

# Materials Use: Science, Engineering, and Society (MUSES)

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## Program Solicitation

NSF 06-518



National Science Foundation  
Directorate for Engineering

**Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

March 13, 2006

February 07, 2007

## REVISIONS AND UPDATES

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1. In furtherance of the President's Management Agenda, in Fiscal Year 2006, NSF has identified programs that will offer proposers the option to utilize Grants.gov to prepare and submit proposals, or will require that proposers utilize Grants.gov to prepare and submit proposals. Grants.gov provides a single Government-wide portal for finding and applying for Federal grants online. A complete listing of these programs is available on the Policy Office website at: <http://www.nsf.gov/bfa/dias/policy>.

In response to this program solicitation, proposers may opt to submit proposals via [Grants.gov](http://Grants.gov) or via the NSF FastLane system. In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

- A. *Collaborative Proposals*. All collaborative proposals must be submitted via the NSF FastLane system. This includes collaborative proposals submitted:
  - by one organization (and which include one or more subawards); or
  - as separate submissions from multiple organizations.

Proposers are advised that collaborative proposals submitted in response to this Program Solicitation via Grants.gov will be requested to be withdrawn and proposers will need to resubmit these proposals via FastLane. (Chapter II, Section D.3 of the Grant Proposal Guide provides additional information on collaborative proposals.)

- B. *All Other Types of Proposals That Contain Subawards*. All other types of proposals that contain one or more subawards also must be submitted via the NSF FastLane system.

2. MUSES was originally part of the Biocomplexity in the Environment (BE) solicitation between FY 2002 and FY 2005. Starting in FY 2006, each of the five BE components has been spun off into separate programs and/or solicitations.

## SUMMARY OF PROGRAM REQUIREMENTS

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## General Information

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### Program Title:

Materials Use: Science, Engineering, and Society (MUSES)

### Synopsis of Program:

MUSES is aimed at soliciting new multidisciplinary activities that encourage researchers in engineering, physical and life sciences, social and behavioral sciences, economics, mathematics, and education to reach beyond their disciplinary boundaries in order to address complex issues related to materials use in the environment. There are two challenges: (a) to propose exploratory research issues that are viable and (b) to create new teams of researchers with the necessary expertise who can work together.

### Cognizant Program Officer(s):

- Delcie R. Durham, Program Director, Directorate for Engineering, Division of Design and Manufacturing Innovation, 529 S, telephone: (703) 292-7060, fax: (703) 292-9056, email: [ddurham@nsf.gov](mailto:ddurham@nsf.gov)
- David L. Nelson, Program Director (SSC), Directorate for Mathematical & Physical Sciences, Division of Materials Research, 1065 N, telephone: (703) 292-4932, email: [dnelson@nsf.gov](mailto:dnelson@nsf.gov)
- Robert E. O'Connor, Program Director, Directorate for Social, Behavioral & Economic Sciences, Division of Social and Economic Sciences, 995 N, telephone: (703) 292-7263, fax: (703) 292-9068, email: [roconnor@nsf.gov](mailto:roconnor@nsf.gov)
- Thomas F. Russell, Program Director, Directorate for Mathematical & Physical Sciences, Division of Mathematical Sciences, 1025 N, telephone: (703) 292-4863, fax: (703) 292-9032, email: [trussell@nsf.gov](mailto:trussell@nsf.gov)
- Bruce K. Hamilton, Division Director, Directorate for Engineering, Division of Bioengineering & Environmental Systems, 565 S, telephone: (703) 292-8320, fax: (703) 292-9098, email: [bhamilto@nsf.gov](mailto:bhamilto@nsf.gov)
- Richard J. Fragaszy, Program Director, Directorate for Engineering, Division of Civil & Mechanical Systems, 545 S, telephone: (703) 292-8360, email: [rfragasz@nsf.gov](mailto:rfragasz@nsf.gov)
- Paul J. Werbos, Program Director, Directorate for Engineering, Division of Electrical & Communications Systems, 675 S, telephone: (703) 292-8339, fax: (703) 292-9147, email: [pwerbos@nsf.gov](mailto:pwerbos@nsf.gov)
- Robert M. Wellek, Deputy Division Director, Directorate for Engineering, Division of Chemical & Transport Systems, 525 N, telephone: (703) 292-8370, fax: (703) 292-9054, email: [rwellek@nsf.gov](mailto:rwellek@nsf.gov)

### Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.041 --- Engineering

## Eligibility Information

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- **Organization Limit:** None Specified.
- **PI Eligibility Limit:** None Specified.
- **Limit on Number of Proposals:** None Specified.

