Fogarty Program HEEDs the Call to Action

Interdisciplinary research designed to inform international policy decisions on health, economic, and environmental ills got a boost last fall with the September 2003 award of the first-ever Health, Environment, and Economic Development (HEED) program grants by the NIH's John E. Fogarty International Center (FIC). HEED grantees are joining together across disciplines and continents to outwit the seemingly intractable health problems—ranging from rising infant mortality rates to a resurgence of malaria epidemics—that face developing countries.

The mission of the FIC, established in 1968, is to reduce disparities in global health by promoting and supporting scientific research and training. "We developed the HEED program in close collaboration with colleagues at the NIEHS because we saw the need for data to better understand the linkages between health, economic development, and environmental degradation," says Sharon Hrynkow, acting director of the FIC. Today the program is supported by the FIC, the NIEHS, the National Institute of Child Health and Human Development, and the NIH Office of Behavioral and Social Sciences Research, with the U.S. Geological Survey providing technical expertise. HEED extends two other FIC programs: International Studies in Health and Economic Development, which seeks to bridge the gap between life science and social science, and the International Training and Research Program in Environmental and Occupational Health, which builds scientific capacity in developing countries [for information on the latter program, see "Building Self-Reliance in Environmental Science: The ITREOH Experience," *EHP* 111:A460–A463 (2003)].

HEED supports projects that "look at how economics affects the environment and how those environmental changes harm human health," says program officer Rachel Nugent. "Instead of just focusing on environmental exposures that affect health, we're saying, 'Let's look more broadly at what's driving the environmental change in the developing country, such as economic factors that influence people's decisions about both health and the environment." In the case of dam building, for example, the decision to construct a dam to provide energy to a growing economy may be supported by cost–benefit analysis on the basis of energy needs versus environmental impacts. But construction may be less advisable when the health impacts of the environmental change are factored in to the analysis.

HEED Awards: Leaders & Topics

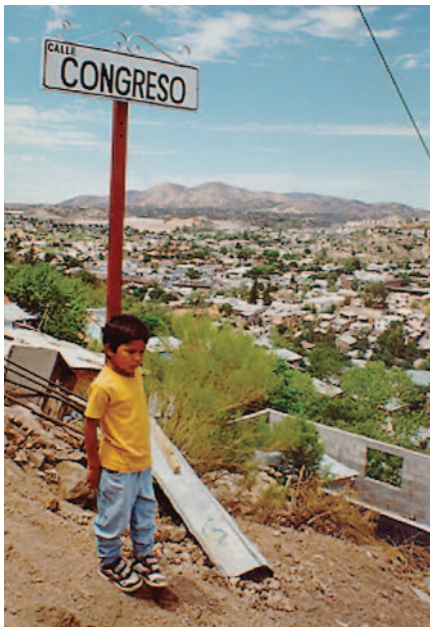
Leslie London (University of Cape Town, South Africa) and Melissa Perry (Harvard University)	Pesticide use in South Africa and Tanzania, including farmers' perceptions of the risks of pesticides
Max Pfeffer (Cornell University) and Diana Sawyer (Center of Development and Regional Planning, Brazil)	Links between economic development, environmental degradation, and malaria in Brazilian Amazonia
Jeffrey Griffiths (Tufts University) and Fernando Sempertegui (Ecuador Biotechnology Center)	Cost–benefit analysis of public policy strategies to resolve and counter the health effects of pollution in Quito, Ecuador
Siobán Harlow (University of Michigan) and Catalina Denman (El Colegio de Sonora, Mexico)	Association between rising infant mortality and deficits in urban environmental infrastructure in *maquiladora* communities along the U.S.–Mexico border
Alan Krupnick (Resources for the Future), Ramanan Laxminarayan (Resources for the Future), and Zou Shoumin (Chinese Research Academy of Environmental Sciences)	Changes to health outcomes as a result of a tradeable emissions permit program in Taiyuan, China
Kenneth Ward (University of Memphis) and Wasim Maziak (Syrian Society Against Cancer)	Social, economic, and environmental conditions of the large urban encampments of recent immigrants from the Syrian countryside
Burton Singer (Princeton University) and Richard Mukabani (University of Nairobi, Kenya)	Community-based vector control for controlling malaria in a small town in Kenya
Michael White (Brown University) and Kofi Awusabo-Asare (University of Cape Coast, Ghana)	Interrelationships among urbanization, lagoon water quality, fish catches, and human health in coastal Ghana
Lori Leonard (The Johns Hopkins University) and Grace Kodindo (University of N'djamena, Chad)	Impact of the Chad–Cameroon Petroleum Development and Pipeline Project on the health, economies, and decision making of households in three affected communities
Stuart Batterman (University of Michigan) and Rajen Naidoo (University of KwaZulu-Natal, South Africa)	Relationship between environmental pollutants, overall quality of life (including health), and economic conditions in a highly industrialized area of South Africa
Reeve Vanneman (University of Maryland), Sonalde Desai (University of Maryland), Abusaleh Shariff (National Council of Applied Economic Research, India), and R. Uma (The Energy and Resources Institute, India)	Impact of air and water pollution on maternal and child health in India, including how social inequalities, gender, and poverty affect exposure levels, and how public policy affects health risks

