

2012 Genomic Science Contractors-Grantees Meeting
February 27-29, 2012
North Bethesda Marriott
Rockville, MD
<https://www.ornl.gov/gtl2012/>

Sunday, February 26th

5:00-8:00 **Early registration and poster set-up** - Grand Ballroom Foyer

Monday, February 27th

7:00-8:30 **Registration – Grand Ballroom Foyer**

7:30-8:30 **Continental Breakfast – Grand Ballroom Foyer**

8:30-9:00 **Welcome & Introduction to the Meeting**
Location: Grand Ballroom ABCD

8:30-8:45 Sharlene Weatherwax, Associate Director, DOE Office of Biological & Environmental Research

8:45-9:00 Joseph Graber, Genomic Science Program Team Lead, DOE Office of Biological & Environmental Research

9:00-11:00 **Plenary Session: DOE Bioenergy Research Centers**

Moderator: Cathy Ronning, DOE-BER

Speakers:

9:00-9:30 **Jim Tiedje, GLBRC/Michigan State University**
"Metagenomics of the Prairie and Biofuel Crop Rhizospheres"

9:30-10:00 **Art Ragauskas, BESC/Georgia Institute of Technology**
"Characterizing the Mechanisms of Reduced Recalcitrance of Biomass"

10:00-10:30 **Aindrila Mukhopadhyay, JBEI/Lawrence Berkeley Natl. Laboratory**
"Engineering advanced microbes for biofuel production"

10:30-11:00 **Coffee Break**

11:00-12:00 **Keynote Presentation: Jim Collins, Boston University**
"Life Redesigned: The Emergence of Synthetic Biology"

12:00-2:00 **Lunch**

- 12:30-2:00 **Lunchtime Student Oral Presentations**
Moderator: Libby White
- 12:30-12:35 **Caroline Milne, University of Illinois**
“Understanding Fundamental Aspects of Butanol Production by Clostridium Beijerinckii”
- 12:38-12:43 **Leandro Neves, University of Florida**
“A Systems Biology, Whole-genome Association Analysis of the Molecular Regulation of Biomass Growth and Composition in Populus Deltoides”
- 12:46-12:51 **Bo Hu, University of Washington**
“Engineering Ethylmalonyl-CoA Pathway in Methylobacterium Exorquens AM1 for Butanol Production: Identification of a Regulator Activating the Expressi”
- 12:54-12:59 **Rajib Saha, Pennsylvania State University**
“Contrasting the Metabolic Capabilities of Cyanothece 51142 and Synechocystis 6803”
- 1:02-1:07 **Yifan Xu, Princeton University**
“Integration of Carbon, Nitrogen, and Oxygen Metabolism in Escherichia coli”
- 1:10-1:15 **Cameron Cotten, University of Wisconsin**
“Constraint-Based Analysis of Microbial Metabolism and Regulation for Improving Biofuel Production”
- 1:18-1:23 **Bushra Samad, University of California Berkeley**
“The PhyloFacts Phylogenomic Encyclopedia of Microbial Gene Families”
- 1:26-1:31 **Robin Rohwer, Pennsylvania State University**
“Development of Quantum Dot Probes for Studies of Synergy Between Components of the Wood-Degrading Fungal Enzymes”
- 1:34-1:39 **Sagar Utturkar, University of Tennessee**
“Plant-Microbe Interfaces: Sequencing of Twenty-one Pseudomonas Genomes and Twenty-three Genomes from Diverse Bacteria Isolated from Populus Deltoides”

2:00-5:00 **Breakout Session A: Plants and Their Environment: Biology, Molecular Interactions, and Homeostasis**
Location: Forest Glen

Moderators: Cathy Ronning & Prem Srivastava, DOE-BER

Description of Session: Study of plant genomics and homeostatic processes in living plants can be based on *in situ* chemical reactions and the environmental effects of perturbations of these chemical reactions. Molecular plant-environment (e.g. microbe) interactions and metabolism, and the use of radioactive tracers to detect and study perturbations of homeostatic reactions will be emphasized in this session.