## Award Information

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- **Anticipated Type of Award:** Standard Grant
- **Estimated Number of Awards:** 4 to 7 -- three to five large awards and one to two exploratory awards in FY 2006. Three to five large awards only in FY 2007 and no planning grants.
- **Anticipated Funding Amount:** \$6,450,000 in FY 2006 and \$4,000,000 in FY 2007, pending availability of funds.

## Proposal Preparation and Submission Instructions

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### A. Proposal Preparation Instructions

- Full proposals submitted via FastLane:
  - Grant Proposal Guide (GPG) Guidelines apply

- Full proposals submitted via Grants.gov:
  - NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: <http://www.nsf.gov/bfa/dias/policy/docs/grantsgovguide.pdf>) To obtain copies of the Application Guide and Application Forms Package: click on the Apply tab on the Grants.gov website, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button.

## B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required by NSF.
- **Indirect Cost (F&A) Limitations:** Not Applicable.
- **Other Budgetary Limitations:** Not Applicable.

## C. Due Dates

- **Full Proposal Deadline Date(s)** (due by 5 p.m. submitter's local time):  
 March 13, 2006  
 February 07, 2007

## Proposal Review Information

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- **Merit Review Criteria:** National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

## Award Administration Information

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- **Award Conditions:** Standard NSF award conditions apply.
- **Reporting Requirements:** Standard NSF reporting requirements apply.

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# I. **INTRODUCTION**

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MUSES (Materials Use: Science, Engineering, and Society) is part of the NSF priority area in Biocomplexity in the Environment.

Biocomplexity refers to the dynamic web of often surprising interrelationships that arise when components of the global ecosystem—biological, physical, chemical, and the human dimension—interact. Investigations of Biocomplexity in the Environment are intended to provide a more complete understanding of natural processes and cycles, of human behaviors and decisions in the natural world, and of ways to use new technology effectively to observe the environment and sustain the diversity of life on earth. By placing biocomplexity studies in an environmental context, this competition emphasizes research with the following characteristics: (a) a high degree of interdisciplinarity; (b) a focus on complex environmental systems that includes non-human biota or humans; and (c) a focus on systems with high potential for exhibiting non-linear behavior.

Emphasis is also placed on developing the people and tools needed to advance biocomplexity studies. To establish and strengthen interdisciplinary areas of investigation, new communities of investigators need to be formed. This can be accomplished by bringing members of disparate disciplines into teams, by developing new methodologies and expertise, and by reaching beyond the borders of the United States for partners in inquiry. In the process, the next generation of researchers learns to work in diverse teams, cross disciplinary boundaries, and use advanced sensing and monitoring, communication and information technologies to work across many scales of time and space.

MUSES projects include three integrative elements:

- An integrated, quantitative, systems-level method of inquiry is essential in biocomplexity studies.
- Education must be addressed and integrated effectively with all research plans. Educational activities provide learning opportunities for students at appropriate levels (ranging from grades K-12 through graduate school), and the general public.
- A global perspective is expected in all proposals. Wherever appropriate and practical, specific international collaborations and networks for research and education are strongly encouraged.

Quantitative approaches and education activities must be incorporated in all projects. International partnerships are also strongly encouraged.

1. **Quantitative Approaches.** Due to the complex nature of systems under investigation, treatment of non-linearities, feedback processes, and integration across temporal or spatial scales is often necessary. Projects must use appropriate quantitative methods, and teams should include individual(s) with demonstrated expertise in the quantitative methods to be used. Quantitative methods may include: conceptual, mathematical or computational models; computer simulation; artificial intelligence techniques; hypothesis testing; statistics; visualization; or database development. Mathematical models must include estimates of uncertainty, and experiments should assess power and precision.
2. **Education.** Competitive projects must integrate research and education. Those benefiting from educational experiences can include participants (such as undergraduates, graduate students, teachers, and postdoctoral associates) and individuals beyond those directly involved in the project. Investigators are encouraged to include students as active participants on interdisciplinary teams. Informal education channels, such as science centers, aquariums, and similar facilities that are easily accessible and attractive to the public may be used to help enhance the public's ability to deal with complex environmental information and make informed decisions about the environment. Educational efforts at the K-12 level should promote the acquisition of scientific inquiry skills and take advantage of technology and use it appropriately.

