

# **BSSD Workshop: Technologies for Characterizing Molecular and Cellular Systems Relevant to Bioenergy**

**BERAC  
October 27, 2016**

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Office of Biological & Environmental Research  
Department of Energy



Office  
of Science

Office of Biological  
and Environmental Research

# September 21-23 Workshop: Technologies for Characterizing Molecular and Cellular Systems Relevant to Bioenergy

Rockville Hilton

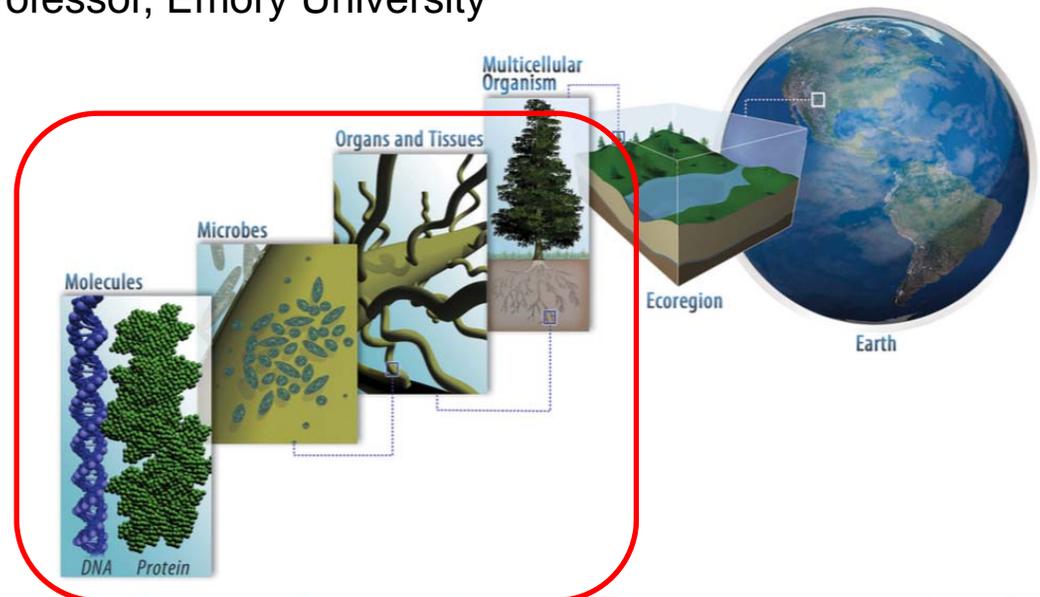
A.K.A. Workshop on Molecular to Mesoscale Technologies

## Co-chairs:

Paul Adams, Ph.D., Division Director, Molecular Biophysics & Integrated Bioimaging, LBNL  
Elizabeth R. Wright, Ph.D., Associate Professor, Emory University

32 Participants

Outcome: Report, early 2017



# Workshop Participants

Chairs: Paul Adams, LBNL, Elizabeth Wright, Emory U.

<b>Participant</b>	<b>Institution</b>	<b>Participant</b>	<b>Institution</b>
<b>Rommie Amaro</b>	UCSD	<b>Britt Hedman</b>	SLAC
<b>Parastoo Azadi</b>	U. Georgia	<b>Hoi-Ying Holman</b>	LBNL
<b>Philip Benfey</b>	Duke U.	<b>Greg Hura</b>	LBNL
<b>Joerg Bewersdorf</b>	Yale U.	<b>Farren Isaacs</b>	Yale U.
<b>Julie Biteen</b>	U. Mich.	<b>Andrzej Joachimiak</b>	ANL
<b>Wah Chiu</b>	Baylor	<b>Udaya Kalluri</b>	ORNL
<b>Bob Cottingham</b>	ORNL	<b>Ken Kemner</b>	ANL
<b>Shi-you Ding</b>	Michigan State U.	<b>Carolyn Larabell</b>	UCSF
<b>Jose Dinneny</b>	Carnegie Inst.	<b>Sean McSweeney</b>	BNL
<b>James Evans</b>	EMSL	<b>Michelle O'Malley</b>	UCSB
<b>Matthew Fields</b>	Montana State U.	<b>Hugh O'Neill</b>	ORNL
<b>Brian Fox</b>	U. Wisc.	<b>Jennifer Pett-Ridge</b>	LLNL
<b>Jamie Fraser</b>	UCSF	<b>Elizabeth Villa</b>	UCSD
<b>Sriram Ganesh</b>	U. Maryland	<b>Tuan Vo-Dinh</b>	Duke U.

