

# LIFE IN EXTREME ENVIRONMENTS (LE<sub>x</sub>EN)

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*Announcement of Opportunity and  
Special Competition for FY 1997*

DIRECTORATE FOR BIOLOGICAL SCIENCES  
DIRECTORATE FOR ENGINEERING  
DIRECTORATE FOR GEOSCIENCES  
DIRECTORATE FOR MATHEMATICAL AND PHYSICAL SCIENCES  
OFFICE OF POLAR PROGRAMS

DEADLINE DATE: *April 14, 1997*



NATIONAL SCIENCE FOUNDATION

## Introduction

Life flourishes on Earth in an incredibly wide range of environments, from high-salt deserts to volcanoes to polar ice. These environments may be analogous to the harsh conditions that exist now, or have existed, on other planets. The study of microbial life-forms and the extreme environments in which they exist here on Earth can provide important new insights into how organisms formed and adapted to diverse environments. This knowledge will provide the basis to understand not only how life originated and evolved on Earth but also how life may thrive on other planets. The preliminary evidence for the past existence of living organisms on Mars has stimulated the recognition that the study of extreme environments on Earth, and the study of the life they support, may be the most effective path toward detecting and understanding the life forms that may exist beyond our own planet.

The Directorates for Biological Sciences (BIO), Engineering (ENG), Geosciences (GEO), Mathematical and Physical Sciences (MPS), and the Office of Polar Programs (OPP) of the National Science Foundation (NSF) announce the creation of an opportunity to enhance knowledge about "Life in Extreme Environments" (LExEn) through highly inter-disciplinary, integrated research programs. A special funding opportunity exists in FY 1997 to highlight NSF's strong interest in this area.

## LExEn Interdisciplinary Research Program

The LExEn research program will explore the relationships between organisms and the environments within which they exist, with a strong emphasis upon those life-supporting environments that exist near the extremes of planetary conditions. In addition, the LExEn program will explore planetary environments in our own solar system and beyond to help identify possible sites for life elsewhere.

Research is required to enhance understanding of the microbial systems on Earth, particularly with respect to their diversity and the mechanisms that allow microbes to survive and alter extreme environments. Examples of relevant topics include studies to discover, quantify, culture and preserve microorganisms from extreme environments; research on the diversity, ecology, physiology, biochemistry, genetics and evolutionary history of microbes from extreme environments within the context of the diversity of conditions found in those environments and/or their possible utility in biotechnology; and paleobiological studies of microbial life on Earth, including efforts which improve understanding of the products of life that are preserved in the geological record. Because of the importance of the interactions between living organisms and their habitats, it is necessary to achieve improved

understanding of present-day or past extreme environments that support or have supported life. Examples of relevant topics include studies designed to explore and fully characterize significant examples of extreme environments in order to understand the active physical, chemical, biological and geological processes that determine their characteristics and result in their ability to support unusual microbial life. In order to provide insights into the possibility of life beyond our own planet, research is also needed to characterize the environments of planets in the solar system and beyond and to understand the commonalities of their formation and evolution. Examples of relevant topics include studies of the formation of Earth, other planets and their satellites; remote sensing of planets and their atmospheres; studies of interstellar grains and meteorites to establish criteria for the presence of biogenic substances; and research on the biogeochemical effects of microbes on their environments on Earth to better design tests for life on other planets.

## FY 1997 Special Competition

NSF is highlighting its interest in LExEn through a special competition as described below. The deadline for proposals is April 14, 1997. Decisions will be made by August 1, 1997.

For the purposes of this announcement "extreme" refers to environments found today on Earth which have attributes that are similar to those that exist on other planetary bodies (at present or in the past), or to those that are postulated to have existed on Earth at the dawn of life. Such environments might include those associated with Earth's hydrothermal systems, sea ice and ice sheets, anoxic habitats, hypersaline lakes, high altitude or polar deserts, or man-made environments such as those created for industrial processes.

It is intended that this Special Competition will constitute the beginning of a new emphasis on basic research on LExEn related issues, and therefore projects that show potential for establishing a foundation for future innovative research will receive special consideration. Because of the importance of the interactions between living organisms and the extreme environments within which they exist, studies are particularly encouraged that cross disciplinary boundaries and foster collaborative investigations

For this Special Competition, projects should couple one or more of the research areas described in the previous section with the development and application of one or more of the following:

- methods to isolate and culture microbes found in extreme environments;
- methods to study these microbes in their natural habitats;
- technologies for non-contaminating sample recovery;

- sensors capable of probing extreme environments;
- methods to study ancient microbial life and paleo-environmental conditions on Earth; and
- techniques for studying other planets.

Research projects of 2-5 years duration are appropriate. Funds available to support projects under this Special Competition are expected to total approximately \$6 million. NSF anticipates making approximately 20 awards in fiscal year 1997 depending on the quality of the proposals received and availability of funds. Neither submitting to the present competition nor receiving an award from this competition will be a prerequisite for research proposals to future LEXen announcements.