Speakers:

- 2:00-2:10 Introduction to the session – Cathy Ronning
- 2:10-2:40 **Jean Greenberg, University of Chicago**
“Tracking the movement of bio-active peptides in Arabidopsis and Poplar
- 2:40-3:10 **Richard Ferrieri, Brookhaven National Laboratory**
“The Role of Radiochemistry in Systems Biology to Study the Interrelationship between Hormone Signaling and Plant Root Development”
- 3:10-3:30 **Coffee Break**
- 3:30-3:50 **Jocelyn Rose, Cornell University**
“Peeling apart the structural and functional complexity of the cuticularized plant cell wall”
- 3:50-4:10 **Leland Cseke, University of Alabama Huntsville**
“Merging bottom-up with top-down research in symbiosis and nutrient cycling”
- 4:10-5:30 Roundtable Discussion – Prem Srivastava
Open Discussions on the Current-State of the Art and Future Direction

2:00-5:00 **Breakout Session B: Enabling Tools and Applications for the DOE Systems Biology Knowledgebase**
Location: Brookside A/B

Moderator: Susan Gregurick, DOE-BER

Description of Session:

The Systems Biology Knowledgebase (Kbase) will be a community-driven software framework enabling the data-driven prediction of microbial, plant, and biological community function in an environmental context. Extensible and scalable, Kbase also will feature open architecture, source code, and open development. The intent of Kbase is to provide access to a distributed, scalable computing resource for data-intensive analysis and will support a large user community with tools and services for **Microbes:** Reconstruction and prediction of metabolic and gene expression regulatory networks for 100 to 1,000 microbes to manipulate microbial function; **Plants:** Integration of phenotypic and experimental data and metadata for 10 key plants related to DOE missions to predict biomass properties from genotype and assemble regulatory data to enable analysis, cross-comparisons, and modeling and **Communities:** Modeling metabolic processes within 10 to 100 microbial communities with DOE relevance and mine metagenomic data to identify unknown genes. This session will highlight some of the modeling tools and capabilities funded by DOE that could enhance the Knowledgebase.

Speakers:

- 2:00-2:30 **Kimmen Sjolander, University of California, Berkeley**
“The PhyloFacts 3.0 Phylogenomic Encyclopedia of Microbial Gene Families: New Developments and Plans”

- 2:30-3:00 **Peter Karp, SRI International**
"Introducing Metabolic Engineering and Atom Mapping Capabilities into Pathway Tools"
- 3:00-3:30 **Chris Henry, Argonne National Laboratory**
"Enhancing the SEED Framework for Curation and Analysis of Genomic Data and Genome-scale metabolic Models"
- 3:30-3:45 **Coffee Break**
- 3:45-4:15 **Mark Gerstein, Yale University**
"Tools and Approaches for Integrating Multiple Genetic and Cellular Networks"
- 4:15-4:45 **Daniel Segre, Boston University**
"From genome-scale to ecosystem-level models of metabolism"
- 4:45-4:00 Discussion of gaps and opportunities in enabling methods for the Knowledgebase

2:00-5:30 **Breakout Session C: Biological Structure Research in the Genomic Science Program**
Location: Glen Echo

Moderator: Roland Hirsch, DOE-BER

Description of Session: Research in systems biology requires application of a wide range of technologies, each of which reveals aspects of the processes that occur in living cells and organisms. The DOE synchrotron light sources and neutron beam facilities provide many experimental capabilities that are being used in research projects in the Genomic Science Program. The talks in this breakout session will explain how specific beamlines at those facilities are being used in GSP projects. The speakers will seek to make the technologies understandable for GSP biologists by focusing on the biological science that is enabled by the beamline experiments.

