

2019 Genomic Science Program Annual PI Meeting

Todd Anderson, Ph.D.

Director, Biological Systems Science Division,
Department of Energy, Office of Biological &
Environmental Research

February 25, 2019



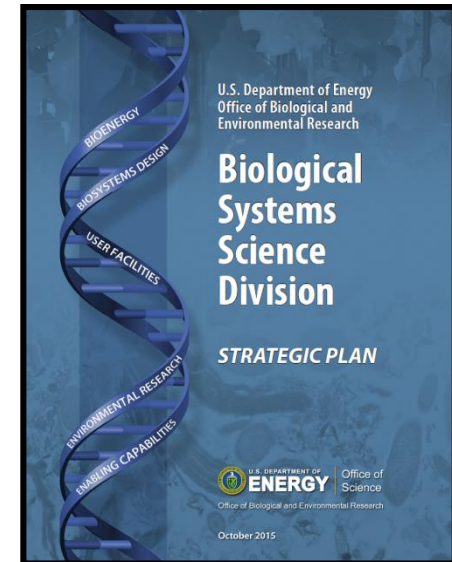
U.S. DEPARTMENT OF
ENERGY

Office
of Science

Office of Biological
and Environmental Research

Biological Systems Science Division

Overarching Goal: Provide the necessary fundamental science to understand, predict, manipulate, and design biological processes that underpin innovations for bioenergy and bioproduct production and to enhance the understanding of natural environmental processes relevant to DOE.



New funding Opportunity Announcements for FY 2019

Systems Biology Enabled Research on the Roles of Microbiomes in Nutrient Cycling Processes (DE-FOA-0002059)

Pre-App due: 3/13/19

Pre-App Response: 3/21/19

Proposals due: 5/17/19 – (Dr. Dawn Adin, Dr. Boris Wawrik)

Genomics-Enabled Plant Biology for Determination of Gene Function (DE-FOA-0002060)

Pre-App due: 3/13/19

Pre-App Response: 3/21/19

Proposals due: 5/17/19 – (Dr. Cathy Ronning)

New Bioimaging Approaches for Bioenergy

Pre-App due: 4/4/19

Pre-App Response: 4/19/19

Proposals due: 5/20/19 – (Dr. Prem Srivastava)

Early Career Research Program (in progress)

Pre-App due: 2/6/19

Pre-App Response: 3/8/19

Proposals due: 4/29/19 – (Dr. Pablo Rabinowicz for BSSD)

The image displays four overlapping posters for Department of Energy FOA announcements. Each poster features the Department of Energy logo and the Office of Science logo. The posters are for the following FOAs:

- FOA-0002059: SYSTEMS BIOLOGY ENABLED RESEARCH ON THE ROLES OF MICROBIOMES IN NUTRIENT CYCLING PROCESSES**
FUNDING OPPORTUNITY ANNOUNCEMENT (FOA) NUMBER: DE-FOA-0002059
- FOA-0002060: GENOMICS-ENABLED PLANT BIOLOGY FOR DETERMINATION OF GENE FUNCTION**
FUNDING OPPORTUNITY ANNOUNCEMENT (FOA) NUMBER: DE-FOA-0002060
- FOA-0002041: NEW BIOIMAGING APPROACHES FOR BIOENERGY**
FUNDING OPPORTUNITY ANNOUNCEMENT (FOA) NUMBER: DE-FOA-0002041
- FOA-0002019: EARLY CAREER RESEARCH PROGRAM**
FUNDING OPPORTUNITY ANNOUNCEMENT (FOA) NUMBER: DE-FOA-0002019

The bottom poster (FOA-0002019) includes a table with the following information:

| FOA Issue Date: | January 7, 2019 |
|--|--|
| Submission Deadline for Letters of Intent: | NA |
| Submission Deadline for Pre-Applications: | February 6, 2019 at 5:00 PM Eastern Time |
| Pre-Application Response Date: | March 8, 2019 |
| Submission Deadline for Applications: | April 29, 2019 at 5:00 PM Eastern Time |

Amendment 00001: This amendment clarifies the eligibility requirements regarding years from PhD, language used in some topical program descriptions, and the relevant technical points of contact.

