

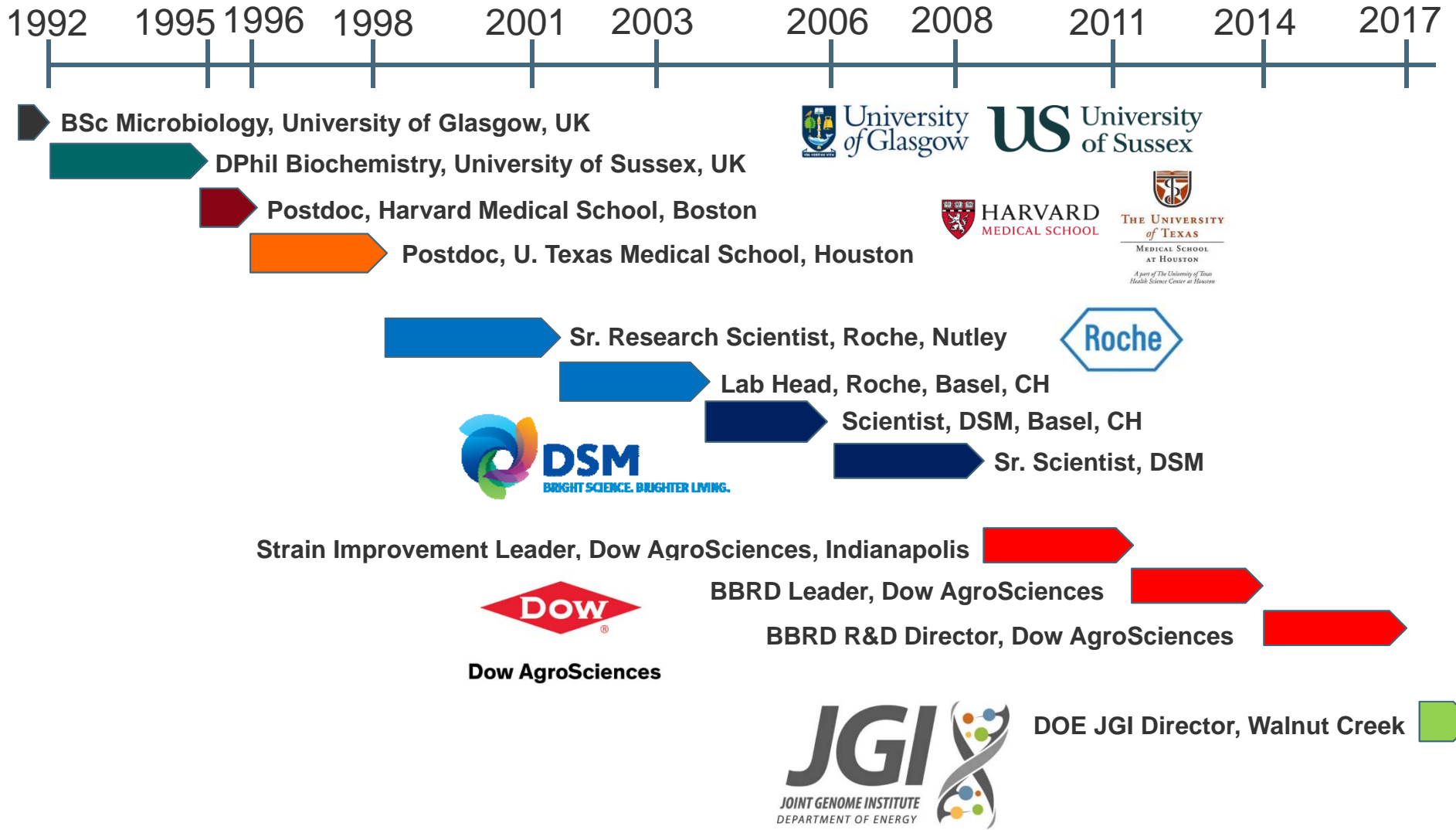
Introduction and Perspective

Dr. Nigel J. Mouncey
Director, DOE JGI



- **Introduction**
 - **Current State of JGI**
 - **Future Directions of JGI – a first glimpse**
-

My Background - Overview



Scientific Experience



- **Science and Scientific Leadership**

- Fundamental understanding of microbial metabolism and regulatory systems to harness microbes to produce commercial products
- Broad expertise and experience in multiple scientific areas and integrating technologies
- Successful development and optimization of production strains and processes for vitamins, insecticides, fungicide, platform chemicals
- Strong promoter of adopting new technologies
- Identified and led collaborations with academia, government research institutes and industry

- **External Presence**

- 2016 World BioMarkets Bio-Based Business Person of the Year
- Nominated for 2016 D.I.C. Wang Award in Biochemical Engineering
- Chair of Publications Committee for SIMB and ad-hoc member SIMB Diversity Committee
- Member of ASM, SIMB, Microbiology Society, ACS
- Extensive network in Industrial Biotechnology, Engineering Biology, Ag Industry

Expertise I bring to the DOE JGI



Safety

- My #1 priority is to ensure we have a safe work environment and that people are working with the best safety practices so as not to harm themselves or others

