

# MacroSystems Biology: Research on Biological Systems at Regional to Continental Scales

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## PROGRAM SOLICITATION NSF 12-532

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### REPLACES DOCUMENT(S): NSF 10-555

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National Science Foundation  
Directorate for Biological Sciences  
Emerging Frontiers

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

April 18, 2012

April 01, 2013

First Monday in April, Annually Thereafter

## IMPORTANT INFORMATION AND REVISION NOTES

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A revised version of the **NSF Proposal & Award Policies & Procedures Guide** (PAPPG), [NSF 13-1](#), was issued on October 4, 2012 and is effective for proposals submitted, or due, on or after January 14, 2013. Please be advised that the guidelines contained in [NSF 13-1](#) apply to proposals submitted in response to this funding opportunity. Proposers who opt to submit prior to January 14, 2013, must also follow the guidelines contained in [NSF 13-1](#).

Please be aware that significant changes have been made to the PAPPG to implement revised merit review criteria based on the National Science Board (NSB) report, [National Science Foundation's Merit Review Criteria: Review and Revisions](#). While the two merit review criteria remain unchanged (Intellectual Merit and Broader Impacts), guidance has been provided to clarify and improve the function of the criteria. Changes will affect the project summary and project description sections of proposals. Annual and final reports also will be affected.

A by-chapter summary of this and other significant changes is provided at the beginning of both the [Grant Proposal Guide](#) and the [Award & Administration Guide](#).

*Please note that this program solicitation may contain supplemental proposal preparation guidance and/or guidance that deviates from the guidelines established in the [Grant Proposal Guide](#).*

Revision Summary:

The solicitation eligibility requirements were changed to remove Federal Agencies and Federally Funded Research and Development Centers (FFRDCs).

Additional detail was provided for the Project Management Plan.

Specific requirements were provided for the Data Management and Access Plan.

The maximum page limits for the Project Management and Data Management and Access Plans were increased by two pages (for a total of 5 pages) for complex projects.

Opportunities supplements for workshops, symposia, conferences, and education (REU, ROA, RAHSS) were added.

## SUMMARY OF PROGRAM REQUIREMENTS

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### General Information

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Program Title:

MacroSystems Biology  
Research on Biological Systems at Regional to Continental Scales

Synopsis of Program:

The MacroSystems Biology: Research on Biological Systems at Regional to Continental Scales will support quantitative, interdisciplinary, systems-oriented research on biosphere processes and their complex interactions with climate, land use, and invasive species at regional to continental scales as well as planning, training, and development activities to enable groups to conduct MacroSystems Biology Research.

Cognizant Program Officer(s):

*Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.*

- Elizabeth R. Blood, telephone: (703) 292-8400, email: [eblood@nsf.gov](mailto:eblood@nsf.gov)
- Henry L. Gholz, telephone: (703) 292-8481, email: [hgholz@nsf.gov](mailto:hgholz@nsf.gov)

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

- 47.074 --- Biological Sciences

## Award Information

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Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 10 to 15

Anticipated Funding Amount: \$15,000,000 to \$20,000,000 pending availability of funds. Two categories of awards will be made. Category 1 Awards: Exploratory or incubation grants to develop teams, explore a high risk idea, strategy, or innovative approach, hold workshops and develop plans to establish regional to continental scale networks of partners. These awards will be 1 to 2 years in duration. Category 2 Awards: Larger and longer grants to support full-fledged MacroSystems Biology Research or Innovative Training to conduct MacroSystems research. These awards may be up to 5 years in duration. Budgets for each type of award should reflect the scope and complexity of the work proposed.

