

# Linking Research to Healthy Living



NATIONAL PRIMATE RESEARCH CENTERS



We are **fortunate** we no longer  
that were the main cause of childhood

# have to fear serious diseases and death only a century ago.

Despite remarkable medical advances of the last 100 years, many serious illnesses remain without cures, and newly discovered diseases threaten our health. Alzheimer's, AIDS, cystic fibrosis, Lou Gehrig's disease, Lyme disease, sickle cell anemia, to name just a few, still present formidable challenges to researchers.

Laboratory animals are an indispensable part of biomedical research, and their contributions to increased understanding of health and disease are well known. Basic research with animal models, which accounts for nearly half of the biomedical investigations carried out in the United States, is an essential step in a continuum that progresses to applied research and then to clinical trials in humans. Nonhuman primate models often provide a critical link between research with small laboratory animals and studies involving humans.



## Because of nonhuman primate research:

- Vaccinated children and adults are protected from polio.
- One million insulin-dependent diabetics are living longer, fuller lives.
- Thousands of people benefit from coronary bypass surgery every year.
- Nearly 38 million Americans with high blood pressure have reduced risk of heart attack, stroke and kidney failure.
- More than 200,000 Americans who have received hip replacements are no longer confined to wheelchairs.
- More than a million people who undergo cataract surgery each year are able to see.
- Thousands of patients with renal failure live longer because of kidney dialysis or kidney transplants.
- Hundreds of thousands of people disabled by stroke or head injury benefit from rehabilitation.
- People with severe depression, bipolar disorder and other psychiatric illnesses lead better lives because of improved medications.
- Millions of children receive better prenatal and postnatal care and are protected from common infections.



## A national resource

The eight National Primate Research Centers (NPRCs) constitute a network of unique research institutions that provide important scientific resources for advancing biomedical knowledge and improving human health. Established by Congress in the early 1960s, the NPRCs have become repositories of scientific expertise, specialized facilities and equipment for research with nonhuman primates.

Funded by grants through the National Center for Research Resources of the National Institutes of Health, the NPRCs develop nonhuman primate models for basic and applied studies of human health and disease. The similarity of nonhuman primates to humans in genetic makeup, behavior and organ system function provides irreplaceable opportunities to understand, prevent and treat human disease. Each NPRC is an integral part of its host academic institution and maintains a faculty of core scientists. The centers also serve as resources to hundreds of affiliated and visiting scientists from every part of the United States, many of whom are supported by grants from the National Institutes of Health. They also welcome investigators from around the world. Conscious of their teaching mission, they train new generations of graduate students, postdoctoral fellows and veterinarians to meet the challenges of biomedical research in the future.

1. Washington National Primate Research Center  
Seattle, Washington
2. Oregon National Primate Research Center  
Beaverton, Oregon
3. California National Primate Research Center  
Davis, California
4. Southwest National Primate Research Center  
San Antonio, Texas
5. Tulane National Primate Research Center  
Covington, Louisiana
6. Yerkes National Primate Research Center  
Atlanta, Georgia
7. New England National Primate Research Center  
Southboro, Massachusetts
8. Wisconsin National Primate Research Center  
Madison, Wisconsin

In 2001, PRC scientists conducted 682 collaborative projects in 42 states.





*Round-the-clock care, nutritious food, fruit and treats, controlled temperatures, pair or group housing for most animals, environmental enrichment, regular medical and dental care and prenatal/post-natal services are all part of animal care.*



## Laboratory animal care

The humane care and appropriate use of laboratory animals is a high priority of the NPRCs. Animals at all the centers live in facilities inspected by the USDA and accredited by the Association for Assessment and Accreditation of Laboratory Animal Care, International. Center researchers, veterinarians and animal caretakers are responsible for the care and well-being of some of the world's largest nonhuman primate breeding colonies.

State-of-the-art veterinary medicine is practiced at every NPRC. Diagnostic procedures, surgical techniques and special treatments ensure the health of each center's colony. Center veterinarians train specialists in laboratory animal medicine and lecture at schools of veterinary medicine throughout the country.