New Investments at the Labs for Cryo-EM and Neutron science

Cryo-EM capabilities

Brookhaven National Laboratory (PI: Sean McSweeney)

Operational support for a new cryo-EM facility (in association with New York State) to stand up a functional cryoEM capability at BNL as soon as FY 2020.

Stanford Linear Accelerator Center (SLAC) (PI: Wah Chiu)

Operational and instrumental support to complement recent NIH-funded cryo-EM center at SLAC.

Lawrence Berkeley National Laboratory (PI: Karen Davies)

Instrumental support for a screening microscope for cryo-EM prior to accessing the high-end cryo-EM instruments.

Cryo-EM



Neutron Science Capabilities

Oak Ridge National Laboratory (PI: Hugh O'Neill)

Pilot funding to build to demonstrate biological applications in neutron science.

Program Manager: Dr. Amy Swain

Integrative Computational Capabilities

Continuing co-development/collaboration between KBase, the Joint Genome Institute (JGI) and NERSC

- Towards a common open-source, open-access IT infrastructure structure for bioinformatics and computational biology.



- Connections with the Environmental Molecular Science Laboratory (EMSL)
- KBase and JGI move into a new building on the LBNL campus in July 2019



Integrative Genomics Building
LBNL Campus

National Microbiome Data Collaborative (NMDC)

- Opportunity at the DOE National Laboratories
- Integrative with ongoing BSSD bioinformatics projects

Informative Workshops for BSSD Planning

BER Workshops

Genome Engineering for Material Synthesis (GEMS) Workshop

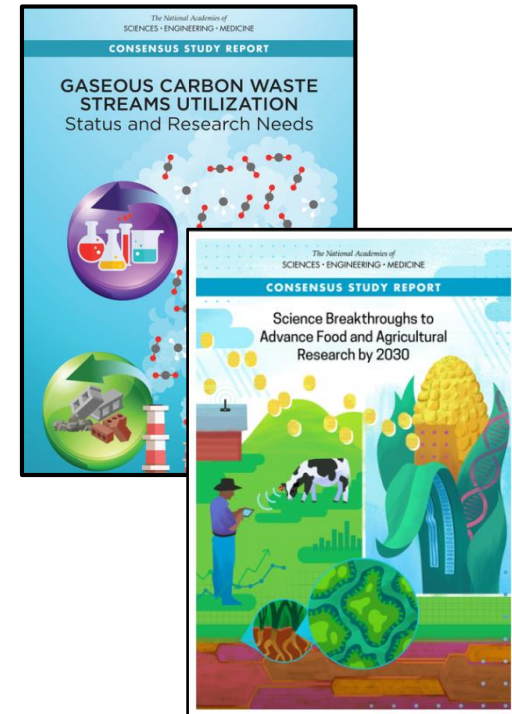
- Exploring possibilities for designed materials using genome engineering techniques
- October 9-11, 2018 (Brief out Weds AM – by **Dr. Brian Fox** – Univ. Wisconsin)

Breaking the bottleneck of genomes: Understanding gene function across taxa

- Addressing the annotation problem in genomics
- November 1-2, 2018 (Brief out Weds AM– by **Dr. Adam Deutschbauer-LBNL**)

National Academy Studies

- **“Developing a Research Agenda for Utilizing Gaseous Carbon Waste Streams.”** Board on Chemical Sciences and Technology and the Board on Energy and Environmental Systems (BER, BES, ARPA-E, FE, EERE)
- **“Breakthroughs 2030: A Process for a 10-year Agenda for Food and Agricultural Research.”**
Board on Agricultural and Natural Resources



