Predictive Intelligence for Pandemic Prevention Phase I: Development Grants (PIPP Phase I)

PROGRAM SOLICITATION
NSF 21-590

National Science Foundation

Directorate for Computer and Information Science and Engineering

Directorate for Biological Sciences

Directorate for Engineering

Directorate for Social, Behavioral and Economic Sciences

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

October 01, 2021

IMPORTANT INFORMATION AND REVISION NOTES

Innovating and migrating proposal preparation and submission capabilities from FastLane to Research.gov is part of the ongoing NSF information technology modernization efforts, as described in Important Notice No. 147 . In support of these efforts, proposals submitted in response to this program solicitation must be prepared and submitted via Research.gov or via Grants.gov, and may not be prepared or submitted via FastLane.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 20-1), which is effective for proposals submitted, or due, on or after June 1, 2020.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Predictive Intelligence for Pandemic Prevention Phase I: Development Grants (PIPP Phase I)

Synopsis of Program:

This solicitation is for Development Grants as part of NSF's new Predictive Intelligence for Pandemic Prevention (PIPP) initiative. This initiative focuses on fundamental research and capabilities needed to **tackle grand challenges in infectious disease pandemics through prediction and prevention**. NSF anticipates releasing a Phase II Center Grants solicitation around 2023. Note that submission or award of a Development Grant is not required to participate in the anticipated PIPP Phase II Center Grants competition.

The PIPP Phase I initiative intends to support planning activities encompassing (1) articulation of a grand challenge centered around a critical and broad question in pandemic predictive intelligence; (2) proposals of novel conceptual research and technology developments that aim to advance state-of-the-art forecasting, real-time monitoring, mitigation, and prevention of the spread of pathogens; and (3) multidisciplinary team formation. *Successful Phase I proposals must identify an innovative interdisciplinary grand challenge that engages integrated computational, biological, engineering, and social/behavioral approaches to formulate and solve critical problems relating to predictive intelligence for pandemic prevention. PIs of Phase I Development Grants are strongly encouraged to develop research and technical approaches that start to address critical aspects of the identified grand challenge.*

NSF's PIPP activities place great emphasis on high-risk/high-payoff convergent research that has the potential for large societal impact. To that end, prospective principal investigators (PIs) must develop teams and proposals that work across scientific, disciplinary, geographic, and organizational divides, push conceptual boundaries, and build new theoretical framings of the understanding of pandemic predictive intelligence.

The Directorates for Biological Sciences (BIO), Computer Information Science and Engineering (CISE), Engineering (ENG), and Social, Behavioral and Economic Sciences (SBE), are jointly collaborating to support the PIPP Phase I activities. Involvement of and collaboration with other research communities with significant effort in related spaces is highly encouraged.

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.

- Mitra Basu, telephone: (703) 292-8649, email: PIPP@nsf.gov
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Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):

- 47.041 --- Engineering
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 25 to 30

Up to a total of $25 million is available in FY 2022 for 25-30 eighteen-month PIPP Phase I Development Grants.

Anticipated Funding Amount: $25,000,000

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

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- 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.
- Minority Serving Institutions (MSIs) are encouraged to apply.

Who May Serve as PI:

Proposing teams should demonstrate, among the PIs and co-PIs, balanced participation from computer and information science, biology, engineering, and social, behavioral, and economic sciences as relevant to the identified Grand Challenge problem.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or co-PI: 1

An individual may be designated as PI or co-PI on at most one project team submitting to this solicitation. In the event that an individual exceeds this limit, proposals will be accepted based on earliest date and time of proposal submission, i.e., the first proposal involving that individual as a PI or co-PI will be accepted, and the remainder will be returned without review. No exceptions will be made.

If a proposal involves multiple organizations, it must be submitted as a single proposal with subawards: separately submitted collaborative proposals are not permitted and will be returned without review.

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 Research.gov: *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):

  October 01, 2021

Proposal Review Information Criteria

Merit Review Criteria:

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

Award Administration Information

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

Despite decades of research, scientists are still struggling to understand the dynamic nature of pathogen and disease emergence. Emerging (and re-emerging) pathogens represent a continuing risk to national security because they threaten health (animal, human, and ecosystem) and economic stability. Often, we fall short on the coordination and breadth of expertise needed to respond to such threats. This is partly because deep and synergetic integration of innovative scientific and technological advances, and effective knowledge and data transfer across disciplines and scales and into practice, has remained elusive and/or ineffective.

Pathogen spread is an ecological process driven by multiscale biological and environmental, as well as human social, behavioral, and economic factors and systems and, therefore, is characterized by multiple organizational, spatial, and temporal scales. **As a consequence, understanding, predicting, and responding to pathogen spread requires innovation in a multitude of science and engineering fields, including environmental, biological, social, behavioral, economic and computer and information science and engineering.** Only careful integration and coordination across scientific and engineering domains will lead to adequate data collection and modeling of interconnected and interdependent systems at the necessary levels of *complexity*.