Speakers:

- 2:00-2:05 Session Introduction
- 2:05-2:40 **Sol Gruner, Cornell University**
Session Keynote:
"Biomolecules Under Pressure: Why it Matters"
- 2:40-3:00 **Frank Collart, Argonne National Laboratory**
Representing: Argonne Structural Biology Center
"Binding Profiles and Crystal Structures of Bacterial Solute Binding Proteins for Transport of Aromatic Products of Lignin Degradation"
- 3:00-3:20 **Zöe Fisher, Los Alamos National Laboratory**
Representing: Los Alamos Protein Crystallography Station
"Elucidating the proton transfer mechanism of carbonic anhydrase using joint neutron/X-ray crystallography"
- 3:20-3:40 **Coffee Break**

- 3:40-4:00 **George Phillips, University of Wisconsin**
Representing: Berkeley Small Angle X-ray Scattering Program
"Characterization of Cellulose Deconstruction Enzymes by Small-Angle X-ray Scattering and X-ray Diffraction"
- 4:00-4:20 **Geng Cheng, Lawrence Berkeley National Laboratory**
Representing: ORNL Center for Structural Molecular Biology
"Understanding the effect of ionic liquid treatment on the structures of lignins in solutions by small angle neutron scattering"
- 4:20-4:40 **Terry Hazen, University of Tennessee**
Representing: Berkeley Synchrotron Infrared Structural Biology Program
"Label-free monitoring of chemical reactions in cells during stress-adaptive response"
- 4:40-5:00 **Blake Simmons, Sandia National Laboratory**
Representing: Berkeley National Center for X-ray Tomography
"Understanding the lipid trigger in algae using x-ray tomography and spectroscopy"
- 5:30-8:00 **Poster Session – Grand Ballroom EFGH**

Tuesday, February 28th

- 7:30-8:30 **Continental Breakfast – Grand Ballroom Foyer**
- 8:30-10:00 **Plenary Session: Small Cogs Turn Big Wheels: Microbial Communities and the Carbon Cycle**
Location: Grand Ballroom ABCD
Moderator: Joe Graber, DOE-BER
- Speakers:
- 8:30-9:00 **Steve Allison, University of California, Irvine**
“Linking Microbial Enzyme Genes with Community Responses to Drought and Nitrogen”
- 9:00-9:30 **Dave Myrold, Oregon State University**
“Meta-omics Analysis of Microbial Carbon Cycling Responses to Altered Rainfall Inputs in Native Prairie Soils”
- 9:30-10:00 **Cheryl Kuske, Los Alamos National Laboratory**
“Patterns of soil community response to elevated atmospheric CO₂ across terrestrial ecosystems”
- 10:00-10:30 **Coffee Break**
- 10:30-12:00 **Plenary Session: DOE User Facilities & Community Resources**
Moderator: Dan Drell, DOE-BER
- Speakers:
- 10:30-11:00 **Eddy Rubin, Joint Genome Institute, Lawrence Berkeley Natl. Lab**
“Science at the JGI”
- 11:00-11:30 **Adam Arkin, Lawrence Berkeley National Laboratory**
“The DOE Systems Biology Knowledgebase”
- 11:30-12:00 **Keith Hodgson, SLAC National Accelerator Laboratory**
“Recent Developments with the LCLS X-ray FEL at SLAC and Prospects for Future Science”
- 12:00-12:15 **DOE Report Update: “Biosystems Design: Report from the July 2011 Workshop”**
Pablo Rabinowicz, DOE-BER
- 12:15-12:30 **DOE Report Update: “Applications of New DOE National User Facilities in Biology: Report from the May 2011 Workshop”**
Roland Hirsch, DOE-BER
- 12:30-2:00 **Lunch**