## Preparation and Submission of Proposals for the FY 1997 Competition

Proposals submitted in response to this Announcement of Opportunity will be accepted from colleges, universities, and other not-for-profit institutions in the United States. Proposals should be prepared and submitted in accordance with the guidelines provided in the NSF brochure, *Grant Proposal Guide (GPG)* NSF 95-27. Single copies of this brochure are available at no cost from:

Forms and Publications Unit  
National Science Foundation  
4201 Wilson Blvd., Room P15  
Arlington, VA 22230  
TEL: (703) 306-1130  
e-mail: pubs@nsf.gov.

Proposals will be subjected to initial screening for the requirements in the *GPG* and will be returned without review or advance notification if deficiencies are found. Proposals will NOT be forwarded to other Programs if found to be inappropriate for this competition. Proposals submitted in response to this announcement must be postmarked no later than April 14, 1997. The Cover Sheet should specify "LEXEN/GEO" in the box for the NSF Organizational Unit.

Group and collaborative proposals involving more than one institution MUST be submitted as a single administrative package from one of the institutions involved. Multiple submissions will not be accepted. (The proposal may be split into separate awards if the project is recommended for support.) The package should include one project summary, one table of contents, one project description, one section for references, and one copy of special information and appendices as specified in *GPG* section II.D.10-11. Additionally, the package should include, for each university and its PIs/co-PIs, a signed cover sheet, budget pages and explanation, results from prior NSF support (up to 2 pages per person), biographic sketches (up to 2 pages per person),

current and pending support for each PI/co-PI, and facilities and other resources unique to each institution. LEXEN/GEO should be referenced in the upper left corner of the proposal cover sheet as the NSF organizational unit. The solicitation number is NSF 97-45.

An original and 20 copies of the proposals should be sent to:

Announcement No. NSF 97-45  
National Science Foundation PPU  
4201 Wilson Blvd. P-60  
Arlington, VA 22230

Proposals may also be submitted electronically. For information, contact the Electronic Proposal Submission Program Director, Division of Information Systems, phone (703) 306-0214, or via e-mail, eps@nsf.gov (Internet).

## Proposal Review

Proposals will be evaluated by ad hoc mail and panel review in accordance with established Foundation procedures and the four general criteria described in the *GPG*. An additional criterion in the evaluation process will be the potential interdisciplinary synergism among the various research components. It is anticipated that each review panel will have expertise in the fields of astronomy, planetary sciences, chemistry, geochemistry, biology, atmospheric sciences, earth sciences, ocean sciences, polar sciences, and engineering.

## FY 1998 and Beyond

The nature of future LEXen special competitions is still under consideration. Future announcements will be posted electronically with hard copies available upon request. If you would like to be alerted to the posting of these announcements, please send a message to "listmanager@nsf.gov" with the command "subscribe nsflexen <your full name>" in the text of the message (the subject line is ignored). Your e-mail address will be extracted from the "From:" field of your request.

If you have questions or require further information, contact:

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The National Science Foundation provides awards for research in the sciences and engineering. The awardee is wholly responsible for the conduct of such research and preparation of the results for publication. The Foundation, therefore, does not assume responsibility for the research findings or their interpretation.

The Foundation welcomes proposals from all qualified scientists and engineers and strongly encourages women, minorities, and persons with disabilities to compete fully in any of the research related programs described here. In accordance with federal statutes, regulations, and NSF policies, no person on grounds of race, color, age, sex, national origin, or disability shall be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance from the National Science Foundation.

Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF projects. See the program announcement or contact the program coordinator at (703) 306-1636.

Privacy Act and Public Burden. The information requested on proposal forms is solicited under the authority of the National Science Foundation Act of 1950, as amended. It will be used in connection with the selection of qualified proposals and may be disclosed to qualified reviewers and staff assistants as part of the review process; to applicant institutions/grantees; to provide or obtain data regarding the application review process, award decisions, or the administration of awards; to government contractors, experts, volunteers, and researchers as necessary to complete assigned work; and to other government agencies in order to coordinate programs. See Systems of Records, NSF 50, Principal Investigators/Proposal File and Associated Records, and NSF-51, 60 Federal Register 4449 (January 23, 1995). Reviewer/Proposal File and Associated Records, 59 Federal Register 8031 (February 17, 1994). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of your receiving an award.

Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Herman G. Fleming, Reports Clearance Officer, Contracts, Policy, and Oversight, National Science Foundation, 4201 Wilson Boulevard, Arlington, VA 22230.

The National Science Foundation has TDD (Telephonic Device for the Deaf) capability, which enables individuals with hearing impairment to communicate with the Foundation about NSF programs, employment, or general information. To access NSF TDD, dial (703) 306-0090; for FIRS, 1-800-877-8339.

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