EPA-STAR GRANTS FOR ENVIRONMENTAL BIOTECHNOLOGY RESEARCH

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The cost of using conventional technologies to clean up the nation=s contaminated soil and water has been estimated as high as $1.7 trillion. Clearly, there is a need for cost-effective alternatives to convert pollutants into harmless compounds that can be subsequently incorporated into the natural cycling components of the biosphere.

The U.S. EPA is actively encouraging and supporting research aimed at developing innovative, cost-effective remediation technologies. Such an innovative approach is bioremediation, the use of plants and microorganisms for environmental cleanup. Bioremediation is emerging as an energy-efficient, cost-effective alternative to conventional cleanup approaches. In addition, bioremediation is potentially less harsh to the environment than other treatment options such as excavation followed by incineration and landfilling, or direct chemical treatment. EPA's interest in bioremediation has focused on the degradation of wastes of highest priority in the matrices of greatest concern such as aquifers, vadose zone, surface soil, sediments and air. Implementation of bioremediation raises complex scientific and technical questions as the interaction of organisms with each other and with contaminated soil is little understood. Emphasizing bioremediation as a major research priority, the EPA has an interest in applying Biotechnology to address other significant environmental concerns such as pollution prevention, pollution detection and environmental monitoring.

The U.S. EPA/ORD/NCER (Office of Research and Development/National Center for Environmental Research) has used several funding mechanisms to support extramural research in environmental biotechnology. In a major development, in collaboration with the NSF (National Science Foundation), the ONR (Office of Naval Research), the DOE (Department of Energy), and the DA (Department of Agriculture), EPA has initiated a research program in bioremediation. The main research priorities addressed by this initiative have been:

- Investigation of the structure of microbial communities and their dynamics in response to normal environmental variation and anthropogenic stresses

- Characterization of biochemical mechanisms, including enzymatic pathways, involved in aerobic and anaerobic degradation of pollutants

- Investigation of microbial genetics as a basis for enhancing the capabilities of microorganisms to degrade pollutants

- Development, testing, and evaluation of innovative biotechnologies for monitoring bioremediation *in situ*, and characterization of biological processes at work

Under the auspices of the Bioremediation Initiative, through the EPA's STAR (Science to Achieve Results) grants program, more than $15 million has been awarded for research in this

area. The number of bioremediation/STAR grants funded and the level of funding are shown in Table 1.

Table 1. EPA-STAR grants funded through the Interagency Bioremediation Research Initiative.

	Grants Number	$ (Million)
1996	8	4.9
1997	9	5.3
1998	12	5.0
Total		15.2

The Environmental Bioremediation Research Initiative funded between 1996 and 1998 targeted a variety of scientific topics; from the development of mathematical models to simulate biodegradation and transport of contaminants in complex systems and to predict the environmental fate of organic pollutants, to the characterization of microbial co-metabolic degradation of ether-bonded compounds such as MTBE, and metabolic engineering of microbes for bioprocessing organic contaminants. More information about the findings of this research can be found at http://es.epa.gov/ncerqa/final.html or http://es.epa.gov/ncerqa/publications/topical/.

The 2001 Interagency Competition in Phytoremediation is a continuation of previous bioremediation research efforts aiming at advancing the-state-of-science of this innovative cleanup approach. The EPA/NSF/ONR joint program on phytoremediation will award more than $2 million for research in this area.

The EPA/ORD is actively seeking to further exploit the potential of biotechnology for environmental restoration including remediation, prevention to avoid environmental contamination, detection and monitoring to provide cost-effective, prompt warning of pollution incidents and, in the case of bioremediation, to monitor the organisms at work and their interaction with indigenous populations. To further advance the use of biotechnology for environmental restoration and to speed up its implementation, the EPA/ORD has identified several research priorities. Some of these are listed below.

Biology:

- Selection of individual or mixture of species for specific functional capacity
- Investigation of the impact of selected species on the ecosystem
- Improvement of properties of selected species by recombinant technology
- Assessment of the risk of releasing genetically-modified-organisms in the environment

Bioprocessing:

- Mechanistic characterization of Ablack-box Aprocesses such as, methane and hydrogen production, nitrogen and sulfur metabolism

- Alteration of environmental conditions to enhance bioremediating processes
- Development/improvement of models to better predict operational performance
- Development of technologies to produce biological materials (e.g., biopolymers) to replace those p

Ecology:

- Characterization of the potential for ecosystem sustainability
- Improvement of the exploration and exploitation of natural resources

Measurements and Monitoring:

- Improvement of measurements tools, procedures and protocols for site assessment
- Development of biosensors for identifying biological and chemical hazards
- Development of new assays (e.g., immunoassay) for specific pollutants
- Development of techniques for tracking organisms within ecosystems (e.g., monitoring mixed microbial populations)
- Development of Aon-line@ toxicity tests to assess the level of contamination or decontamination

EPA research priorities in environmental biotechnology will be presented and opened for discussions and suggestions.