BSSD Staff Changes



Dan Drell

Program Manager

Joint Genome Institute

Retired from Federal Service September 2018



Boris Wawrik

Program Manager

Environmental Genomics

Started January 2019



Sujata Emani

AAAS Science & Technology Policy Fellow

–working with BSSD

Started September 2018

The Biological Systems Science Division Portfolio

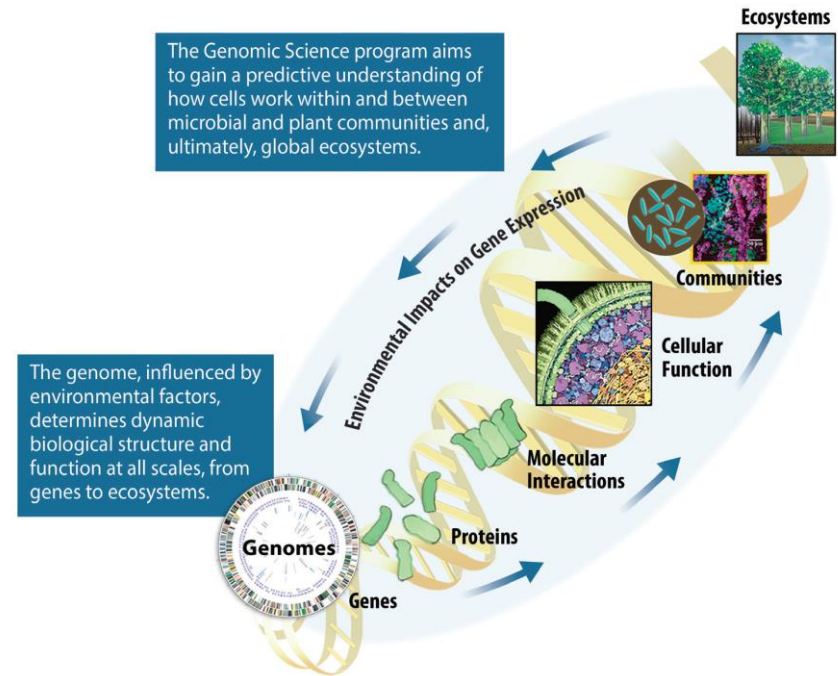
Genomic Science Program

- *Bioenergy Research Centers (BRCs)*
- *Systems Biology for Bioenergy*
- *Plant Biology Research**
- *Sustainability Research for Bioenergy*
- *Biosystems Design*
- *Environmental Microbiome Science**
- *Computational Biosciences*

*Biomolecular Characterization and Imaging Science**

Facilities & Infrastructure

- *Joint Genome Institute (JGI)*



Bioenergy Research Centers

Annual Reviews completed

Multidisciplinary fundamental science guided by milestones & deliverables, targeted to key areas needed to improve production of biofuels from renewable biomass.

➤ **Center for Bioenergy Innovation (CBI)**

Oak Ridge National Laboratory (<https://cbi.ornl.gov/>)



➤ **Great Lakes Bioenergy Research Center (GLBRC)**

University of Wisconsin, Michigan State University (<https://www.glbrc.org/>)



➤ **Joint BioEnergy Institute (JBEI)**

Lawrence Berkeley National Laboratory (<https://www.jbei.org/>)



➤ **Center for Advanced Bioenergy and Bioproducts Innovation (CABBI)**

University of Illinois (UIUC) (<https://cabbi.bio/>)



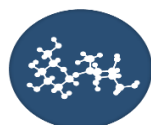
Program Manager:
Dr. Kent Peters



Sustainability



Feedstock



Biomass



**Conversion
biofuels &
bioproducts**

Development Deconstruction

Monday: Plenary
8:30-10:30AM Fairfax Ballroom

Systems Biology for Bioenergy

Fundamental, systems-level understanding of microbes and microbial communities relevant to advanced biofuels production.

- Research to advance the development of promising new model organisms relevant to biofuels production.
- Development of novel microbial functional capabilities and biosynthetic pathways relevant to the production of advanced biofuels and the development of strategies to overcome associated metabolic challenges resulting from pathway modification.
- Development of novel analytical technologies or high throughput screening approaches.