## Eligibility Information

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Organization Limit:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI:

None Specified

## Proposal Preparation and Submission Instructions

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### A. Proposal Preparation Instructions

- Letters of Intent: Not Applicable
- Preliminary Proposal Submission: Not Applicable
- Full Proposals:
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. 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).
  - 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/publications/pub\\_summ.jsp?ods\\_key=grantsgovguide](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide))

### B. Budgetary Information

- Cost Sharing Requirements: Inclusion of voluntary committed cost sharing is prohibited.
- Indirect Cost (F&A) Limitations: Not Applicable
- Other Budgetary Limitations: Not Applicable

### C. Due Dates

- Full Proposal Deadline(s) (due by 5 p.m. proposer's local time):
  - April 18, 2012
  - April 01, 2013
  - First Monday in April, Annually Thereafter

## Proposal Review Information Criteria

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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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The biosphere has changed more in the past 50 years than during any time in human history. Climate change, land use change, and the introduction of invasive species that collectively affect living systems by altering the fundamental relationships between life and the non-living environment that sustains it. Many of the changes challenge our understanding of how the biosphere works - how the ecological systems on which we depend will respond to changes in climate, land use, biodiversity, and a host of related environmental factors. Our current understanding of the biosphere is largely based on knowledge derived either from small plot research or from satellite-scale remote sensing. However, the basic scientific knowledge needed to understand the biosphere at regional to continental and annual to decadal scales, to quantify the strong and weak forces regulating the biosphere, and to predict the consequences of climate and land use change and invasive species on living systems is difficult to extrapolate from studies conducted at local or global scales.

A major challenge in developing a predictive capability is that biosphere responses are often non-linear and can involve contagious spread of organisms and diseases from local to continental scales, with the most extreme impacts in zones where multiple factors converge. Large and often unpredictable changes in the biosphere can result from the interplay between fine-scale patterns and processes coupled with broad scale dynamics. These cross-scale interactions contribute to the observed non-linear dynamics and may be accompanied by abrupt threshold responses. Because many of these responses and feedbacks occur at regional to continental scales, they cannot be investigated by disconnected studies of individual ecosystems or short periods of observation.

## II. PROGRAM DESCRIPTION

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The National Science Foundation invites proposals from interdisciplinary teams of scientists to conduct innovative, integrated, systems-oriented macroscale biology ("MacroSystems Biology") research to detect, understand, and forecast the consequences of climate and land use change and invasive species on the biosphere at regional to continental scales. Proposals should address the scales where the ecological research challenges are the greatest and where research has the greatest potential to transform the field of ecology by addressing issues that have long hindered development of large-scale ecological research. Projects should strive to provide a mechanistic understanding of how multiple scale dynamics contribute to the structure, functioning, and change of the biosphere and lead to the development of a more predictive understanding of ecological change. Proposals should be well grounded in theory, include novel approaches that will result in a theoretical framework for a predictive understanding of macroscale biology, and show great promise for enhancing basic theoretical understandings.

Proposals should include quantitative research approaches such as mathematical or computational models; numerical simulations; artificial intelligence techniques; statistics; visualization; or database development. Proposals are encouraged for the development and/or integration of macrosystems models (e.g., data-assimilation, biological, ecological, environmental) that connect local, regional, and continental scales. These models should address key problems linking ecological and evolutionary processes over a variety of spatial and temporal scales. Projects should develop theoretical foundations that will be useful for modeling based on either existing data and/or data to be collected by existing or planned environmental observatories. Mathematical models should include appropriate estimates of uncertainty, and experiments should assess power and precision.

The MacroSystems Biology program supports research that may include natural, managed, and disturbed ecosystems, including those in terrestrial, freshwater, wetland, coastal (including salt marsh and mangrove), and human-dominated environments. For proposals with marine (deep ocean) study sites, the PI should contact a MacroSystem Biology Program Officer prior to submission to determine if it should be referred to the Biological Oceanography Program in the Division of Ocean Sciences.

Non-exclusive example questions include:

\* What are the structuring processes that determine the temporal dynamics and spatial structure of regional systems? Are these processes scale dependent? How do these processes vary across the continent or at continental margins?

\* How does inter-annual variability of biosphere exchange respond to oscillations in general circulation patterns (e.g., El Niño Southern Oscillation, Pacific Decadal Oscillation, North Atlantic Oscillation)? How does the onset of these effects track in time and space with the teleconnections of these general circulation patterns across the continent?