Examples of specific education plans, as well as other activities likely to demonstrate broader impacts, are available electronically at [www.nsf.gov/pubs/2002/nsf022/bicexamples.pdf](http://www.nsf.gov/pubs/2002/nsf022/bicexamples.pdf). Some specific examples of products that will benefit society include exhibits, databases, computer-based simulations, or kits that could be used by students or the public to collect and analyze data.

Reviewers will be asked to consider and evaluate the educational activities. Please refer to the section, "Integration of Research and Education" in Section VI.A of this solicitation.

Consistent with NSF's emphasis on the integration of research and education in projects solicited and funded by the Foundation, investigators are encouraged to include a section that describes the educational implications of their research work in their papers submitted for publication.

3. **Global Perspective.** Because environmental processes transcend national boundaries, collaborations between U.S. investigators and foreign counterparts are encouraged wherever appropriate. Many research projects offer excellent opportunities for students at U.S. and foreign institutions to gain experience in the conduct of research in other countries. NSF awards are normally limited to the support of the U.S. portion of the collaboration. In the case of some developing countries, limited funds may be available to support the involvement of the foreign collaborator. Investigators may wish to consult with the cognizant program officers for global perspectives listed in the section on contact information. For information about NSF support for international collaborative programs, see the [Office of International Science and Engineering](#).

## II. PROGRAM DESCRIPTION

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Physical and biological environmental systems are ultimate sources of the materials required for the great variety of manufactured goods produced by modern societies. Understanding the supply, transformation, use, and reuse of the resources provided by natural systems as well as the environmental effects of introducing alternative materials or new processes are complex problems that challenge many disciplines. Both technological issues, such as process and product redesign and manufacturing, as well as behavioral and organizational factors, such as economic and other social forces that affect consumption and adoption of new technologies and materials, must be addressed. Studies in the Materials Use: Science, Engineering, & Society (MUSES) topical area are aimed at understanding these interactions in order to (a) reduce adverse human impact on the total, interactive system of resource use, and (b) maximize the efficient use of individual materials throughout their life cycles. MUSES includes fundamental research on: (a) global budgets and cycles of key materials; (b) means and methods for carefully assessing a material's impact at every stage of its entire life cycle; (c) design for sustainability addressing materials, processes, systems, and supporting social structures that optimize the use of materials throughout their total life cycle, and (d) modeling the impact of materials substitutions or modifications on a total materials use basis.

Research in this topical area must stress the fundamental understanding of comprehensive materials flows that extend from natural resource (physical and biota) materials extraction; through processing and manufacturing, assembly, and distribution and consumer use; and on through recycling, disposal, and reuse. In some cases, the synthesis and characterization of new classes of materials with desired properties may be involved. Models should include relationships among constructed, natural, and social systems and consider continuous materials use in addition to life cycle practice. Energy consumption during life cycle is relevant. Materials use at widely ranging scales is within the scope of MUSES, from niche specialty markets to major construction projects - highways, bridges, large buildings, etc. Also within the scope of MUSES is consideration of materials "escape" during transportation, transformation or storage (leaks, accidents or intentional destructive actions). Illustrative examples of advanced materials that may be considered as part of this activity include, but are not limited to: the synthesis of new materials with value-added functional performance for applications such as biodegradable food containers, electronic materials for sensing in hazardous or extreme environments, disposable hospital products; materials modifications through processing that extend the life or ease the remanufacturability such as hybrid coatings that can be readily removed or upgraded; and materials substitutions that lead to low emission and fuel efficient engines or alternative energy sources, or alloys and composites for lightweight aircraft and automobiles.