Broadens the portfolio in microbial research on advanced biofuels production

Monday: Breakout Session C
2:00-5:00 PM Fairfax Ballroom B

BER Program Manager: Dr. Dawn Adin

Plant Feedstocks Genomics for Bioenergy

Research to overcome the biological barriers to the low-cost, high-quality, scalable and sustainable production of bioenergy feedstocks using the tools of genetics and genomics

- Developing the scientific basis for new bioenergy crops
- Complementary with ongoing bioenergy research in BRCs and Biosystems Design

BER Program Manager: Dr. Cathy Ronning and Dr. Bill Goldner (USDA)

Monday: Breakout Session B
2:00-5:00 PM Ash Grove Ballroom

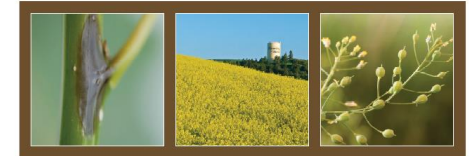
New FOA in Plant Biology

Research to address the challenges and opportunities in associating gene(s) to function (i.e., genotype to phenotype) in DOE-relevant plant systems.

Goal: Elucidate and validate functional roles of genes, gene families, and associated pathways.

Plant Feedstock Genomics for Bioenergy Joint Awards 2006–2018

genomicscience.energy.gov/research/DOEUSDA/



United States
Department
of Agriculture

National Institute
of Food and
Agriculture



U.S. DEPARTMENT OF
ENERGY

Office of
Science

January 2019

Latest Awards:

https://genomicscience.energy.gov/research/DOEUSDA/usda_doe_handout.pdf



NATIONAL INSTITUTE OF FOOD AND AGRICULTURE
U.S. DEPARTMENT OF AGRICULTURE

Sustainability Research for Bioenergy

Research to Advance Bioenergy Agriculture

Understanding plant/soil/microorganism interactions in field settings

- Enhance biomass productivity under changing conditions by:
 - Investigating molecular and physiological mechanisms that control bioenergy crop vigor, resource use efficiency, resilience/adaptability to abiotic stress;
 - Defining and characterizing interactions of bioenergy crop plants with the surrounding environment.
- Investigate the role(s) of microbial communities in the complex plant-soil environment:
 - Contributing to plant performance, adaptation, and resilience under changing environmental conditions and abiotic stressors;
 - Impacts of introducing bioenergy cropping systems on the local ecosystem.



Poster Session Presentations
Mon-Tues 5:00-7:00PM Tysons Ballroom

Program Manager:
Dr. Cathy Ronning

Biosystems Design

Plant biodesign awards:

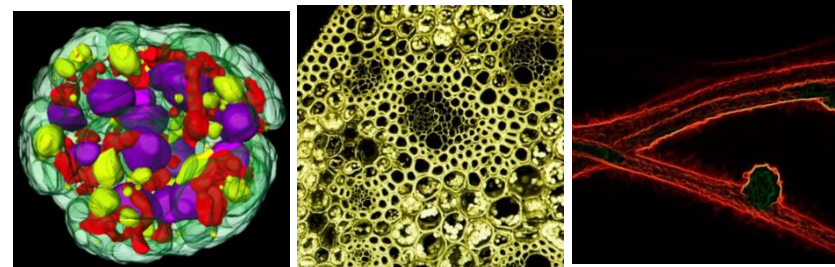
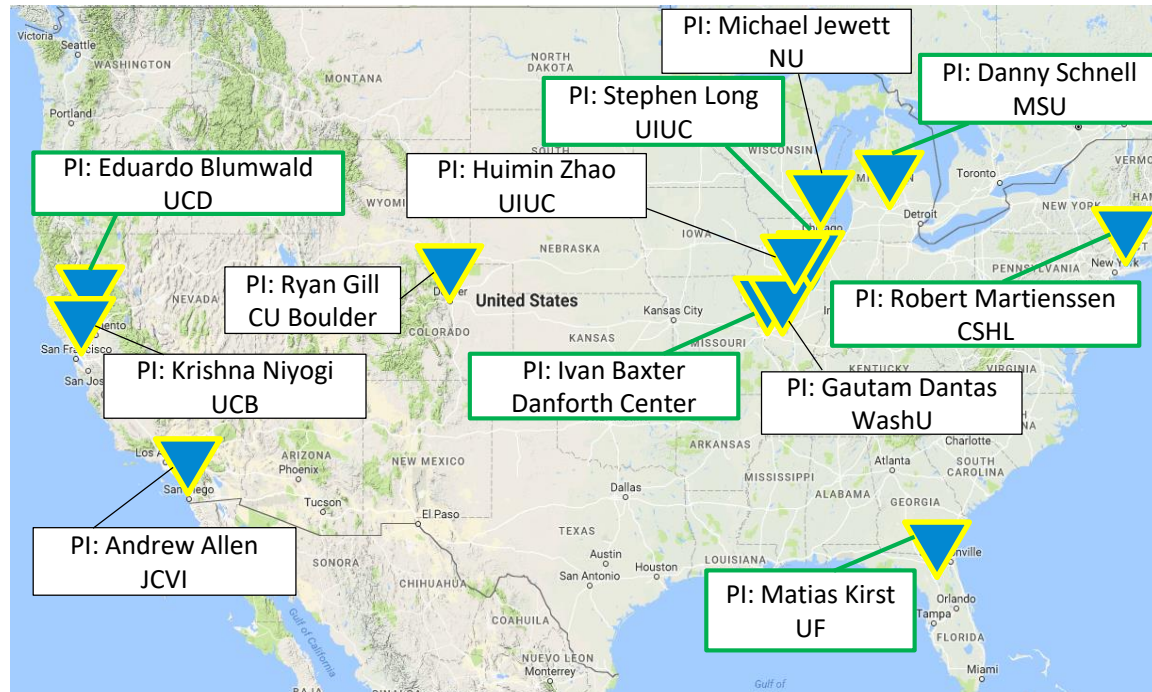
- Transitioning from model plants such as *Arabidopsis* and *Setaria* to *Camelina* and sorghum
- Adding energy cane and aquatic monocot (duckweed)
- Targeting nitrogen fixation by engineering symbiosis
- Increase water use and photosynthetic efficiency
- Engineer oil production in stems and leaves

