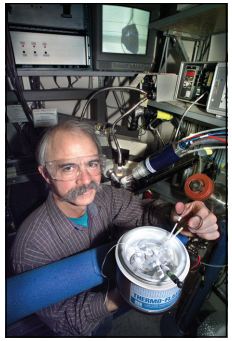
Main Facilities

Brookhaven National Laboratory has unique facilities for studying the structures of biological molecules and investigating their functions.



- The National Synchrotron Light Source generates high intensity x-ray, ultraviolet, and infrared light, which can be used to probe the structures and inner workings of biological molecules. This facility has helped scientists decipher the structures of proteins on the surface of the Lyme disease bacterium and one form of common cold virus. These findings are expected to help scientists treat diseases and develop new vaccines.
- The Center for Imaging and Neuroscience includes four major imaging instruments: two positron emission tomography (PET) scanners, and two magnetic resonance imaging (MRI) scanners. The imaging facilities are used to investigate the neurological effects of various diseases — including drug addiction, cancer, epilepsy, and multiple sclerosis — as well as aging.
- The Brookhaven Linac Isotope Producer is a unique national resource for the production of many isotopes crucial to nuclear medicine for both research and routine clinical use.
- The Biology Department at Brookhaven has built a unique Scanning Transmission Electron Microscope to investigate the intricate details of tissues from living beings, ranging from bacteria to humans.
- The Cyclotron Isotope Research Center is a future facility that will develop and produce new medical radioisotopes for diagnostic and therapeutic applications.
- The Booster Applications Facility is a new accelerator jointly developed by NASA and the Department of Energy. Planned for 2005, this facility will greatly expand the nation's ability to study the biological effects of space radiation.

A View of Brookhaven

Brookhaven National Laboratory is a multipurpose research laboratory funded by the U.S. Department of Energy. Located on a 5,300-acre site on Long Island, New York, the Laboratory operates large-scale facilities for studies in physics, chemistry, biology, medicine, applied science, and advanced technology.

Brookhaven's 3,000 scientists, engineers, and support staff are joined each year by more than 4,000 visiting researchers from around the world.

An aerial view of Brookhaven Lab.

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BROOKHAVEN NATIONAL LABORATORY

managed for the U.S. Department of Energy
by Brookhaven Science Associates, a company
founded by Stony Brook University and Battelle

Life Sciences

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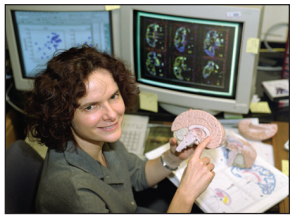
Current Life Sciences Programs

Research activities in the life sciences at Brookhaven National Laboratory have a long and distinguished history of contributions to basic studies on DNA and proteins, the cellular mechanisms that modify them, the development of imaging techniques to investigate human disease, and to biomedical applications based on knowledge resulting from these studies.

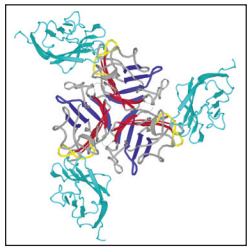
DNA Damage and Repair: Brookhaven biologists study the responses of cells to damaged DNA and the biochemistry and genetics of the mechanisms that repair DNA in bacteria, plants, and animals. New, highly sensitive techniques have been developed to accurately measure DNA damage and its repair.

Sequencing Techniques: Brookhaven's Genome Sequencing Group has developed techniques for sequencing difficult regions of human chromosomes. Using such techniques, the scientists have successfully closed gaps in the sequence of chromosome 19.



Addiction Research: Brookhaven scientists are investigating the mechanisms of addiction to nicotine, cocaine, marijuana, methamphetamine, alcohol, and solvents. By looking at changes in brain chemistry and by learning how drugs cause these changes, the scientists can propose preventive measures and help design new anti-addiction drugs.

Viral Research on the Common Cold Virus:



Brookhaven scientists have investigated how one type of cold virus binds to human cells to infect it. They isolated the parts of the virus that fit into human cell-surface receptors like a key fits inside a lock. This discovery could help scientists devise ways to block the binding of the virus to the human cell.

Plant Research: Brookhaven scientists are redesigning plant enzymes to produce industrial materials and energy sources that are more environmentally friendly than fossil fuels.

New Breast-Imaging Technique: The technique, called diffraction enhanced imaging, can detect and study calcifications in breast tissue. Calcifications are associated with breast cancer, and their early detection is crucial for diagnosis and treatment.

Clostridium botulinum Neurotoxins: These toxins are among the most poisonous known so far. The crystal structure of *C. botulinum* neurotoxin type B, determined by using high-intensity x-rays, has provided insight into its catalytic and binding sites.

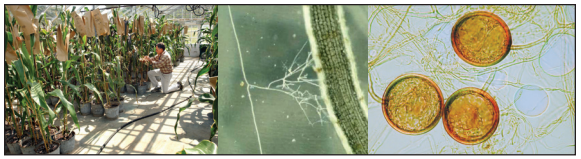
Future Life Sciences Projects

Brookhaven life scientists are participating in various large-scale projects aimed at decoding the human genome; producing new, more efficient radiotracers; understanding the effects of DNA damage by radiation; and developing a large imaging program that integrates complementary imaging technologies.

Cyclotron Isotope Research Center: This center will fulfill the urgent national need for a continuous and reliable supply of present and future radioisotopes for biomedical research, and serve as a training facility for nuclear- and radiochemists.

Biomedical Engineering: This multi-departmental and multi-institutional initiative is aimed at developing technologies for imaging the brain of fully alert animals.

Space Biomedical Research: Brookhaven scientists are refining methods to detect and quantify the biological effects of space radiation. This work will help assess the radiation risks faced by astronauts on long-term space missions, and could help improve the cancer-killing potential of radiation therapy.



Genomes to Life Project: The aim of this multi-institutional initiative is to gain a comprehensive understanding of complex living systems. The scientists will focus on analyzing natural microbial communities associated with the roots of corn and poplar trees — two well-studied plants. These studies are expected to improve human health and may be used to help combat bioterrorism.

Center for the Structure of Complex Proteins: This center will be focused on solving the structure of proteins located in cell membranes. Some of these proteins are targets of many important drugs while others are important in bioremediation, carbon management, and renewable energy.

Cancer Research Center: This initiative will include basic research on cancer-induced DNA damage and repair, diagnosis based on various imaging techniques, and treatment by microbeam radiation and radioisotopes.

Past Successes in the Life Sciences

- Discovery of the radiotracers technetium-99m and thallium-201, which are used worldwide in heart stress tests.
- Use of L-dopa to relieve the symptoms of Parkinson's disease.
- First chemical synthesis of a human insulin.
- Use of the plant *Tradescantia* to monitor potential environmental health hazards.
- Genetic engineering of bacteriophage T7 to make large amounts of proteins used in research, medicine, and industry.
- Determination of the structure of a key protein on the surface of the bacterium that causes Lyme disease.
- Discovery of fluorodeoxyglucose (FDG), a radiotracer used in Positron Emission Tomography (PET) scanning to diagnose cancer, brain disease, and heart disease.