Specific areas of interest include, but are not limited to:

- Spatially and temporally explicit budgets for key materials, including ways in which human activities define, perturb, dominate or limit materials flow and supply.
- Acquisition, comprehension, and integration of data sets and models from engineering, environmental, economic, and social spheres, and the development of robust ways to utilize potential data intersections and model interoperability to predict materials flows.
- Patterns and driving forces of human consumption of resources, for example, the role of incentives in encouraging less wasteful materials use or the redesign of markets to provide more accurate signals of the societal costs associated with the use of materials.
- Metrics and assessment models for forecasting the results of substituting materials made from renewable resources for those made from non-renewable resources, including trade-offs such as land use and water consumption.
- Design and synthesis of desirable materials with predictable properties while evaluating environmental friendly impacts on biocomplex systems at each stage of their development as useful materials; viz. processing and fabrication, assembly and manufacture, and eventual recycling of spent materials.

- Development of "intrinsically secure" chemistries and processes such that the vulnerability to the threat of terrorism is reduced by reductions in the quantities or toxicities of intermediates and end products.

Both group and developmental activities submitted in response to the MUSES theme must involve multidisciplinary research and education, that (a) include an economist and/or a social scientist on a team with scientists and engineers from physical, chemical, biological, and/or geological disciplines; (b) integrate economic and other social factors with material acquisition, materials design, and/or manufacturing considerations; and (c) use or develop computational models or simulations appropriate for the complexity, multidisciplinary, and global scale of these systems. The teams undertaking these MUSES projects must have appropriate expertise ranging from earth and materials sciences to engineering to economics to social sciences. They must also have appropriate expertise to undertake sophisticated quantitative modeling and integrated educational projects. International partnerships could be particularly valuable to research and education in this topical area.

### III. ELIGIBILITY INFORMATION

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The categories of proposers identified in the [Grant Proposal Guide](#) are eligible to submit proposals under this program announcement/solicitation.

### IV. AWARD INFORMATION

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Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

Approximately \$6,450,000 million is expected to be available in FY 2006 and \$4,000,000 million in FY 2007. The funding will support three to five research and education awards each year conducted by multidisciplinary teams of researchers who may request up to \$400,000 per year for three to five years duration. In FY 2006 ONLY, up to five small awards (not to exceed \$100,000 and up to a one year duration) may be funded in response to proposals for developmental activities such as proof of concept studies that can include meetings to build international and/or interdisciplinary teams or high-risk exploratory research. No planning grants will supported in FY 2007.

### V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

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#### A. Proposal Preparation Instructions

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##### Full Proposal Instructions:

Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane:

Proposals submitted in response to this program announcement/solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF Website at: [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=gpg](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg). Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

Proposers are reminded to identify this program announcement/solicitation number in the program announcement/solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

- Full proposals submitted via Grants.gov:

Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: (<http://www.nsf.gov/bfa/dias/policy/docs/grantsgovguide.pdf>). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

In determining which method to utilize in the electronic preparation and submission of the proposal, please note the following:

A. Collaborative Proposals. All collaborative proposals must be submitted via the NSF FastLane system. This includes collaborative proposals submitted:

- by one organization (and which include one or more subawards); or
- as separate submissions from multiple organizations.

Proposers are advised that collaborative proposals submitted in response to this Program Solicitation via Grants.gov will be requested to be withdrawn and proposers will need to resubmit these proposals via FastLane. (Chapter II, Section D.3 of the Grant Proposal Guide provides additional information on collaborative proposals.)

B. All Other Types of Proposals That Contain Subawards. All other types of proposals that contain one or more subawards also must be submitted via the NSF FastLane system.

## Project Description

All project descriptions are limited to 20 pages in length. With the exceptions noted below, proposers may organize the different components of the project description as they wish.

