

# Understanding the Rules of Life: Building a Synthetic Cell

## An Ideas Lab Activity

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### PROGRAM SOLICITATION

#### NSF 18-599

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National Science Foundation

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

December 28, 2018

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

May 13, 2019

### IMPORTANT INFORMATION AND REVISION NOTES

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Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 18-1), which is effective for proposals submitted, or due, on or after January 29, 2018.

### SUMMARY OF PROGRAM REQUIREMENTS

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#### General Information

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**Program Title:**

Understanding the Rules of Life: Building a Synthetic Cell  
An Ideas Lab Activity

**Synopsis of Program:**

In 2016, the National Science Foundation (NSF) unveiled a set of "Big Ideas," 10 bold, long-term research and process ideas that identify areas for future investment at the frontiers of science and engineering (see [https://www.nsf.gov/news/special\\_reports/big\\_ideas/index.jsp](https://www.nsf.gov/news/special_reports/big_ideas/index.jsp)). The Big Ideas represent unique opportunities to position our Nation at the cutting edge of global science and engineering leadership by bringing together diverse disciplinary perspectives to support convergence research. As such, when responding to this solicitation, even though proposals must be submitted to the Division of Emerging Frontiers in the Directorate for Biological Sciences (BIO/EF), once received, the proposals will be managed by a cross-disciplinary team of NSF Program Directors.

This solicitation describes an Ideas Lab on "Building a Synthetic Cell." Ideas Labs are intensive workshops focused on finding innovative solutions to grand challenge problems. The ultimate aim of this Ideas Lab organized by the National Science Foundation is to facilitate the generation and execution of innovative research projects aimed at designing, fabricating, and validating synthetic cells that express specified phenotypes. The aspiration is that mixing researchers who have diverse scientific backgrounds will engender original thinking and innovative approaches that will transform our understanding of cellular processes, the molecular mechanisms that underscore the building and function of systems that reproduce life traits, the self-assembly of life-like systems, soft condensed matter, and the physics and chemistry of life that are needed to design and build cellular components, cells and multicell systems.

The ability to design and manufacture synthetic cells has significant implications for the scientific and economic enterprise of the United States. The synthesis of viable cells from non-living molecules and materials can open the door to the production of functional biomaterials and improved biofuels, large scale chemical synthesis, non-silicon-based computing, novel soil engineering, and medical and pharmaceutical advances, to name just a few possibilities. The study of synthetic cells, and of the processes used in their creation, can also provide a window on the origin and evolution of life on Earth and, potentially, provide insight into extraterrestrial life.

Synthetic cells have a number of shared characteristics. They may possess many of the structures of biological cells and reproduce capabilities such as self-replication, metabolism and response to environmental cues. However, they may be engineered using novel molecules and materials and structures to mimic single or complex biological functions. There are many reasons to engage in synthetic cell research; for example, to better understand what constitutes a living system, to identify the truly essential functions of cells, and building in itself can be a way to

demonstrate understanding. Synthetic cell research employs a wide range of approaches including 'top down' methodologies exemplified by efforts to construct a 'minimal cell' by gradually deleting genes and components until a system with the fewest components that still exhibits the hallmarks of life is obtained. The alternative 'bottom up' approaches involve assembling molecular building blocks until cellular functions are obtained. These approaches might meet in the middle, and may inform each other.

The design and production of synthetic cells requires the development of innovative and integrative experimental approaches in combination with novel theoretical frameworks, improved mathematical models, new artificial biomaterials, predictive understanding of biological function, and the identification of causal relationships in biological systems (e.g. genotype/phenotype, structure/function), all within an ethical framework that is sensitive to the profound implications of the research being conducted. Building a synthetic cell is a grand challenge at the interface between biological, mathematical, computer and physical sciences and engineering that has the potential to advance not only applications, but also our fundamental understanding of how cells self-assemble and function and of emergent order in non-equilibrium systems. Meeting this challenge requires simultaneous careful exploration of the social and ethical dimensions of such research as well as educating today's students to engage in the activities and technologies required both for developing synthetic cells and for their use in biology, engineering, chemistry, pharmaceutical development, and other activities. Only by doing so will we be able to fully understand both the societal benefits and risks as well as their potential for willful misuse or unintended damage to natural biological systems. In concert with technology development, educating students and the lay public will also be important to ensure an accurate understanding of the scientific advances resulting from the development and use of synthetic cells.

