree offerings in the environmental sciences and related fields.

As the NIEHS K–12 programs mature and grow, so grows a new generation of students who learn early on that science is good stuff. **–Susan M. Booker**

Hillside High School

A whole new world. Kenneth Cutler introduces Hillside students to the prototype molecular biology laboratory and training center.

Getting in Touch with Your Inner-City Child



On 27 March 2000, over 400 academic researchers, health professionals, community and environmental advocates, and policy makers met to discuss the environmental health concerns of urban communities and the children who live in them. The conference was organized by the Columbia Center for Children's Environmental Health.

The Columbia center is one of eight centers established by the NIEHS and the U.S. Environmental Protection Agency to address issues in children's environmental health. The center is based on a new paradigm in which scientific research using state-of-the-art molecular approaches is closely linked to community outreach and education. NIEHS director Kenneth Olden said at the conference, "These partnerships between community and academia are an example of what needs to happen all over the country" to create new approaches for solving environmental health problems.

The conference featured the work being conducted at the Columbia center, including research in environmentally related diseases in children such as asthma, developmental disorders, and cancer. The research being conducted at the center includes a prospective study of 560 pregnant women who live in the inner city of New York. The women will be studied for their exposure to environmental tobacco smoke, pesticides, and other agents that may be related to their children's developing asthma later in life. In the women assessed so far, over half show evidence of exposure to environmental tobacco smoke. All of the women show evidence of exposure to chlorpyrifos, a toxic pesticide that may have deleterious effects on the fetus. "These studies underscore the importance of identifying early life exposures and assessing their effects in human populations," said Jean Ford, director of Columbia University's Harlem Lung Center.

Frederica Perera, a pioneer in the area of molecular epidemiology and the use of biomarkers for the assessment of exposure in populations, directs the Columbia center. Center studies, she said, depend on a close collaboration between researchers and community leaders. Said Perera, "Our team of scientific researchers has worked closely with community leaders so that we are doing the best possible research—not only using advanced molecular approaches, but ensuring that the research is responsive to the concerns of the community."

One of the community partners working closely with the Columbia center is West Harlem Environmental Action, a community-based organization that aims to address issues of environmental justice in West Harlem. Peggy Shepard, the group's executive director and cofounder, said at the meeting that "community-centered academic research can yield the data that are needed so that the community can mobilize its residents to affect real policy change." The need for a research agenda that includes community-based research was emphasized by many of the conference presenters. During his keynote speech, U.S. Surgeon General David Satcher said that "since children are defenseless against the barriers [to health] confronting them early in life, it is up to communities, in partnership with local, state, and federal governments, to ensure that their environment affords them an opportunity for a healthy start." **–Luz Claudio**

NIEHS Investigates Arctic Health Issues

A natural connection. A recent conference highlighted the need for biomarkers of exposure to contaminants in the subsistence diets of indigenous Arctic peoples.

In 1991, the eight nations that make up the North Polar region (Canada, Denmark, Finland, Iceland, Norway, Sweden, Russia, and the United States) created the Arctic Monitoring and Assessment Programme (AMAP) to characterize the levels and effects of environmental contamination in the Arctic. One result of that program was *Arctic Pollution Issues: A State of the Arctic Environment Report* and a companion document, *The AMAP Assessment Report: Arctic Pollution Issues*, both issued in 1997, which detailed the unique environmental and health problems facing the Arctic's ecology and populations [see *EHP* 106:A64–A69 (1998)]. This past May, health and environmental officials, research scientists, medical providers, leaders of indigenous communities, and concerned Arctic citizens met in Anchorage, Alaska, to explore these issues at the International Conference on Arctic Development, Pollution, and Biomarkers of Human Health.

At the meeting, organized by the NIEHS and the Alaska Area Native Health Service, Andrew Gilman, director of Health Canada's Office of Sustainable Development, noted that although the AMAP reports described relatively low levels of hazardous substances in the Arctic air, water, and food web compared to other geographic areas, those levels cannot be dismissed as insignificant because of the reliance of indigenous peoples throughout the Arctic on a diet of fish and marine and terrestrial mammals, which ingest and bioaccumulate environmental contaminants such as persistent organic compounds and heavy metals. Addressing conference participants, Gilman said, "The relationship between indigenous people in the Arctic and their food is entirely different from your relationship with a Big Mac." Representatives of indigenous peoples at the conference explained that hunting and fishing and the preparation and consumption of the typical subsistence diet in the Arctic not only meets nutritional needs but is a fundamental component of the peoples' spiritual and cultural life. Thus, environmental threats to the food web are of deep concern, particularly since the isolation of the Arctic area means that indigenous groups have no acceptable alternative to subsistence fishing and hunting. Both Gilman and Arctic residents challenged the environmental health scientists present to develop the tools needed to monitor exposures and effects from environmental contamination in the Arctic.

This is a difficult challenge. Much of the contamination in the region actually originates in the lower latitudes and is deposited by winds sweeping up over the North Pole. Also, the Arctic human population is small, culturally diverse, and distributed across a vast, harsh geographic area, making it difficult to conduct disease surveillance and monitoring, provide public health prevention services, and deliver health care.

Much of the Arctic conference focused on biomarkers under development to measure exposures to pollutants, their effects, and variations in people's susceptibility to such effects. Biomarkers have unlimited potential to clarify the interactions between pollution, ecological systems, and human health in the Arctic environment, says William Suk, director of the Chemical Exposures and Molecular Biology Branch at the NIEHS. For example, many of the emerging assays discussed in Anchorage are intended to identify low levels of exposure to environmental contaminants in animal species or humans and to detect subtle, subclinical biochemical precursors of human disease or dysfunction. Tony Knap, director of the Bermuda Biological Station for Research, says that the value of biomarkers is that they may offer the technology needed to monitor contamination of the physical, ecological, and human Arctic environments, and may provide Arctic residents and policy makers with data needed to intervene before potential problems progress to pollution crises.

However, the biomarkers discussed at the meeting are currently under development and none are ready for application. Furthermore, when such biomarkers are considered for use in the Arctic, they present ethical and public health questions that must be considered by researchers and the people who might be tested for them. For instance, ethical concerns include how information obtained through the use of biomarkers that identify individual heightened genetic susceptibility to adverse effects of Arctic contamination could be used by prospective employers or insurance providers, and what the effects of this kind of information on the emotional health of the people tested might be. Challenges from a public health standpoint include the logistics of monitoring remote Arctic populations, complying with regulations in the eight different Arctic countries, and interpreting test results when it is unlikely that background levels or matched control groups with similar exposure routes exist.

Suk notes that research scientists from various disciplines rarely meet with the potential beneficiaries of the application of their studies, so meetings such as this are a step in the right direction because they place research questions in a human context, accentuate the need for better tools to monitor exposures and effects, and may prompt more consideration of the end applications of biomarker research into the AMAP health effort. The NIEHS is expected to provide the AMAP Human Health Assessment Group with a report and recommendations from the Anchorage conference by the end of the summer.

–Dan C. VanderMeer