The following sections MUST be included under separate headings in the project description:

- **Results from Prior NSF Support.** This section is required only for principal investigators and co-investigators who have received NSF funding in the last five years. Refer to [GPG](#) for more information. (This section may contain, but does not require, up to five pages to describe the results).
- **Education Plan.** The research plan should include integrated educational activities as a part of the narrative. Highlight these integrated activities in this section by specifying the project's educational goals, the methods that will be used to attain those goals, how the educational activities will be evaluated, and the role of project personnel in educational efforts. If educational products are expected to result, describe those products and indicate how they will be disseminated. (This section is usually between 1 and 2 pages in length).
- **Management Plan.** The following information should be provided: (1) a description of the management structure that will enable the team to work effectively; and (2) specification of the qualifications of each of the senior personnel as well as the contribution they are expected to make to the project. This section increases in importance as the number of senior personnel or institutions involved in the project increases. (This section is usually between 1 and 2 pages in length).
- **Project Significance.** This section should clearly specify what proposers expect will be the results and contributions of the project. The section should describe both the anticipated intellectual merit of the proposed work as well as its anticipated broader impacts. Intellectual merit and broader impacts are NSF's two primary merit review criteria, and major items to be considered in each one are specified in [GPG](#). Examples illustrating activities likely to demonstrate broader impacts also are available electronically at <http://www.nsf.gov/pubs/2002/nsf022/bicexamples.pdf>. Education and international activities are among the examples. (This section is usually about 1 page in length.)

## Biographical Sketches

A biographical sketch with a 2 page limit must be provided for each investigator and each person identified as senior personnel.

## Current and Pending Support

Each person identified as a principal investigator or as senior personnel must submit a current and pending support form. This proposal is considered a pending support activity.

## Conflicts of Interest

In addition to the formal submission of the proposal, the principal investigator must send a compilation of conflicts of interest information in a spreadsheet format (**preferably in MS-Excel format**) by e-mail directly to the MUSES competition at [muses0405@nsf.gov](mailto:muses0405@nsf.gov). The spreadsheet must be submitted no later than one week after the proposal-submission deadline for that BE topical area.

The top of the list should include the proposal number of the proposal submitted to the BE topical area. Include the full names of all people for whom there would be a conflict of interest related to reviewing this proposal because of their association with one or more of the senior personnel on the project. Conflicts to be identified are: (1) Ph.D. thesis advisors or advisees, (2) postdoctoral advisors or advisees, (3) collaborators or co-authors for the past 48 months, and (4) any other individuals or institutions with which the investigator has financial ties (please specify type). For further clarification of conflicts of interests, please refer to the [NSF Grant Policy Manual, Section 510](#).

Three columns are suggested for the spreadsheet: People for whom there is a conflict, the senior personnel whose relationship makes the person in that row conflicted, and the relationship that causes the conflict of interest.

## Supplementary Documentation

Appropriate items for inclusion in the Supplementary Documentation sections are specified in [GPG](#). For example, letters of commitment from collaborating institutions, including foreign institutions, should be placed in this section, as well as documents associated with the use of human subjects, hazardous materials, vertebrate animals, or endangered species.

Proposals that include materials in this section that belong in the project description may be returned without review.

## Appendices

Not permitted.

## Proposals Involving Collaborators at Foreign Institutions

Proposers are reminded they must provide biographical sketches of all senior project personnel, including those at foreign institutions. In addition, as supplementary documentation, proposals involving foreign collaborators must provide letters of commitment from the foreign counterpart institutions. Please note that although eligibility for this competition is restricted to U.S. organizations, as described in the [GPG](#), collaborations with foreign institutions may be considered. As noted above, proposals that contain subawards must be submitted via FastLane.

## Pre-Submission Checklist

MUSES proposals must be in compliance with GPG and special requirements in the program solicitation in order to be considered for review. Proposals not in compliance with these requirements will be returned without review. Please refer to the following checklist to address some of the items for which proposals often are non-compliant:

- Font and margin requirements
- Paginated pages
- Project summary that includes a brief description of broader impacts
- Project description that is 20 pages or less and includes separate sections for Results from prior Support, Education Plan, Management Plan, and Project Significance.
- Biographical Sketches for all senior personnel
- Conflict of Interest spreadsheet submitted to appropriate program leader by e-mail.



Proposers are reminded to identify the program announcement/solicitation number (06-518) in the program announcement/solicitation block on the proposal Cover Sheet. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

## B. Budgetary Information

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### Cost Sharing:

Cost sharing is not required by NSF in proposals submitted under this Program Solicitation.