This Ideas Lab advances the objectives of one of *10 Big Ideas for Future NSF Investments*: 'Understanding the Rules of Life: Predicting Phenotype'. The 10 Big Ideas will push forward the frontiers of U.S. research and provide innovative approaches to solve some of the most pressing problems the world faces, as well as lead to discoveries not yet known.

This multi-directorate program is one element of NSF's multi-year effort towards the goals of the Understanding the Rules of Life Big Idea ([https://www.nsf.gov/news/special\\_reports/big\\_ideas/life.jsp](https://www.nsf.gov/news/special_reports/big_ideas/life.jsp)). US researchers may submit preliminary proposals only *via* FastLane for participation in the Ideas Lab in which a set of multidisciplinary ideas will be developed. These multidisciplinary ideas will form the basis of the full proposals to be written based on the discussion within the Ideas Lab.

#### **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) 292-2283, email: [chacunni@nsf.gov](mailto:chacunni@nsf.gov)
- Mitra Basu, telephone: (703) 292-8649, email: [mbasu@nsf.gov](mailto:mbasu@nsf.gov)
- Krastan B. Blagoev, telephone: (703) 292-4666, email: [kblagoev@nsf.gov](mailto:kblagoev@nsf.gov)
- Ellen Carpenter, telephone: (703) 292-5104, email: [elcarpen@nsf.gov](mailto:elcarpen@nsf.gov)
- Joseph T. Miller, telephone: (703) 292-7214, email: [jtmiller@nsf.gov](mailto:jtmiller@nsf.gov)
- John Parker, telephone: (703) 292 5034, email: [joparker@nsf.gov](mailto:joparker@nsf.gov)
- Steven W. Peretti, telephone: (703) 292-7029, email: [speretti@nsf.gov](mailto:speretti@nsf.gov)
- Margaret Fraiser, telephone: (703) 292-8172, email: [mfraiser@nsf.gov](mailto:mfraiser@nsf.gov)

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

- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.050 --- Geosciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- Education and Human Resources
- 47.079 --- Office of International Science and Engineering
- 47.083 --- Office of Integrative Activities (OIA)

## **Award Information**

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

**Estimated Number of Awards:** 4 to 6

**Anticipated Funding Amount:** \$10,000,000

Subject to the availability of funds

## **Eligibility Information**

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**Who May Submit Proposals:**

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E.

**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:**

An individual may serve as PI or coPI on only one proposal.

## 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 Proposal Preparation Instructions:** This solicitation contains information that supplements the standard *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) proposal preparation guidelines. Please see the full text of this solicitation for further information.

**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):  
December 28, 2018
- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):  
May 13, 2019

## Proposal Review Information Criteria

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**Merit Review Criteria:**

National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

## Award Administration Information

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**Award Conditions:**

Additional award conditions apply. Please see the full text of this solicitation for further information.

**Reporting Requirements:**

Standard NSF reporting requirements apply.

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## I. INTRODUCTION

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Natural cells emerge from the coordinated operation of a large number of biomolecules with their environment. Such cells survived and evolved during dramatic changes in the Earth's geochemistry and under sometime challenging environmental conditions such as radiation, heat, and pressure. To decipher the basic requirements of a living cell from the myriad functions that exist to make it resistant to damage, some have taken a reductionist approach, in which for example, genes nonessential for survival are removed from 'simple' cells. The identification of these genes and the elucidation of their function and the molecular mechanism by which they exert that function can inform and accelerate the design and building of synthetic cells. Conversely, a synthetic bottom up approach might involve the development of membrane-free functional cell components and the assembly of reconstituted organelles into a functional self-replicating cell. For either approach, progress towards making a synthetic cell demands an interdisciplinary effort by biophysicists, chemists, mathematicians, geologists, social scientists, ethicists, materials scientists, and computer scientists working synergistically with biologists and engineers to make progress on this multifaceted problem. In addition, developing the technology will require educating graduate and undergraduate students and the technical workforce who will assist in development efforts, and who will use these cells in the future in biophysical, biochemical, engineering, and pharmaceutical applications.