Leadership

- Strategic Leadership for development of vision, strategy, values
- Combining multiple technologies to build integrated platforms
- Ensure scientific excellence in all we do
- Promotion of innovation and collaboration

People

- Building and developing diverse and inclusive teams and leaders that are fully empowered
- Focus on effective, open and transparent communication at all levels

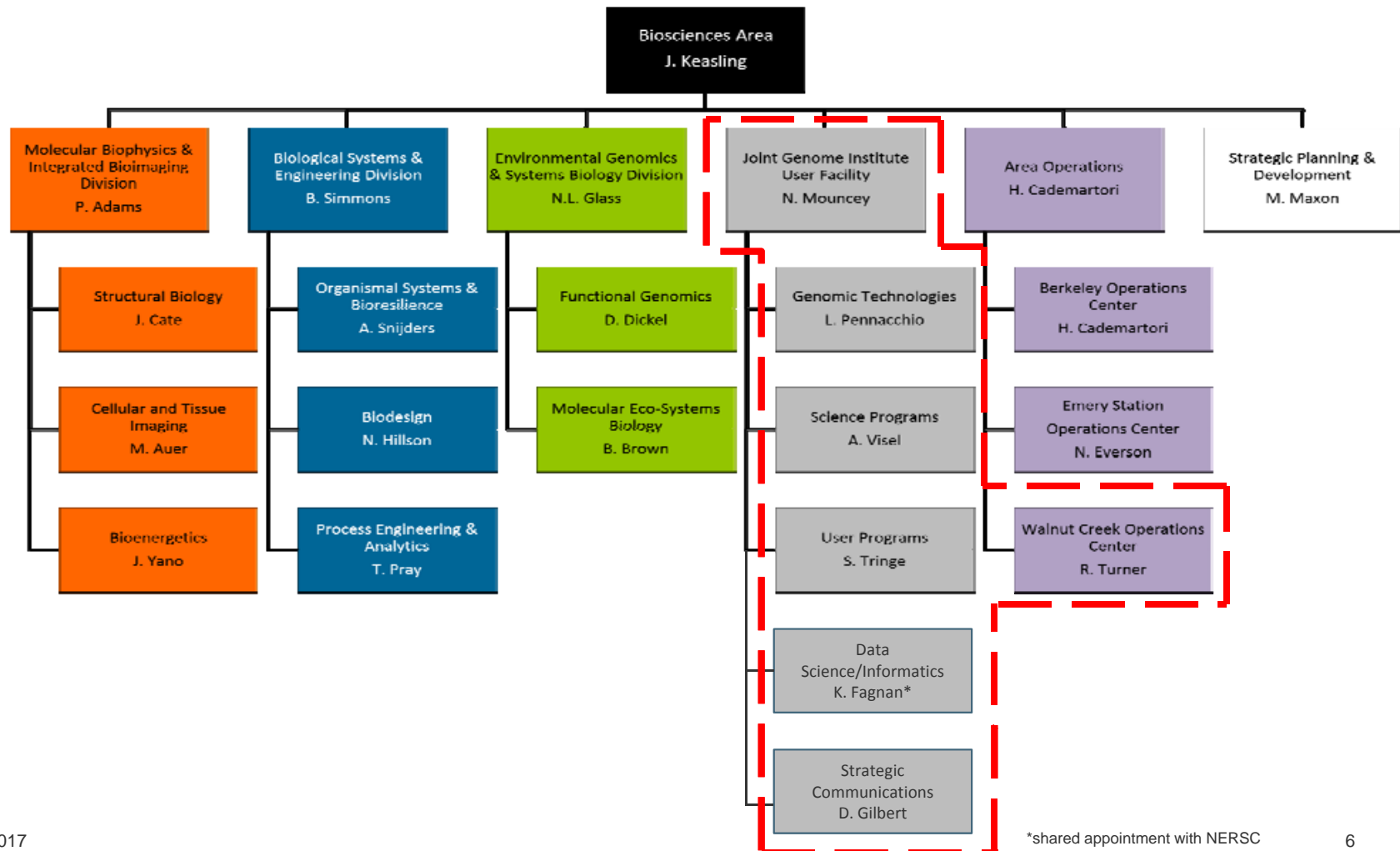
Operations

- Fiscal responsibility to manage multi-million \$\$ budgets
- Experience in building design and relocation of departments
- Knowledge and experience in developing and deploying IP strategies

JGI is part of LBNL Biosciences Area



Biosciences Area Structure

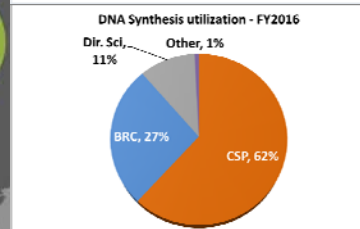
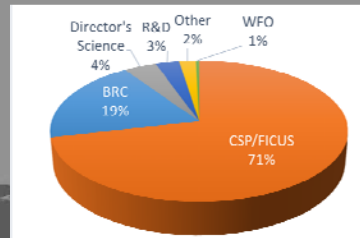


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Serving a Global User Community