## C. Due Dates

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Proposals must be submitted by the following date(s):

**Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

March 13, 2006

February 07, 2007

## D. FastLane/Grants.gov Requirements

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- **For Proposals Submitted Via FastLane:**

Detailed technical instructions for proposal preparation and submission via FastLane are available at: <https://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail [fastlane@nsf.gov](mailto:fastlane@nsf.gov). The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

**Submission of Electronically Signed Cover Sheets.** The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see Chapter II, Section C of the Grant Proposal Guide for a listing of the certifications). The AOR must provide the required electronic certifications within five working days following the electronic submission of the proposal. Proposers are no longer required to provide a paper copy of the signed Proposal Cover Sheet to NSF. Further instructions regarding this process are available on the FastLane Website at: <http://www.fastlane.nsf.gov/>

- **For Proposals Submitted Via Grants.gov:**

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. The Grants.gov's Grant Community User Guide is a comprehensive reference document that provides technical information about Grants.gov. Proposers can download the User Guide as a Microsoft Word document or as a PDF document. The Grants.gov User Guide is available at: <http://www.grants.gov/CustomerSupport>. In addition, the NSF Grants.gov Application Guide provides additional technical guidance regarding preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: [support@grants.gov](mailto:support@grants.gov). The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

**Submitting the Proposal:** Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed

application will be transferred to the NSF FastLane system for further processing.

## VI. PROPOSAL REVIEW INFORMATION

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### A. NSF Proposal Review Process

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Reviews of proposals submitted to NSF are solicited from peers with expertise in the substantive area of the proposed research or education project. These reviewers are selected by Program Officers charged with the oversight of the review process. NSF invites the proposer to suggest, at the time of submission, the names of appropriate or inappropriate reviewers. Care is taken to ensure that reviewers have no conflicts with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority-serving institutions, or adjacent disciplines to that principally addressed in the proposal.

The National Science Board approved revised criteria for evaluating proposals at its meeting on March 28, 1997 ([NSB 97-72](#)). All NSF proposals are evaluated through use of the two merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

On July 8, 2002, the NSF Director issued [Important Notice 127](#), Implementation of new Grant Proposal Guide Requirements Related to the Broader Impacts Criterion. This Important Notice reinforces the importance of addressing both criteria in the preparation and review of all proposals submitted to NSF. NSF continues to strengthen its internal processes to ensure that both of the merit review criteria are addressed when making funding decisions.

In an effort to increase compliance with these requirements, the January 2002 issuance of the GPG incorporated revised proposal preparation guidelines relating to the development of the Project Summary and Project Description. Chapter II of the GPG specifies that Principal Investigators (PIs) must address both merit review criteria in separate statements within the one-page Project Summary. This chapter also reiterates that broader impacts resulting from the proposed project must be addressed in the Project Description and described as an integral part of the narrative.

Effective October 1, 2002, NSF will return without review proposals that do not separately address both merit review criteria within the Project Summary. It is believed that these changes to NSF proposal preparation and processing guidelines will more clearly articulate the importance of broader impacts to NSF-funded projects.

The two National Science Board approved merit review criteria are listed below (see the [Grant Proposal Guide](#) Chapter III.A for further information). The criteria include considerations that help define them. These considerations are suggestions and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and for which he/she is qualified to make judgments.

#### **What is the intellectual merit of the proposed activity?**

How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields? How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of the prior work.) To what extent does the proposed activity suggest and explore creative and original concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

#### **What are the broader impacts of the proposed activity?**

How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)? To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships? Will the results be disseminated broadly to enhance scientific and technological understanding? What may be the benefits of the proposed activity to society?

NSF staff will give careful consideration to the following in making funding decisions:

#### ***Integration of Research and Education***

One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

#### ***Integrating Diversity into NSF Programs, Projects, and Activities***

Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

**Additional Review Criteria:**

:Successful proposals must be highly interdisciplinary, addressing the inherent complexity and highly coupled nature of science, engineering and societal research necessary to the advance the spirit of MUSES: reducing adverse human impact on the interactive system of resource use while maximizing the efficient use of individual materials throughout their life cycles. The three integrative elements--quantitative approaches, education, and global perspectives--are also important. Research projects must include quantitative approaches or advanced conceptual models to study the systems chosen for investigation and specific plans for education. Proposals that promote the development of long-term international partnerships will be given special consideration.

