

The Brain: Understanding Neurobiology

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 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

About the National Institute on Drug Abuse

The National Institute on Drug Abuse (NIDA), one of the research institutes that make up the National Institutes of Health, was established in 1974 as the Federal focal point for research, treatment, prevention and training services, and data collection on the nature and extent of drug abuse. NIDA's mission is to lead the Nation in bringing the power of science to bear on drug abuse and addiction. This charge has two critical components. First, NIDA supports and conducts research across a broad range of disciplines to explore the biomedical and behavioral foundations of drug abuse. Second, NIDA ensures that the results of research are rapidly and effectively disseminated so that the scientific findings can be used to improve drug-abuse and addiction prevention, treatment, and policy.

NIDA is the world's leading supporter of research on the health aspects of drug abuse and addiction. NIDA-supported science addresses the most fundamental and essential questions about drug abuse, ranging from the molecule to managed care, and from DNA to community outreach research. When NIDA was founded, many people incorrectly viewed drug abuse as a problem of people with character flaws and weak wills. Today, thanks to the research accomplishments of hundreds of scientists, those simplistic ideologies are being replaced by a better understanding of the complex biological, behavioral, social, and public health aspects of drug abuse. Scientists have shown that while initial experimentation with drugs may be voluntary, continuing drug abuse changes the brain in fundamental and long-lasting ways. These brain changes trigger the compulsive drug-seeking and drug-taking behaviors that are the hallmarks of drug addiction. NIDA's scientists have clearly shown that drug abuse is a preventable behavior and drug addiction is a treatable brain disease. Among the many and diverse accomplishments over the past three decades, NIDA-supported research has:

- identified the molecular sites in the brain where every major drug of abuse—opiates, cocaine, PCP, and THC (the active ingredient in marijuana)—has its initial effect. These discoveries, together with computer-aided drug design, are paving the way to the development of novel medications to break the cycle of addiction.
- produced a neurobehavioral model to explain drug-taking behavior to improve treatment and rehabilitation methods.
- supported the development of two medications, LAAM and naltrexone, through the approval process by the FDA for the treatment of opiate addiction.
- supported the development and evaluation of

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 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

pharmacologic treatment for newborns withdrawing from exposure to narcotics.

- defined nicotine addiction and the scientific basis for therapy using nicotine gum and skin patches.
- pioneered innovative community-based research on AIDS-prevention efforts that showed that drug users will change AIDS risk behaviors, which can reduce their susceptibility to HIV infection and AIDS.
- demonstrated that participation in methadone treatment significantly reduces HIV seroconversion rates and decreases high-risk behaviors.
- demonstrated that successful drug-abuse treatment reduces criminality as well as relapse to addiction.
- demonstrated the value of treating drug abusers' depression and other mental disorders to improve the results of addiction therapy.
- measured the positive impact of comprehensive research-based community drug-prevention strategies that involve the media, schools, families, neighborhoods, and the workplace.
- used advanced imaging techniques to identify in awake humans the specific brain circuits that are involved in craving, euphoria, and other sequelae of drug addiction. These exciting studies will provide the foundation for the development of new, targeted medications to block individual aspects of drugs.
- used molecular genetic technologies to clone the genes for the major receptors for virtually every abusable drug, thus providing scientists with the tools necessary to study in fine detail how drugs of abuse exert their many behavioral effects.
- produced genetically engineered animals in which a particular drug receptor had been eliminated, or "knocked out." These animals are providing unprecedented insight into how drugs exert their many effects in the brain and produce addiction.
- demonstrated that prenatal exposure to cigarettes and marijuana have long-term effects on cognitive performance.
- successfully immunized rats against the psychostimulant effects of cocaine, thus opening up the possibility of developing a vaccination against cocaine addiction.

The results of these and other achievements through NIDA-funded research offer this country's best hope for solving the medical, social, and public health problems of drug abuse and addiction.

The need for greater knowledge of drug abuse continues to grow. Ever-changing drug use patterns, the continuing transmission of HIV infection among drug abusers, and the need to develop new and effective treatment and prevention methods underscore the importance of research in finding new and better ways to alleviate the

<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:

- **Women Are Scientists Video and Poster Series.**² 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://science.education.nih.gov/students>)
- **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 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 This project is a collaborative effort between OSE and the NIH Office of Research on Women's Health.

pain and devastation of addiction. NIDA's goals for the future include:

- to design and develop new medications for opioid and cocaine addiction, especially for use during pregnancy, by building on the recent molecular discoveries that have uncovered the basis for addiction in the brain.
- to develop techniques to detect subtle effects of drug exposure in children of drug-using parents to provide opportunities for early preventive or clinical intervention.
- to broaden research on women and addiction to determine the biological and behavioral differences that need to be addressed in effective drug-abuse prevention and treatment.
- to reduce the spread of HIV infection through improved drug-abuse interventions and better understanding of the interactions of drugs of abuse and the body's immune system.
- to apply state-of-the-art neuroimaging techniques to the problems of drug-abuse prevention and treatment.
- to design, develop, and test new behavioral therapies and promote their use for appropriate patient populations.
- to study the treatment of special clinical problems presented by drug abusers with HIV, tuberculosis, hepatitis, and other infections.
- to understand the organization and financing of drug abuse treatment and its benefits to the larger health care system.
- to identify the protective and resiliency factors that prevent drug use in those individuals with multiple risk factors so more effective prevention techniques can be developed.
- to strengthen the research infrastructure, by providing additional opportunities for research training and career development for clinical researchers and improved mechanisms for training and mentoring of minority researchers.
- to expand the use of scientific information to educate the public about the real nature of drug abuse and addiction and the hope and promise for more effective prevention and treatment.
- to broaden the dissemination of research findings and improve drug-abuse prevention and treatment practice and policy.