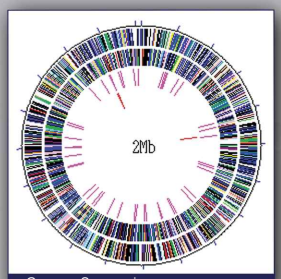
Research Opportunities in Microbial Biology at the National Science Foundation



Genome Sequencing


Microbial Communities and Interactions


Cultivation of Novel Microbes


Sampling Diverse Environments


Microbial Observatories

Microorganisms are the most abundant and diverse forms of life on Earth, but most of the microbial world remains to be discovered and explored. At the dawn of the twenty-first century, the full-scale exploration of microbial systems, spanning all levels of biological organization, from the genome to the biosphere is an attainable goal. This promises to revolutionize understanding of the identity, properties and interactions of microorganisms in the laboratory and in nature:

- the components and systems operating in a single cell;
- how cells sense signals from one another and the environment;
- how they regulate metabolic activity in response to environmental changes;
- how microbes share or acquire new genetic information;
- how to define and recognize microbial species;
- the interrelationships between all microbial species on the Tree of Life;
- the structure and function of microbial communities and their impact on the biosphere.

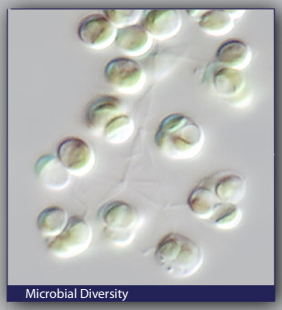
Exciting microbial research projects charting new ground are being supported by the National Science Foundation. Some recent examples include:

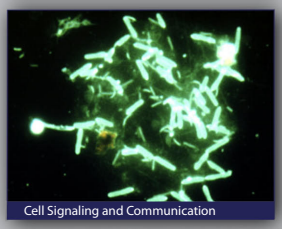
- The genomes of diverse microorganisms are being sequenced. These microbes are important to many aspects of fundamental biology and/or have applications in agriculture, biotechnology, and the environment. These include prokaryotes such as Agrobacterium tumefaciens, Haloarcula marismortui, Epulopiscium spp., and the sample of Bacillus anthracis used in the bioterrorist attack in Florida in 2001. They also include eukaryotic microbes such as the filamentous fungus Neurospora crassa, and the eukaryotic protist Tetrahymena thermophila.

- Microbial Observatories have been established at more than 30 sites on five continents, from Yellowstone National Park to the Great Salt Plains National Wildlife Refuge; from the ice-covered Dry Valley Lakes of McMurdo Station, Antarctica to deep waters of the Black Sea; from freshwater lakes in the Hawaiian Islands to the gut tract of Iguanas in the Galapagos!

- Isolation and analysis of DNA from the ocean off the coast of Monterey, California revealed a widespread new group of phototrophic bacteria important in the global carbon cycle.

- The genome sequences of representatives of eight bacterial phyla with no previously sequenced representatives, and sequence analysis of multiple nuclear genes sampled from 1,500 different species of fungi contribute components to ìAssembling the Tree of Lifeî

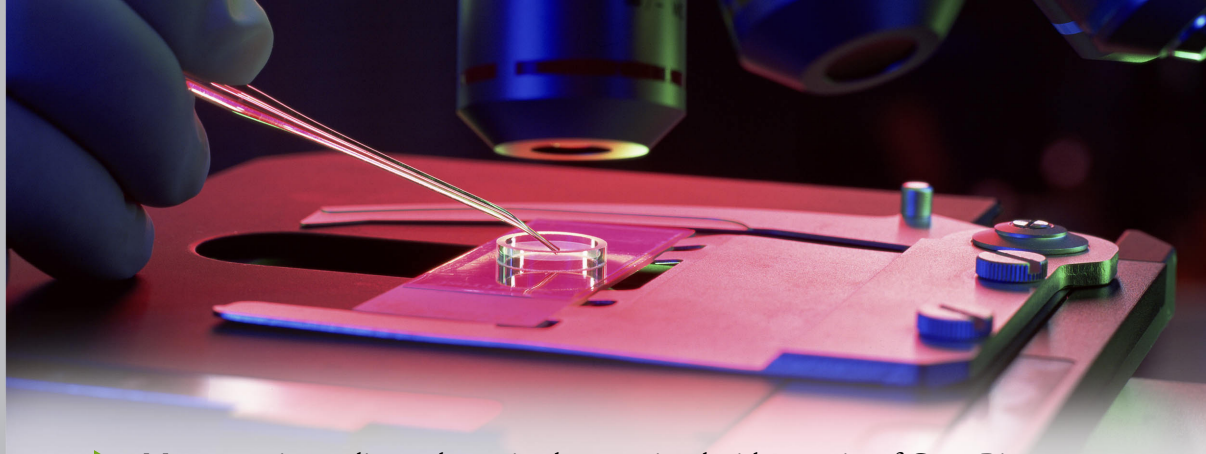

Microbial Diversity


Cell Signaling and Communication


Development and Regulation


Genetic and Genomic Diversity


New Product Discovery



- Metagenomics studies explore microbes associated with a species of Costa Rican caterpillar, and microbes in the soil at Alaska's Toolik Lake Long Term Ecological Research Site.
- Mechanisms of communication among bacterial cells as they organize into biofilms and communities have been revealed.
- The roles of marine viruses are being explored through genomics to decipher their response to diverse environmental cues in the open Ocean, and their controlling influence on microbial food webs in the Chesapeake Bay.

Microbial research is supported by over 50 programs and special competitions at NSF. A few programs that focus on microbes include:

- The Microbial Genetics component of the Genes and Genome Systems Cluster in the Division of Molecular and Cellular Biosciences. The Division of Molecular and Cellular Biosciences currently uses a cross-cluster panel to evaluate proposals on Prokaryotic Molecular and Cellular Biology.
- Microbial Genome Sequencing – A joint effort between NSF and USDA CSREES NRI with the goals of understanding (i) novel aspects of microbial biology; (ii) the diversity and the roles microorganisms play in the biosphere; (iii) the impact that microorganisms have on agriculture, natural resources, forestry and food safety; (iv) the organization and evolution of microbial genomes.
- Microbial Observatories and Microbial Interactions and Processes - funds integrative studies that explore novel microorganisms, their interactions in consortia and communities, and aspects of their physiology, biochemistry and genomics in relationship to the processes that they carry out in the environment.
- Postdoctoral Research Fellowships in Microbial Biology - support training and research in a host institution on the basic biology of protozoan, microalgal, fungal, archaeal, bacterial, and viral species that are not generally considered to be model organisms.
- Research in Biogeosciences 2003: Exploring the Interface Between Geology and Biology: Opportunities in Geomicrobial Processes – proposals to increase understanding of the impact of microbes' biogeochemical processes and processes at the microbe-mineral interface, and to elucidate the deep geologic record of microbial activity and the co-evolution of the geosphere and biosphere.

To obtain an annotated list of these and other funding opportunities at the National Science Foundation, go to http://www.nsf.gov/bio/mcb/microbe/list.htm. For further information contact Dr. Matthew D. Kane, Program Director, Division of Molecular and Cellular Biosciences, National Science Foundation; Phone: (703) 292-7186; Email: mkane@nsf.gov.

National Science Foundation | 4201 Wilson Blvd. Arlington, VA 22230 www.nsf.gov

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