In addition to NSF's standard review criteria, planning or exploratory activities will be evaluated on their interdisciplinarity and their potential to advance the study of biocomplexity in the environment.

In the evaluation of proposals submitted by teams of investigators, considerations in addition to standard NSF review criteria are:

- Strength of the collaborations planned and degree of interdisciplinarity
- Effectiveness of the group organization and management plan
- Value to education in these topical areas
- Strength of the dissemination plans
- Extent, effectiveness, and long-term potential of collaborations with industries, national laboratories, and comparable research centers abroad, when appropriate.

Descriptions of educational activities should specify goals, methods to attain those goals, and the expertise of individuals to accomplish them. Thus, they will be evaluated based on:

- Potential interest to and appropriateness for the audience targeted
- Quality of planning and appropriateness of personnel
- Feasibility and potential for resulting in a disseminable product
- Integration and complementarity to the research efforts
- Focus on integrated learning and discovery and the preparation of U.S. students for a broad set of careers in environmental fields.

## **B. Review Protocol and Associated Customer Service Standard**

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All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. Proposals submitted in response to this announcement/solicitation will be reviewed by Ad Hoc and/or panel review.

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, are sent to the Principal Investigator/Project Director by the Program Director. In addition, the proposer will receive an explanation of the decision to award or decline funding.

NSF is striving to be able to tell proposers whether their proposals have been declined or recommended for funding within six months. The time interval begins on the closing date of an announcement/solicitation, or the date of proposal receipt, whichever is later. The interval ends when the Division Director accepts the Program Officer's recommendation.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

## VII. AWARD ADMINISTRATION INFORMATION

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### A. Notification of the Award

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Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program Division administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See section VI.A. for additional information on the review process.)

### B. Award Conditions

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An NSF award consists of: (1) the award letter, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award letter; (4) the applicable award conditions, such as Grant General Conditions (NSF-GC-1); \* or Federal Demonstration Partnership (FDP) Terms and Conditions \* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreement awards are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC). Electronic mail notification is the preferred way to transmit NSF awards to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

Consistent with the requirements of OMB Circular A-16, *Coordination of Geographic Information and Related Spatial Data Activities*, and the Federal Geographic Data Committee, all NSF awards that result in relevant geospatial data must be submitted to Geospatial One-Stop in accordance with the guidelines provided at: [www.geodata.gov](http://www.geodata.gov).

More comprehensive information on NSF Award Conditions is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, available electronically on the NSF Website at [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=gpm](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpm). The GPM is also for sale through the Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402. The telephone number at GPO for subscription information is (202) 512-1800. The GPM may be ordered through the GPO Website at <http://www.gpo.gov/>.

\*These documents may be accessed electronically on NSF's Website at <http://www.nsf.gov/awards/managing/>. Paper copies of these documents may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [pubs@nsf.gov](mailto:pubs@nsf.gov).

### C. Reporting Requirements

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For all multi-year grants (including both standard and continuing grants), the PI must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period.

Within 90 days after the expiration of an award, the PI also is required to submit a final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for the PI and all Co-PIs. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project reporting system, available through FastLane, for preparation and submission of annual and final project reports. This system permits electronic submission and updating of project reports, including information on project participants (individual and organizational), activities and findings, publications, and other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system.

## VIII. CONTACTS FOR ADDITIONAL INFORMATION

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General inquiries regarding this program should be made to:

- Delcie R. Durham, Program Director, Directorate for Engineering, Division of Design and Manufacturing Innovation, 529 S, telephone: (703) 292-7060, fax: (703) 292-9056, email: [ddurham@nsf.gov](mailto:ddurham@nsf.gov)
- David L. Nelson, Program Director (SSC), Directorate for Mathematical & Physical Sciences, Division of Materials Research, 1065 N, telephone: (703) 292-4932, email: [dnelson@nsf.gov](mailto:dnelson@nsf.gov)
- Robert E. O'Connor, Program Director, Directorate for Social, Behavioral & Economic Sciences, Division of Social and

Economic Sciences, 995 N, telephone: (703) 292-7263, fax: (703) 292-9068, email: [roconnor@nsf.gov](mailto:roconnor@nsf.gov)

