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Division of Molecular and Cellular Biosciences: Investigator-Initiated Research Projects (MCB)

PROGRAM SOLICITATION
NSF 17-589

REPLACES DOCUMENT(S):
NSF 13-510

National Science Foundation

Directorate for Biological Sciences
Division of Molecular and Cellular Biosciences

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

November 20, 2017

All research proposals, including RUI and RCN proposals, will be accepted on or before this deadline.

IMPORTANT INFORMATION AND REVISION NOTES

Revision Summary

Collaborators & Other Affiliations (COA) information specified in the PAPPG should be submitted using the instructions and spreadsheet template found at https://nsf.gov/bfa/dias/policy/coa.jsp.

The Division has revised the solicitation to address some of the community input:

1. Descriptions of programs and their funding priorities were updated to better reflect the current status of science in those fields.
2. Language about the submission of overlapping proposals was added. During the time a proposal from a PI who is not a beginning investigator is under review in the Division of Molecular and Cellular Biosciences, an overlapping proposal cannot be submitted to other federal funding agencies.
3. Information regarding other funding opportunities was updated to include information originally disseminated via a Dear Colleague Letter, including submission of collaborative proposals with the US-Israel Binational Science Foundation and submission of supplements for Improving Graduate Preparedness for Entering the Workforce.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 17-1), which is effective for proposals submitted, or due, on or after January 30, 2017.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Division of Molecular and Cellular Biosciences: Investigator-Initiated Research Projects (MCB)

Synopsis of Program:

The Division of Molecular and Cellular Biosciences (MCB) supports quantitative, mechanistic, predictive, and theory-driven fundamental research designed to promote understanding of complex living systems at the molecular, subcellular, and cellular levels. While recognizing the need for thorough and accurate descriptions of biological complexes and pathways, the priority of the Division is to support work that advances the field by capturing the predictive power of mechanistic, quantitative, and evolutionary approaches. MCB is soliciting proposals in four core clusters:

- Cellular Dynamics and Function
- Genetic Mechanisms
- Molecular Biophysics

- Systems and Synthetic Biology

MCB gives high priority to research projects that use theory, methods, and technologies from life and physical sciences, mathematics, computational sciences, and engineering to address major biological questions that elucidate the rules governing subcellular and cellular processes. Research supported by MCB uses a range of experimental and computational approaches--including *in vivo*, *in vitro,* and *in silico* strategies--and a broad spectrum of model and non-model organisms, including microbes and plants. Typical research supported by MCB integrates theory and experimentation. Projects are particularly welcome that address the emerging areas of: multi-scale integration; transformative methods and resources (when driven by compelling biological questions); molecular and cellular evolution; the synthesis of life-like systems; and the quantitative prediction of the phenome from genomic information. Highest funding priority is given to applications that have outstanding intellectual merit and strong broader impacts, while proposals with weaknesses in either category (or those that are perceived as likely to have an incremental impact) will not be competitive. Proposals that are motivated by relevance to human health and disease treatment are not appropriate for the Division and will be returned without review.

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.

- Charles Cunningham, telephone: (703) 292-8440, email: mcb-cdf@nsf.gov
- Arcady Mushegian, telephone: (703) 292-8440, email: mcb-gm@nsf.gov
- Engin Serpersu, telephone: (703) 292-8440, email: mcb-mb@nsf.gov
- Devaki Bhaya, telephone: (703) 292-8440, email: mcb-ssb@nsf.gov

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

- 47.074 --- Biological Sciences

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 110

Anticipated Funding Amount: $83,000,000

Pending availability of funds, approximately $83M will be committed for the total budget of all new awards in each cycle.

Eligibility Information

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.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

None. However MCB strongly discourages submission of two or more proposals with the same researcher serving as the lead Principal Investigator. Proposals that are a duplicate of, or substantially similar to, a proposal already under consideration by NSF from the same submitter are subject to return without review. This also applies to previously declined proposals that have not been substantially revised.

Duplicate and Overlapping Proposals to Other Federal Agencies:

Only beginning PIs may submit duplicate and overlapping proposals under consideration by another federal agency. If a PI who is not a beginning investigator submits an overlapping proposal to other federal agencies at the time of submission to MCB, or at any time during the review of the proposal by the Division, MCB will return the proposal without review or withdraw it from funding consideration.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
  - Full Proposals submitted via FastLane: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
  - 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: https://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. submitter's local time):

  November 20, 2017

  All research proposals, including RUI and RCN proposals, will be accepted on or before this deadline.