Project Particulars

This first round of HEED projects includes 11 pilot projects, none of which will exceed two years or $100,000 per year in direct costs. When the researchers finish these pilot projects, they may apply for a five-year HEED grant to continue their research.

The projects vary in size from 4 to 12 key personnel. Each project team must have at least one member from the health, social, and environmental science disciplines, and must employ approaches from the behavioral, social, environmental, and biomedical sciences. In addition, each team must be multinational. The HEED program requires grantees to perform capacity building, expanding the skills and knowledge base of team members from developing countries. This would include, for example, ensuring that team members can get credit toward graduate degrees while working on the project or have opportunities to publish, says Nugent.

Policy recommendations are a key outcome of HEED projects. Grantees examine local and national policy issues so they understand the concerns of policy makers before undertaking their research.



When want persists. Despite overall economic growth, *maquiladora* communities along the U.S.–Mexico border continue to suffer severe infrastructure deficits.

During the execution of the project and upon its completion, grantees communicate with policy makers and provide data and policy recommendations as needed.

The Program in Action

In one project funded by HEED, Siobán Harlow, an associate professor of epidemiology at the University of Michigan School of Public Health, and her Mexican and U.S. colleagues are examining links between industrialization, urbanization, and infant health in the U.S.–Mexico border towns of Nogales and Hermosillo. Both of these towns are home to *maquiladoras*, communities that have grown up around the foreign-owned assembly plants that dot the border. *Maquiladoras* are marked by their poor housing, inadequate water and sewer systems, and insufficient infrastructure to dispose of industrial waste.

Although economic indicators in these regions have improved, infant death rates in some border cities are almost double Mexico's national average, which in 2002 was 13.8 deaths per 1,000 live births. The health effects of economic growth in these northern towns had gone unanalyzed, despite growing evidence of serious deficits in the urban and environmental infrastructure, says Harlow. "Just looking at economic growth doesn't answer the question about whether the development is successful," she says.

Using data collected from maps, the U.S. Census, city archives, and interviews with residents, the team will develop an index of socioenvironmental vulnerability, which rates how well communities can sustain environmental assaults, based on such factors as their economic condition and family support systems. The team will map both vulnerability levels and infant mortality rates to see if an association exists between the two, and then develop strategies for identifying and protecting at-risk populations. If the pilot project is successful, Harlow and her colleagues will use the approach in 8–10 other *maquiladora* communities.

Further south, HEED grantee Max J. Pfeffer, a professor of development sociology at Cornell University's College of Agriculture and Life Sciences, and colleagues from Cornell, Princeton University, and Brazil's Center of Development and Regional Planning are studying the factors that contribute to the spread of malaria and other diseases in the frontier areas of Brazilian Amazonia. There is considerable road and dam construction, with accompanying deforestation, as the natural resources of this region are being developed. According to Pfeffer, when settlement began in 1984, 100% of the area was virgin forest. By 1999, that figure had dropped to about 58%. The rapidly changing habitat leads to ecologic imbalances that ultimately result in rises in vectorborne disease. Although the dangers of deforestation to the global environment have been well documented, knowledge of the human health–environment relationships within Amazonia is limited, says Pfeffer.

In addition to looking at how changes in land use affect human health, the team is analyzing the effect of social networks and government programs on treatment for malaria. Disease eradication strategies in Brazilian Amazonia that rely heavily on insecticides, particularly DDT, have not halted malaria epidemics. But more recent approaches involving socioenvironmental control and management have enabled public health workers to concentrate efforts in areas with higher risk, promoting more cost-effective interventions for malaria control and significantly decreasing transmission of the disease. Some of the actions included in successful socioenvironmental programs have included reorganizing health agencies at local and state levels, increasing local community participation and knowledge about the disease, and investing in personnel, equipment, and training.