The goal of this Ideas Lab is to stimulate innovative and transformative research proposals that leverage developments in biophysics, chemistry, computer science, geosciences, materials, soft condensed matter, and biology with progress in engineering and social sciences to make substantial progress towards producing a synthetic cell. The 21<sup>st</sup> century convergence of science and engineering as well as the development of new instruments, scientific methods and engineering platforms along with our deeper understanding of deep-time environmental variables and biological function have brought the field to a point at which a fundamental breakthrough is possible. The challenge is to combine expertise from diverse disciplines to understand how to make the next big steps towards a synthetic cell and how to guide this research in an ethically-responsible manner. Education, both in existing technologies, and in applications for the future, is also an important consideration.

The key objective of this Ideas Lab is to bring together researchers from diverse scientific backgrounds in a discussion that engenders fresh thinking and creative approaches to accelerate the pace of research towards synthetic cells. Questions that may be considered include but are not limited to:

- At what level do the physical processes in a cell matter and when can a cell be viewed as an information processing system?
- What are the challenges in a typical design cycle? Are there viable mathematical models to explore cell dynamics? What are the limits of cellular computation in the context of speed and accuracy?
- Are the molecules in a cell in a special and possibly thermodynamic state or does a cell only require the right components to function?
- What role does being far from equilibrium have on the system?
- What are the ethical, legal and social implications of building a synthetic cell?
- What are the educational needs of the field, and how will we educate the researchers, students, and technicians who will develop and use synthetic cells?
- What are the appropriate methods to educate the lay public about the advances, benefits, risks and ethics of developing synthetic cells?

**Participation in the Ideas Lab requires an invitation in response to a preliminary proposal. Submission of a full proposal derived from the Ideas Lab requires both participation in the Ideas Lab and an invitation to submit a full proposal.**

Full proposals derived from the Ideas Lab must include ideas that could lead to a step-change, rather than to incremental advances in our knowledge. It is expected that these full proposals will be generated by multidisciplinary teams; the teams may include researchers with expertise in biology, physics, biophysics, mathematical modeling, statistics, chemistry, engineering, computer science, or any other discipline suited to shed light on the topic. Additionally, each proposing group should contain at least one bioethics researcher and should develop an educational plan to train the students and technicians who will participate in the project, as well as to provide generalized instruction in synthetic cell technology and applications for graduate and undergraduate students and for the lay public. Given the likely complexity of the proposed research, the participation of specialists in other relevant areas is strongly encouraged.

## II. PROGRAM DESCRIPTION

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### The Ideas Lab

An Ideas Lab is an interactive workshop on a focused problem and typically involves up to 30 participants. This Ideas Lab aims to stimulate thinking in promising new, or currently under-developed research areas relevant to the successful design and fabrication of a synthetic cell.

Participants will be expected to engage constructively in dialogue with one another, the facilitators, and the Director and Mentors to develop collaborative research proposals. Collaboration is an integral aspect of the activity.

The Ideas Lab is sponsored by NSF. As such, only those eligible to apply for funding from NSF will be eligible to apply to attend the Ideas Lab.

The Ideas Lab will run over five days starting mid-morning on Day One and finishing mid-afternoon on Day Five. At the outset, the participants will work collaboratively to identify and define the scope of the research challenges relating to the creation of a synthetic cell. As the Ideas Lab progresses, participants will dynamically develop and hone novel ideas about how the identified challenges may be addressed. These ideas and approaches will be used in the development of research projects that are genuinely innovative and high risk. The Ideas Lab will include inputs from a variety of sources and will aim to develop collaborative research projects. Following the Ideas Lab, proposals may be submitted by teams selected to submit a full proposal.