\* How will the biosphere respond to changes in natural- and human-induced forces such as climate, land use, and invasive species across a range of spatial and temporal scales? What is the pace and pattern of the responses? What is the effect on biosphere services at local, regional, and continental scales?

\* What is the impact of "connectivity" (local patterns and processes affecting broad-scale ecological dynamics) on the global environment? What are the strong and weak forces that connect or influence regions?

\* What are the causes and consequences of regional synchrony in dynamics of populations? Are there continental scale drivers that entrain regional and local patterns of population growth, dispersal, speciation, or diversification?

\* How are local and regional scale process of invasion and disease transmission shaped by continental scale patterns of connectivity? How can continental scale data inform forecasts of disease outbreaks and invasions? How do invasive species or emerging diseases arrive at a new location?

\* How do climate and land-use changes impact temperature and carbon cycling in lakes and streams, and what is their effect on aquatic metabolism? How do these changes alter the connectivity among regions or regional feedbacks to climate? \* How do changes in intensity, spatial distribution and frequency of extreme events affect regional systems and their attributes? How will changes in regional systems affect other regions or their connectivity (e.g. soil erosion and airborne dust, water retention, nutrient export, invasive species)?

\* What are the ecological and socio-ecological consequences of local land-use changes at regional and continental scales? What are the spatial and temporal patterns in human activity within a region and their consequences to the biosphere?

\* How are dust, nutrient, or biological source and deposition regions (connected through air and water vectors) related to patterns of human activity or land use, and how do the biosphere structure, function, and services respond to changes in loadings resulting from changing human activity or land use?

\* How does climate change affect regional temperature, hydrology, and drought severity, and what influences are predicted for species distributions and interactions, phenology, evolution, or biosphere productivity and biogeochemistry?

\* How will climate-change-induced impacts on fuel accumulation, combustibility and rates of ignition impact fire regimes of landscapes, regions, or continents?

Proposals may leverage existing research networks (i.e., The Long Term Ecological Research (LTER) Network), research sites (i.e., Critical Zone Observatories - CZO), field stations, synthesis centers, ongoing and proposed academic and federal programs, and research observatories such as the National Ecological Observatory Network (NEON) and the Ocean Observing Initiative (OOI). However the proposals must clearly demonstrate how the research will develop fundamentally new knowledge and enhance theory.

The study of regional to continental scale dynamics may involve research at multiple sites, locations or ecosystems. It must be explicit in the proposal how the suite of sites proposed will elucidate regional or continental scale theory. Proposals that lack a regional or continental scale framework (e.g., proposals that are simply inter-site comparisons or multi-site analyses of general ecosystem concepts or theories) will not be considered.

Proposals should contain innovative approaches to develop the capabilities of people and/or tools needed to advance these areas of research in the future, so that the next generation of researchers will learn to work in diverse teams across disciplinary and international boundaries, and use advanced sensing and monitoring, communication, and information technologies to work across many scales of time and space.

Expansion of the NSF's required post-doctoral mentoring opportunities to provide innovative training of the next generation of MacroSystems scientists is particularly encouraged. Proposals involving post-docs must offer an innovative and forward thinking plan for post-doctoral training that extends beyond the mentoring that would normally occur as part of a single research project. Training opportunities could include short-courses, collaboratories, or other related activities (national or international). Sample topics might include leadership, large project management, application of statistical methods for integrating data across scales, analytical methods useful for macro-scale studies, or computational techniques for dealing with large, regional or continental datasets.

Regional to continental scale processes transcend international boundaries. The data, information, knowledge, and expertise to fully

understand these dynamics may require international partnerships. Relevant and appropriate international partnerships are encouraged through this solicitation and other NSF solicitations to conduct collaborative research and to build collaborations (e.g., Research Coordination Networks). Funding guidelines for involving international collaborators include:

\* Travel expenses for US scientists and students participating in exchange visits integral to the project.

\* Project-related expenses for international partners to engage in research activities while in the United States as a project participant.

\* Project-related expenses for US participants to engage in research activities while abroad as a project participant.

