BER Staff

science.energy.gov/ber/

Unless noted, email addresses for BER staff follow the format: firstname.lastname@science.doe.gov

Associate Director Office

Sharlene Weatherwax, 301-903-3251
Associate Director of Science
for Biological and Environmental Research

David Thomassen, 301-903-9817
Chief Scientist

Michael R. Riches, 301-903-3264
Senior Technical Advisor
mike.riches@science.doe.gov

Kathy Holmes, 301-903-3251
Administrative Specialist

Biological Systems Science Division (BSSD)

Sharlene Weatherwax, Acting Director, 301-903-3213
Terry Jones, Secretary, 301-903-3213
Joanne Corcoran, Program Support, 301-903-6488
Shireen Yousef, Science Assistant, 301-903-6020

Genomic Science
Daniel Drell, 301-903-4742
Joseph Graber, 301-903-1239
Roland Hirsch, 301-903-9009
Arthur Katz, 301-903-4932
Pablo Rabinowicz, 301-903-0379

Computational Biosciences
Susan Gregurick, 301-903-7672

Biofuels Research and Bioenergy Research Centers
Joseph Graber, 301-903-1239
Susan Gregurick, 301-903-7672
John Houghton, 301-903-8288
Catherine Ronning, 301-903-9549
Michael Teresinski, 301-903-5155
Sharlene Weatherwax, 301-903-3213

Plant Feedstocks
Catherine Ronning, 301-903-9549
Pablo Rabinowicz, 301-903-0379

Radiochemistry and Imaging Instrumentation
Prem Srivastava, 301-903-4071

Radiobiology
Noelle Metting, 301-903-8309
Arthur Katz, 301-903-4932

Lab and Facility Safety
Michael Teresinski, 301-903-5155

Ethical, Legal, and Societal Issues
Elizabeth White, 301-903-7693
Daniel Drell, 301-903-4742

Medical Applications
Dean Cole, 301-903-3268

Structural Biology Infrastructure
Roland Hirsch, 301-903-9009

Human Research Subjects Protection
Elizabeth White, 301-903-7693

User Facility
Joint Genome Institute www.jgi.doe.gov
Daniel Drell, 301-903-4742
Susan Gregurick, 301-903-7672

Climate and Environmental Sciences Division (CESD)

Gerald Geernaert, Director, 301-903-3281
Secretary, 301-903-3281
Leslie Runion, Program Support, 301-903-9135
Karen Carlson-Brown, Program Support, 301-903-3338
Patrik Horan, Science Assistant, 301-903-0488

Atmospheric System Research
Wanda Ferrell, 301-903-0043
Ashley Williamson, 301-903-3120
Rick Petty, 301-903-5548

Terrestrial Ecosystem Science
Daniel Stover, 301-903-0289

Terrestrial Carbon Sequestration Research
Michael Kuperberg, 301-903-3511

Subsurface Biogeochemical Research
Todd Anderson, 301-903-5549
Paul Bayer, 301-903-5324
Roland Hirsch, 301-903-9009
Arthur Katz, 301-903-4932
David Lesmes, 301-903-2977

Regional and Global Climate Modeling
Renu Joseph, 301-903-9237

Earth System Climate Modeling
Dorothy Koch, 301-903-0105

Integrated Assessment Research for Climate
Bob Vallario, 301-903-5758

Climate Information and Data Management
Wanda Ferrell, 301-903-0043

User Facilities

Atmospheric Radiation Measurement Climate Research Facility
www.arm.gov
Wanda Ferrell, 301-903-0043
Rick Petty, 301-903-5548

Environmental Molecular Sciences Laboratory
www.emsl.pnl.gov
Paul Bayer, 301-903-5324

Small Business Innovation Research (SBIR)

Climate and Environmental Sciences SBIR
Rick Petty, 301-903-5548
David Lesmes, 301-903-2977

Biological Systems Science SBIR
Prem Srivastava, 301-903-4071
Susan Gregurick, 301-903-7672
Dean Cole, 301-903-3268

