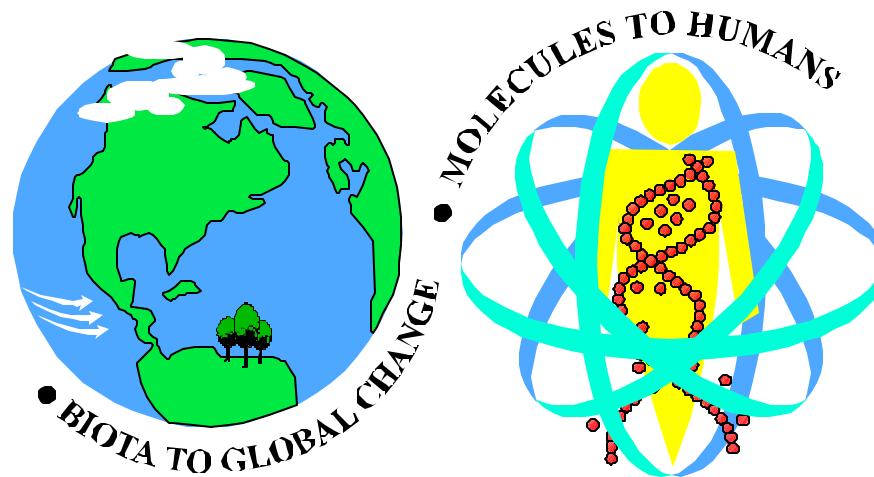


DOE Programs (Abbreviated) on Metabolic Engineering

Interagency Conference on Metabolic Engineering
January 23, 2003



John Houghton, Ph.D.
Office of Biological and Environmental Research
Office of Science

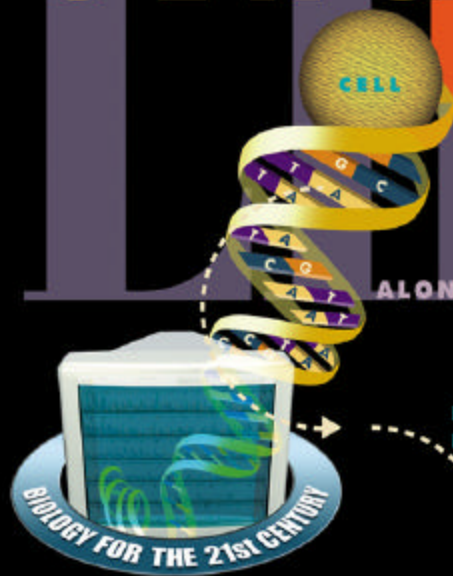
Several Offices in DOE

- Science
 - Biological and Environmental Research
 - Basic Energy Sciences (Energy Biosciences)
 - <http://www.sc.doe.gov/production/bes/eb/ebhome.html>
- Energy Efficiency and Renewable Energy
 - Hydrogen, Fuel Cells, and Infrastructure Technologies
 - Biomass

GENOMES to LIFE

BIOLOGICAL SOLUTIONS FOR ENERGY CHALLENGES

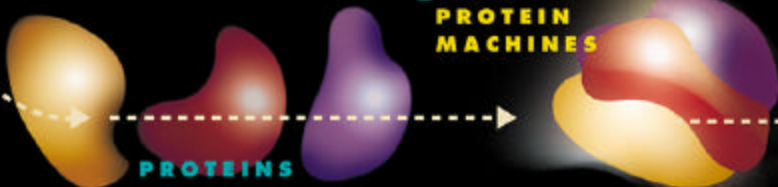
INNOVATIVE APPROACHES ALONG UNCONVENTIONAL PATHS



DNA SEQUENCE DATA FROM GENOME PROJECTS

Genes and other DNA sequences contain instructions on how and when to build proteins

goal
IDENTIFY PROTEIN MACHINES



Proteins perform many of life's most essential functions. To carry out their specific roles, they often work together in the cell as protein machines.

Clean up the environment
Sequester excess carbon
Protect workers and the public
Apply knowledge of microbial functional capabilities
Produce and use energy

goal
EXPLORE FUNCTION IN MICROBIAL COMMUNITIES

goal
DEVELOP COMPUTATIONAL CAPABILITIES TO UNDERSTAND COMPLEX BIOLOGICAL SYSTEMS

goal
CHARACTERIZE GENE REGULATORY NETWORKS

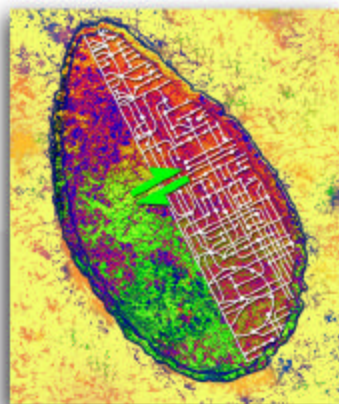
COMMUNITY OF CELLS

WORKING CELL

Many protein machines interact through complex, interconnected pathways. Analyzing these dynamic processes will lead to models of life processes.