1,391 users in FY2016

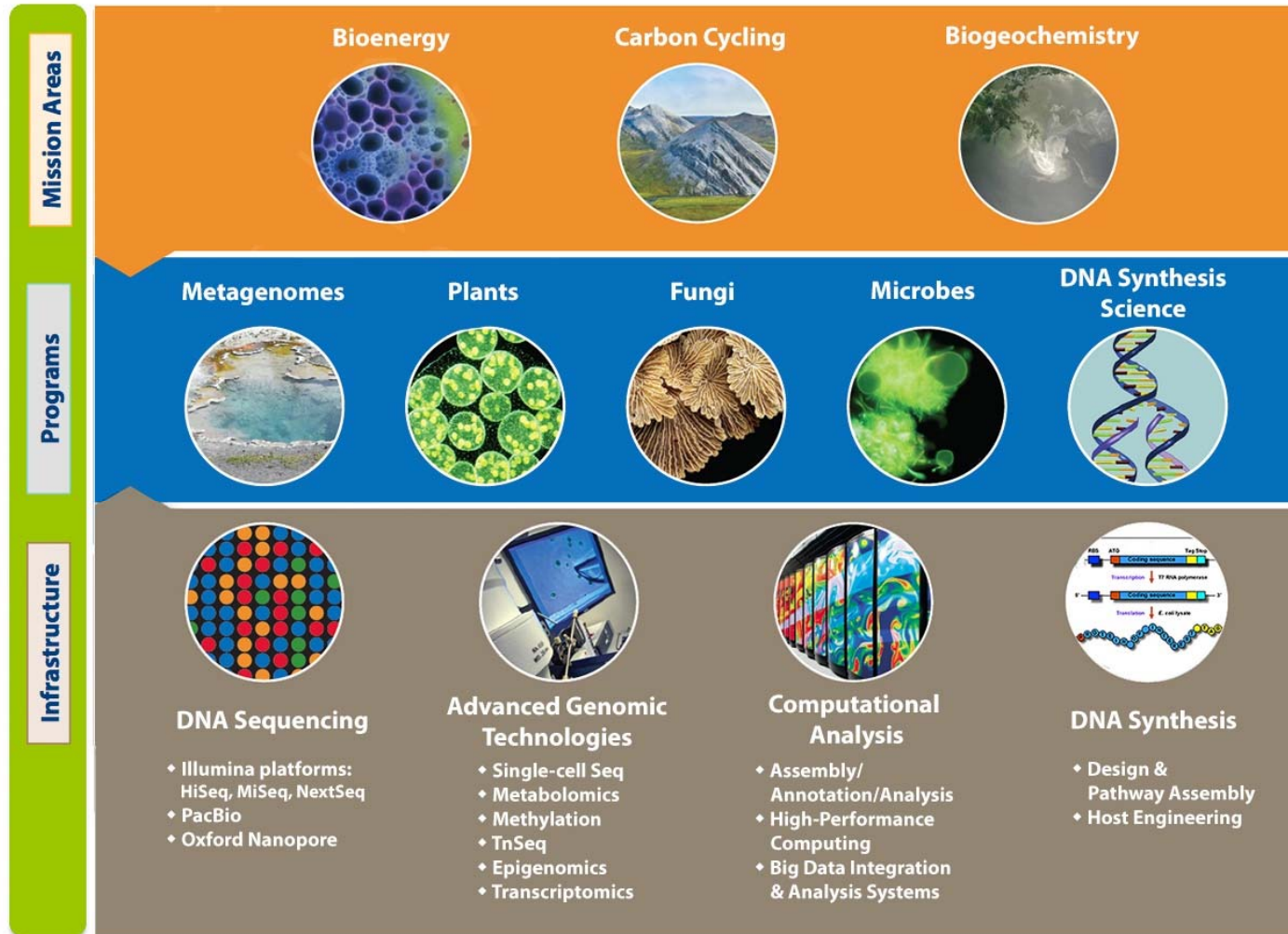


>14,000 new registered data users in FY2016