- Thomas F. Russell, Program Director, Directorate for Mathematical & Physical Sciences, Division of Mathematical Sciences, 1025 N, telephone: (703) 292-4863, fax: (703) 292-9032, email: [trussell@nsf.gov](mailto:trussell@nsf.gov)
- Bruce K. Hamilton, Division Director, Directorate for Engineering, Division of Bioengineering & Environmental Systems, 565 S, telephone: (703) 292-8320, fax: (703) 292-9098, email: [bhamilto@nsf.gov](mailto:bhamilto@nsf.gov)
- Richard J. Fragaszy, Program Director, Directorate for Engineering, Division of Civil & Mechanical Systems, 545 S, telephone: (703) 292-8360, email: [rfragasz@nsf.gov](mailto:rfragasz@nsf.gov)
- Paul J. Werbos, Program Director, Directorate for Engineering, Division of Electrical & Communications Systems, 675 S, telephone: (703) 292-8339, fax: (703) 292-9147, email: [pwerbos@nsf.gov](mailto:pwerbos@nsf.gov)
- Robert M. Wellek, Deputy Division Director, Directorate for Engineering, Division of Chemical & Transport Systems, 525 N, telephone: (703) 292-8370, fax: (703) 292-9054, email: [rwellek@nsf.gov](mailto:rwellek@nsf.gov)

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: [support@grants.gov](mailto:support@grants.gov).

For questions related to the use of FastLane, contact:

- Brian E. Dawson, Information Technology Specialist, Directorate for Geosciences, 705 N, telephone: (703) 292-4727, fax: (703) 292-9042, email: [bdawson@nsf.gov](mailto:bdawson@nsf.gov)

## IX. OTHER PROGRAMS OF INTEREST

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The NSF *Guide to Programs* is a compilation of funding for research and education in science, mathematics, and engineering. The NSF *Guide to Programs* is available electronically at <http://www.nsf.gov/cgi-bin/getpub?gp>. General descriptions of NSF programs, research areas, and eligibility information for proposal submission are provided in each chapter.

Many NSF programs offer announcements or solicitations concerning specific proposal requirements. To obtain additional information about these requirements, contact the appropriate NSF program offices. Any changes in NSF's fiscal year programs occurring after press time for the *Guide to Programs* will be announced in the NSF *E-Bulletin*, which is updated daily on the NSF Website at <http://www.nsf.gov/home/ebulletin>, and in individual program announcements/solicitations. Subscribers can also sign up for NSF's *MyNSF News Service* (<http://www.nsf.gov/mynsf/>) to be notified of new funding opportunities that become available.

## ABOUT THE NATIONAL SCIENCE FOUNDATION

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The National Science Foundation (NSF) funds research and education in most fields of science and engineering. Awardees are wholly responsible for conducting their project activities and preparing the results for publication. Thus, the Foundation does not assume responsibility for such findings or their interpretation.

NSF welcomes proposals from all qualified scientists, engineers and educators. The Foundation strongly encourages women, minorities and persons with disabilities to compete fully in its programs. 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 subjected to discrimination under any program or activity receiving financial assistance from NSF, although some programs may have special requirements that limit eligibility.

*Facilitation Awards for Scientists and Engineers with Disabilities* (FASED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF-supported projects. See the GPG Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <http://www.nsf.gov>

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
  
- **For General Information** (NSF Information Center): (703) 292-5111
  
- **TDD (for the hearing-impaired):** (703) 292-5090
  
- **To Order Publications or Forms:**  
  
Send an e-mail to: [pubs@nsf.gov](mailto:pubs@nsf.gov)  
  
or telephone: (703) 292-7827
  
- **To Locate NSF Employees:** (703) 292-5111

## PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to applicant institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies needing information as part of the review process or in order to coordinate programs; and to another Federal agency, court or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records," 63 Federal Register 268 (January 5, 1998). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to an information collection unless it displays a valid OMB control number. The OMB control number for this collection is 3145-0058. 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 and any other aspect of this collection of information, including suggestions for reducing this burden, to: Suzanne Plimpton, Reports Clearance Officer, Division of Administrative Services, National Science Foundation, Arlington, VA 22230.

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