Microbial biodesign awards:

- New non-model yeast that produce oils and organic acids
- Expanding algae genome-scale design and engineering to diatoms and green algae
- Developing *in vivo* and cell-free microbial bioprocessing systems
- Computer-aided design and high throughput recombineering in model and non-model microorganisms

Tuesday Breakout Session E
2:00-5:00 PM Fairfax Ballroom A

Systems biology and genome engineering to enable design of new biological systems for bioenergy and bioproduct production



BER Program Manager:
Dr. Pablo Rabinowicz

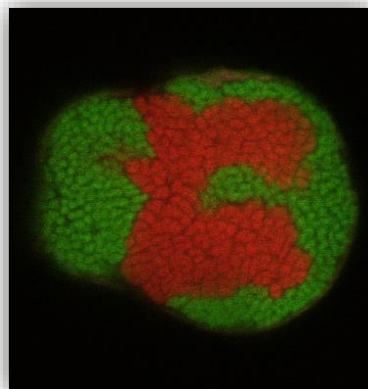
Environmental Microbiome Science

Genome enabled research linking structure and function of microbial communities with key environmental or ecosystem processes

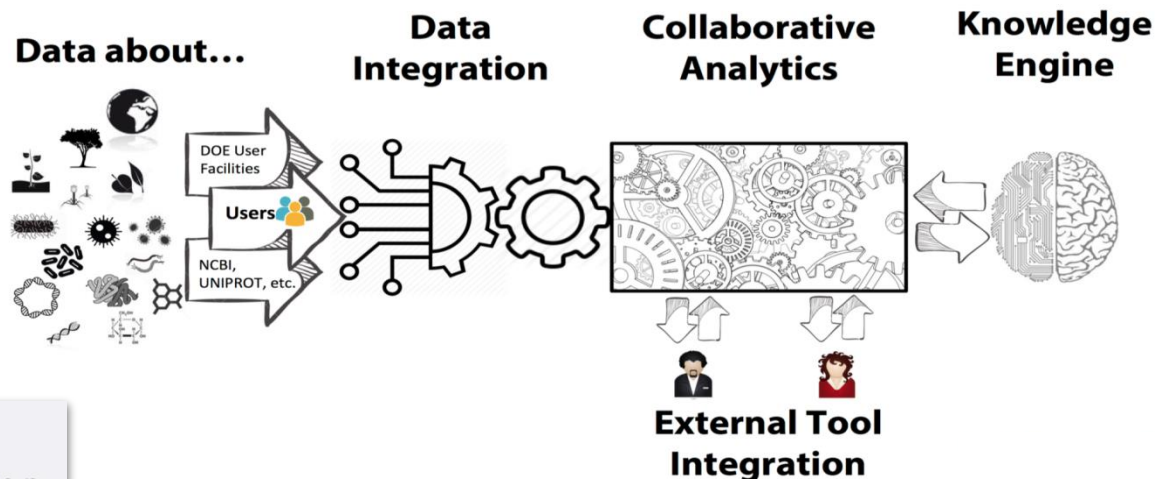
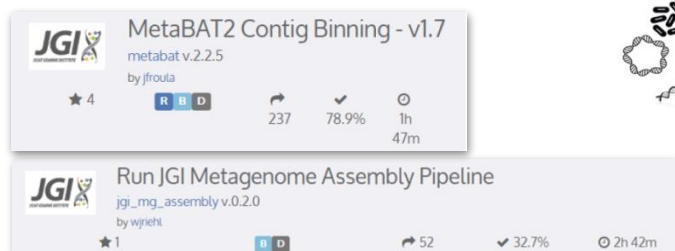
- Systems biology of model microbes and consortia important in carbon cycle and environmental processes of relevance to DOE
- Extending systems biology approaches and understanding to integrated microbial communities and plant-microbe interactions
- Development of environmental “meta-omics” approaches to understand how shifts in environmental variables impact microbial community structure and functional processes
- High resolution, high throughput techniques for analysis of biological processes across multiple scales of spatial and temporal resolution
- Development of new techniques for in situ bioprocess analysis in terrestrial ecosystems

Poster Session Presentations
Mon-Tues 5:00-7:00PM Tysons Ballroom

BER Program Manager:
Dr. Dawn Adin and Dr. Boris Wawrik



- Knowledge engine Apps built
