

# Advanced Biomanufacturing of Therapeutic Cells (ABTC)

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## PROGRAM SOLICITATION

NSF 17-502



National Science Foundation

Directorate for Engineering  
Division of Chemical, Bioengineering, Environmental and Transport Systems

**Preliminary Proposal Due Date(s) (required)** (due by 5 p.m. submitter's local time):

January 04, 2017

Preliminary Proposal Submission Deadline

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

April 17, 2017

Invited Proposal Deadline

## IMPORTANT INFORMATION AND REVISION NOTES

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**Preliminary Proposals** submitted in response to this solicitation should be submitted in accordance with the *NSF Proposal & Award Policies & Procedures Guide (PAPPG) (NSF 16-1)*.

**Full Proposals** submitted in response to this solicitation should be submitted in accordance with the revised NSF PAPPG (NSF 17-1). NSF anticipates release of the PAPPG in the Fall of 2016 and it will be effective for proposals submitted, or due, on or after January 30, 2017.

## SUMMARY OF PROGRAM REQUIREMENTS

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### General Information

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**Program Title:**

Advanced Biomanufacturing of Therapeutic Cells (ABTC)

**Synopsis of Program:**

In recent years, somatic cells as therapeutic agents have provided new treatment approaches for a number of pathological conditions that were deemed untreatable, or difficult to treat. Several successful cell therapies using T cells have been demonstrated for cancer and autoimmune diseases, while stem cell therapies have given relief for heart disease and stroke. Hundreds of clinical trials are ongoing to examine efficacy of cell therapies for a variety of other diseases including diabetes, Alzheimer's, Parkinson's, and Crohn's disease. Production of therapeutic cells is currently expensive and, therefore, cost prohibitive for the large number of people who might benefit from these treatments. The overarching goal of this Advanced Biomanufacturing of Therapeutic Cells (ABTC) solicitation is to catalyze well-integrated interdisciplinary research to understand, design, and control cell manufacturing systems and processes that will enable reproducible, cost-effective, and high-quality production of cells with predictable performance for the identified therapeutic function.

**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.*

- Carol Lucas, telephone: (703) 292-4608, email: [carlucas@nsf.gov](mailto:carlucas@nsf.gov)
- Rajakkannu Mutharasan, telephone: (703) 292-4608, email: [rmuthara@nsf.gov](mailto:rmuthara@nsf.gov)

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

- 47.041 --- Engineering

### Award Information

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**Anticipated Type of Award:** Standard Grant or Continuing Grant

**Estimated Number of Awards:** 7 to 10

Anticipated Funding Amount: \$5,000,000

## Eligibility Information

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### Who May Submit Proposals:

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.

### Who May Serve as PI:

There are no restrictions or limits for the allowable organizations listed above.

### Limit on Number of Proposals per Organization:

There is no limit on the number of preliminary proposals or proposals per organization. However, there is a limitation on the number of submissions per scientist as noted below.

### Limit on Number of Proposals per PI or Co-PI: 2

An individual may appear as PI, co-PI, other senior personnel, or consultant on no more than two preliminary proposals or proposals submitted in response to this solicitation. This limitation includes preliminary proposals or proposals submitted by a lead organization or any sub-award submitted as part of a preliminary proposal or proposal. Please be advised that if an individual's name appears, in any capacity, on more than TWO preliminary proposals or proposals, all submittals after the first two preliminary proposals or proposals (based on the time-stamp) will be returned without review.

## Proposal Preparation and Submission Instructions

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### A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposals:** Submission of Preliminary Proposals is required. Please see the full text of this solicitation for further information.
- **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

- **Preliminary Proposal Due Date(s) (required)** (due by 5 p.m. submitter's local time):

January 04, 2017

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

April 17, 2017

Invited Proposal Deadline

## Proposal Review Information Criteria

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### Merit Review Criteria:

National Science Board approved criteria apply.

## 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 use of human cells of various types as therapeutic agents has progressed at a rapid rate over the recent decade and has provided new treatment approaches for a number of disease conditions that were deemed untreatable or difficult to treat. Successful outcomes have been achieved for cancer and autoimmune diseases. Similarly, stem cell therapies have given relief for heart disease and stroke. Hundreds of clinical trials are ongoing to examine efficacy of cell therapies for a variety of diseases including diabetes, Alzheimer's, Parkinson's, and Crohn's disease.

