U.S. Department of Energy

Microbial Genome Program

Exploring genomes will reveal how organisms perform functions relevant to DOE missions

Office of Science
U.S. DEPARTMENT OF ENERGY

Why Microbes?

Microbes have an enormous range of chemical capabilities, some of which surpass human technologies and have far-reaching implications for addressing DOE mission challenges. Researchers have only scratched the surface of understanding the diversity of microbes, which live in virtually all environments and make up a significant portion of the Earth's biomass.

Bioremediation

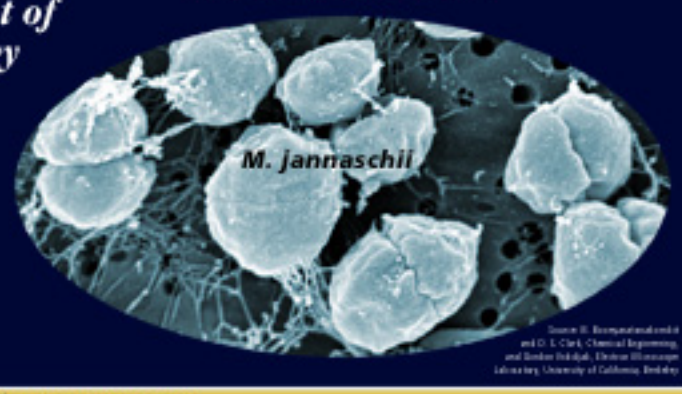
Cleanup of toxic-waste sites worldwide

Acidithiobacillus ferrooxidans
Burkholderia LB400
Caulobacter crescentus
Dechloromonas RCB
Dehalococcoides ethenogenes
Deinococcus radiodurans R1
Desulfitobacterium hafniense DCB-2
Desulfovibrio desulfuricans G20
Desulfovibrio vulgaris
Desulfuromonas acetoxidans
Ferroplasma acidarmanus fer1
Geobacter metallireducens
Geobacter sulfurreducens
Mesorhizobium BNC1
Methylococcus capsulatus
Novosphingobium aromaticivorans F199
Pseudomonas fluorescens PFO-1
Pseudomonas putida
Ralstonia metallidurans CH34
Rhodobacter sphaeroides 2.4.1
Shewanella oneidensis MR-1

Energy Production

Energy generation and development of renewable energy sources (e.g., methane and hydrogen)

Methanobacterium thermoautotrophicum delta H
Methanococcoides burtonii DSM6242
Methanococcus jannaschii DSM2661
Methanopyrus kandleri AV19
Methanosarcina barkeri Fusaro



What's a Microbe? What's a Genome?

Microbes are the invisible bacteria, archaeae, protozoa, and fungi that inhabit our environment—our bodies, our food and water, and even the air we breathe. A **genome** is all the DNA in any organism. It contains the information that orchestrates the chemical reactions needed for all life functions.

Technology Development, Pilot Projects

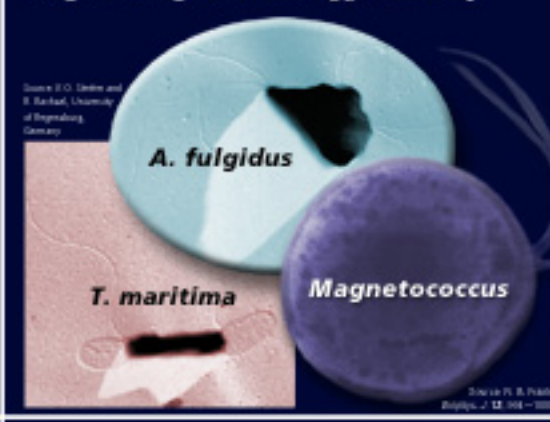
Production and biotechnology

Borrelia burgdorferi B31
Brucella melitensis 16M
Enterococcus faecium
Exiguobacterium 255-15 (NASA)
Haemophilus somnus 129PT
Mycoplasma genitalium G-37
Psychrobacter 273-4 (NASA)
Streptococcus suis 1591
Xylella fastidiosa Dixon (almond)
Xylella fastidiosa Ann1 (oleander)