Pfeffer points out that the success of interventions depends on their joint utilization. "No environmental intervention alone will solve the problem of malaria transmission if adequate social structures

Adapt at all cost. Rapid ecosystem change in Brazil (lower right) has led to widespread malaria. More effective than spraying DDT (above) is teaching locals (top right) how to lower their risk.

Top group: Elkeo Gaxiola/HEED; bottom group: John Sydenstricker-Neto/Cornell University

are not in place," he says. "Similarly, behavioral changes, no matter how appropriate, would not be enough to avoid a high risk of malaria transmission if environmental controls were not implemented." Eventually the team plans to expand their approach to address other diseases, such as dengue.

Local residents are very receptive to the researchers' efforts, Pfeffer notes. Team members work closely with residents, asking about their health and their strategies for protecting themselves from infection; in collaboration with in-country professionals, they are also searching for new approaches to lower residents' risk of developing malaria. "We have to work carefully to show them what we are doing is for them, and that we are not taking anything away [from them]," he says.

A Healthful Collaboration

Although policy makers may nod in approval at the idea of taking an interdisciplinary approach to solving the environmental health problems of developing countries, few opportunities to develop such strategies actually exist, Pfeffer says. Most institutions don't support such research, and scientists themselves are often very focused on their own disciplines, he says.

Leslie London, an associate professor of public health at the University of Cape Town who received a HEED program grant to study the costs and benefits of pesticide use in Tanzania and South Africa, agrees. "Many researchers remain locked in their own disciplinary cocoons, while others actively seek cross-disciplinary links," he says. He adds, "For [our team], some of our most valuable learning experiences have been in collaboration with colleagues outside of usual disciplines."

Other researchers are starting to catch on, as well, which is good news for the future of environmental health research and the problems it addresses. "The value of interdisciplinary research to solve environmental problems is increasingly recognized, including by the National Academies," says Nugent. "We are beginning to make good progress in providing opportunities to solve these complex problems using a multifaceted approach." **–Tina Adler**

For more information on the HEED program, visit **http://www.fic.nih.gov/programs/HEED.html**

Headliners | Childhood Obesity

NIEHS-Supported Research

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Obesity and Asthma Risk in School-Age Children

Gilliland FD, Berhane K, Islam T, McConnell R, Gauderman WJ, Gilliland SS, Avol E, Peters JM. 2003. Obesity and the risk of newly diagnosed asthma in school-age children. Am J Epidemiol 158:406–415.

Both asthma and obesity have been rapidly increasing in incidence among children in the past 20 years. Health care providers have explained this association as evidence that children with asthma are less likely to engage in physical activity and therefore more prone to gain weight. However, this interpretation has been challenged in recent studies, including this work by an NIEHS-supported research team from the University of Southern California.

The team studied the association of newly diagnosed asthma and the development of obesity using data collected at yearly assessments over a six-year period. The data were gathered as part of the Children's Health Study of Southern California, a longitudinal study of respiratory health among nearly 3,800 youngsters aged 7–18. Most of the children were white or Hispanic. About 20% had a history of physician-diagnosed allergy; 24% of the boys and 21% of the girls reported ever experiencing wheeze.

The data revealed that new-onset asthma was diagnosed about 1.5 times more often among overweight and obese children. Boys had a slightly higher risk of about twofold. Interestingly, the effect of being overweight was about twice as high in nonallergic children as in children with documented allergies (the authors note, however, that this difference may be due in part to an underreporting of allergy).

These findings may have important public health implications in the battle to control the epidemics of both asthma and obesity in children. During the last decade alone, the prevalence of overweight in U.S. children has increased by 40%. If being overweight does indeed contribute to developing asthma, public health professionals may need to target obesity prevention in their efforts to control asthma. Further longitudinal epidemiologic and mechanistic studies are necessary to confirm these results and to identify all causes of the childhood asthma epidemic. **–Jerry Phelps**

NIH Roadmap for Medical Research

In May 2002, Elias Zerhouni became director of the NIH and promptly set out to enhance the agency's capacity to foster state-of-the-art science utilizing current technology. The NIH, Zerhouni reasoned, had to streamline the process by which emerging systems-level views of cells and disease could be applied to clinical care—in other words, shorten the distance from the laboratory bench to the bedside. An explosion in biology knowledge fueled by the growth of genomics and related fields was providing new means to link diseases through common biological pathways, and NIH research, Zerhouni wrote in the 3 October 2003 issue of *Science*, needed to reflect this new reality.