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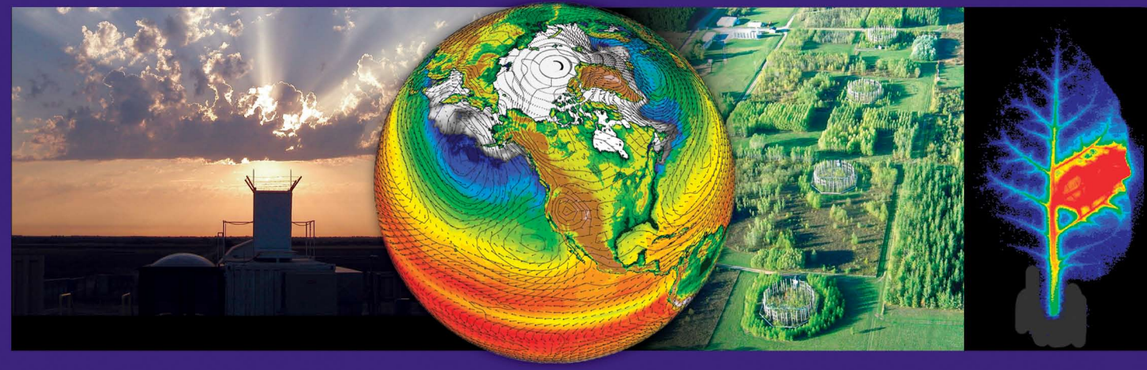
Biological and Environmental Research

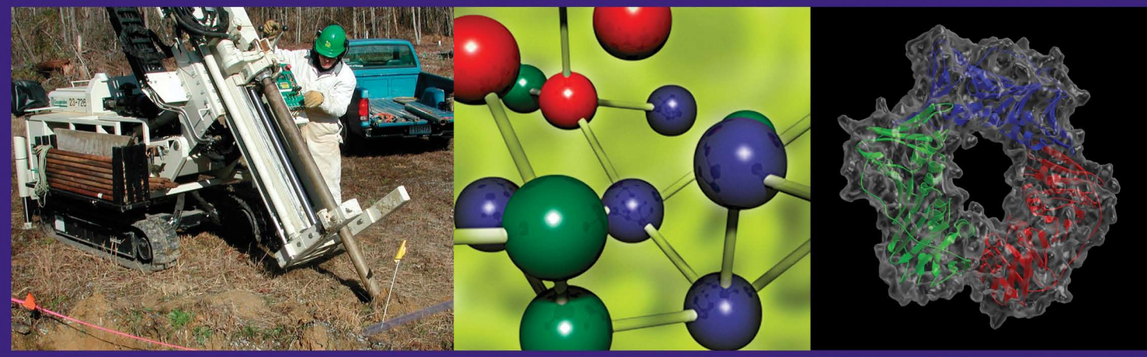
Understand Complex Biological and Environmental Systems by…

EXPLORING the frontiers of genome-enabled biology

DISCOVERING the physical, chemical, and biological drivers of climate change



SEEKING the biological, geochemical, and hydrological determinants of environmental sustainability and stewardship



U.S. DEPARTMENT OF ENERGY | Office of Science

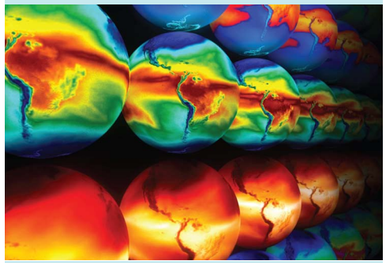
DOE Mission-Inspired Science

Addressing critical national needs

Insights from genomics are advancing the development of grasses and fast-growing trees for biofuel production.

Sustainable Biofuels

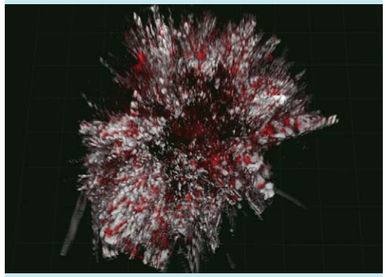
To support the development of biofuels as major sustainable national energy resources, the DOE Biological and Environmental Research (BER) program is using the power of genomics and systems biology to study microbes, fungi, and plants important to solving energy challenges.



Model simulations project future climate.

Climate Science

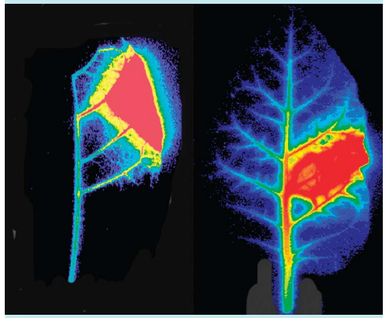
To inform decision making about energy use and climate change, BER is seeking to resolve the greatest uncertainties in climate science. Research activities include studying the effects of greenhouse gas emissions on Earth's climate and biosphere, improving the world's most powerful climate models, and working to understand carbon cycling in terrestrial ecosystems.