### How will the Ideas Lab Work?

The Ideas Lab is an intensive, interactive and free-thinking environment, where a diverse group of participants from a range of disciplines and backgrounds gets together for five days - away from their everyday worlds - to immerse themselves in collaborative thinking and come up with innovative approaches.

The nature of the Ideas Lab requires a high degree of trust among participants to make the required breakthroughs in scientific thinking. This trust extends to allowing the free and frank exchange of scientific ideas, some being in the very early stages of development. The discussion should not be about ideas that are already well-developed but not yet published. Rather, the goal is to bring individuals from different disciplines together to interact and engage in free thinking based on first principles, to learn from one another, and to create an integrated vision for future research projects. It is expected that these ideas would be shared within the Ideas Lab, but their confidentiality would be respected outside the Ideas Lab.

The Ideas Lab will be led by a Director whose role is to assist in defining the topics and help facilitate discussions at the event. The Director will be joined by a small number of Mentors. The Director and Mentors will be selected by NSF based on their intellectual standing, their impartiality and objectivity, and their broad understanding of, and enthusiasm for, the subject area. The Director and Mentors will fully participate in the Ideas Lab but will not be eligible to receive research funding under this collaborative activity. They will therefore act as impartial peer reviewers in the process, providing a function analogous to that of an NSF review panel.

The process can be broken down into several stages:

- Defining the scope of the challenges
- Evolving common languages and terminologies among people from a diverse range of backgrounds and disciplines
- Sharing perspectives and understanding of the scientific challenges, as well as the diverse expertise brought by the participants to the Ideas Lab
- Taking part in break-out sessions focused on the challenges, using creative thinking techniques
- Capturing the outputs in the form of highly innovative research projects
- Using "real-time" peer review to develop projects at the Ideas Lab

The Ideas Lab will be an intensive event. For the well-being of participants, the venue offers opportunities for relaxation, and the timetable will include networking and other activities as a break from the detailed technical discussions.

### Who Should Apply to Participate?

Having the right mix of participants influences the success or failure of such an activity. Applications are encouraged from individuals representing diverse research areas across a range of disciplines. Contributions to this challenge should be submitted by researchers working in a variety of disciplines or research areas including, mathematics, physics, biology, chemistry, geosciences, ethics and statistics, engineering, and graduate and undergraduate education. However, we are not defining the disciplines that should be represented at this Ideas Lab; rather we are asking potential participants to indicate how their expertise can address the challenges associated with the creation of a synthetic cell.

The ability to develop and pursue a new approach will also be crucial. Expertise is required from a broad range of disciplines, and applicants should not feel limited by conventional perceptions: the Ideas Lab approach is about bringing together people who would not normally interact. We actively encourage applications from people who are experts in their own research areas but have not yet applied it to this challenge.

This is an opportunity to share ideas and develop future collaborations. Participants at any stage of their research career are welcomed; however, they must be eligible to apply for funding from NSF.

#### Location and Date

This Ideas Lab will take place at a location to be determined, in the vicinity of NSF headquarters in Northern Virginia from Monday, 25<sup>th</sup> February to Friday, 1<sup>st</sup> March, 2019. The environment will encourage free and open-minded thinking, which are vital for the success of such an event. Additional information about the venue and meeting logistics will be provided to the selected participants. It should be noted that all travel to the Ideas Lab, accommodation, refreshments, breakfast, lunch and dinner costs will be covered by NSF. However, all incidental costs incurred while at the event will be borne by the participant.

#### Applications for this Activity

In brief, any individual interested in participating in the Ideas Lab should respond to this solicitation by submitting a preliminary proposal application. Participation in the Ideas Lab is by invitation only from the pool of applicants who submitted a preliminary proposal.

