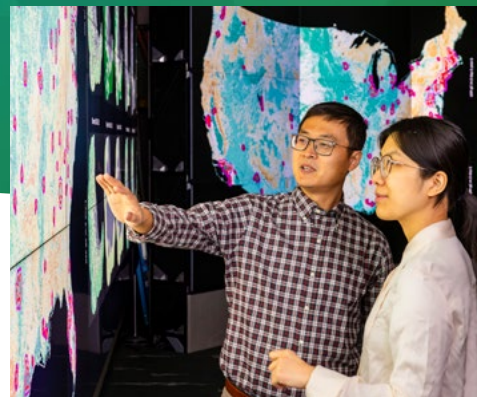




OAK RIDGE NATIONAL LABORATORY

Biological and Environmental Systems Science



Oak Ridge National Laboratory's (ORNL's) Biological and Environmental Systems Science Directorate (BESSD) provides innovative solutions to problems of global significance in energy, environment, and health through collaborative research and advanced technologies.

Our researchers enjoy an open, inclusive, and innovative workplace where they collaborate to advance energy solutions, improve Earth system models, and push the frontiers of systems and synthetic biology. Focus areas include understanding how genes influence ecosystem-level processes; learning more about how biodiversity shapes the world around us; developing novel, secure biodesign tools and test beds for enzyme engineering; applying the world's fastest supercomputers to transform biological and environmental data into solutions; advancing signature technologies for dynamic characterization of complex biological and environmental systems; and applying emerging capabilities that promise to transform how science is done through automated, data-rich, and interconnected systems.

Through our R&D, we support resilient ecosystems, enable competitive economies, and facilitate stewardship of managed and natural resources.

299

Staff

21

Research groups

1,756

Journal publications in the past 5 years

43

Patents in the past 5 years

3

Governor's chairs

"We translate fundamental science discoveries into solutions that support national competitiveness, energy security, and a thriving bioeconomy."

—Associate Laboratory Director **Paul Langan**,
Biological and Environmental Systems Science



Our Research

Environmental Sciences—Our researchers expand scientific knowledge and develop innovative strategies and technologies that help sustain Earth's natural resources.

Biosciences—Our scientists advance knowledge discovery and develop technology to characterize and engineer complex biological systems that benefit the environment and our bioeconomy.

Systems Science at Every Scale

BESSD is home to the US Department of Energy's (DOE's) **Atmospheric Radiation Measurement (ARM) Data Center**, which provides cutting-edge computing capabilities and data to scientists around the world. The **Center for Bioenergy Innovation**, a DOE Bioenergy Research Center, enables high-impact and value-added advances along the bioenergy supply chain. The **Climate Change Science Institute** fosters the integration of experiments, measurements, and simulation to achieve a predictive understanding of our changing world. The University of Tennessee/ORNL **Center for Molecular Biophysics** explores the structural dynamics of biomolecules by uniquely working at the interface of biology, chemistry, and the physical sciences, aided by neutron and computational sciences. The **ORNL Distributed Active Archive Center for Biogeochemical Dynamics** provides scientists with access and tools to explore terrestrial ecology data from NASA Earth Science missions.

Recent Impacts

Building upon a rich history of breakthroughs in biology and ecology, BESSD scientists are proud to have sequenced the first tree genome, pioneered the field of global change biology, and solved the 40-year mystery of how bacteria transform mercury into highly toxic methylmercury. Recently, BESSD scientists have:

- Created the largest integrated dataset of its kind on the poplar tree microbiome, enabling genes-to-ecosystems linkages to advance resilient ecosystems and biobased fuel sources.
- Leveraged expertise in quantum biology, artificial intelligence, and bioengineering to improve how genome editing tools work on non-model organisms like microbes for efficient fuel production.
- Developed and tested a new model that can simulate an entire flood event, greatly improving predictions.
- Refined Earth system models to inform the nation's primary assessment of environmental risk for communities and natural ecosystems.
- Developed a capability to insert multiple genes at once into plants in a single step, significantly speeding the development of hardy bioenergy plants.
- Designed a molecule to disrupt the infection mechanism of the SARS-CoV-2 coronavirus that can be used for new treatments for COVID-19 and other viral infections.
- Increased the accessibility and interoperability of data in the ORNL Distributed Active Archive Center for Biogeochemical Dynamics, managing NASA's rich repository of global terrestrial ecology observations.



The **Advanced Plant Phenotyping Laboratory** provides advanced imaging and data capabilities to connect plant gene functions to physical traits, accelerating the development of hardy plants for bioenergy and carbon storage.



The **Next-Generation Ecosystem Experiments Arctic** gathers and models observational data to predict how this vulnerable, carbon-rich ecosystem is responding to environmental change.



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