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria apply.

Award Administration Information

Award Conditions:

Standard NSF award conditions apply.

Reporting Requirements:

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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I. INTRODUCTION

The Division of Molecular and Cellular Biosciences (MCB) places a high-priority on projects that provide mechanistic insight that can be used predictively to establish and verify the rules governing life's processes. MCB encourages proposals that address major biological questions at the intersections of biology with other disciplines, such as physics, chemistry, mathematics, computer sciences, and engineering.

The following cross-cutting areas of research, most notably where they elucidate the rules governing life's processes, will be given high priority for funding in all clusters in MCB.

- **Integrating Across Scales:** integrating knowledge from single molecules to molecular machines and from networks to subcellular and cellular complexity.
- **Transformative Methods and Resources:** developing technologies for molecular and cellular biology research (when motivated by compelling biological questions), including biophysical and computational methods for broad application and genetic resources for model systems.
- **Molecular and Cellular Evolution:** discovering mechanisms and theoretical underpinnings of evolutionary changes in molecules, genomes, and cells.
- **Synthesizing Life-Like Systems:** using synthetic molecular parts and processes to understand the transition from simple to complex and to build novel living systems.
- **Genomes to Phenomes:** integrating theoretical, computational, and high-throughput experimental approaches to determine and predict how the genome/epigenome gives rise to the phenotype.

The Division recognizes that a basic understanding of life's rules and processes has many potential applications to societal needs, and PIs are encouraged to consider these applications as Broader Impacts of the proposed work (e.g., bio-based technologies, addressing environmental issues, and medicine). However, research **motivated** by relevance to human health and disease is not supported by MCB and such medically motivated projects will be returned without review.

MCB also continues to support projects that include effective Broader Impacts activities (e.g., educational and training opportunities for the next generation of researchers, scientific educators, and scientifically literate citizens). Proposed activities can include development of educational, broadening participation, and outreach activities, or participation in existing institutional infrastructure for education, training, and outreach. Successful proposals (especially CAREER proposals) often demonstrate close integration between scientific and educational aims and have a plan to assess the effectiveness of the proposed activities. Innovative activities that seek to broaden participation of underrepresented individuals in molecular and cellular research are given high priority.

II. PROGRAM DESCRIPTION

The Division is organized into four clusters. The cluster descriptions are provided to help the community understand the breadth of current interests and to provide insight into funding priorities. MCB recognizes that some projects bridge the intellectual edges of more than one cluster and encourages PIs to contact a Program Director to discuss where to submit projects that cross cluster boundaries. Likewise, MCB seeks to foster interdisciplinary research and consequently works closely (often by co-reviewing and co-funding) with other areas at NSF having related priorities including: the Physics of Living Systems (PoLS) Program, the Chemistry of Life Processes (CLP) Program, the Mathematical Biology (MB) Program, the Division of Integrative Organismal Systems (IOS), the Divisions of Environmental Biology (DEB), the Division of Biological Infrastructure (DBI), and the Chemical, Bioengineering, Environmental, and Transport Systems (CBET) Division. PIs are encouraged to investigate all relevant areas within NSF and to contact the appropriate program directors with questions.

Cellular Dynamics and Function Cluster

The cluster seeks theory-driven investigations of diverse cellular and subcellular systems. Research proposals are encouraged that use multidisciplinary physical, chemical, mathematical and computational approaches to provide novel techniques and integrative insight into fundamental cellular functions. Innovative proposal using plants, microbes, and nontraditional model species are encouraged. Proposals that rely heavily on descriptive approaches are given lower priority.

The cluster encourages proposals in the following areas:

- Predictive understanding of the behavior of living cells through integration of modeling and experimentation.
- Evolutionary approaches to understanding the rules governing cellular functions.
- Integration of function with emerging cellular properties across broad spatiotemporal scales.

Genetic Mechanisms Cluster

The cluster supports inventive studies seeking to address fundamental mechanisms involved in the evolution, organization, dynamics, and utilization of genetic information within cellular systems. Projects are encouraged that employ theoretical, computational, and experimental approaches to integrate structural, biochemical, genetic, and "omic" (genome, transcriptome, interactome, phenome, etc.) data to discover rules that help explain the relationship of genotype to molecular phenotype. Interdisciplinary research is encouraged, and when driven by compelling questions, development and use of innovative *in vivo* and *in vitro* technical and computational approaches are welcome.