- Relation engine prototype deployed
- JGI Collaboration products released



- Three User working groups established (microbiome, metabolism, functional genomics)



Program Manager:
Dr. Ramana Madupu

- **Monday: User Science Breakout Session A**
2:00-5:00 PM Fairfax Ballroom A
- **Tuesday: Plenary**
8:30-10:00 AM Fairfax Ballroom
- **Tuesday: Hand's On Session**
1:00-5:00 PM Potomac room
- **Tuesday: Data Challenges Break out Session D**
2:00-5:00 PM Fairfax Ballroom B

Structural Biology Beamline Resources

Supported by BER and Other Sponsors at DOE Basic Energy Sciences Light Source and Neutron User Facilities

BER Structural Biology and Imaging Resources at Synchrotron and Neutron Facilities

Scientists have made remarkable progress over the past few decades in biological imaging, from the atomic scale (subnanometer) to the cellular (micron) scale. There are extraordinary opportunities for scientists working to understand and harness biological systems for addressing mission-relevant challenges of the U.S. Department of Energy's (DOE) Office of Biological and Environmental Research. Many of these advances are made possible by the unique crystallography, scattering, spectroscopy, and imaging capabilities available at DOE's neutron and synchrotron light sources, which are national user facilities. [more...](#)

Biomass Deconstruction

User Experiences Highlights Related Reports

[BERStructuralBioPortal.org](https://structuralbioportal.org)

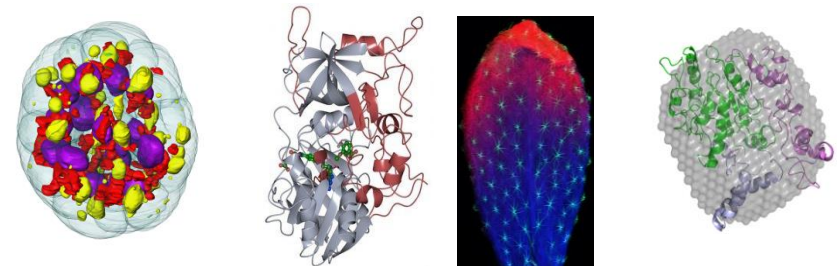


Some of the techniques available:

X-ray Crystallography; X-ray Cell Tomography, X-ray and Neutron and Scattering; Infrared spectromicroscopy, X-ray Spectroscopy and Imaging.