*Scientists study monkey versions of AIDS, such as the simian retrovirus (artistic concept below) and other infectious diseases in the quest for finding vaccines.*



## Vaccines for **infectious diseases**

- Scientists face major challenges in their quest to develop a vaccine for human immunodeficiency virus (HIV), the agent that causes AIDS. Biomedical researchers at the NPRCs depend heavily on monkeys to develop treatments that may someday protect people from this epidemic. Promising vaccine approaches are being tested in monkeys, and some have already advanced to clinical trials.
- NPRC researchers are overcoming obstacles in developing a vaccine against malaria, a disease that affects millions of people every year. New World monkeys are used in vaccine studies because they are susceptible to the same parasites that cause human malaria. A number of promising vaccines have successfully stimulated protective responses in monkeys and may soon be ready for clinical trials.
- Chimpanzees are uniquely susceptible to human hepatitis infections and serve as an indispensable model for this global health problem. Research with chimpanzees at the NPRCs has led to vaccines that protect an increasing number of people from hepatitis B and the cirrhosis and liver cancer that it causes. Chimpanzees have also played an important role in the discovery and cloning of the hepatitis C virus and in the development of assays to essentially eliminate the risk of its transmission through blood transfusions. Ongoing efforts to develop a vaccine and better antivirals for hepatitis C are dependent on testing in chimpanzees.
- The NPRCs, with their scientific expertise in bacterial and viral diseases and specialized facilities for studying infectious agents, are a valuable resource in the nation's new war on bioterrorism.





*Left: Monkeys 25 to 30 years old, seldom found in the wild, are invaluable in studying biological and cognitive changes that occur in aging.*

*Right: PET scans show healthy levels of dopamine neurons (first panel) and levels found when Parkinson's disease is present (second panel). NPRC researchers are working to cure Parkinson's disease by transplanting embryonic stem cells.*



## Cures for **diseases of the brain**

- The decline of mental function in patients with Alzheimer's disease is associated with the loss or damage of specific nerve cells. Age-related reduction in the functions of these nerve cells also occurs in monkeys. NPRC scientists have shown that grafting genetically modified cells directly into the brains of monkeys is a safe procedure that can help restore cell function. These techniques are now being extended to humans in an attempt to slow the decline of mental function in Alzheimer's patients.
- Parkinson's disease is a slow, progressive disease characterized by tremors, muscular rigidity and loss of motor function. Scientists know that the disease is associated with degeneration of brain cells that produce the chemical messenger dopamine. NPRC scientists recently developed a new method for delivering a gene that helps protect monkey brain cells. The treatment successfully prevented the progression and reversed the symptoms of Parkinson's disease.

*Below: People with mental illness lead happier, more productive lives and premature infants receive better nutrition thanks to primate research.*



## Models for **diabetes and obesity**

- Diabetes is a disease that affects the body's ability to produce insulin, a hormone that allows blood glucose (blood sugar) to enter the cells of the body and be used for energy. Diabetes can now be treated with insulin shots, often administered by the patient. A critical need exists to develop and characterize nonhuman primate models of this disease. These models will allow scientists to study the genetic and molecular mechanisms of diabetes, identify specific molecular and cellular targets for therapy, and test new therapeutic interventions.
- As part of a national effort to address the epidemic of obesity, scientists at the NPRCs are studying the mechanisms that regulate food intake and energy balance. They are also studying the effects of diet on the biology of aging. Studies in rhesus monkeys have shown that a reduction in calories over a period of several years lowers the risk of cardiovascular disease and reduces predisposition toward diabetes.

## Treatments for **mental disorders and addiction**

- Anxiety and attention deficit hyperactivity disorder (ADHD) are among the most frequently diagnosed of all neuropsychiatric disorders. Although many people can be treated with conventional medications, these drugs often have unwanted side effects. Primate center scientists are making important contributions to our understanding of the biological basis and treatment of these debilitating illnesses.
- NPRC scientists were among the first to document a link between cocaine's addictive properties and its ability to enhance transmission of dopamine in the brain. Currently, they are exploring the consequences of prenatal exposure to cocaine and investigating the potential of new medications to counteract cocaine addiction.
- Although depression affects both sexes, women are twice as likely as men to be affected. Studying certain brain cells found in nonhuman primates and humans alike has allowed primate center scientists to identify the way reproductive hormones and their receptors control mood. This research may lead to better treatments for depression in women.