Funding priority is given to proposals that employ quantitative frameworks and promise high-impact advances in the following areas:

- Chromatin- and RNA-mediated regulatory mechanisms.
- Dynamics and spatiotemporal coordination of genome replication, DNA repair, chromatin modification, transcription, and translation.
- Origin and evolution of genetic polymers, including DNA, RNA and proteins.

Molecular Biophysics Cluster

The cluster supports research into the structure and dynamics of biomolecules. Research with a goal to establish the fundamental principles that underlie biomolecular interactions, regulation of biological function at the atomic, near-atomic, and molecular levels, or to use these principles to design new functions is of interest to the cluster. Studies that utilize robust experimental and computational approaches in a synergistic fashion receive the highest priority. The cluster encourages studies under conditions that mimic the native physiological environment, and seeks research at the interface of the biological sciences with the physical, chemical, mathematical and engineering sciences. Proposals involving mechanistic biochemistry or those that involve the study of systems from which broad biological principles cannot be derived will be given lower priority.

Proposals in the following areas are particularly encouraged:

- Large scale computations comprising of millions of atoms that incorporate experimental constraints obtained using a variety of techniques ranging from NMR to high-resolution electron microscopy.
- Methodological developments that provide insight into molecular dynamics on multiple timescales with a goal towards understanding their role in molecular recognition and function.
- Determination of the structure and interactions of very large assemblies (e.g., ribosomes, photosystems) at high resolution.

Systems and Synthetic Biology Cluster

The cluster supports proposals that make use of the tools of systems and synthetic biology to generate a comprehensive understanding of complex interactions within biological systems across different scales. Proposals using experimental and computational approaches in a synergistic fashion are a high priority. The cluster seeks proposals using tractable established or emerging model systems that focus on: regulatory and metabolic network dynamics; fundamental rules governing complex behavior; microbial communities and their interactions; and fundamental principles of biological systems.

The cluster encourages proposals in the following areas:

- Systems-level analysis of regulatory, signaling, and metabolic networks, including the interactions among networks.
- Synthetic biology approaches for understanding the origin of life, the minimal cell and emerging behaviors of complex interactions.
- Experimental and computational tool development to facilitate systems and synthetic biology studies.
- Microbiome studies with the potential to reveal rules of assembly and function in well-defined natural and synthetic communities using systems and synthetic biology approaches.

Other Funding Opportunities in the Division

Core programs will accept proposals for international collaborative research under an agreement for a single review process between NSF and the US-Israel Binational Science Foundation (BSF). This opportunity was announced as a separate Dear Colleague Letter but is now incorporated into this solicitation. Submission instructions are as follows:

The NSF proposal must be submitted to a participating NSF/BIO/MCB program. The Israeli institution submits a parallel proposal to BSF via the BSF submission system. The NSF proposal title should be prefaced with NSF/MCB-BSF. Budget forms submitted to NSF should only indicate the amount requested by the US institution. The NSF proposal should include a PDF of the BSF budget as a supplementary documents. Biosketches of the Israeli PIs should also be submitted as supplementary documents.

Requests for funding for activities that would be considered supplements including support for Improving Graduate Preparedness for Entering the Workforce, can also be included at the time of submission of the original proposal and included in the budget. Alternatively, requests for funding of these activities may be made via a supplement request to an existing award.

In addition to the regular research proposals sought under this solicitation, the Division supports a variety of other Foundation-wide and Directorate-wide activities:

- Faculty Early Career Development Program (CAREER) proposals should be submitted by the deadlines listed in the CAREER solicitation.
- Research Coordination Networks (RCN), and Research at Undergraduate Institutions (RUI) proposals should be submitted by the deadlines in this solicitation.
- Grants for Rapid Response Research (RAPID), for Early-concept Grants for Exploratory Research (EAGER), and for limited

support of special meetings and workshops can be submitted at any time. Conference proposals should be submitted in accordance with the Grant Proposal Guide at least 6 months before the start date of the conference. See NSF Proposal and Award Policies and Procedures Guide for information about these types of proposals. **Before submitting EAGER, RAPID, and conference proposals, please contact a program director in the area of the proposal.**

- Research Advanced by Interdisciplinary Science and Engineering (RAISE) Proposals can be submitted at any time. **Before submitting RAISE proposals, please contact a program director in the area of the proposal.**

III. AWARD INFORMATION

Pending availability of funds, approximately $83M will be committed for the total budget of all new awards in each cycle. Requested budget and duration should be in proportion to the proposed scope of the project. The Division funds research projects of varying durations (typically 3 to 5 years) and size.