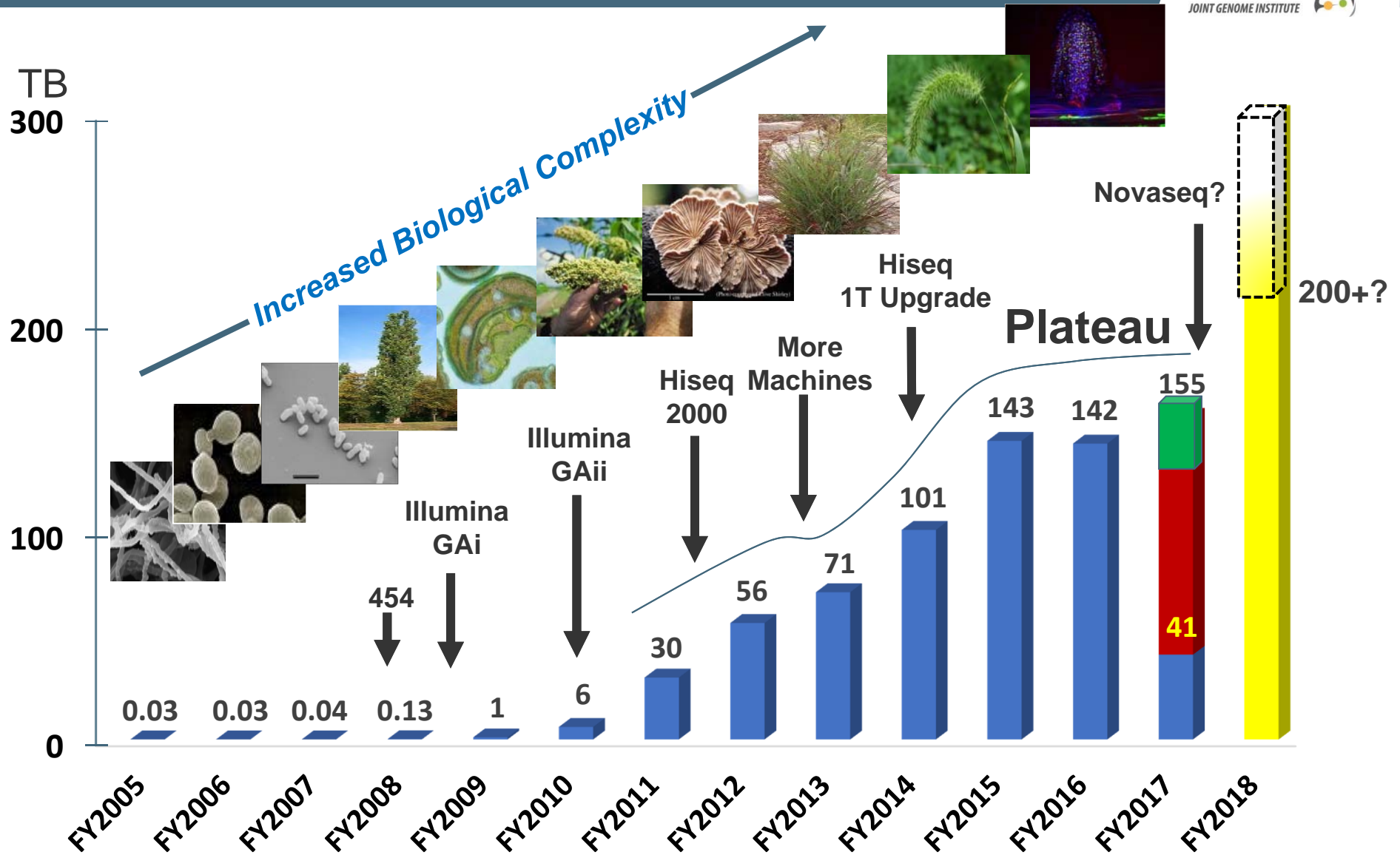
514 projects active in FY2016
160 new projects initiated