URL DOEGenomesToLife.org

Using Microbial Capabilities for DOE Challenges



N. europaea

Analyze Microbes in GTL Facilities

- Identify protein machines and understand their functions
- Understand gene regulation
- Develop models of cell and cell community behavior under different conditions

Achieve whole-system insights into microbial capabilities and the activities of microbial communities and ecosystems

Use microbial capabilities



Produce clean, abundant energy

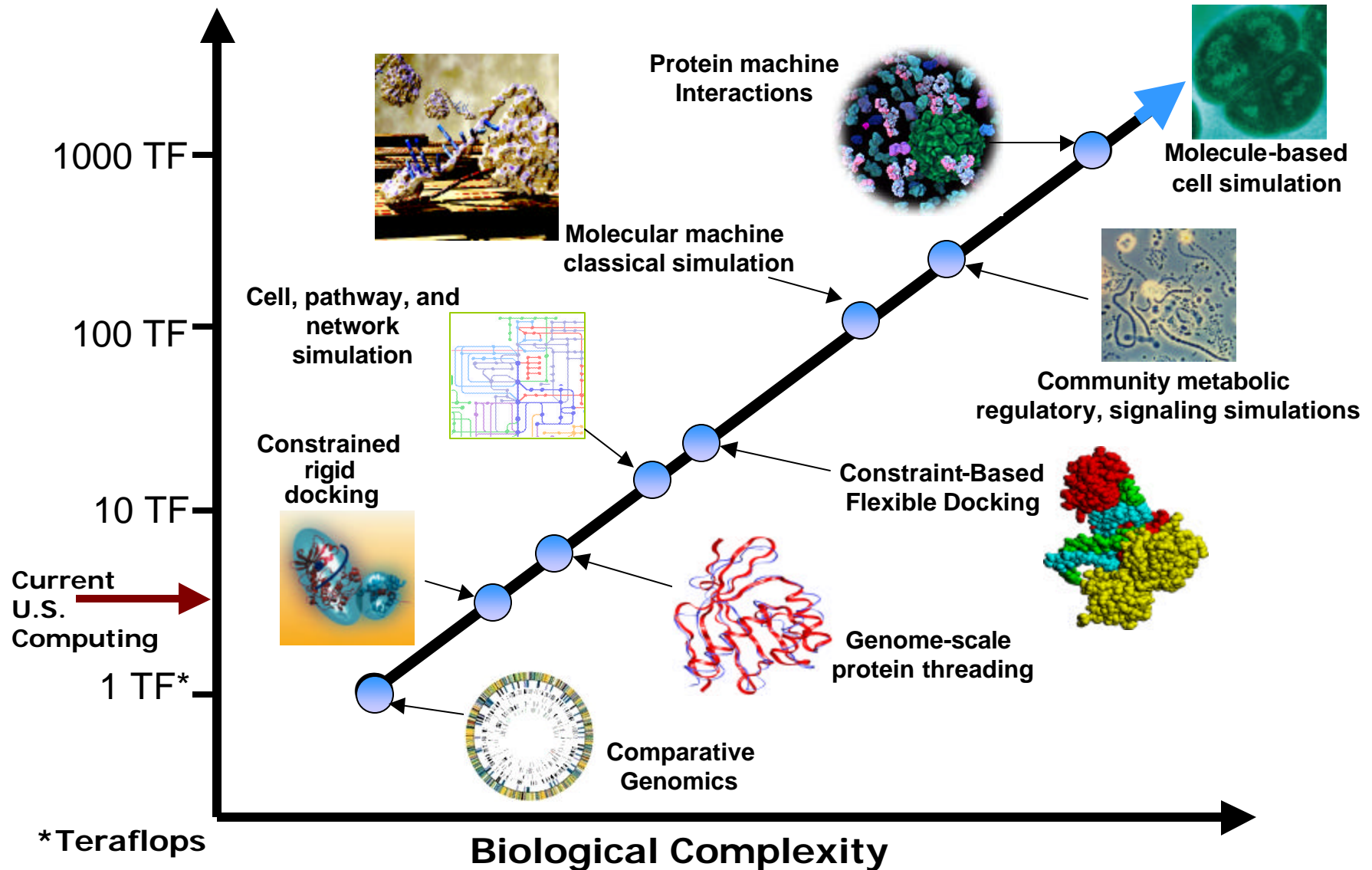
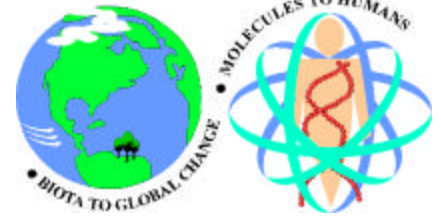