IV. ELIGIBILITY INFORMATION

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.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

None. However MCB strongly discourages submission of two or more proposals with the same researcher serving as the lead Principal Investigator. Proposals that are a duplicate of, or substantially similar to, a proposal already under consideration by NSF from the same submitter are subject to return without review. This also applies to previously declined proposals that have not been substantially revised.

Duplicate and Overlapping Proposals to Other Federal Agencies:

Only beginning PIs may submit duplicate and overlapping proposals under consideration by another federal agency. If a PI who is not a beginning investigator submits an overlapping proposal to other federal agencies at the time of submission to MCB, or at any time during the review of the proposal by the Division, MCB will return the proposal without review or withdraw it from funding consideration.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

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 Proposal & Award Policies & Procedures Guide* (PAPPG). The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg. Paper copies of the PAPPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from 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: (https://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.

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. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

See PAPPG Chapter II.C.2 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 PAPPG instructions.

- **Results of Prior NSF Support.** Results of prior NSF support must be reported for each PI or co-PI identified on the proposal who has received any NSF funding with a start date in the past five years, regardless of whether the support was directly related to this proposal or not. Format for results of prior support should follow that described in the PAPPG.
- **RET and RAHSS funds**. If Research Experiences for Teachers (RET) or Research Assistantships for High School Students (RAHSS) funds are requested as part of the full proposal, descriptions of those activities should be included in Supplementary Documents. The description is limited to 3 pages in all circumstances. For example, if funds are requested for multiple categories of activity (RET, RAHSS) or if multiple institutions on a collaborative proposal are requesting funds for one or more categories, the 3 page limit still applies. The entire budget for these activities should be included in Participant Support Costs, including stipends, travel, and supplies. A detailed breakdown of the budget for each separate category of request must be explained in the budget justification. Budgets for RET activities are generally under $15,000 per teacher. Budgets for RAHSS activities are generally under $6,000 per student.
- **BIO Proposal Classification Form**: Applicants must complete the Proposal Classification Form. The Proposal Classification Form is required for all submissions to BIO; FastLane will not allow processing of the proposal without it.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

C. Due Dates

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

  November 20, 2017

  All research proposals, including RUI and RCN proposals, will be accepted on or before this deadline.

D. FastLane / Grants.gov Requirements

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. 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. 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

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 PAPPG Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: https://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

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. (PAPPG 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 PAPPG 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

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.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

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

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 https://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.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

C. Reporting Requirements

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 Proposal & Award Policies & Procedures Guide* (PAPPG) Chapter VII, available electronically on the NSF Website at https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.

When submitting an annual or final report, the PIs are required to include the following information.

- Information about the project participants. It is essential that the PI reports names, roles on the project and current position (if the person has left the institution) of each person involved in the project. This includes information about the postdoctoral fellows, graduate students, undergraduate students, teachers, faculty from undergraduate institutions, and other personnel that were supported by the original grant or by a supplement to the grant. This information should be uploaded as a table.
- List of all publications must be reported through the Project Report System and not uploaded as a separate file.
- Broader impacts of the project, including educational and outreach activities must be included.

A project report will be returned to the PI if it does not contain information about human resources supported and their tracking or about the educational and outreach activity if included in the original grant or in a supplemental funding request.

VIII. AGENCY CONTACTS

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:

- Charles Cunningham, telephone: (703) 292-8440, email: mcb-cdf@nsf.gov
- Arcady Mushegian, telephone: (703) 292-8440, email: mcb-gm@nsf.gov
- Engin Serpersu, telephone: (703) 292-8440, email: mcb-mb@nsf.gov
- Devaki Bhaya, telephone: (703) 292-8440, email: mcb-ssb@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: 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.

IX. OTHER INFORMATION

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

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 (FASED) provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See the *NSF Proposal & Award Policies & Procedures Guide* Chapter II.E.6 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 https://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: nsfpubs@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
Office of the General Counsel
National Science Foundation
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