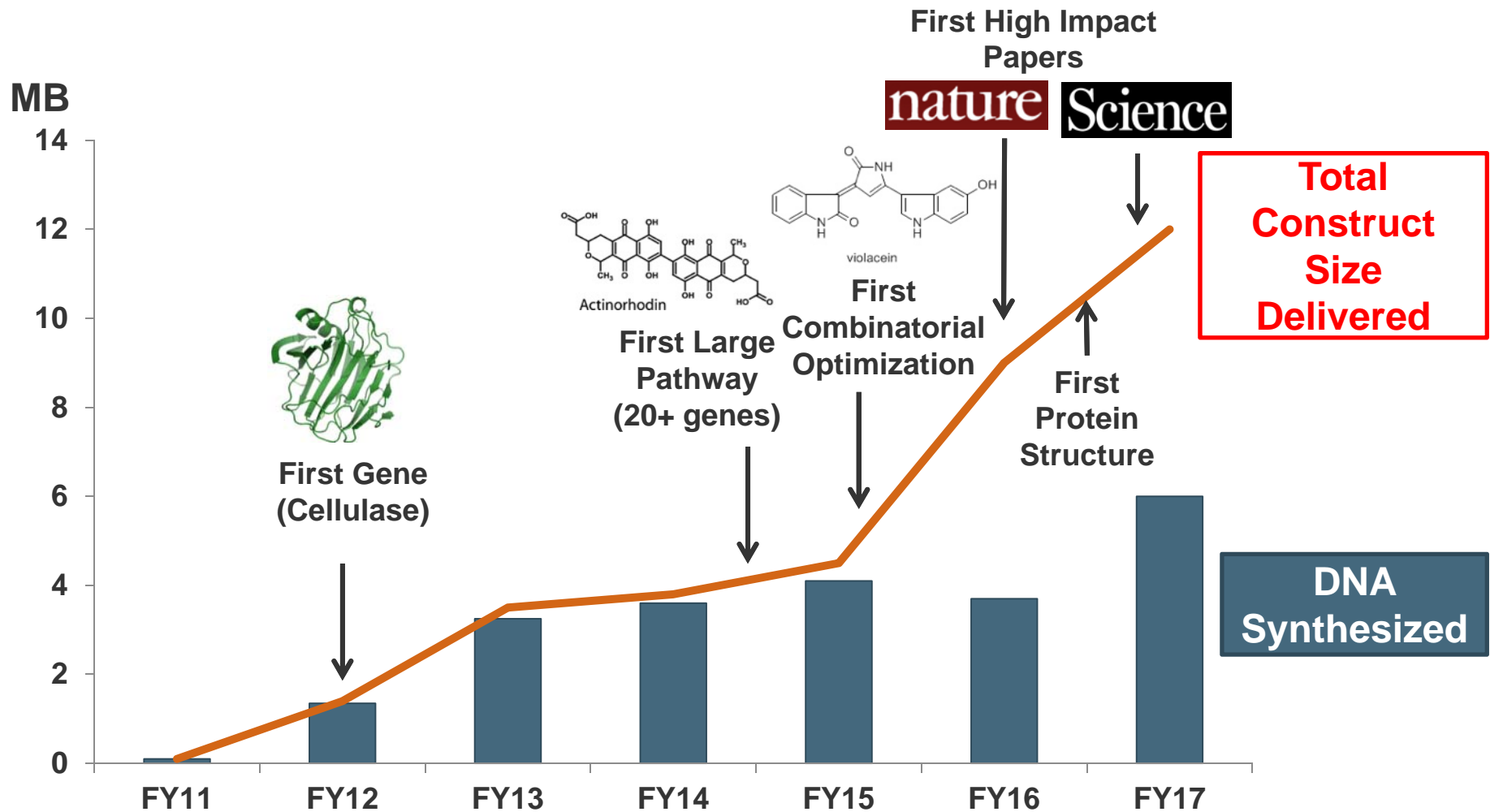
JGI Program Structure



Increases in Genome Sequencing and Analysis



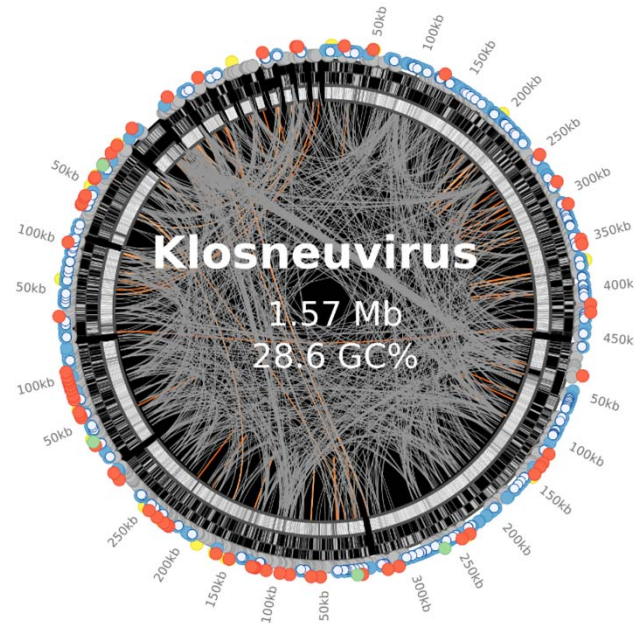
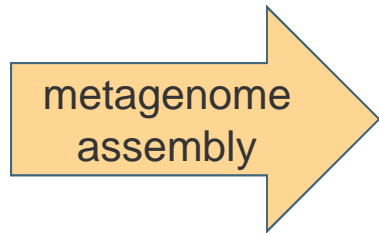
Increases in DNA Synthesis and Scientific Output



Science Highlight 1: Origins of Giant Viruses Revealed



Wastewater treatment plant in Klosterneuburg, Austria



Genome includes unusually complete translation machinery

REPORT

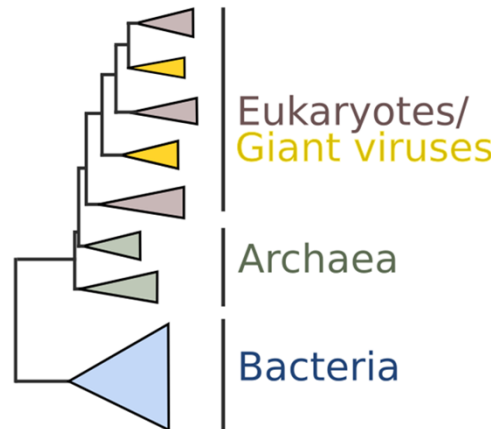
Science

VIRAL GENOMICS

Giant viruses with an expanded complement of translation system components

Frederik Schulz,^{1*} Natalya Yutin,² Natalia N. Ivanova,¹ Davi R. Ortega,³ Tae Kwon Lee,^{4,†} Julia Vierheilig,⁴ Holger Daims,⁴ Matthias Horn,⁴ Michael Wagner,⁴ Grant J. Jensen,^{3,5} Nikos C. Kyrpides,¹ Eugene V. Koonin,^{2*} Tanja Woyke^{1*}