See posters and visit with staff during the poster session

<https://science.energy.gov/bes/suf/user-facilities/>



BER Program Manager : Dr. Amy Swain

User Facilities & Infrastructure



➤ **Community Science Program (CSP) FY2020 Topics**

(LOIs due April 11, 2019)

- Genes to function
- Plant functional genomics and microbiomes
- Inter-organismal interactions
- Microbes and communities involved in elemental cycling in terrestrial and coastal environments
- Algal genomics

JGI User Meeting and NELLI workshop
April 2-5, San Francisco, CA

Tuesday: Plenary
8:30-10:00 AM Fairfax Ballroom

➤ **CSP New Investigator Call**

Proposal due Mar 1 & Nov 4, 2019

➤ **DNA Synthesis Call**

Proposals due July 31, 2019

➤ **FICUS (JGI-EMSL) Call:**

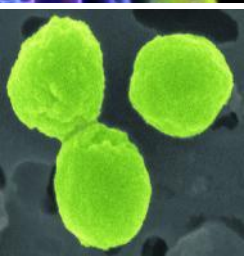
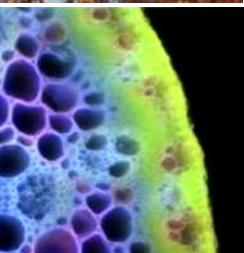
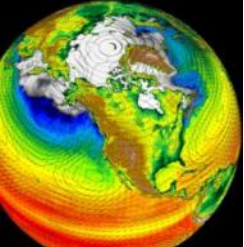
LOIs due Mar 20, 2019

- Combines JGI genomics *and* molecular characterization at the Environmental Molecular Sciences Laboratory (EMSL)

Program Manager:
Dr. Ramana Madupu

Mapping Research Efforts onto BSSD Objectives

| Core Objectives in: | FOA-led efforts | DOE Lab-led efforts |
|---|--|---|
| Plant & Microbial Bioenergy Research | <ul style="list-style-type: none"> Bioenergy Research Centers Plant Biology Research Systems Biology for Bioenergy Sustainability Research for Bioenergy DOE-UCLA Institute | <ul style="list-style-type: none"> Bioenergy Research Centers ORNL – Lignocellulosic degradation LLNL – Resource allocation in microbial communities (Pilot) BNL- Quantitative Plant Science |
| Biosystems Design & Synthetic Biology | <ul style="list-style-type: none"> Biosystems Design Harvard Project | <ul style="list-style-type: none"> (Pilot) LBNL m-CAFÉs elements of the BRCs |
| Carbon/Nutrient Cycling & Environmental Microbiology | <ul style="list-style-type: none"> Environmental Microbiome Science Sustainability Research for Bioenergy | <ul style="list-style-type: none"> LBNL- ENIGMA project LANL – Soil Metagenomics ORNL- Plant-Microbe Interactions LANL LLNL PNNL (Pilot) LBNL m-CAFÉs <p style="margin-left: 400px;">} Soil Microbiome Research</p> |
| Enabling Capabilities | <ul style="list-style-type: none"> Computational Biosciences Bioimaging Research | <ul style="list-style-type: none"> KBase Computational Biosciences Bioimaging Research National Microbiome Data Collaborative |
| User Facility Integration | | <ul style="list-style-type: none"> Joint Genome Institute Structural Biology Infrastructure NERSC EMSL |



<http://science.energy.gov/ber>

Thank you!

BSSD Program Staff

Dr. Dawn Adin

Dr. Sujata Emani (AAAS S&T Policy Fellow)

Dr. Kent Peters

Dr. Ramana Madupu

Dr. Pablo Rabinowicz

Dr. Cathy Ronning

Dr. Seema Singh (SNL Detailee)

Dr. Prem Srivastava

Dr. Amy Swain

Dr. Boris Wawrik

Dr. Elizabeth White

Ms. Meredith Rutledge



<http://genomicscience.energy.gov>



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