# Workshop Goal: Identify Integrative Technologies to Facilitate Systems Biology Research

The Biological and Systems Sciences Division is interested in gaining a predictive understanding of plant and microbial biology for a host of DOE-relevant missions including:

- Bioenergy development
- Carbon/nutrient cycling processes in the environment
- Biosystems design/synthetic biology
- Sustainability research

## ***Identify or Develop Integrative Technologies to:***

- Understand key biological processes within and among plant and microbial cells
- Test/verify hypotheses of genome-to-function translation
- Understand the spatio-temporal nature of metabolism within/among cells
- Identify metabolic bottlenecks to pathway design or optimization
- Understand biomolecular structure-function relationships
- Improve computational descriptions and predictions of cellular processes

# Current Enabling Capabilities



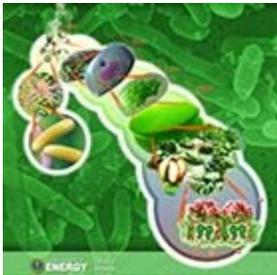
- **Joint Genome Institute**
  - User Facility for genome sequencing and interpretation



- **Systems Biology Knowledgebase**
  - Online open source systems biology platform



- **Structural Biology Infrastructure**
  - Light and Neutron source experimental stations for structural biology and imaging



- **New Bioimaging Technologies**
  - Imaging technology development program underway



- **Environmental Molecular Science Laboratory**
  - User Facility for proteomics, microscopy, cell dynamics



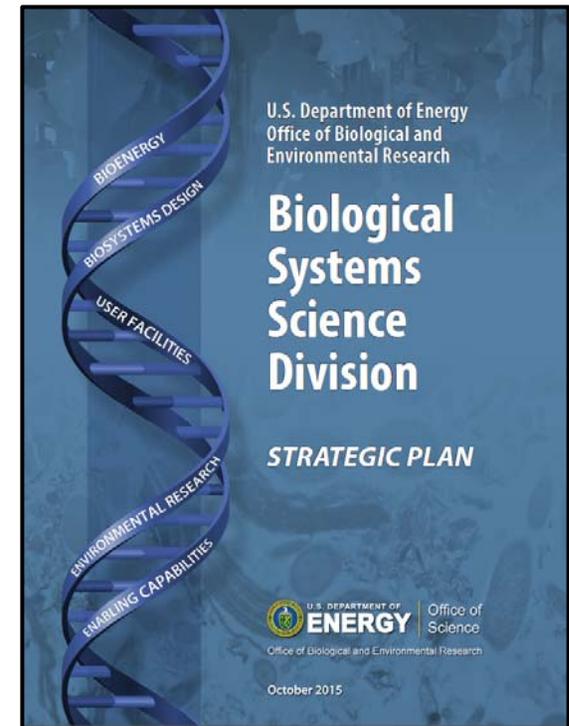
- **National Energy Research Supercomputing Center**
  - Computational resources and expertise for basic scientific research

# Rationale - 2015 BSSD Strategic Plan

**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.*

**Objective 4:** Develop the enabling computational, visualization, and characterization capabilities to integrate genomic data with functional information on biological processes.

- Convened workshop to identify and articulate the scientific basis for requesting for new resources

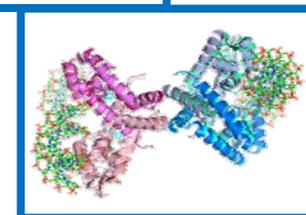
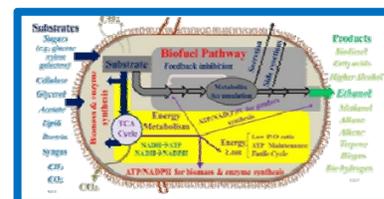


# Biology Themes

plenary and breakout sessions

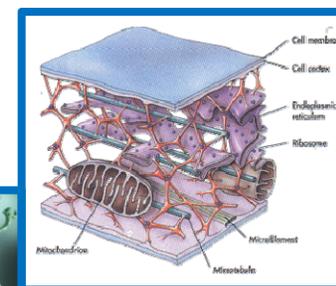
- **Cellular ultrastructure and physiology**

- Metabolic Pathways in Plants, microbes and fungi
- Cellular structure, organization, signalling, network



- **Bioenergy and bioproducts production**

- Cell Wall Composition and Degradation
- Synthetic Biology/Biosystems Design



- **Environmental microbiology**

- Community Interactions (including Rhizosphere)
- Biogeochemical Cycling of Elements



# Workshop Charge Summary

## Charge to Biologists:

- What are the barriers to making advances in characterizing your (representative) systems of interest?
- Are there paths to overcoming them?
- What other biological systems would benefit?
- What are the length and time scales involved?

## Charge to Technology Experts:

- What current technical limits prevent the biological advances described above? e.g., resolution/scale, sample preparation, experimental conditions, stability, accessibility, analysis tools, etc.
- What technologies might be adapted, created, further developed, or combined to address the barriers?
- What are the obstacles to applicability or broad use of potential technological solutions?

*Stay tuned...*

Report expected in early 2017