Science, April 7th, 2017



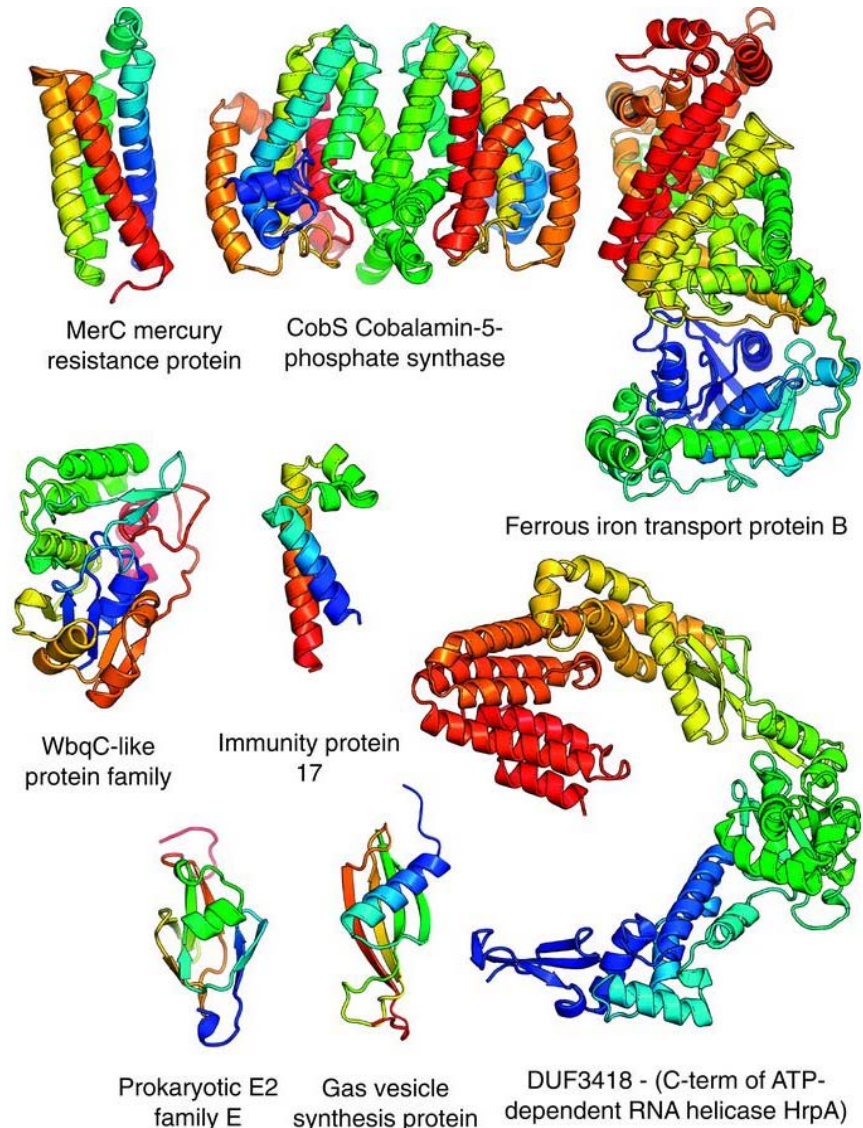
Phylogenomic analysis:

- Giant viruses accumulated DNA from eukaryotic hosts
- “DNA Gobblers”, rather than a 4th domain of life

Science Highlight 2: Metagenomics-Enabled Protein Structure Prediction



- Collaboration with D. Baker (UW)
- Protein structure prediction guided by evolutionary conservation of residue-residue contacts
- Mined deep metagenomic data in JGI's Integrated Microbial Genomes (IMG) system
- Generated models for 614 protein families with previously unknown structures



REPORT

PROTEIN STRUCTURE

Science

Protein structure determination using metagenome sequence data

Sergey Ovchinnikov,^{1,2,3} Hahnbeom Park,^{1,2} Neha Varghese,⁴ Po-Ssu Huang,^{1,2} Georgios A. Pavlopoulos,⁴ David E. Kim,^{1,5} Hetunandan Kamisetty,⁶ Nikos C. Kyrpides,^{4,7} David Baker^{1,2,5*}

Science, January 20th, 2017



Science Highlight 3: FICUS Project Uncovers New Biomass-Degrading Enzymes



FICUS
Facilities Integrating
Collaborations for User Science



FICUS User
Michelle O'Malley



Herbivore
Guts



Early-Diverging
Fungi



Transcriptomics



Proteomics

Identified novel, sequence-divergent
enzymes for biomass degradation

JGI Informatics/Data Science



Our sophisticated informatics infrastructure enables JGI to generate petabytes of high-quality sequence data and insights for the User community

 We collaborate with  to

 Run JGI's data and analytics infrastructure

 Scale up JGI workflows to handle the data deluge

 Enable new scientific analyses through FICUS

 We collaborate with  **KBase** to

PREDICTIVE BIOLOGY
DOE Systems Biology Knowledgebase

 Connect Users to the analytical capabilities in KBase

 Build KBase narratives with JGI public data and pipelines seamlessly

The New KBase and JGI Home - IGB



Groundbreaking Ceremony
31st January, 2017



The Integrative Genomics Building (IGB)

- Co-Locate JGI and KBase
- Expected Move: early 2019
- Construction work started in Nov. 2016
- Micropile installation ongoing
- **As of today, there were >12,000 h worked and 0 Safety Incidents**