Today, this thinking is reflected in a far-reaching set of initiatives known collectively as the NIH Roadmap for Medical Research. The Roadmap was released after several months of meetings with biomedical and behavioral experts from academia, industry, the private sector, and health care, along with other stakeholders, and it identifies knowledge gaps and needs, providing a framework of priorities for NIH activities in the coming years.

NIEHS director Kenneth Olden is "excited and pleased" about the opportunities contained in the new scheme. "All the NIEHS's priorities are embedded in the Roadmap," he says. "It's a perfect fit for what this institute has to be about if it intends to be a player in the NIH."

Nuts and Bolts

The path to the Roadmap began with a set of questions posed by the NIH to more than 300 biomedical leaders in late 2002. What are today's most pressing scientific challenges? What are the roadblocks to progress? What must be done to overcome these roadblocks? And what efforts are beyond the mandate of one or a few institutes, but rather are the responsibility of the whole NIH?

The answers to these questions were molded into three core themes that today form the Roadmap's foundations. Working under the first theme, known as New Pathways to Discovery, investigators will seek to better understand complex biological systems, in part by building new tools for biomedical research, such as imaging technologies and informatics databases. Within the Research Teams of the Future theme, scientists will explore new organizational models for interdisciplinary research and training, and investigate opportunities for high-risk studies that could produce extraordinary findings. And under the third theme, known as Re-engineering the Clinical Research Enterprise, NIH scientists will create integrated research networks and related informatics. This effort will entail new approaches to training the research workforce, facilitating translational research, and assessing patient-reported outcomes, among other activities.

The three Roadmap themes are further divided into nine separate "implementation groups" that collectively administer a total of 27 tangible research initiatives. According to Dushanka Kleinman, the assistant director for NIH Roadmap coordination, implementation of all 27 initiatives will begin in 2004. Kleinman says each initiative will be coordinated by a single lead institute that works closely with the designated implementation group to coordinate initiative activities and monitor progress. All of the fiscal year 2004 initiatives will draw monies from a collective funding pool fed by a combination of the NIH director's discretionary fund and contributions made by all the NIH institutes and centers, amounting to about one-third of a percent of each of their annual budgets. Currently valued at $128 million for fiscal year 2004, NIH officials expect the cumulative Roadmap for the years 2004–2009 to total $2.1 billion.

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Specifics relating to the administration of the Roadmap are under development. A framework for operations of initiatives is now being drafted, Kleinman says, that will provide guidelines for both pre- and postaward management. The draft is expected sometime this spring. Moving forward, the Roadmap will strive to ameliorate what many experts see as deficiencies in the existing U.S. clinical research system: poor integration of regional networks, inadequate training for clinical investigators, inconsistent data standards, and a propensity for avoiding risky research in the NIH's approach to science.

Construction Ahead

Anne Sassaman, director of the NIEHS Division of Extramural Research and Training, points out two Roadmap initiatives that she believes will figure especially prominently on the NIEHS radar. One is Metabolomics Technology Development, which falls under the New Pathways to Discovery theme and is led by the National Institute of Diabetes and Digestive and Kidney Diseases. This initiative will develop tools to measure concentrations of carbohydrates, lipids, amino acids, and other metabolites within single cells. The resultant data will enable researchers to better understand the cellular metabolome—the collection of all metabolites and their activities, under both normal and diseased states.

Metabolomics is the ultimate step forward from gene expression, Sassaman explains, placing the field squarely in the context of gene–environment interactions, which are addressed at the NIEHS, in particular at the institute's National Center for Toxicogenomics, where scientists study how environmental pollutants and the genome interact to produce disease.

A second initiative, Interdisciplinary Research Centers, falls under the Research Teams of the Future theme and is led by the National Center for Research Resources. This initiative will create interdisciplinary programs that address significant and complex biomedical problems, particularly those that may resist more traditional research approaches. Because environmental health is largely interdisciplinary, combining toxicology, epidemiology, and other related specialties, the NIEHS will benefit from NIH efforts to promote cross-training among scientists with divergent backgrounds, Sassaman says.

But the NIEHS is by no means limited to these two initiatives. According to Allen Dearry, associate director for research coordination, planning, and translation at the NIEHS and the institute's Roadmap liaison, opportunities for the NIEHS exist within each of the 27 initiatives. "All Roadmap initiatives are relevant to the NIEHS extramural community," he says. "Furthermore, NIEHS staff contributed directly to many of these Roadmap initiatives, including those related to clinical research."

