

Genomics:GTL (GTL, formerly Genomes to Life) is a research program that aims to develop a predictive understanding of biological systems relevant to energy production and other Department of Energy (DOE) missions in environmental remediation and climate change mitigation (see illustration, GTL Systems Biology for DOE Missions, below).

GTL research is conducted at national laboratories and universities and includes single-investigator projects, multi-institutional collaborations, and fundamental research centers. GTL is run by the Office of Biological and Environmental Research (OBER) in partnership with the Office of Advanced Scientific Computing Research, both within DOE's Office of Science.

The DNA sequence of an organism's complete genome is the starting point to understanding any biological system. Scientists from the three Bioenergy Research Centers and other GTL projects are working with the DOE Joint Genome Institute to sequence the genomes of energy-related plants,

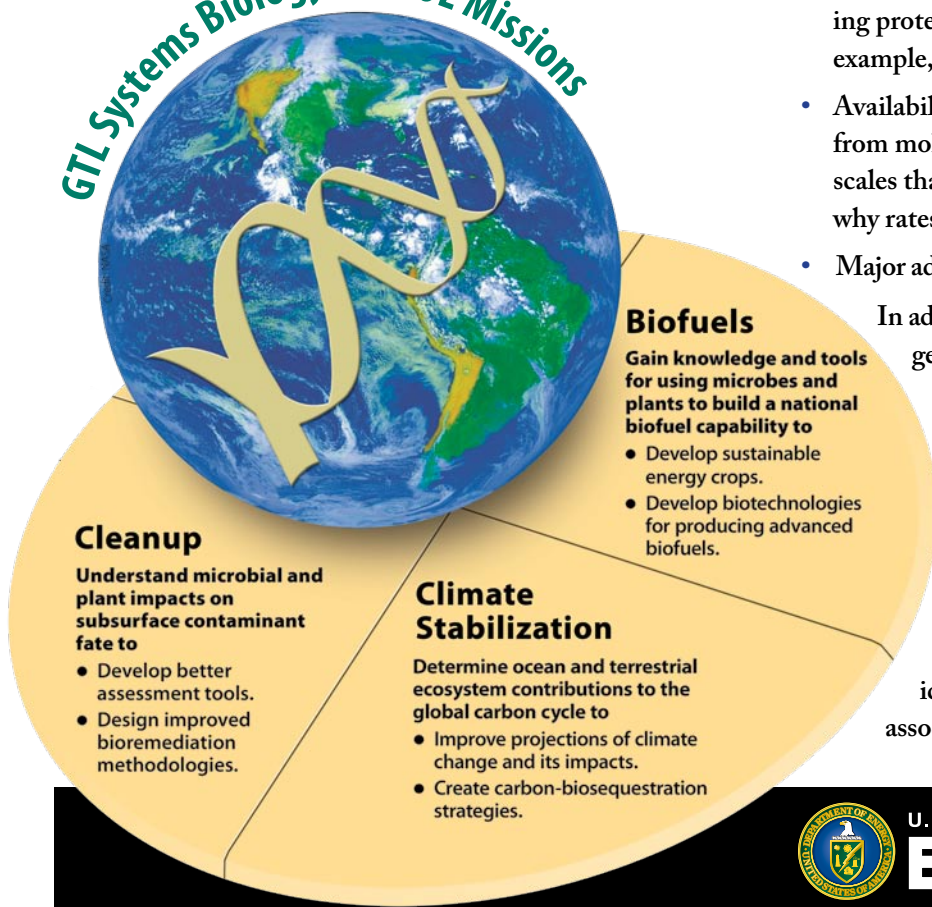
as well as microbes and fungi that degrade biomass or impact plant productivity. Building on this foundation of genomic information, the whole-systems understanding of biology generated by GTL will enable scientists to redesign proteins, biochemical pathways, and even entire plants or microbes important to solving bioenergy challenges and meeting other DOE needs. Even though the specific functions of these systems vary, common fundamental principles control the behavior of all biological systems. Knowledge of these underlying principles will advance biological solutions to DOE missions.

Several developments have converged in recent years to suggest that GTL systems biology research into microbes and plants may be able to overcome critical roadblocks to large-scale production of fuels from plant biomass. The ability to rapidly sequence the DNA of any organism is a critical but modest part of these new capabilities. Others include:

- Development of high-throughput techniques and commercially available reagents for protein production and characterization to test thousands of natural and engineered protein variations.
- Emergence of a range of new instrumentation for observing proteins and other cell constituents to determine, for example, how cell walls are constructed.
- Availability of technologies for high-resolution imaging from molecular to cellular to microbial-community spatial scales that can be used to help understand, for example, why rates of cellulose degradation vary.
- Major advances in computational capability.