#### Additional Funding Opportunities

This solicitation does not apply to requests for supplemental funding, or conference and workshop proposals all of which should be submitted, following the standard guidelines, by selecting "In response to GPG" on the proposal cover sheet and then selecting " MacroSystems Biology. " Funding for these activities will be available on a competitive basis and based on availability of funds.

#### Supplemental Funding Requests

December 1 annually (or next business day if that is a weekend or holiday) is the deadline date for RET, RAHSS, and ROA educational supplement requests. Guidance for PIs preparing supplemental requests is posted at: <http://www.nsf.gov/bio/supp.jsp>. Projects anticipating the inclusion of undergraduate research experiences are encouraged to include REU support as part of the research proposal itself, rather than as a supplemental request.

#### Conferences, Workshops and Symposia

The MacroSystems Biology program supports conferences, symposia and workshops that bring experts together to discuss current research, to expose other researchers or students to new research methods and approaches, and to discuss future directions of major research activities in regional to continental scale Biology or fundamental underlying theories (e.g. scaling). Conferences will be supported only if equivalent results cannot be achieved at regular meetings of professional societies or an established conference series. PIs should contact a MacroSystems Biology Program Officer before submitting a proposal for a conference/workshop. More information about submission of these proposals can be found at [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=gpg](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg).

### III. AWARD INFORMATION

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Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 10 to 15

Anticipated Funding Amount: Up to \$20,000,000 pending availability of funds. Two categories of awards will be made. Category 1 Awards: Exploratory or incubation grants to develop teams, to explore high risk ideas, strategies, or innovative approaches, and/or to develop plans to establish regional to continental scale networks of partners. These awards will be 1 to 2 years in duration. Category 2 Awards: Larger and longer grants to support full-fledged MacroSystems Biology Research or Innovative Training to conduct MacroSystems research. These awards may be up to 5 years in duration. Budgets for each type of award should reflect the scope and complexity of the work proposed.

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

### IV. ELIGIBILITY INFORMATION

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Organization Limit:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI:

None Specified

## V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

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### A. Proposal Preparation Instructions

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Full Proposal Preparation 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 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 [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov). Proposers are reminded to identify this program solicitation number in the program 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/publications/pub\\_summ.jsp?ods\\_key=grantsgovguide](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)). 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 [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov).

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

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via the NSF FastLane system. Chapter II, Section D.4 of the Grant Proposal Guide provides additional information on collaborative proposals.

Important Proposal Preparation Information: FastLane will check for required sections of the proposal, in accordance with *Grant Proposal Guide* (GPG) instructions described in Chapter II.C.2. The GPG requires submission of: Project Summary; Project Description; References Cited; Biographical Sketch(es); Budget; Budget Justification; Current and Pending Support; Facilities, Equipment & Other Resources; Data Management Plan; and Postdoctoral Mentoring Plan, if applicable. If a required section is missing, FastLane will not accept the proposal.

Please note that the proposal preparation instructions provided in this program solicitation may deviate from the GPG instructions. If the solicitation instructions do not require a GPG-required section to be included in the proposal, insert text or upload a document in that section of the proposal that states, "Not Applicable for this Program Solicitation." Doing so will enable FastLane to accept your proposal.

The information below supplements the standard proposal preparation guidelines in the GPG and the NSF Grants.gov Application Guide. It pertains to all submissions.

Proposal Cover Sheet.

Indicate the solicitation number in the PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE block. (Grants.gov Users: The program solicitation number will be pre-populated by Grants.gov on the NSF Grant Application Cover Page.) If your project includes international activities, you must check the box for "International Cooperative Activities Country Name" that appears under Other Information when the "remainder of cover sheet" is clicked, then select the countries involved.

NOTE: For all proposals, a starting date of February 1 or later should be requested.