Vastly reduce cleanup costs

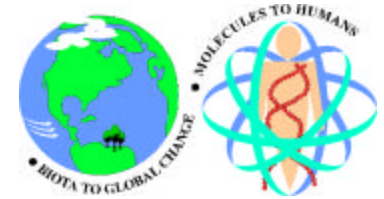


Help mitigate effects of CO₂ on climate

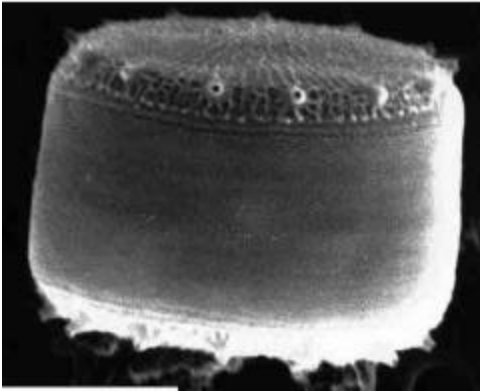
High-Performance Computing Roadmap for the Genomes to Life Program



Using the natural diversity of microbes to find biotechnology solutions

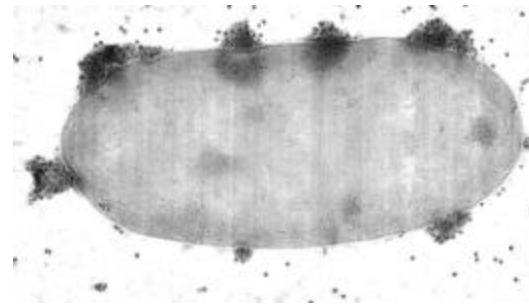


Thalassiosira pseudonana



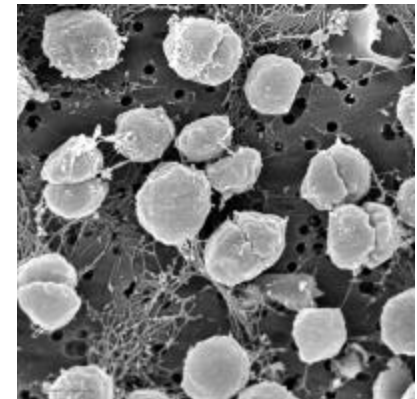
Ocean carbon pumping

Microbulbifer 2-40



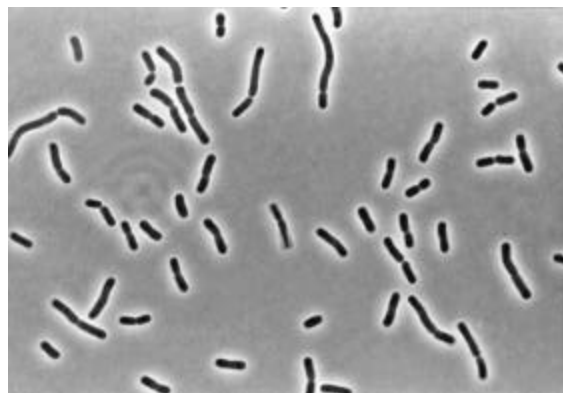
Biomass conversion

Methanococcus jannaschii



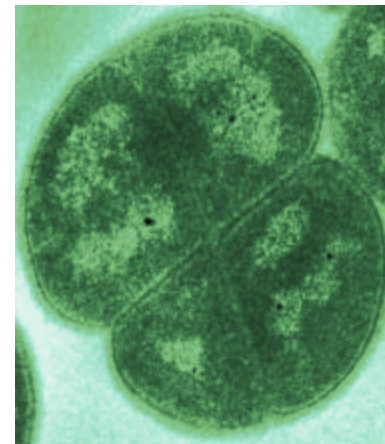
Methane production

Exiguobacterium 255-15



Low temperature enzymes for industry

Deinococcus radiodurans



Radiation resistance -
bioremediation

PROPOSED

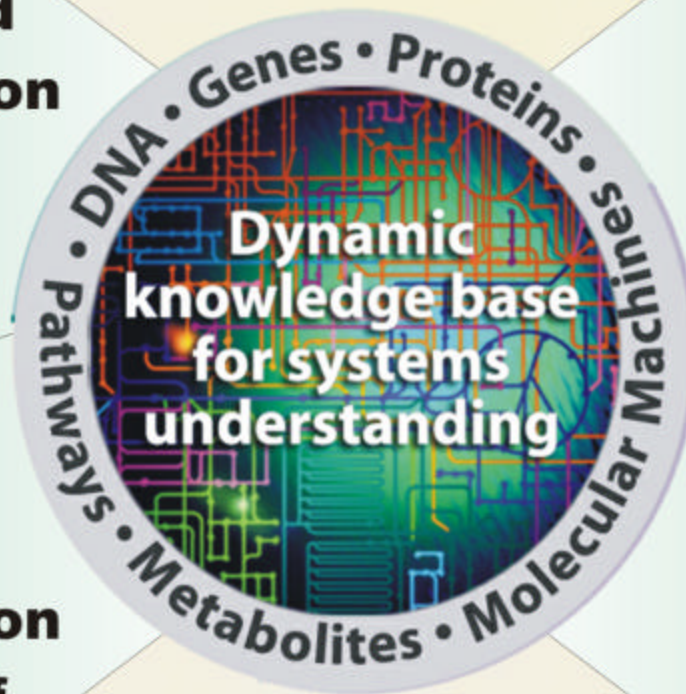
User Facilities for 21st Century Biology

Facility I
Production and
Characterization
of Proteins

Facility II
Whole
Proteome
Analysis

Facility III
Characterization
and Imaging of
Molecular
Machines

Facility IV
Analysis and
Modeling of
Cellular
Systems



Office of Science
Genomes to Life
Department of Energy

Office of Science Financial Assistance Program Notice 03-05: Genomes to Life

AGENCY: U.S. Department of Energy

ACTION: Notice inviting grant applications.

SUMMARY:The Office of Biological and Environmental Research (OBER) and the Office of Advanced Scientific Computing Research (ASCR) of the Office of Science (SC), U.S. Department of Energy (DOE), hereby announce their interest in receiving applications for research in the following areas that support the Genomes to Life research program (<http://www.doe.genomestolife.org/>):

- 1) Technologies and strategies to image individual proteins and multi-protein complexes in microbes and to image complex microbial communities;
- 2) Technologies for the high-throughput synthesis of proteins and their biological characterization;
- 3) Molecular tags to identify individual proteins and to characterize multi-protein complexes in microbial cells;
- 4) High resolution, quantitative microbial biochemistry;
- 5) New genomic strategies and technologies for studying complex microbial communities;
- 6) Pathway inference in prokaryotes;
- 7) Implications for society, the law, education, and technology transfer; and
- 8) Other novel and innovative technologies and research strategies to address the core goals of the Genomes to Life research program.