**Submission of the preliminary proposal will be considered an indication of availability to attend and participate through the full course of the five-day residential workshop.**

Participants will be selected based on their expertise, interests, and other characteristics described in their submitted preliminary proposals. The participants should be willing to engage in frank disclosure and assessment of ideas in a collegial, professional, and responsible fashion. An independent selection committee will recommend a list of potential participants from all applicants. NSF Program Staff in consultation with the Ideas Lab Director and Mentors will select the final list of participants from the submitted preliminary proposals.

Following the Ideas Lab, participants will be invited to submit to NSF full proposals, based on the outline developed at the Ideas Lab, by the **May 13, 2019** deadline.

### III. AWARD INFORMATION

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Approximately \$10,000,000 will be available in fiscal year (FY) 2019. Up to 6 awards will be made pending availability of funds and the type, scale, and variety of project ideas developed at the Ideas Lab.

### IV. ELIGIBILITY INFORMATION

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#### Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E.

#### 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:

An individual may serve as PI or coPI on only one proposal.

### 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.

**Submission of Preliminary Proposals is required for participation in the Ideas Lab. Please note, the preliminary proposal must come from one individual and cannot include co-PIs or collaborators.** Participants in the Idea Lab will be selected on the basis of information submitted in the preliminary proposal. The applications are limited to **two pages of "Project Description,"** which should be submitted as a preliminary proposal in the NSF FastLane system ONLY, not through Grants.gov. Standard NSF formatting guidelines apply. See the [NSF Proposal & Award Policies & Procedures Guide](#) (PAPPG) for guidance. Proposers are reminded to identify the program solicitation number (located on the first page of this document) in the first block on the NSF Cover Sheet. Compliance with this

requirement is critical to determining the relevant proposal processing guidelines. Please note that even though proposals must be submitted to BIO/EF, once received the proposals will be managed by a cross-disciplinary team of NSF Program Directors.

The Project Description section of the preliminary proposal applications should conform to the following guidelines:

**Page One:**

- Please include the sentence I am available February 25 - March 1, 2019 and can commit to attend all 5 days of the event. If you cannot commit to attend all 5 days of the event, please explain.
- Provide a brief summary of your professional background (no more than one half page). Please note, if you are selected as a participant, information provided in answer to this question will be made available to the other participants to facilitate networking at the Ideas Lab workshop.
- How do you see your expertise and interests contributing to realizing the goal of this workshop? (no more than half a page).

**Page Two:**

Please spend some time considering your answers to the following questions. Your responses (no more than 150 words each) will help us assess your suitability (unrelated to your research track record) for the innovative and collaborative setting of this intensive, interactive, fast-paced event.

- What is your approach to teamwork? What strengths do you bring to a team effort?
- How would you explain your area of interest to individuals with different expertise to your own? How easy do you find this?
- This workshop is especially suited to individuals who enjoy stepping outside their areas of expertise or interest, are positively driven, enjoy creative activity, and can think innovatively. It is an intensive setting requiring you to develop novel approaches with individuals you may not know. How do you consider yourself suited?
- What do you hope to gain from participating in this workshop, personally and professionally?

Applicants must include a **Biographical Sketch** and a **Current and Pending Support** document (prepared in accordance with standard NSF formatting guidelines).

**No appendices or supplementary documents may be submitted.**

**Full Proposal Instructions:** Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the guidelines specified 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](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-PUBS (7827) or by e-mail from [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov).

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.

**Special instructions for submitting full proposals to this Big Idea solicitation**

**FastLane Users:** Proposers are reminded to identify the program solicitation number (located on the first page of this document) in the first block on the NSF Cover Sheet. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Please note that even though proposals must be submitted to BIO/EF, once received the proposals will be managed by a cross-disciplinary team of NSF Program Directors.

**Research.gov Users:** The Prepare New Proposal setup will prompt you for the program solicitation number (located on the first page of this document). Compliance with this requirement is critical to determining the relevant proposal processing guidelines. As stated previously, even though proposals must be submitted to BIO/EF, once received the proposals will be managed by a cross-disciplinary team of NSF Program Directors.