Finding New Direction

What the Roadmap does not explicitly provide, some experts say, are specific references

to disease prevention. David Eaton, who is associate dean for research at the University of Washington School of Public Health and Community Medicine and director of the university's Center for Ecogenetics and Environmental Health, says this could be a problem for institutes (such as the National Cancer Institute and the NIEHS) that have focused substantial portions of their research portfolios on prevention-based strategies.

Although many Roadmap initiatives are relevant to the NIEHS, says Eaton, it is less clear where more traditional prevention-based research projects will fit into the plan. "Any institute that continues to pursue prevention-based research might have a harder time justifying their budgets if their activities aren't consistent with the Roadmap," he says. This is unfortunate, he adds, because "from a public health perspective, it can be more effective to prevent a disease from happening than to treat it after it's formed."

However, Eaton and other stakeholders do note that support for disease prevention is implied in many parts of the document. Dearry, for instance, points out that technologies developed as part of New Pathways to Discovery will enhance the creation of biomarkers and disease indicators, which he says apply to prevention research. "A lot of people are worried because they don't see words like 'prevention' or references to specific diseases like cancer in the Roadmap," Olden adds. "But nothing in the Roadmap is institute-specific, nor should it be. The focus is not on specific diseases but on an understanding of disease mechanisms. We want to understand how biological systems function; these principles will apply to all diseases."

Olden says the NIEHS is well positioned to take advantage of the Roadmap's emphasis on systems biology as well as interdisciplinary and translational research. Ongoing NIEHS research in toxicogenomics and bioinformatics applies in this context, he says. So do the existing interdisciplinary research centers on breast cancer and child health. "We will continue to do exactly what we've been doing," Olden says. "It's not so much about predicting the orientation of a new NIH director. It's about anticipating where science is going and making sure you're in the right place and hopefully ahead of the pack." **–Charles W. Schmidt**

For more information on the NIH Roadmap for Medical Research, visit **http://www.nihroadmap.nih.gov/**

Welcome to Hydroville!

beyond the BENCH

You won't find Hydroville on any map of Oregon. Yet the town is one of the most important factors in the improved science and environmental education being offered to many Oregon high school students. Hydroville is a fictitious town, but its residents face some very real problems, and that's where the learning comes in.

It's all part of an innovative project called the Hydroville Curriculum Project. Funded by the NIEHS, the Oregon State University (OSU)–based project aims to improve the overall academic performance of high school students by letting them delve into some real-life problems. "There is quite a bit of misinformation out in the public about the risks to human health from environmental exposures to chemicals. Through the Hydroville project, we are helping students to understand the basic concepts of environmental health science so that students can use scientific data to evaluate environmental health risks," says Nancy Kerkvliet, director of outreach and education for the OSU Environmental Health Sciences (EHS) Center and principal investigator for the Hydroville project.

The environmental health science scenarios in Hydroville are based on real events that have taken place in Oregon and elsewhere during the last few years—a pesticide spill, an outbreak of a mysterious illness, unacceptable indoor air quality, and a problem with water quality. Tackling these problems are high school students in OSU's Science and Math Investigative Learning Experiences (SMILE) program and in 12 pilot high schools in Oregon. Working with the students are scientists and educators from the EHS Center as well as the university's Marine/Freshwater Biomedical Sciences Center and Department of Public Health. Other educators from the Oregon Department of Education provide expertise in state and national standards, and curriculum adaptation.

So, what do the students actually do? In working through the pesticide spill scenario, they broke into groups to investigate an outbreak of illness in Hydroville. One group assumed the role of public health physicians, investigating the onset of illness and the symptoms of the victims, many of whom lived in the same apartment complex. Another group took on the role of epidemiologists, determining whether the apartment residents had been present when an organophosphate chemical was sprayed to stop a flea infestation. An industrial hygienist group collected samples from toys, clothes, and carpets and used gas chromatography to study the different levels of pesticide concentration. Still another group of students worked as toxicologists, testing pets for enzyme levels that would indicate pesticide exposure.

"This really is an entirely new approach to educating students about real-life problems," says SMILE director Eda Davis-Butts. "The students attack the problems as if they were real, using appropriate scientific methods and equipment. It not only gets them interested in environmental health sciences, it makes them much more aware of the world around them." **–Mark Floyd**

Teaming up to learn. High school students work together using scientific methods to unravel environmental mysteries based on real-life scenarios.

Hydroville Curriculum Project