Biotechnology and Applied Microbiology

Production of chemicals to improve process efficiency

Aquifex aeolicus VF5
Archaeoglobus fulgidus DSM4304
Bifidobacterium longum DJO10A
Brevibacterium linens BL2
Clostridium acetobutylicum
Ehrlichia chaffeensis Sapulpa
Ehrlichia canis Jake
Halobacterium halobium
Lactobacillus brevis ATCC367
Lactobacillus bulgaricus ATCCBAA-365
Lactobacillus casei ATCC334
Lactobacillus gasseri ATCC33323
Lactococcus lactis cremoris SK11
Leuconostoc mesenteroides
Magnetococcus MC-1
Magnetospirillum magnetotacticum MS-1 ATCC31632
Oenococcus oeni PSU1
Pediococcus pentosaceus ATCC25745
Pseudomonas syringae B728a
Pyrobaculum aerophilum
Pyrococcus furiosus
Streptococcus thermophilus LMD-9
Thermotoga maritima MSB8



Cellulose Degradation

Efficient conversion of biomass to products such as ethanol, methane, and hydrogen

Clostridium thermocellum ATCC27405
Cytophaga hutchinsonii ATCC33406
Microbulbifer 2-40
Phanerochaete chrysosporium
Thermobifida fusca YX

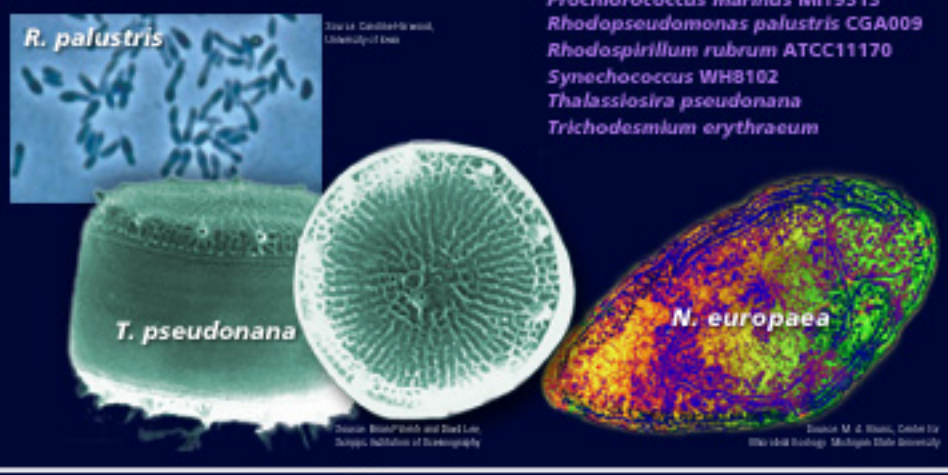
Innovative, High-Impact Science

In 1994 DOE initiated the Microbial Genome Program as a spinoff of its Human Genome Program. MGP's goal is to generate biological solutions to challenging DOE missions in energy, environmental cleanup, biodefense, and global climate change. Scientists expect to find a vast repertoire of useful functions in the microbial world.

Carbon Sequestration

Management of global carbon to help stabilize climate

Azotobacter vinelandii AvOP
Chlorobium tepidum
Chloroflexus aurantiacus J-10-fl
Nitrosomonas europaea ATCC25978
Nostoc punctiforme ATCC29133
Prochlorococcus marinus MED4
Prochlorococcus marinus MIT9313
Rhodopseudomonas palustris CGA009
Rhodospirillum rubrum ATCC11170
Synechococcus WH8102
Thalassiosira pseudonana
Trichodesmium erythraeum



Complementary DOE programs

- **NABIR (Natural and Accelerated Bioremediation Research) Program**
  NABIR develops methods based on natural microbial processes for the bioremediation of contaminated soils, sediments, and groundwater.
- **BI-OMP (Biotechnological Investigations–Ocean Margins Program)**
  Studies linkages between coastal carbon and nitrogen cycles and the processes affecting global change.
- **Carbon Sequestration**
  Explores strategies for sequestration of carbon in oceanic and terrestrial environments.
- **Genomes to Life Program**
  Combines completed DNA sequence data with advanced high-throughput technologies to develop a fundamental understanding of life processes. Genomes to Life focuses on organisms with capabilities of interest to DOE.

Web Sites

Microbial Genome Program: *www.ornl.gov/microbialgenomes*
Genomes to Life: *DOEGenomesToLife.org*
DOE Joint Genome Institute: *www.jgi.doe.gov*
Microbial Genomes: *genome.ornl.gov/microbial*
Comprehensive Microbial Resource: *nit.integratedgenomics.com.GOLD*
Natural and Accelerated Bioremediation Research: *www.lbl.gov/NABIR*
BI-OMP: *www.sc.doe.gov/ober/OGC/omp.html*
Carbon Sequestration Program: *cdiac2.esd.ornl.gov/*
Human Genome Project: *www.ornl.gov/hgmis*

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