

### About the National Institutes of Health

The National Institutes of Health (NIH), the world's top medical research center, is charged with addressing the health concerns of the nation. The NIH is the largest U.S. governmental sponsor of health studies conducted nationwide.

Simply described, the NIH's goal is to acquire new knowledge to help prevent, detect, diagnose, and treat disease and disability, from the rarest genetic disorder to the common cold. The NIH works toward that goal by conducting research in its own laboratories in Bethesda, Maryland and at several other locations throughout the United States; supporting the research of nonfederal scientists throughout the country and abroad; helping to train research investigators; and fostering communication of medical information to the public.

### The NIH Supports Research

A principal concern of the NIH is to invest wisely the tax dollars entrusted to it for the support and conduct of medical research. Approximately 82 percent of the investment is made through grants and contracts supporting research and training in more than 2,000 universities, medical schools, hospitals, and research institutions throughout the United States and abroad.

Approximately 10 percent of the budget goes to more than 2,000 projects conducted mainly in NIH laboratories. About 80 percent covers support costs of research conducted both within and outside the NIH.

### NIH Research Grants

To apply for a research grant, an individual scientist must submit an idea in a written application. Each

### The Mission of the National Institute of Environmental Health Sciences: Preventive Medicine

Preventing disease is one of the most important services a government agency can provide to citizens. Protecting people from avoidable illness and death saves money, spares suffering, and improves the quality of life for society.

The most effective way to prevent disease and disability is to understand the cause of an illness and change the conditions that permit it to occur. A key strategy for preventing many diseases or minimizing disease progression is to minimize or eliminate adverse effects of chemicals in the environment and food supply. This preventive strategy underlies the concept of "environmental health." The premier research facility for this discipline in the United States is the National Institute of Environmental Health Sciences (NIEHS) of the National Institutes of Health (NIH). NIEHS is headquartered in Research Triangle Park, North Carolina, but much of the NIEHS-supported research is conducted at universities, independent laboratories, and Centers across the country.

The NIEHS is unique within the National Institutes of Health because its primary focus is to prevent disease rather than to find ways to treat illnesses already afflicting people. The Institute does this by approaching health as an integrated response of all organ systems of the body to the environment. Areas of special interest to NIEHS are cancer, birth defects, asthma, diabetes, infertility, neurodegenerative and developmental disorders, and autoimmune disease. Thus, rather than focusing on one or two specific organs, like the heart or liver, the NIEHS takes a holistic approach to human health and a preventive approach to medicine.

This focus on preventive medicine reflects the findings of national surveys, which repeatedly find that environmental health is one of the top priorities of the American public. Americans believe that reducing exposures to adverse environmental agents is the best way to protect their health and the health of their children. This belief is supported by a continually growing base of knowledge suggesting that environmental chemicals may be important triggers of many human medical problems such as:

- cancer
- autoimmune diseases
- Parkinson's disease
- neurodegenerative disorders
- birth defects
- asthma
- heart disease

application undergoes a peer review process. A panel of scientific experts, who are active researchers in the medical sciences, first evaluates the scientific merit of the application. Then, a national advisory council or board, composed of eminent scientists as well as members of the public who are interested in health issues or the medical sciences, determines the project's overall merit and priority. Because funds are limited, the process is very competitive.

### **The Nobelists**

The rosters of those who have conducted research, or who have received NIH support over the years, include some of the world's most illustrious scientists and physicians. Among them are 101 scientists who have won Nobel Prizes for achievements as diverse as deciphering the genetic code and learning what causes hepatitis.

Five Nobelists made their prize-winning discoveries in NIH laboratories: Doctors Christian B. Anfinsen, Julius Axelrod, D. Carleton Gajdusek, Marshall W. Nirenberg, and Martin Rodbell.

### **Impact of the NIH on the Nation's Health**

The research programs of the NIH have been remarkably successful during the past 50 years. NIH-funded scientists have made substantial progress in understanding the basic mechanisms of disease and have vastly improved the preventive, diagnostic, and therapeutic options available.