DATES: Statements of intent to apply, including information on collaborators, areas of proposed research and technology development, and a short (one page) summary of the proposed research should be submitted by Tuesday, January 7, 2003.

Formal research applications are due by 4:30 PM E.D.T. Tuesday, April 22, 2003.

<http://www.science.doe.gov/grants/Fr03-05.html>

DOE: EERE

Office of the Hydrogen, Fuel Cells and Infrastructure Technologies Program (OHFCIT)

- **Vision**

A prosperous future for the Nation where hydrogen energy and fuel cell power are clean, abundant, reliable, and affordable

- **Mission**

Research and develop hydrogen production, delivery, storage and fuel cell technology for transportation and stationary power.

- **R&D**

Hydrogen Production

Hydrogen Delivery/Transport

Hydrogen Storage

Fuel Cells

EERE: OHFCT Hydrogen Production

- Fossil Fuels
- Biomass
 - Gasification/Pyrolysis
 - Fermentative Micro-organisms
 - No significant research currently funded
 - Seeking guidance, basic research, etc. etc.
- Photolytic
 - Photosynthetic (algal) organisms
 - Extensive collaborative research effort (NREL and universities)
 - Significant efforts on genetics and genetic engineering
 - Photovoltaic Electrolysis
- Electrolysis
- High temperature Chemical-Cycle/Water Splitting

DOE:EERE

Office of the Biomass Program (OBP)

- Mission

Develop technologies for for the production of fuels for transportation from biomass. Develop technologies for biorefineries to produce fuels, power and bioproducts.

- Biorefinery Platforms

- Sugar based for ethanol and bioproducts
- Gasification/Pyrolysis for fuels, power and bioproducts

[Plant Sciences: Extensive biotechnology and genetics/metabolic engineering needed to increase plant productivity to biomass reduce cost. USDA asked to lead this effort (2002)]

EERE: OBP

- Sugar Based Biorefinery Research
 - Develop breakthrough cellulase enzyme technology to cost effectively hydrolyze cellulosic biomass to sugars
 - Extensive research effort: Novozymes, Genencor and others
 - Develop improved fermentation/micro-organism technology for ethanol and several chemicals and chemical intermediates (lactic acid, succinic acid, etc.
 - Extensive research efforts in progress. Many accomplishments with additional work on-going.
 - Develop a variety of breakthrough thermochemical processes for various bioproducts cost effective production

Thank you