Project Summary. The project summary consists of an overview, a statement on the intellectual merit of the proposed activity, and a statement on the broader impacts of the proposed activity. Provide a summary description of the project, including its research or development theme and key innovative features, in a manner that will be informative to a general technical audience. In the overview include the title of the project, the name of the principal investigator, and the lead organization. Also list all other participating institutions/organizations, including international collaborators. If the project includes international activities, those activities should be described in the overview. Proposals that do not contain the Project Summary, including an overview and separate statements on intellectual merit and broader impacts will not be accepted by FastLane or will be returned without review.

Table of Contents: The Table of Contents is system generated and cannot be edited.

Project Description.

Project Descriptions are limited to 15 pages total, including several specific required parts described below. This 15 page limit does not include pages devoted to references, the project budget, or supplementary documentation. The project description includes:

- a. Results of Prior NSF Support: Proposals must include relevant results from prior NSF support.
- b. Description of Research and Education Activities: The description should provide a clear statement of the research and education activities to be undertaken. It should include the empirical and theoretical foundations of the work, with reference to relevant work of the applicants and others; details of the methods to be used; and explain the significance of the outcomes. The narrative should reflect the intellectual merit of the work, its innovativeness, and responsiveness to the objectives of the solicitation. As appropriate, clear description of qualitative, quantitative, or experimental methods and procedures should be included. Projects involving international collaborations or other activities should describe them here.

**Please note that per guidance in the GPG, the Project Description must contain, as a separate section within the narrative, a discussion of the broader impacts of the proposed activities. You can decide where to include this section within the Project Description.**

Biographical Sketches. Each proposal must include biographical sketches for all senior investigators, and also include biographical sketches for principal foreign collaborators. All biographical sketches must adhere to the format given in the GPG.

Project Budget. The budget justification (up to 3 pages) should explain and justify major cost items. For undergraduate and graduate student participants and postdoctoral associates, include a breakdown of costs by types of participants. Funds to cover the cost of attendance of the PI at an annual awardee meeting in Arlington, VA should be requested.

Proposals Involving Multiple Organizations. Proposals involving multiple organizations may be submitted in one of two ways: (1) as a single proposal with one organization serving as the lead organization and with support to other organizations provided through subawards, or (2) as a collaborative proposal, where each submitting organization must meet the eligibility criteria outlined in section IV. Please note that all collaborative proposals submitted as separate submissions from multiple organizations must be submitted via FastLane. Chapter II, Section D.4 of the GPG provides additional information on collaborative proposals.

Proposals Involving Collaborators at Foreign Organizations. Proposers are reminded they must provide biographical sketches of all senior project personnel, including those at foreign organizations. In addition, as supplementary documentation, proposals involving foreign collaborators should provide documentation of a willingness to collaborate through letters of commitment from the international counterpart organizations. Please note that although eligibility for this competition is restricted to US organizations collaborations with foreign organizations may be considered.

Projects with international activities should include: a) details on the complementary expertise of the US and foreign partners; b) a description of the proposed contributions and division of labor among participating researchers and institutions; c) plans for involving US students and junior researchers.

#### Supplementary Documents

##### 1. Data Management and Access Plan (up to 5 pages commensurate with complexity of project)

The PAPPG contains a clarification of NSF's long standing data policy. All NSF proposals must describe plans for data management and sharing of the products of research, or assert the absence of the need for such plans. FastLane will not permit submission of a proposal that is missing a Data Management Plan. The Data Management Plan will be reviewed as part of the intellectual merit or broader impacts of the proposal, or both, as appropriate. Links to data management requirements and plans relevant to specific Directorates, Offices, Divisions, Programs, or other NSF units are available on the NSF website at: <http://www.nsf.gov/bfa/dias/policy/dmp.jsp>. See Chapter II.C.2.j of the GPG for further information about the implementation of this requirement.

Because MacroSystems Biology research may involve significant data collection, harvesting, integration, assimilation, and modeling among large collaborations, the MacroSystems Biology data management and access plan should contain detailed descriptions of the data sets that will be collected or collated, including their sources and plans for interpretation or analysis, for preservation, documentation, and sharing of data, samples, and physical collections, and for their final disposition. Particular attention should be paid to data archival and longer term availability. The data management plan also should include the models, their data sources, and model calibration and validation information. It should not contain an elaboration of model theory, equations, or algorithms that belong in the Project Description. The NSF encourages appointment of a data management coordinator where appropriate. This supplementary document must be labeled "Data Management Plan". The NSF Fastlane system will accept Data Management Plans greater than the two page limit indicated in the GPG. Do not be concerned by any notification of the two page limit.