During the past few decades, NIH research played a major role in making possible achievements like these:

- Mortality from heart disease, the number one killer in the United States, dropped by 36 percent between 1977 and 1999.
- Improved treatments and detection methods increased the relative five-year survival rate for people with cancer to 60

- diabetes
- learning and behavioral disorders
- kidney disease
- infertility
- uterine fibroids
- osteoporosis
- low birthweight

A major component of NIEHS research investigates how exposures to specific agents, such as an agricultural compound or a water contaminant, affect health. The Institute conducts and supports such studies both in whole animals in the laboratory as well as by doing epidemiologic studies of the occurrence of the disease and relevant environmental exposures in humans. This work gives valuable insight into the potential of certain environmental agents to cause specific diseases or disabilities. In turn, this insight can lead to an improved understanding of the underlying mechanisms by which these agents act. The studies are further complemented by research that identifies early markers of exposure or disease, called biomarkers, that can potentially be used as early warning systems in clinical practice.

### **How NIEHS Does Its Work: Understanding the Human Body in Health and Disease**

The substantial long-term commitment the United States has made to funding biomedical science has led to significant improvement in our understanding of the nature of disease at the cellular and molecular levels, and it has provided researchers with extraordinary tools for unraveling the secrets of the genetic basis of disease and genetic susceptibility to disease-causing agents.

NIEHS is using and extending this information to make further advances in the area of environmental health, especially in improving our understanding of the very early molecular events that begin the disease process. Thus, a large part of NIEHS research is devoted to understanding the fundamental biological processes that maintain life and how environmental agents can adversely affect these processes and set the stage for disease and disability.

In essence, an important goal of NIEHS is to describe the first of what can be thought of as a three-stage disease process:

- Stage 1: Initial "trigger," or initiating event, that can be environmental in origin.
- Stage 2: Progression of cellular and molecular events that are set in motion by the trigger.
- Stage 3: Clinical signs that lead to diagnosis and treatment of disease.

The key to prevention is successful intervention at Stage 1, before the disease process gets under way. However, much of biomedical research has

percent.

- With effective medications and psychotherapy, the 19 million Americans who suffer from depression can now look forward to a better, more productive future.
- Vaccines protect against infectious diseases that once killed and disabled millions of children and adults.
- In 1990, NIH researchers performed the first trial of gene therapy in humans. Scientists are increasingly able to locate, identify, and describe the functions of many of the genes in the human genome. The ultimate goal is to develop screening tools and gene therapies for the general population for cancer and many other diseases.

### **Educational and Training Opportunities at the NIH**

The NIH offers myriad opportunities including summer research positions for students. For details, visit <http://science-education.nih.gov/students>.

For more information about the NIH, visit <http://www.nih.gov>.

### **The NIH Office of Science Education**

The NIH Office of Science Education (OSE) is bringing exciting new resources free of charge to science teachers of grades kindergarten through 12. OSE learning tools support teachers in training the next generation of scientists and scientifically literate citizens. These materials cover information not available in standard textbooks and allow students to explore biological concepts using real world examples. In addition to the curriculum supplements, OSE provides a host of valuable resources accessible through the OSE Web site (<http://science-education.nih.gov>), such as:

- **Snapshots of Science and Medicine.**<sup>2</sup> This online

concentrated on Stage 3, diagnosis and treatment. While more is now being learned about Stage 2—the molecular and cellular events leading to disease—relatively little is known about Stage 1, the initiation of the cascade of cellular and molecular events that start the disease process. Yet this first stage is the most important one for successful disease prevention and intervention.

Further complicating our understanding of the environmental causes of disease is the fact that individuals can differ in their susceptibility to environmental agents. Some people can detoxify potentially dangerous compounds rapidly because their bodies have enzymes that break down these chemicals quickly. However, other people's bodies may detoxify the same agents much more slowly. Consequently, they remain exposed to these potential dangers for a longer time.

Likewise, the ability of the body to repair environmental damage to genetic material varies from person to person. In addition, the level of toxicity of a particular environmental agent can vary depending on the time of life during which exposure occurred. For example, some agents may be particularly damaging during fetal development or infancy.

In sum, the following elements make up a person's "risk profile" for any potential environmental health hazard:

- Exposure to environmental agents such as chemicals and microorganisms.
- Specific time at which exposures occur.
- Underlying individual susceptibility to these environmental agents.