*Above: Just a few decades ago, children born with Down's Syndrome and diabetes or other complications would not have been expected to live past their teens. Today, thanks to basic research with nonhuman primates, most of these children are now adults living healthy, productive lives.*

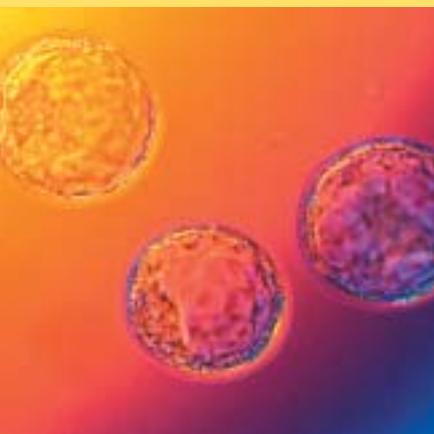


## Improvements in **women's health**

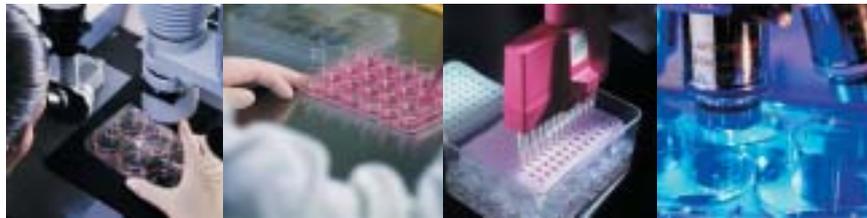
During the past decade, expanded research on women's health issues at the NPRCs has generated important new information about diseases that largely affect women.

- Women undergo more significant biological changes than men — the onset of menstruation, pregnancy, parturition, lactation and menopause. Despite living an average of seven years longer than men, women suffer poorer health outcomes and greater disability caused by complications from pregnancy and childbirth, osteoporosis, and breast, cervical and ovarian cancers. Nonhuman primate research has made progress in finding treatments and cures for these complications and diseases.
- Endometriosis is a gynecological condition that affects an estimated five million American women in their reproductive years. It occurs when the tissue that normally lines the uterus and is shed during menstruation is found growing outside the uterus. The abnormal adhesions can be removed through surgical techniques developed through research with nonhuman primates.
- Polycystic ovary syndrome (PCOS) causes infertility and can be life threatening. Women with PCOS are also at high risk for obesity and diabetes. Scientists at the NPRCs have created a primate model of PCOS and are studying ways to better treat the disease.

*Nonhuman primate models are helping researchers discover the causes and treatments of problems that are unique to women, such as miscarriage, endometriosis and polycystic ovary disease.*



*The NPRCs are committed to improving the health of people around the world. Their contributions depend on state-of-the-art facilities and technologies.*



## Advances in **genetic medicine**

Modern biotechnologies are providing a better understanding of how our bodies function, and can now offer real hope for conquering many previously incurable illnesses. Powerful techniques enable scientists to pinpoint the thousands of single gene disorders that affect over 2.5 million people, as well as many major diseases that have a genetic factor, such as heart disease, cancer, asthma, diabetes and Alzheimer's disease.

New technologies being perfected at the NPRCs will enable scientists to produce genetically similar animals, which will result in better experimental results and reduce the number of animals needed in research.

Nonhuman primate models are crucial for understanding the biological basis and potential treatments for genetic disorders in people. They are especially valuable in allowing the study of rare genetic diseases. Most genetically modified animals are mice, but because genetically modified monkeys can reveal a broader range of clinical symptoms, they will become an essential bridge between laboratory studies in mice and clinical trials in humans.

NPRC scientists are already playing a leading role in developing techniques for curing disease by replacing defective genes. Gene therapy treatments, which treat the sources rather than symptoms of disorders, will likely be used extensively in human medicine within the next few decades.



business card holder



**Among their many contributions NPRC scientists are working on:**

- New surgical procedures to repair congenital heart defects
- Finding a cure for diabetes
- Safe and effective vaccines against AIDS and other infectious diseases
- Restoring function to paralyzed victims of spinal cord injuries
- New treatments for multiple sclerosis
- Better understanding and treatment of psychiatric illness
- Cancer prevention and treatment
- Finding a cure for sickle cell anemia
- Identifying the causes of alcoholism and drug addiction
- Learning the cause of Alzheimer's disease
- Finding a cure for Parkinson's disease
- New treatments for asthma and pulmonary fibrosis
- Developing new drugs to treat heart disease
- Improving immunotherapy treatments following transplant surgery

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