Microbes can transform minerals in the subsurface environment.

Subsurface Biogeochemistry

To advance understanding and predictions of contaminant mobility in the subsurface, BER is developing predictive models that integrate hydrological, microbiological, and geochemical knowledge over a range of scales. These models also will aid assessments of potential approaches to carbon sequestration and waste isolation.



Movement of plant compounds is tracked using radiochemistry tools developed for human medicine.

Biology-Physics Interface

To develop technologies that are transferable to diverse applications, BER is exploring research at the interface of biological and physical sciences.

Biological and Environmental Research

Mission

Advance world-class biological and environmental research and provide scientific user facilities to support Department of Energy missions in scientific discovery and innovation, energy security, and environmental responsibility.

Approach

- Understand complex biological and environmental systems across many spatial and temporal scales.
- Leverage diverse scientific insights by coupling theory, observations, experiments, models, and simulations.
- Support interdisciplinary research that engages scientists from national laboratories, academia, and industry.

Divisions

Biological Systems Science Division (BSSD)

BSSD aims to achieve a predictive understanding of complex biological systems with potential use in bioenergy, carbon cycling, and biogeochemistry.

BSSD research activities include

- Using genomics and systems biology to understand plants and microbes.
- Supporting DOE Bioenergy Research Centers to provide transformational breakthroughs in cellulosic biofuels.
- Developing real-time, high-resolution technologies for analyzing dynamic biological processes.

Climate and Environmental Sciences Division (CESD)

CESD aims to achieve a predictive understanding of climate change, ecosystem response to climate change, and contaminant fate and transport in the subsurface.

CESD research activities include

- Resolving the greatest uncertainties in climate change.
- Improving the world's most powerful climate models.
- Providing the science to inform environmental remediation strategies.
- Working to understand carbon cycling in terrestrial systems.

DOE Bioenergy Research Centers

Bringing together top scientists from multiple disciplines, DOE BER established three Bioenergy Research Centers in 2007 to deliver high-risk, high-return breakthroughs in cellulosic biofuel production. DOE's Oak Ridge National Laboratory leads the BioEnergy Science Center in Tennessee. The University of Wisconsin-Madison leads the Great Lakes Bioenergy Research Center. DOE's Lawrence Berkeley National Laboratory leads the Joint BioEnergy Institute in California. Each center is using genomics and advanced analytical technologies to understand (1) how to make grasses, wood, and other cellulosic materials easier to break down into sugars, (2) which enzymes degrade biomass most efficiently, and (3) how to advance the microbial production of ethanol and other gasoline-replaceable fuels from sugars.

User Facilities

Empowering an international community of scientists with the most advanced technologies

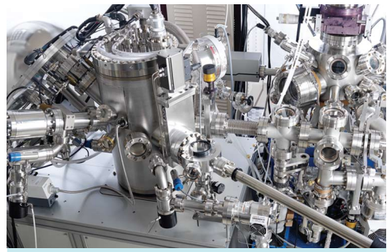
DOE Joint Genome Institute (JGI)

Sequencing more than one trillion DNA base pairs per year, JGI in Walnut Creek, California, provides state-of-the-science capabilities for genome sequencing and analysis. With more than 1800 worldwide collaborators on active projects, JGI is the preeminent facility for sequencing plants, microbes, and microbial communities that are foundational to energy and environmental research.

As one of the largest dedicated DNA sequencing facilities in the world, JGI expertise and technologies enable analysis of complex genomes.

DOE Environmental Molecular Sciences Laboratory (EMSL)

By integrating experimentation with supercomputing, EMSL in Richland, Washington, enables the study of environmental challenges at the molecular level. EMSL has helped thousands of researchers use a multidisciplinary, collaborative approach to solve important challenges in biological interactions and dynamics, subsurface science, and interactions at the interfaces of natural and engineered materials.



The electron spectrometer at EMSL is used to study the chemical properties of materials at nanoscale resolution.

DOE Atmospheric Radiation Measurement (ARM) Climate Research Facility

The ARM Climate Research Facility provides highly instrumented ground stations at various locations, mobile resources, and aerial vehicles to continuously measure cloud and aerosol properties. ARM Facility measurements have set the standard for long-term climate research observations and provide an unparalleled resource for examining atmospheric processes and evaluating climate model performance.

Observations from the ARM Facility's scanning cloud radars reduce uncertainties in cloud parameterizations used in climate models.