This complex interaction of risk factors and individual susceptibility increases or decreases the risk of disease in an individual while obscuring the contribution of any specific factor. However, new technologies and knowledge developed during the past several decades will help researchers tease apart these different elements as they relate to specific diseases.

Understanding the nature of this differing susceptibility is especially important for enhancing our ability to identify environmental triggers of disease whose effects on health vary depending on the individual. Without such an understanding, an important source of disease could easily be obscured in studies that are not designed to account for individual levels of response. By defining the components of enhanced susceptibilities, NIEHS enables risk managers to make decisions that protect our most vulnerable citizens.

magazine—plus interactive learning tools—is designed for ease of use in high school science classrooms. Three issues, available for free, are published during the school year. Each focuses on a new area of research and includes four professionally written articles on findings, historical background, related ethical questions, and profiles of people working in the field. Also included are a teaching guide, classroom activities, handouts, and more. (<http://science-education.nih.gov/snapshots>)

- **Women Are Scientists Video and Poster Series.**<sup>3</sup> This series provides teachers and guidance counselors with free tools to encourage young women to pursue careers in the medical field. The informative, fullcolor video and poster sets focus on some of the careers in which women are currently underrepresented. Three video and poster sets are now available: *Women are Surgeons*, *Women are Pathologists*, and *Women are Researchers*. (<http://science-education.nih.gov/women>)
- **Internship Programs.** Visit the OSE Web site to obtain information on a variety of NIH programs open to teachers and students. (<http://scienceeducation.nih.gov/st>)
- **National Science Teacher Conferences.** Thousands of copies of NIH materials are distributed to teachers for free at the OSE exhibit booth at conferences of the National Science Teachers Association and the National Association of Biology Teachers. OSE also offers teacher-training workshops at many conferences. (<http://science-education.nih.gov/exhibits>)

In the development of learning tools, OSE supports science education

In addition to contributing to the creation of new environmental health knowledge, the NIEHS also serves the public by empowering individuals and communities to manage, and reduce, their environmental problems. These programs include

- Grants to support university-community partnerships that address local environmental health issues.
- Outreach activities required by NIEHS of academic research institutes it supports.
- Communication tools such as the NIEHS journal, *Environmental Health Perspectives*.

### **Environmental Medicine: The 21st Century's Hope for Health**

The major health wish of the American people is to prevent disease and disability, rather than being burdened with the cost and pain of treatment. Clearly the 20th century, with its soaring health costs and elaborate surgical techniques, fell short of this desire.

The 21st century may bring a new dawning to preventive medicine, particularly in the area of environmental medicine. Environmental medicine is the linking of environmental agents to actual diseases and disorders. The core principle of environmental medicine is that it is far better to **prevent** disease than to have to treat disease and that this prevention can best be accomplished through minimizing adverse environmental effects.

The NIEHS provides the sound scientific foundation for defining the health effects of a broad array of environmental agents. Translating these findings into effective prevention strategies requires that NIEHS communicate its discoveries to federal regulatory agencies such as the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA) and to public health agencies such as the Centers for Disease Control and Prevention (CDC). These organizations in turn use this information to calculate new standards to protect health. This information is also the scientific basis for many laws passed by the U.S. Congress to protect the health of U.S. citizens.

The NIEHS is committed to promoting and protecting the health of the American people. The Institute has managed to achieve excellence in science and to generate the good science needed for use in environmental health regulatory policy. Recent examples include EPA's new air quality standards for particulate matter and CDC's lowering of the action level for blood lead. These achievements required forward-thinking leadership, good management, openness and consensus building, and public-private partnerships.

reform as outlined in the *National Science Education Standards* and related guidelines.

We welcome your comments about existing resources and suggestions about how we may best meet your needs. Feel free to send your comments to us at <http://science-education.nih.gov/feedback>.

2, 3 These projects are collaborative efforts between OSE and the NIH Office of Research on Women's Health.

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Numerous scientific opportunities now exist to vastly improve the relevance and timeliness of environmental health information. The foundation is laid, and a new era of informed preventive care awaits only the fruition of research and education being carried out by NIEHS.

For more information about NIEHS, please visit our Web site at <http://www.niehs.nih.gov/>.