##### 2. Project Management Plan (up to 5 pages commensurate with the complexity of the project)

All Projects must provide a description of the management plan for coordinating the activities, particularly those projects involving multiple investigators and multiple institutions.

- This description should include plans for internal means of communication, coordination of data and information management, evaluation and assessment of progress, allocation of funds and personnel, and other specific issues relevant to the proposed activities.
- A table summarizing the role of each investigator is required including PI, co-PIs, other senior personnel, and paid consultants at all organizations involved. The exact time commitment of each key project member should be indicated in the management plan, regardless of any request for his/her salary from NSF.
- Coordination and how the project will be managed within and across organizations and disciplines should be clearly defined, including identification of the specific coordination mechanisms that will enable cross-institution and/or cross-discipline scientific integration (e.g., regular meetings or teleconferencing, yearly workshops, graduate student exchange, project meetings at conferences, videoconferences, etc.).
- A timetable with yearly goals should be provided that includes benchmarks for the major anticipated project milestones and deliverables and expected dates for their release.

##### 3. Postdoctoral Researcher Mentoring Plan (1 page maximum)

Each proposal that includes funding for one or more post-docs must include a mentoring plan that explicitly states the roles of the post-doc as well as how they will interact with the other project personnel. See [GPG, Chapter II.C.2.j](#) for additional information on postdoctoral researcher mentoring plans. This supplementary document must be labeled "Postdoctoral Researcher Mentoring Plan".

#### Single Copy Documents:

*Collaborators/Individuals with Conflicts of Interest. Provide one list for the entire project (including any and all collaborative proposals) in an alphabetized table, of the full names and institutional affiliations of all persons with potential conflicts of interest as specified in NSF's Grant Proposal Guide. For each PI, Co-PI and other Senior Personnel, include all co-authors/editors and collaborators (within the past 48 months), all graduate advisors and advisees, and any other individuals or institutions with which the investigator has financial ties (please specify type). Do not include the names of people with whom you do not have conflicts as this may unnecessarily limit qualified reviewers. In addition, list all subawardees who would receive funds through the MacroSystems Biology award.*

## B. Budgetary Information

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Cost Sharing: Inclusion of voluntary committed cost sharing is prohibited

## C. Due Dates

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

April 18, 2012

April 01, 2013

First Monday in April, Annually Thereafter

## D. FastLane/Grants.gov Requirements

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- For Proposals Submitted Via FastLane:

Detailed technical instructions regarding the technical aspects of 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 funding opportunity.

**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. Further instructions regarding this process are available on the FastLane Website at: <https://www.fastlane.nsf.gov/fastlane.jsp>.

- 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. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: [http://www07.grants.gov/applicants/app\\_help\\_reso.jsp](http://www07.grants.gov/applicants/app_help_reso.jsp). 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. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

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Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in the GPG as [Exhibit III-1](#).

A comprehensive description of the Foundation's merit review process is available on the NSF website at: <http://www.nsf.gov/bfa/dias/policy/meritreview/>.

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in [Empowering the Nation Through Discovery and Innovation: NSF Strategic Plan for Fiscal Years \(FY\) 2011-2016](#). These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the core strategies in support of NSF's mission 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 variety of learning perspectives.

Another core strategy in support of NSF's mission is broadening opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which 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.

## A. Merit Review Principles and Criteria

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The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct



a fair, competitive, transparent merit review process for the selection of projects.