In addition to GTL, OBER is supporting related genomic bioenergy collaborative research with other government agencies. A research program jointly sponsored by OBER and the U.S. Department of Agriculture (USDA) Cooperative State Research, Education, and Extension Service's National Research Initiative supports genome-based approaches to accelerate plant-breeding programs and improve potential bioenergy crops. DOE and USDA also are working together to identify and understand sustainability issues associated with a rapid scaleup of biofuel production.

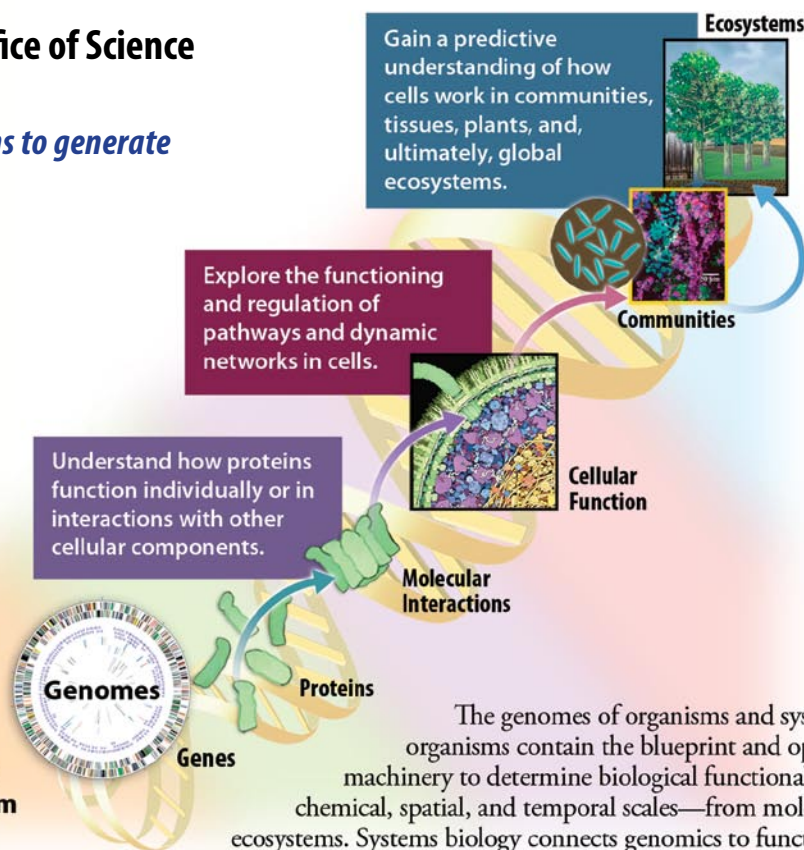
GTL Systems Biology for DOE Missions



U.S. Department of Energy Office of Science Genomics:GTL Program

*Conducting multiscale explorations to generate
a broad knowledgebase*

**The genome determines
dynamic biological structure
and function at all scales, from
genes to ecosystems**



Websites for More Information

Genomics:GTL Home Page

genomicsGTL.energy.gov

Contains site directory and links to FAQs, news, GTL-funded research, educational materials, and related documents.

DOE Mission Focus: Biofuels

genomicsGTL.energy.gov/biofuels/

Contains numerous topical fact sheets focused mainly on cellulosic ethanol.

DOE Bioenergy Research Centers

genomicsGTL.energy.gov/centers/

Contains information about the three DOE Bioenergy Research Centers, their missions, funding, and research strategies.

Image Gallery

genomics.energy.gov/gallery/

Contains downloadable images related to genomics and the Genomics:GTL program.

Breaking the Biological Barriers to Cellulosic Ethanol: A Joint Research Agenda (2006)

genomicsGTL.energy.gov/biofuels/b2bworkshop.shtml

Outlines detailed research plan for developing new technologies to transform cellulosic ethanol—a renewable, cleaner-burning, and carbon-neutral alternative to gasoline—into an economically viable transportation fuel.

DOE Joint Genome Institute (JGI)

jgi.doe.gov

Describes JGI's integrated high-throughput sequencing and computational analyses that enable genomic-scale, system-based scientific approaches to DOE-relevant challenges in energy and the environment.

DOE Office of Biological and Environmental Research

www.science.doe.gov/Program_Offices/BER.htm

DOE Office of Science

www.science.energy.gov

For more information, contact the Office of Biological and Environmental Research of the U.S. Department of Energy Office of Science at genomics.gtl@science.doe.gov or www.sc.doe.gov/ober/staff.html

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