Source cells for biomanufacture are most often autologous, allogeneic, and pluripotent types. Typically, an enrichment or separation step is involved, followed by genetically modifying the cells or differentiating them to a suitable phenotype. Expansion in a bioreactor is a central step where the target cells are grown to the desired concentration and subsequently purified and formulated prior to introduction into patients. This multi-step manufacturing system is expected to produce cells that have high potency and low variability. Current production processes are typically run in an open loop format without online biological function monitoring capability due to unavailability. Potency assays often are inadequate, and an indicator function is used in lieu of the required therapeutic function. Culture media in bioreactors are often formulated using natural materials that inevitably introduce variability, yet the final cell product is required to be uniform with low or no variability. Source cells can also introduce variability.

Production of therapeutic cells is currently expensive and, therefore, cost prohibitive for the large number of patients who might benefit from these treatments. The availability, affordability and quality of therapeutic cells are critical considerations that require research and innovation in cell manufacturing systems and processes. Examples include T-cells for cancer therapies and heart repairing adult phenotype cardiomyocytes. While great successes have been achieved, new fundamental knowledge in manufacturing methods is required to make these new approaches commonly available. For example, what are the bioreactor conditions that cause loss of biological potency of cells during expansion? Can closed cell bioreactor systems be designed and operated effectively? Can new potency assays or sensors be developed that provide process data for tracking the progress of cell expansion? Can a universally common base cell platform be designed to genetically customize specific therapeutic cells that can be expanded for effective treatment? Can scalable separation and purification of source cells or production cells be accomplished without loss of potency? Can potent product cells be separated and formulated in a single manufacturing step?

To this end, the Engineering Directorate, through its Division of Chemical, Bioengineering, Environmental, and Transport Systems, began in Fiscal Year 2015, investments in advanced Biomanufacturing initiatives. In FY 2015, [thirteen projects](#) were funded via the EAGER mechanism to examine stem cell differentiation methods. In FY 2016 [eleven projects](#) were also funded as EAGERS to examine fundamentals of T- cell manufacturing methodologies. Some projects are focused on novel methods for enriching T cells with desired phenotype and potency based on unique surface markers, mass spec profiling, mRNA classifiers, smart membranes,

and computer models. Some projects are examining innovative transfection techniques such as CRISPR-Cas9 gene editing and DNA carrying nanoparticles. Other projects are exploring unusual expansion stimulation methods such as dendritic cell mediated expansion or encapsulated interleukin-2 mediated expansion. Additionally, several projects are improving bioreactor designs to reduce cost, enable automation, reduce human intervention, and increase cell production by applying metabolic cell engineering principles.

The current solicitation broadens the scope of this activity. It aims to address some of the critical challenges in cell production by emphasizing cell manufacturing fundamental research and by promoting collaborations across disciplines and with research groups in industry.

## II. PROGRAM DESCRIPTION

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The overarching goal of ABTC is to catalyze well-integrated interdisciplinary research that will improve the understanding, design, and control of cell manufacturing systems and processes to enable reproducible, cost-effective, and high-quality production of cells with predictable performance for the identified therapeutic function. This solicitation has the following objectives:

- Develop cell culture strategies that ensure reproducible cell products of specified performance potency;
- Significantly advance the understanding of the cell manufacturing systems and processes through experimental and modeling approaches;
- Enable research that will lead to innovative system and technological solutions to critical cell manufacturing problems;
- Enable real-time biological monitoring of cells in production bioreactors.

Proposals should incorporate NSF's mission toward growing a scientific workforce capable of developing and managing cell biomanufacturing systems through education and other professional development opportunities for students.

Applications that propose innovations in tissue and organ culture, materials design for tissues, bioprinting, storage methodologies as core innovations are not encouraged.

**Collaboration across disciplines:** ABTC research has natural linkages to researchers in immunology, cell therapies, and a wide spectrum of other related disciplines. Such collaborations should be considered to improve definitions of underlying scientific problems, thus enhancing the probability that effective and impactful approaches will be developed. Proposals must document that the proposed research is truly interdisciplinary, that the respective components are fully integrated and necessary for the successful execution of the proposed project, and that the research team contains sufficient expertise to carry out all dimensions of the research plan. **Plans for integration of the respective research components must be fully outlined in the proposal.**

**Collaboration with Industry:** ABTC research also has natural linkages with industrial research groups in the business of cell biomanufacturing. Collaboration with an industrial research group is encouraged through NSF's **Grant Opportunities for Academic Liaison with Industry (GOALI)**. GOALI proposals that integrate fundamental research with translational results are highly encouraged. More information on GOALI requirements can be found [here](#). Proposals submitted under GOALI must document that the proposed research is truly translational, that the respective components are integrated and necessary for the successful execution of the proposed project, and that the research team has sufficient expertise to carry out the research plan.