**Grants.gov Users:** The program solicitation number will be pre-populated by Grants.gov on the NSF Grant Application Cover Page, however you will need to locate the Division Code, Program Code, Division Name, and Program Name for the specific solicitation you are applying to by visiting <https://www.fastlane.nsf.gov/pgmannounce.jsp>. As stated previously, even though proposals must be submitted to BIO/EF, once received the proposals will be managed by a cross-disciplinary team of NSF Program Directors.

Full proposals based on project ideas developed through interactions at the Ideas lab should conform to the project outline developed at the conclusion of the workshop. If substantive changes are contemplated, an NSF Program Director should be contacted for guidance.

As detailed in the PAPPG (II.C.1.e), information regarding collaborators and other affiliations must be provided for each individual who has a biographical sketch in this proposal. If you have correctly added biographical sketches for all persons, there should be a separate space within Single Copy Documents to upload each individual's file. The COA information must be provided through use of the [COA template](#).

Proposers are reminded to identify the NSF publication number (located on the first page of this document) 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.

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## B. Budgetary Information

**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):  
December 28, 2018
- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):  
May 13, 2019

## 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 Full 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 Full 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 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/](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 *Building the Future: Investing in Discovery and Innovation - NSF Strategic Plan for Fiscal Years (FY) 2018 – 2022*. 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. (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.

#### **Additional Solicitation Specific Review Criteria**

This activity, particularly the Ideas Lab approach, is designed to foster the development and implementation of creative and innovative project ideas that have the potential to transform research paradigms and/or solve previously intractable problems. We anticipate that awards made through this solicitation will be high-risk/high-impact, as they represent new and unproven ideas, approaches and/or technologies. Projects that involve the application of novel, collaborative, or interdisciplinary approaches will therefore receive priority during the consideration process. In addition, full proposals derived from the Ideas Lab will be evaluated to determine whether the scientific themes/objectives in the proposal are congruent with the ideas presented at the Ideas Lab, and whether any significant changes in project scope or resources from those presented at the Ideas Lab have been justified.

## **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, or Ideas Lab.

Proposals submitted in response to this program solicitation will be reviewed by Ad hoc Review and/or Panel Review, Internal NSF Review, or Ideas Lab Mentors.

The competition will be consistent with the guidelines for an Ideas Lab described in the [PAPPG Part I.II.E.5](#).

#### **Stage 1. Selection of Participants:**

NSF Program Directors will convene a panel of external reviewers to advise on the selection of participants in the Ideas Lab. This group will comprise individuals who will be barred from receiving any research funding through, or in any other way collaborating on, the Ideas Lab. These individuals will be subject matter experts from diverse disciplines pertinent to the topic of the Ideas Lab. The selection panel will review the preliminary proposals submitted by applicants and will advise NSF Program Directors on participant selection. Final selection decisions regarding participation in the Ideas Lab workshop will be made by NSF.

Overall, the panel will seek to ensure that a balance of expertise and experience is present at the Ideas Lab workshop; their assessment will be based on the specific criteria outlined below:

- The ability to develop new and highly original research ideas;
- The potential to contribute to research between disciplines; and
- The ability to work in interdisciplinary teams.

Individuals interested in participating in the Ideas Lab workshop will submit a preliminary proposal including information regarding the applicant's specific expertise and personal attributes that will enhance the success of the Ideas Lab workshop. Submission of the preliminary proposal will be considered an indication of commitment to attend and participate through the full course of the five-day residential Ideas Lab workshop on February 25 – March 1, 2019, should the proposer be invited. The decisions of NSF about whom to invite will be final and binding.

#### **Stage 2. Ideas Lab:**

Applicants selected by NSF will participate in the Ideas Lab workshop, building collaborations and refining ideas. Organizing NSF Program Directors will select up to 6 qualified persons to serve as Mentors during the workshop. This group will also comprise individuals who will be barred from receiving any research funding through, or in any other way collaborating on, the Ideas Lab. These individuals will be subject matter experts from diverse disciplines pertinent to the topic of the Ideas Lab. One of the Mentors will act as the Director of the workshop and will be responsible for leading the activities of the Mentors.

