

Overview of Research

The Jackson Laboratory (JAX) is an independent, not-for-profit research institution dedicated to the betterment of human health through genetic research. The research carried out on campus is supported by federal grants and/or private funding awarded to each Principal Investigator (PI). The Laboratory offers its investigators the privilege of conducting basic research and pursuing interesting findings as they arise, often leading to breakthrough discoveries in unexpected directions.

The Jackson Laboratory is home to over 35 PIs conducting research within the scope of mammalian genetics. Eight major areas can be described as the research focus of JAX: cancer; bioinformatics and computational biology; developmental biology; immunology and hematology; metabolic diseases; neurobiology and sensory deficits; genomics; and resource-related research. Many of the PIs' conduct research in more than one category, and virtually all work done at JAX has a basic connection to unraveling the genetic causes of disease.

Cancer:

The Jackson Laboratory was founded in 1929 as one of the first cancer research institutes in the United States. Although the Laboratory has expanded to encompass a variety of interests over the years, characterizing the genetic aspects of cancers and tumor growth remains a research focus today. In fact, JAX is a designated National Cancer Institute Basic Cancer Research Center.

Cancer studies at JAX range from investigating basic immunological pathways and their connection with the disease, to specific mouse models of cancer, including mammary and ovarian cancers, as well as leukemia and AIDS research. Research projects to elucidate the genetic basis of tumorigenesis (tumor development and growth) and metastasis (the spreading of the disease to other parts of the body) are also underway.

Bioinformatics and Computational Biology:

The Jackson Laboratory has expanded its research base over the last ten years, with Bioinformatics and Computational Biology an integral part of that growth. Bioinformatics is the application of computers and databases to the storage and retrieval of biological information, whereas computational biology refers to the development of software applications that address specific biological questions. Our bioinformatics department consists of more than 80 professionals, including PIs, software engineers, database editors, user support, and administrative support staff.

Contributions from JAX to the field of Bioinformatics include two award winning databases: The Encyclopedia of the Mouse Genome, which was a finalist for the 1992 Computerworld Smithsonian Institution award for innovation in information technology; and the Mouse Genome Database (MGD), which was nominated for the 1995 Computerworld Smithsonian award. In addition, one of the first gene expression databases, the Gene Expression Database for Mouse Development (GXD), allows researchers to obtain information about gene expression patterns. We invite you to see these databases in action on The Jackson Laboratory's Informatics Home Page: <http://www.informatics.jax.org>.

Developmental Biology and Aging:

Unraveling the blueprint for mammalian development from conception to death is the focus of several research groups at The Jackson Laboratory. This work falls into three broad categories: fertilization, embryology, and aging. Investigations range from developing culture conditions associated with measuring egg development and in vitro fertilization, to piecing together gene pathways in embryogenesis, to the study of senescence (aging) and the onset of disease associated with old age.

Genomics:

Virtually all the research done at The Jackson Laboratory contains a prominent genetics component. In addition to the study of disease models, there are more academic ventures being pursued in the study of genomics. These range from developing new techniques in molecular biology to Human Genome-related projects to gene mapping and elucidating chromosome structure.

Hematology/Immunology:

The immune system is one of the more dynamic and complex systems in mammals. Genetic pathways and environmental stimuli interact, triggering and maintaining a defense system to guard the health of an entire organism. In conjunction with the immune system, hematopoiesis, or the development of blood cells, is an essential component to maintaining health. The genetic basis for both immune function and hematopoiesis can be studied using defined mouse models for disease.

Dr. George Snell, an immunologist, was instrumental in understanding the genetic bases responsible for organ transplantation. He was awarded the Nobel Prize in 1980 for his groundbreaking work done at The Jackson Laboratory, and is known as the "father of immunogenetics." His work paved the way for others using mouse models to study disease and possible immunological treatments.

Metabolic Diseases:

Researchers at The Jackson Laboratory are investigating different aspects of metabolic disease. Several million people worldwide are affected by obesity, diabetes, atherosclerosis, gallstone formation, hypertension, and glaucoma. Although these diseases are treatable, they still take a toll on society and individuals in terms of health care, emotional, and physical costs. Deciphering the genetic basis for these diseases is the focus for several members of the JAX faculty. Getting at the root of the problem, so to speak, may lead to a cure for these conditions.

Many mouse models exist for a number of these diseases that are similar to the disease states seen in humans. Using breeding schemes, transgenic (introducing a gene or part of a gene into an animal) and knock-out technology (effectively inactivating a gene through genetic manipulation), these models are providing a wealth of information to scientists in the laboratory.

Neurobiology and Sensory Deficits:

It is estimated that thousands of genes are specifically expressed in the mammalian nervous system. Their interactions and pathways are phenomenally complex, ranging from brain development to daily central nervous system function to contributing to psychological states and behavior. Research at The Jackson Laboratory involves discovering gene mutations that can cause debilitating central nervous system diseases. The genetic basis for epilepsy and many other sensory disorders, and elucidating the function of specific cell types in the brain, are foci for JAX investigators.

Research Leads to Resources:

Many resources have emerged from continuing research by JAX investigators, mainly in the realm of genetic resources: gene mapping; animal husbandry and genetic quality control; specialized molecular techniques; cryopreservation; and, of course, providing genetically defined mice. One necessary, and unexpected, corollary of being a mouse "mecca" is an allergy research program investigating new methods of controlling allergy symptoms specific to mouse antigen. In addition to the animal resources and databases available at JAX, the international journal *Mammalian Genome* was born at JAX, and currently publishes articles devoted to molecular biology and genomics. These invaluable resources would not be available to the worldwide research community if it were not for the continuing pursuit of knowledge in genetics and genomics here at The Jackson Laboratory.

In addition to providing the worldwide scientific community with resources, whether they are mice, DNA, or information, continuing research is an essential component for maintaining our resource standard of excellence. Improvements to resources at JAX range from setting standards for techniques like cryopreservation and microinjection, to characterizing new mouse mutants, to developing new and better ways to ensure the health of animal colonies and the humans who care for them.