Most recent projects

**Use of gene sequencing, signature lipid biomarker analysis and microbial physiology testing - A polyphasic approach to assess and monitor microorganisms in damaged environments** - This 3-year Laboratory Directed Research and Development project comprised of small subunit ribosomal (ssr)RNA gene sequencing and signature lipid biomarker analysis to survey and characterize selected microbial ecosystems in damaged environments. Newly isolated intrinsic microorganisms were physiologically characterized using the BIOLOG system, also. The study applied, compared, and correlated different microbial community assessment techniques.

**Search for Ancient Microorganisms in Lake Baikal** - DOE-IPP (NN-40) funded project that targeted the microbial diversity present at Lake Baikal in Russia, the oldest and deepest continental lake in the world in south central Siberia. This Thrust I project enabled us to collect water, soil, and sub-bottom sediment samples, and characterize the microbial diversity present. Over 2,200 strains were isolated and preserved. The isolated microorganisms were identified based on biochemical tests. They were further characterized via whole-cell fatty acid methyl ester (FAME) analysis, genomic DNA fingerprinting, and restriction enzyme profiling. Also, a larger subset of isolates underwent electron microscopic cell morphology and fine structure investigations.
**Current projects**

**Microbially Derived Agricultural Crop Protection Products** - DOE IPP program (NN-40) funded three-way collaboration (LBNL, VECTOR, and DuPont). The objective of the Thrust-2 project is to screen the some 2,000 isolated microorganisms from the earlier Lake Baikal project and add another 5 - 8,000 isolates from extreme environments in Russia. Colleagues at VECTOR do most of the new collections, we grow up the microorganisms under conditions that trigger secondary metabolite production, and DuPont screens for new lead molecules and natural products. Some 70% of the DOE funds will be subcontracted to the Russian collaborators.

**Screening of Botanical and Microbial Species Collected within the Territory of the Newly Independent States (NIS) of the Former Soviet Union for Pharmaceutical and Agrochemical Activities** - DOE IPP program (NN-40) funded three-way collaboration (LBNL, IIMB, American Home Products). The objective of the project is to screen plant and microbial extracts collected by colleagues in the Ukraine near the failed Chernobyl nuclear power plant for lead molecules and natural products that can be used in biomedicine and agriculture. We are screening the samples for a new class of antibiotics targeting the inhibition of DNA polymerase III in Gram (+) microorganisms. The project is in its third and last year and will close in 2001. Some 70% of the DOE funds are subcontracted to the partner institutes in the Ukraine.

**Pending projects**

(white papers, preproposals, and full proposals submitted or under preparation or just stuff that would be fun to do)

**Microbial Diversity for Novel Biotechnology Applications** - a pending FY 2002 DOE-IPP project that proposes to develop a multi-year program for the systematic seasonal collection of microbial diversity in the extreme environments of Kamchatka, Russia for novel biotechnology applications. The US industrial partners are Diversa Corporation, New England BioLabs, and SibEnzyme, a privately owned Russian biotech company.

**Quorum-Sensing-Dependent Biological Structure and Function in Biofilm of Microbial Organisms** - We want to investigate the influence of simulated microgravity environment conditions on microbial community dynamics and ecology, and learn how cell density-dependent signaling can be stopped or harnessed for intervention during long-term space flight. We propose to investigate quorum sensing in single-species and in biostimulated and/or bioaugmented multi-species biofilms; study the production, secretion, and spatial distribution of autoinducers in microcolonies and biofilms; elucidate crosstalk within the biofilm community; and examine cell density-controlled gene expression and biological structure and function that affect biofilm behavior.

**Toluene Dioxygenase: A Model System for Integrated Analysis of Function and Genome Plasticity** - By using an integrated strategy that combines computational analysis, genetic engineering, and x-ray protein crystallography, we aim to explore and thereby expand the use of microbial dioxygenases, a class of enzymes known to be important in biocatalysis. Furthermore, since a human protein involved in tyrosine catabolism and defective in type III tyrosinemia is believed to be structurally and functionally related to microbial toluene dioxygenases, this work will result in novel biological insights of interest to a broad range of investigators. Although the focus here is a specific set of proteins, a significant by-product of the research will be a general
experimental and computational approach for analyzing, interpreting and predicting the structure/function relationship of proteins. Since functional toluene dioxygenase requires the interaction of several proteins in concert, the chosen model system may also allow the identification of domains that mediate protein-protein interactions. Finally, the versatility of this enzyme model system will warrant genomic plasticity characterization.

**Transformation of Metals and Radionuclides in High-Nitrate Contaminated Subsurface Environments** - The project’s objective is to employ newly developed assessment techniques that enable the speciation and quantification of metals and radionuclides and to facilitate the development of innovative bioprocessing for their in-place immobilization in high nitrate-contaminated subsurface environments.

**Regulation and Integration of Cellular Processes: Copper and Iron Homeostasis in E. coli** - We propose to use the delicate balance, the homeostatic control of copper and iron, their uptake, distribution, and metabolism to study how networks of mutually activating and repressing genes (or gene products), so-called "genetic regulatory networks" organize the surprisingly complicated behavior of living systems. In an *E. coli* model, we want to integrate computational efforts for predicting, controlling, and designing cellular behavior and experimental validation of the predictions.

**Molecular Nanotechnology** - The project goal is to generate patterned metallized surface layers or nanofilms using the crystallized protein surface layer (S-layer) of bacteria and archaea. These new materials will offer challenging options for biology-based layout of electronic circuits, for the manufacturing of nanodevices, microreaction and new catalysis systems, highly selective nanofilters, nanoscale sensors, and for numerous biomedical, biotechnology, and bioremediation applications.