## 1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

## 2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. Both criteria are to be given full consideration during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. ([GPG Chapter II.C.2.d.i.](#) contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including [GPG Chapter II.C.2.d.i.](#), prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- Intellectual Merit: The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- Broader Impacts: The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
  - a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
  - b. Benefit society or advance desired societal outcomes (Broader Impacts)?
2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

## Additional Solicitation Specific Review Criteria

In addition to responding to the standard NSF review criteria, reviewers will be asked to place emphasis on the following:

- The extent to which the proposal is well grounded in theory, includes novel approaches that will result in a theoretical framework for a predictive understanding of macroscale biology, and shows great promise for enhancing basic theoretical understandings.
- The extent to which the proposals are highly interdisciplinary and broadly integrate across relevant biological, atmospheric, geological, social, mathematical, and engineering disciplines. The interdisciplinary research is expected to be reflected in the Principal Investigators involved in the project. Projects will be given consideration if they promote the development of collaborative partnerships with other research platforms, observatories, research centers, or networks.
- The proposal addresses the inherent complexity and highly connected nature of the biosphere, includes multi-scale perspectives, is focused on understanding processes at regional to continental scales, and places a high priority on scaling and integrating the results from observations at one scale to better understand processes and dynamics at other scales.
- The proposal includes quantitative approaches, advanced conceptual models, data assimilation, or other modeling approaches to study the systems chosen for investigation.

In accordance with the [NSF Proposal & Award Policies & Procedures Guide](#), all proposals submitted in response to this solicitation must explicitly address the Broader Impacts criterion. Although proposed Broader Impacts activities in any of the identified categories are acceptable, investigators are especially encouraged to undertake activities that effectively address goals and challenges associated with one or more of the following key areas:

- recruitment, education, and training of the future scientific, engineering, technical, and policy workforce and leadership needed to pursue basic research on regional to continental scale biology;
- innovative and collaborative post-doctoral leadership fellows with project management, leadership, technological and collaborative training and opportunities;
- tools and infrastructure to provide government and industry policymakers with current knowledge on issues related to regional to continental scale processes affecting the biosphere and associated biological feedbacks, so as to better inform decisions on adaptation and mitigation;
- improved public awareness and understanding of the interconnections between the biosphere, climate change, and sustainability and their impacts, and technical strategies for adaptation and mitigation;
- opportunities to engage a diverse community of learners and educators in regional to continental scale research.

## B. Review and Selection Process

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Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review 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.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director accepts the Program Officer's 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 Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

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 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.B. 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 (GC-1); \* or Research Terms and Conditions \* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

\*These documents may be accessed electronically on NSF's Website at [http://www.nsf.gov/awards/managing/award\\_conditions.jsp?org=NSF](http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF). Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov).

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the *NSF Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=aag](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag).

### C. Reporting Requirements

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For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer at least 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). Within 90 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. 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 Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the *NSF Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=aag](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag).

## VIII. AGENCY CONTACTS

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*Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.*

General inquiries regarding this program should be made to:

- Elizabeth R. Blood, telephone: (703) 292-8400, email: [eblood@nsf.gov](mailto:eblood@nsf.gov)
- Henry L. Gholz, telephone: (703) 292-8481, email: [hgholz@nsf.gov](mailto:hgholz@nsf.gov)

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: [fastlane@nsf.gov](mailto:fastlane@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).

## IX. OTHER INFORMATION

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The NSF Website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this Website by potential proposers is strongly encouraged. In addition, National Science Foundation Update is a free e-mail subscription service designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF Regional Grants Conferences. Subscribers are informed through e-mail when new publications are issued that match their identified interests. Users can subscribe to this service by clicking the "Get NSF Updates by Email" link on the [NSF web site](#).

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this new mechanism. Further information on Grants.gov may be obtained at <http://www.grants.gov>.

## ABOUT THE NATIONAL SCIENCE FOUNDATION

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The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

*Facilitation Awards for Scientists and Engineers with Disabilities* provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 for instructions

regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

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: [nspubs@nsf.gov](mailto:nspubs@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; and 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 proposer 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 or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; 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," 69 Federal Register 26410 (May 12, 2004), and [NSF-51](#), "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). 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 Office of Management and Budget (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 the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton  
Reports Clearance Officer  
Division of Administrative Services  
National Science Foundation  
Arlington, VA 22230

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