## III. AWARD INFORMATION

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**Anticipated Type of Award:** Continuing Grant or Standard Grant

**Estimated Number of Awards:** 7 to 10

**Anticipated Funding Amount:** \$5,000,000

## IV. ELIGIBILITY INFORMATION

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### Who May Submit Proposals:

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.

### Who May Serve as PI:

There are no restrictions or limits for the allowable organizations listed above.

### Limit on Number of Proposals per Organization:

There is no limit on the number of preliminary proposals or proposals per organization. However, there is a limitation on the number of submissions per scientist as noted below.

### Limit on Number of Proposals per PI or Co-PI: 2

An individual may appear as PI, co-PI, other senior personnel, or consultant on no more than two preliminary proposals or proposals submitted in response to this solicitation. This limitation includes preliminary proposals or proposals submitted by a lead organization or any sub-award submitted as part of a preliminary proposal or proposal. Please be advised that if an individual's name appears, in any capacity, on more than TWO preliminary proposals or proposals, all submittals after the first two preliminary proposals or proposals (based on the time-stamp) will be returned without review.

#### Additional Eligibility Info:

Individual researchers and researchers at ineligible organizations may be included on proposals from eligible institutions through sub-awards or as consultants.

## V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

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### A. Proposal Preparation Instructions

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**Preliminary Proposals (required):** Preliminary proposals are required and must be submitted via the NSF FastLane system, even if full proposals will be submitted via Grants.gov.

An application to the ABTC solicitation consists of submission of a preliminary proposal, followed by submission of a standard full proposal from invited applicants. The invitation decision will be based on the evaluation of preliminary proposals.

Preliminary proposals will be evaluated by a panel of experts, and approximately 15 meritorious preliminary proposals will move to the next stage of competition. PIs of the selected preliminary proposals will be invited to submit a full proposal within 45 days of preliminary proposal deadline. Invited proposals will then be evaluated by a panel of experts for award selection. Any proposals received that were not invited will be returned without review.

The project description section of a preliminary proposal is limited to **three** pages and should contain in the narrative: (a) the identified cell biomanufacturing problem or limitation, (b) proposed strategies to overcome the problem or limitation, (c) potential impact on current cell biomanufacturing processes, and (d) anticipated impact on workforce development. A list of references may be included in the "References Cited" section and is outside of the page limit. A single line budget estimate, including indirect costs, should be included in the project description section; a detailed budget is not required. A list of investigators and their NSF prescribed biographical sketches should be included in the "Biographical Sketches" section. Please note, the **PRELIMINARY PROPOSAL** box on the cover page **MUST** be checked.

**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.5 of the Grant Proposal Guide provides additional information on collaborative proposals.

See Chapter II.C.2 of the [GPG](#) for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the GPG instructions.

### B. Budgetary Information

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#### Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

### C. Due Dates

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- **Preliminary Proposal Due Date(s) (required)** (due by 5 p.m. submitter's local time):

January 04, 2017

#### Preliminary Proposal Submission Deadline

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

April 17, 2017

Invited Proposal Deadline

## D. FastLane/Grants.gov Requirements

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### For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions 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.

### 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://www.grants.gov/web/grants/applicants.html>. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical 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.

Proposers that submitted via FastLane are strongly encouraged to use FastLane to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

## 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/merit\\_review/](http://www.nsf.gov/bfa/dias/policy/merit_review/).

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014-2018*. 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 strategic objectives 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 must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of 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.

## 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 evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. 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 strives to be able to tell



applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

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. After an administrative review has occurred, Grants and Agreements Officers perform 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.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, 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.

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## 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 notice, 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 notice; (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 notice. 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 no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 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).

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## 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:

- Carol Lucas, telephone: (703) 292-4608, email: [carlucas@nsf.gov](mailto:carlucas@nsf.gov)
- Rajakkannu Mutharasan, telephone: (703) 292-4608, email: [rmuthara@nsf.gov](mailto:rmuthara@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, "NSF Update" is an information-delivery system 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 [Grants Conferences](#). Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on [NSF's website](#).

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this 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.

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

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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
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## 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  
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