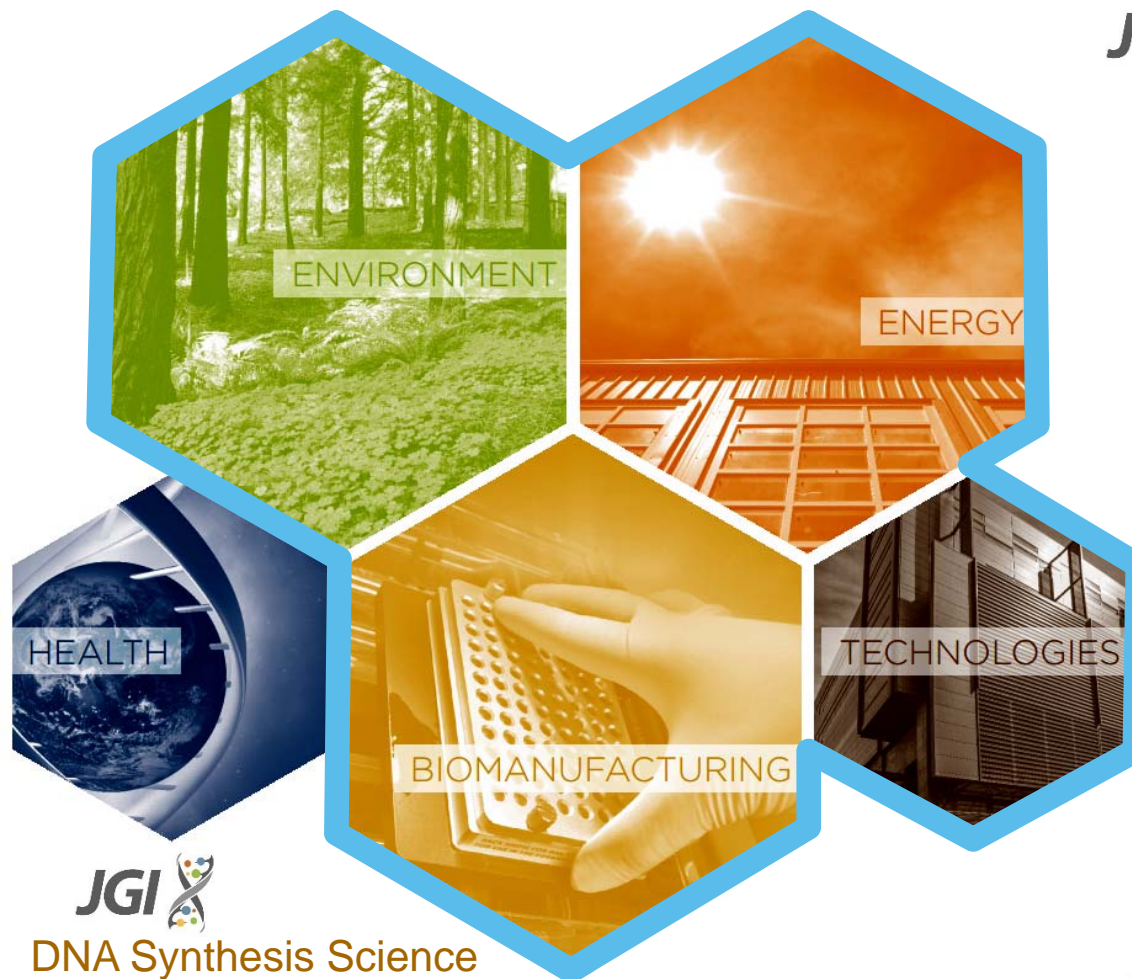
Aligning the JGI Vision with the Biosciences Strategic Plan and Program Development Efforts



Biosciences Strategic Plan



- Biogeochemical Cycles
- Carbon Cycling
- Rhizosphere
- Soil ecosystems



- DNA Synthesis Science



- Genomics of plant feedstocks
- Data mining for biomass-degrading enzymes



- Sequencing
- Molecular Biology
- Synthesis
- Analysis



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The DOE JGI Continues to Evolve



Structure

1997

The Human Genome Project

2004

A Production Sequencing User Facility

2012

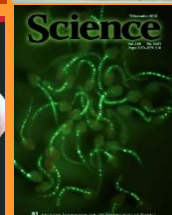
A Next-Generation Genome Science User Facility

2017....

An *Integrative* Genome Science User Facility

Science

Human & Animals



Plants & Microbes



Metagenomes, Host Interactions, Pathway Modeling, DNA Synthesis, Metabolomics



Integrative 'omics, (micro)biome, enzymology, scalable data science

Mission

sequence, assemble and annotate

GENOMES

understand gene and genome


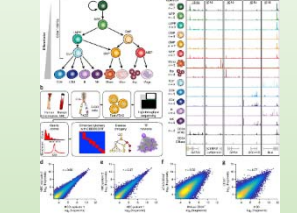



FUNCTION

harness sequence and functional knowledge for

INTEGRATION

Long-Term Challenges/Opportunities for DOE JGI – The I⁵ Framework

The DOE JGI is the leading integrative genome science user facility for understanding and solving the world's evolving energy and environmental challenges

Identification	Interrogation	Investigation	Integration	Interaction
				
<ul style="list-style-type: none">•What additional diversity should we sequence?•How do we best explore composition of (micro)biomes and host-microbe interactions?•Can we develop faster sequencing and analysis methods?	<ul style="list-style-type: none">•How do we enable scaleable high-performance computation?•Can we build new analysis tools, software and pipelines to generate new insights?	<ul style="list-style-type: none">•How do we rapidly assay gene function at scale?•How can we efficiently engineer diverse organisms?•How do we combine technical approaches to analyze gene function?	<ul style="list-style-type: none">•Can we combine diverse datasets into a single platform?•How do we integrate data to build systems-level understanding?•How do we drive understanding into solutions?	<ul style="list-style-type: none">•What new User communities can we build?•How do we better interact with LBNL and other NLs/UFs?•How do we grow awareness of JGI capabilities?•How do we sustain and grow expertise?

