Biosciences

The Biosciences Division at Oak Ridge National Laboratory (ORNL) advances science and technology to better understand complex biological systems and their relationship with the environment. Research focuses on innovations that support the nation's growing bioeconomy and on scientific challenges in biology for US Department of Energy missions in energy and the environment.

Scientists use high-performance computing (HPC), artificial intelligence, and genomic algorithms to uncover networks of genes that contribute to complex traits critical in bioenergy, climate-resistant crops, human health, and other focus areas. They leverage ORNL's neutron science capabilities to increase understanding of the myriad structures and interactions inside cells. Researchers are examining ways to use biodesign tools to engineer more safe, reliable, and productive ecosystems. Fundamental science discoveries about the human microbiome are helping to inform the development of new diagnostics and treatments for a range of diseases.

Understanding Biological Systems

Our scientists develop new knowledge, tools, and solutions focused on biodesign and systems biology, biocomputing and information, and bioimaging and analytics.

Bioanalytical Mass Spectrometry—Develops and deploys high-performance mass spectrometry techniques for characterization of biomolecules

Biological and Environmental Research Information System—Supports DOE's Biological and Environmental Research program as its primary communications resource

Computational and Predictive Biology—Employs data science, predictive modeling, and HPC to transform biological data into knowledge

Integrative Microbiomics—Combines cellular, molecular, and genomic approaches to study microbes and their interactions with hosts and the environment

Metabolomics and Biomass Characterization—Applies functional genomics and characterization techniques to enhance biomass crop productivity

Molecular and Cellular Imaging—Advances and implements tools to observe biological function in action

Molecular Biophysics—Applies scalable computing and data science to characterize the structure, function, and dynamics of complex biomolecular systems

Plant Systems Biology—Explores the network of genes, proteins, metabolites, and environmental signals that lead to improved plant performance

Synthetic Biology—Develops and applies techniques for biosystems design to solve renewable energy and environmental challenges

“Biosciences span from genes to ecosystems. Our diverse community of scientists employs techniques from exascale computing to microfluidics in enabling biological approaches to environmental sustainability.”

Julie Mitchell, Director, Biosciences Division
Research and Development Centers

Joint Institute for Biological Sciences—The Joint Institute for Biological Sciences is a collaborative research and education effort between the University of Tennessee (UT) and ORNL focused on biomedical research with positive, measurable impacts on health outcomes relevant to the region and the nation. Focus areas include opioid use disorder, Alzheimer’s disease, and cancer.

Center for Bioenergy Innovation—The Center for Bioenergy Innovation (CBI) is harnessing natural diversity and beneficial plant–microbe interactions to create high-performance biomass feedstocks for environmentally friendly, cost-effective, and industrially relevant bioproducts and biofuels. CBI creates value-added coproducts from lignin residues and engineers microbes that consolidate biofuel production processes, thereby increasing efficiency and lowering costs.

Center for Molecular Biophysics—The UT/ORNL Center for Molecular Biophysics performs research at the interface of biological, environmental, physical, computational, and neutron sciences. The goal is to study and understand the function of biologically relevant molecular systems by employing HPC simulations in combination with biophysical experiments.

Advanced Plant Phenotyping Laboratory—A unique high-throughput plant phenotyping system aids the scientific community in connecting plant gene functions to observable traits. The system automates measurement of a range of key plant characteristics using the most diverse suite of imaging capabilities of any system worldwide.

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