- 12:30-2:00 **Lunchtime Student Oral Presentations**
Moderator: Libby White, DOE-BER
- 12:30-12:35 **Ali Zomorodi, Pennsylvania State University**
“OptCom: A Multi-level Optimization Framework for the Metabolic Modeling and Analysis of Microbial Communities”
- 12:38-12:43 **Yuekai Sun, Stanford University**
“Reliable Numerical Methods for FBA and FVA”
- 12:46-12:51 **Caleb Levar, University of Minnesota**
“Spatioelectrochemistry: The Molecular Basis for Electron Flow within Metal-Reducing Biofilms”
- 12:54-12:59 **Harish Nagarajan, University of California San Diego**
“Integrated Genome-Scale Modeling of Syntrophic Consortia Reveals the Microbial Community Dynamics and Mechanisms of Electron Transfer”
- 1:02-1:07 **Michael Souza, University of California Berkeley**
“Evolutionary and Experimental Evidence-based Functional Annotation of Genes”
- 1:10-1:15 **Matthew Benedict, University of Illinois**
“Methanogenic Archea and the Global Carbon Cycle: A Systems Biology Approach to the Study of Methanosarcina Species”
- 1:18-1:23 **Anne Dekas, California Institute of Technology**
“Linking Phylogeny and Function of Methanotrophic Archaeal-Bacterial Consortia in Deep-Sea Methane Seeps”
- 1:26-1:31 **Kachana Padmanabhan, North Carolina State University**
“Computational Methodologies for Identification of Phenotype-specific Biological Processes in Microbial Communities”
- 1:34-1:39 **Darcy McRose**
“Vitamin Biosynthesis and Regulation in Marine Algae”

2:00-5:00 **Breakout Session D: DOE Office of Basic Energy Sciences: Photosynthetic Systems Research**
Location: Brookside A/B

Moderator: Gail McLean, DOE Office of Basic Energy Sciences

Description of Session: This session highlights projects in the Photosynthetic Systems program in DOE’s Office of Basic Energy Sciences (BES). This program supports basic research in natural photosynthesis and brings together biology, chemistry, biochemistry, and biophysics to uncover the fundamental science of the biological capture of sunlight and its conversion to and storage as chemical energy.

Speakers:

2:00-2:10 Session Introduction

- 2:10-2:40 **Kevin Redding, Arizona State University**
"Routing of Electrons in the Photosynthetic Firmicute, *Heliobacterium modesticaldum*"
- 2:40-3:10 **Christine Kirmaier, Washington University in St. Louis**
"Controlling Electron Transfer Pathways in Photosynthetic Reaction Centers"
- 3:10-3:40 **K.V. Lakshmi, Rensselaer Polytechnic Institute**
"The Mechanism of Solar Water Oxidation in Nature: A Cross Species Comparison of the Structure of the S-State Photochemical Intermediates of Photosystem II"
- 3:40-4:00 **Coffee Break**
- 4:00-4:30 **Ann McDermott, Columbia University**
"Shifting Shapes: NMR Studies of Conformational Flexibility in Light Harvesting Complexes"
- 4:30-5:00 **Robert Burnap, Oklahoma State University**
"Genetic Regulatory Circuits Integrating the Light and Dark Reactions of Oxygenic Photosynthesis"

2:00-5:00 **Breakout Session E: Integrating Societal considerations/Impacts into BER-funded Research**
Location: Forest Glen

Moderator: Libby White, BER

Description of Session: As BER's Genomic Sciences Program's research progresses, DOE will continue to incorporate into such research a component that addresses societal considerations/impacts. This session will focus on ongoing efforts at DOE and other organizations to look at societal considerations/impacts, as well as gaps/potential future ELSI research needs.