The DOE JGI is comprised of highly-skilled and diverse talent founded on a culture of scientific excellence, trust, curiosity, passion and collaboration

Opportunities Under Consideration I

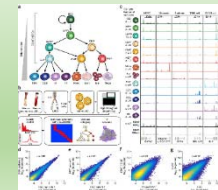


- **Identification** : Continued Discovery
 - New sequence efforts – more communities, spatial/temporal, algae, expanded plants, trees, protists?
 - Build tools for microbiome characterization
 - Evaluate new sequencing methodologies and faster pipelines
- **Interrogation** : Ask Questions of our Data
 - Develop Data Science strategy for scaleable data management and analysis
 - Build out new analysis tools and algorithms
- **Investigation** : Functional Exploration
 - Build out DNA synthesis platform and couple with high-throughput metabolomics and proteomics
 - Develop rapid prototyping systems e.g. cell-free systems
 - Develop methods for high-throughput phenotyping
 - Focused efforts on secondary metabolite biosynthesis and roles

Identification



Interrogation



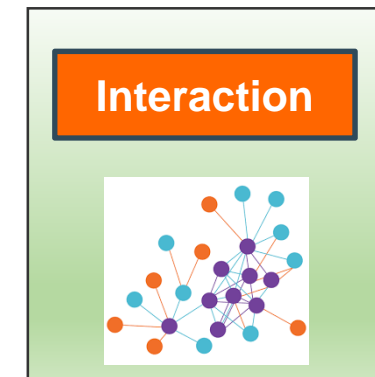
Investigation



Opportunities Under Consideration II



- **Integration** : Bringing Capabilities Together
 - Develop single portal to handle all data and cross-Program data
 - Develop systems wide analysis approaches with seamless interaction between KBase and JGI
 - Identify cross-technology collaborations with other User Facilities
 - Develop JGI enzymology platform
- **Interaction** : User Engagement
 - Expand User Communities to include Industry
 - Establish Industry Advisory Committee
 - Develop framework for Industry Engagement Program
 - Cross-Program User Communities/Forums
 - JGI Outreach and Communication Strategy



- **In order to meet and sustain this vision, JGI culture will evolve alongside the science and technology:**
 - Stronger and more empowered leadership through new leadership teams and leadership training
 - Broader and deeper emphasis on safety through increased leadership engagement and continuous improvement
 - Developing people through performance management, skill development, mentorship
 - Continued focus on diversity AND inclusion
 - Development of communication strategy and plan
-

Asks to BERAC

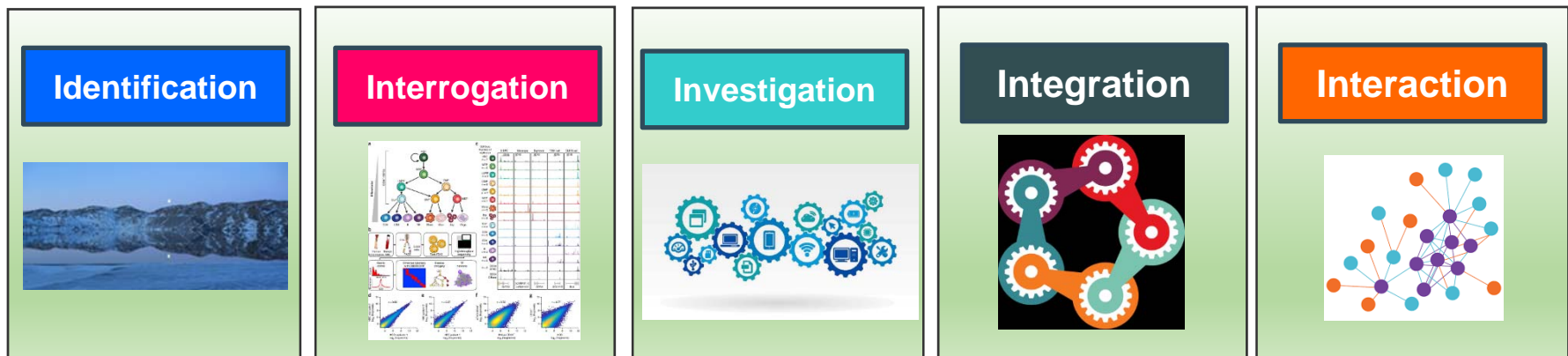


- **Is BERAC supportive of the JGI's direction?**
 - **From the I⁵ framework, what do you consider as the priority opportunities for JGI?**
 - **Are there other opportunities you feel JGI should consider?**
 - **What are the thoughts from BERAC on increasing industry engagement with the JGI?**
 - **Are there any business process reviews I should consider in how JGI spends taxpayer dollars?**
-

The I⁵ Framework for DOE JGI



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The DOE JGI is comprised of highly-skilled and diverse talent founded on a culture of scientific excellence, trust, curiosity, passion and collaboration