Anonymous real-time peer review involving the participants and the Mentors will be incorporated into a workshop format, providing iterative constructive feedback during the development of project ideas. The workshop will use a team of facilitators to guide the creation of interdisciplinary teams and the creative development of ideas, and to ensure that the workshop progresses in a productive manner. At the end of the workshop, the Mentors will provide a consensus report summarizing their evaluation of each project idea. The recommendations of the Mentors are advisory to NSF. Informed by their advice, within seven to fourteen days following the workshop, NSF Program Directors will consider which projects to invite for submission as full proposals. At their discretion, NSF Program Directors may invite some, all or none of the Ideas Lab projects for submission to NSF as full proposals. NSF Program Directors will issue written invite/not invite full proposal decisions to the Ideas Lab participants with instructions to submit invited full proposals to NSF by May 13, 2019. These invited full proposals must be prepared according to standard NSF *Proposal & Award Policies & Procedures Guide*.

It is anticipated that these full proposals developed through the Ideas Lab workshop will feature the following:

- Novel, highly multidisciplinary research projects, clearly reflecting the distinctive opportunity for creating such projects that the Ideas Lab mechanism provides;
- Clear evidence that the team has the capability to deliver its project as a high-quality multidisciplinary activity; and
- Clear relevance and potential to make a distinctive and novel contribution to addressing the research challenges of building a synthetic cell.

Inclusion of international partners as Senior Investigators is encouraged; however, no NSF funding can be directed to research in overseas labs. NSF funds can be used for travel and student exchange essential to the project.

#### **Stage 3. Review and recommendation of full proposals:**

NSF-invited full proposals arising from the Ideas Lab will be submitted *via* FastLane, Research.gov or Grants.gov by May 13, 2019. NSF-invited proposals will be reviewed internally by the cognizant NSF Program Officers, the Ideas Lab panelists, and other external reviewers, as appropriate.

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

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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 [https://www.nsf.gov/awards/managing/award\\_conditions.jsp?org=NSF](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](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 *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=papppg](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papppg).

#### Special Award Conditions:

Grantees will be required to include appropriate acknowledgment of NSF support under the Understanding the Rules of Life in any publication (including World Wide Web pages) of any material based on or developed under the project, in the following terms:

"This material is based upon work supported by the National Science Foundation the Understanding the Rules of Life Big Idea under Grant No. (Grantee enters NSF grant number.)"

Grantees also will be required to orally acknowledge NSF support using the language specified above during all news media interviews, including popular media such as radio, television and news magazines.

### 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 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=papppg](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=papppg).

## 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:

- Charles Cunningham, telephone: (703) 292-2283, email: [chacunni@nsf.gov](mailto:chacunni@nsf.gov)
- Mitra Basu, telephone: (703) 292-8649, email: [mbasu@nsf.gov](mailto:mbasu@nsf.gov)
- Krastan B. Blagoev, telephone: (703) 292-4666, email: [kblagoev@nsf.gov](mailto:kblagoev@nsf.gov)
- Ellen Carpenter, telephone: (703) 292-5104, email: [elcarpen@nsf.gov](mailto:elcarpen@nsf.gov)
- Joseph T. Miller, telephone: (703) 292-7214, email: [jtmiller@nsf.gov](mailto:jtmiller@nsf.gov)
- John Parker, telephone: (703) 292 5034, email: [joparker@nsf.gov](mailto:joparker@nsf.gov)
- Steven W. Peretti, telephone: (703) 292-7029, email: [speretti@nsf.gov](mailto:speretti@nsf.gov)
- Margaret Fraiser, telephone: (703) 292-8172, email: [mfraiser@nsf.gov](mailto:mfraiser@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).

## 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 (FASSED)* 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:** 2415 Eisenhower Avenue, Alexandria, VA 22314
- **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](mailto: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  
Alexandria, VA 22314

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