- 2:00 – 2:05 **Libby White, BER**
Session Introduction
- 2:05 - 2:25 **Amy Wolfe, Oak Ridge National Laboratory**
"Societal Implications of Science and Technology Research and Development Undertaken at U.S.DOE Research Centers"
- 2:25 – 2:45 **Sarah Carter, Venter Institute**
Managing the Risks of Synthetic Biology Assessing the U.S. Regulatory System
- 2:45 - 3:05 **Nathan Hillson, Lawrence Berkeley National Laboratory**
Assessing and Mitigating the Risks of Large-scale Metabolic Engineering
- 3:05 - 3:20 **Coffee Break**
- 3:20 – 3:40 **Paula Olsiewski, Sloan Foundation**
Overview of Sloan Foundation's Synbio-ELSI Program

- 3:40 – 4:00 **Dave Rejeski, Wilson Center**
Summary of Fall 2010 Workshop and Other Related Wilson Center Efforts
- 4:00 – 4:30 **Tom Murray, the Hastings Center**
The Evolution of ELSI, where it is today, and how it could respond to Synthetic Biology
- 4:30 – 5:00 Wrap up discussion/Panel Discussion of Previous Speakers

2:00-5:00 **Breakout Session F: Innovative Analytical and Imaging Technology for Plants and Microbes**
Location: Glen Echo

Moderators: Arthur Katz & Dean Cole, DOE-BER

Description of Session: The Genomic Science program supports basic research that includes the application and development of a variety of imaging and analytical technologies. The biological challenge for these technologies remains extending their capabilities in order to simultaneously measure multiple chemical and biological species at multiple scales within complex, heterogenous cellular and environmental systems. One critical step will be increasing temporal and spatial resolution. This breakout session will introduce current capabilities of key technologies and relate how they can be used to address significant biological problems of interest to the BER community.

Speakers:

- 2:00-2:30 **Mitch Doktycz, Oak Ridge National Laboratory**
“Microfluidic technologies for characterizing plant-microbe interfaces.”
- 2:30- 3:00 **Haw Yang, Princeton University**
“Visualizing Molecular Reactivity in Context.”
- 3:00- 3:30 **Paul Bohn, Notre Dame University**
”Applications of In Situ Raman Microscopy and Spectroscopy to Spatially and Temporally Distributed Processes in Complex Multi-Organismal Systems.”
- 3:30- 3:45 Break
- 3:45 -4:15 **Kenneth Hammel, University of Wisconsin**
“Fungal Biodegradative Oxidants in Lignocellulose: Fluorescence Mapping and Correlation with Gene Expression.”
- 4:15- 4:45 **Drew Weisenberger, Jefferson Lab**
“PET Radiotracer Imaging in Plant Biology”
- 4:45-5:00 Observations and Comments

5:30-8:00 **Poster Session – Grand Ballroom EFGH**

Wednesday, February 29th

7:30-8:30 **Continental Breakfast – Grand Ballroom Foyer**

8:30-10:00 **Plenary Session: Extending Systems Biology to the Community Scale**

Location: Grand Ballroom ABCD

Moderator: Roland Hirsch, DOE-BER

Speakers:

8:30-9:00 **Margie Romine, Pacific Northwest National Laboratory**
"Genome Sequence-Enabled Investigations of Microbial Interactions in Mat Communities"

9:00-9:30 **Chris Marx, Harvard University**
"Evolution of cooperation in synthetic, multi-species microbial consortia"

9:30-10:00 **Dave Stahl, University of Washington**
"Adaptive and evolutionary dimensions of microbial communities"

10:00-10:30 **Coffee Break**

10:30-11:50 **Plenary Session: DOE Early Career Research Program**

Moderator: John Houghton, DOE-BER

Speakers:

10:30-10:50 **Susannah Tringe, Lawrence Berkeley National Laboratory**
"Microbial Communities in Restored Freshwater Wetlands"

10:50-11:10 **Sam Hazen, University of Massachusetts**
"Optimizing Plant-Microbial Systems for Energy – Mapping Feedstock Quality Genes in *Brachypodium distachyon*"

11:10-11:30 **Yongqin Jiao, Lawrence Livermore National Laboratory**
"Understanding Uranium Resistance and Mineralization by *Caulobacter crescentus*"

11:30-11:50 **Mary Dunlop, University of Vermont**
"Engineering Robust Hosts for Microbial Biofuel Production"

12:00 **Close-out and Adjournment**