OAK RIDGE NATIONAL LABORATORY

Biosciences

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

Understanding Biological Systems

Our scientists enjoy an open, inclusive, and innovative workplace where they apply high-performance computing (HPC) to discover complex genetic traits critical to bioenergy, resilient crops, and more. We use the Laboratory's neutron science capabilities to increase understanding of cell structure and intracell interactions. We develop biodesign tools to engineer safer, more reliable, and more productive plant-microbe systems, and inform development of new disease diagnostics and treatments through fundamental science discoveries.

Bioanalytical mass spectrometry—Developing and deploying high-performance mass spectrometry techniques for characterization of biomolecules

Biological and environmental research information systems—Supporting DOE's Biological and Environmental Research program as its primary communications resource

Biomaterials and biomass characterization—Applying laser and magnetic resonance spectroscopy to characterize the molecular and elemental composition of biomaterials and plant feedstocks

Computational and predictive biology—Employing data science, predictive modeling, and HPC to transform biological data into knowledge

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

Molecular and cellular imaging—Advancing and implementing tools to observe biological function in action

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

Plant systems biology—Exploring the network of genes, proteins, metabolites, and environmental signals that lead to improved plant performance

Synthetic biology—Developing and applying techniques for biosystems design to solve energy security and environmental challenges

1,017
Publications in the past 5 years

123
Staff

10,000-plant
AI-assisted phenotyping system

25 TB
Dataset spanning *Populus* microbiome to ecosystem processes

62
Patents in the past 5 years

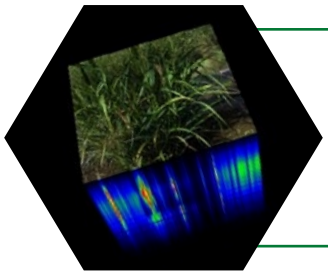
"We push the boundaries of biology to develop transformative solutions that advance biotechnology, resilience, and biosecurity."

—Biosciences Division Director **Jesse Labbé**

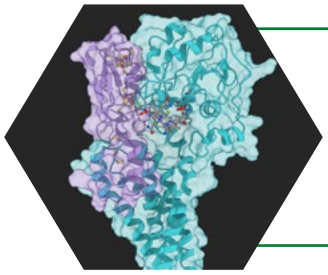
OAK RIDGE National Laboratory
U.S. DEPARTMENT of ENERGY | Office of Science

25-G01183

Center for Bioenergy Innovation—The Center for Bioenergy Innovation (CBI) harnesses natural diversity and beneficial plant–microbe interactions to create high-performance plant feedstocks for environmentally friendly, cost-effective, and industrially relevant bioproducts and sustainable aviation fuel. CBI creates value-added coproducts from lignin residues and engineers microbes and catalysts to increase biofuel production efficiency and to lower costs.



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 one of the most diverse suites of plant imaging capabilities worldwide.



Center for Molecular Biophysics—The University of Tennessee/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.

Recent Impacts

- Developed a method to insert multiple genes into plants in a single step, accelerating plant transformation.
- Created the largest integrated dataset of its kind on the poplar tree microbiome, enabling research linking genes to ecosystem benefits.
- Used AI, bioengineering and quantum biology to improve gene editing tools for microbes that can be used to support biotechnologies.
- Developed a computational method to accelerate the discovery and analysis of fungal metabolites.
- Created a high-throughput method of analyzing moss proteins for clues to the preservation of carbon-rich peatlands using AI and supercomputing.
- Developed the SAGE DNA editing tool to work on virtually any microbe for biofuels production, plastics recycling, and many other applications.
- Invented and helped scale ethanol upgrading technology, with resulting gasoline blendstock approved by the U.S. Environmental Protection Agency.
- Designed a molecule to disrupt the infection mechanism of the SARS-CoV-2 coronavirus that can be used to treat viral disease.

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