The PIPP initiative provides an opportunity and challenge for multidisciplinary teams to work across scientific, disciplinary, geographic, and organizational divides to implement an effective approach to pandemic predictive intelligence. This requires fundamental research on integrating knowledge about molecular and organismal properties and interactions of pathogens, their hosts and the host ecosystems with information about pathogen transmission and evolutionary dynamics, especially in the face of environmental change. A priority is strategic identification of genetic or molecular signatures and understanding of host-pathogen-environment interaction mechanisms that can be used to discover, track, minimize or prevent emerging diseases. However, the foundational capabilities needed to transform this biological knowledge into outbreak prediction and prevention cannot be advanced without interdisciplinary approaches and technological advances in sensing, data collection, modeling and simulation, and artificial intelligence. Hence, insights and innovation from computer and information science and engineering are critical in generating and integrating knowledge for infectious disease pre-emergence, outbreak, prediction and prevention. Additionally, understanding how human attitudes, social behavior, and the drivers underlying both contribute to disease transmission, prediction and prevention through their determination of policy and behavioral obstacles and supports is key, and diverse methods to support understanding policy and behavioral obstacles and supports need to be considered.

Potential multidisciplinary research areas include, but are not limited to, (a) pre-emergence studies that predict rare events in multiscale, complex, dynamical systems; (b) technology innovation in sensing and data collection for predictive intelligence; (c) exploring the interdependence of biological and behavioral mechanisms across scales from the molecular to the global; and (d) the relationship between human behavior and disease development and transmission.

The goal is to transform society's ability to forecast the likelihood of pandemic-scale events, detect outbreaks early, and respond quickly, thereby limiting transmission before an epidemic, let alone a pandemic, can occur.

To address this challenge, NSF is organizing a set of activities around the broad theme of **Predictive Intelligence for Pandemic Prevention (PIPP).** The PIPP vision is realized through an interrelated set of efforts comprising:

- A series of Workshops starting in February 2021;
- This Phase I: Development Grants solicitation; and
- An anticipated Phase II: Center Grants solicitation (to be described in a future solicitation), subject to availability of funds, which will support a smaller number of larger Centers, selected via a second competitive proposal and review process. NSF anticipates releasing a Phase II solicitation around 2023. Submission or award of a Development Grant is not required to participate in the anticipated PIPP Phase II Center Grants competition.

II. PROGRAM DESCRIPTION

Development Grant Overview

This PIPP Phase I initiative solicitation encourages individuals with compelling foundational scientific and technological expertise to identify one or more grand challenges for PIPP, develop a research project that establishes the urgency and potential of an envisioned center in the identified priority area(s), and assemble a team with pertinent research and planning expertise. Development Grant proposals must be innovative, collaborative and advance basic scientific understanding of how pandemics emerge. The approaches envisioned in successful Phase I proposals will use innovative computational, engineering and systems-level analytic techniques to formulate and solve critical biological problems relating to predictive intelligence for pandemic prevention in an environment of biological, physical and social constraints. The use of emerging platforms for scalable, real-time data are highly encouraged. Collaboration and convergence should go beyond traditional disciplinary, organizational and geographic boundaries to build innovative connections and integrate research. Development Grant projects also are urged to conceptualize and pilot new modes for engaging the community in ways that can be scaled up to larger collaborations and transformative science, engineering, and social/behavioral practice outcomes.

Phase I Development Grants are eighteen-month awards aimed at defining research priorities, developing interdisciplinary teams, and pursuing initial convergent fundamental research advances that justify future Centers. Specific outcomes expected include identification of PIPP grand challenges and pilot projects that can address aspects of these challenges, as well as development of new strategies and innovative approaches to foster scientific breakthroughs involving researchers from diverse scientific backgrounds.

Given the complexity of the proposed endeavor, NSF recognizes that a prospective team will identify a PIPP grand challenge that requires a broad range of skills and development of new relationships to successfully address the full challenge. With these issues in mind, the Phase I Development Grants can be used to support team-formation activities (e.g., filling expertise gaps), to develop and nurture relationships with the stakeholder community, and to access specialized

resources needed to address the proposed challenge.

Each proposal must describe a rationale that justifies the need for the collective effort of a group of scientists and others to enable transformative advances in predictive intelligence and the installation of suitable measures at appropriate junctures in real time so as to prevent future pandemics. Essential aspects of the Intellectual Merit of development grant proposals will be the innovative vision for a grand challenge, that is, a Center-scale problem, the potential for transformative research outcomes, and how those will go beyond the current science in addressing (pre) emergence of a yet-unknown pathogen. The processes that will be used to enable convergence for broad, interdisciplinary groups – for example, through internal planning meetings, travel coordination, or virtual collaboration – must be described. A clear plan for engaging in planning phase activities and developing the capabilities for the grand challenge with partners outside the immediate collaborators must be included.

Proposers are highly encouraged to contact the Program Directors at PIPP@nsf.gov prior to submission with any questions about research ideas, budgets, and submissions.

To facilitate proposal planning, key characteristics of a competitive proposal include:

- **An ambitious and forward-looking scientific grand challenge (GC) problem** motivated by PIPP with a clear justification for the choice of problem with respect to a future pandemic landscape. The GC should be centered around a critical and broad question in pandemic predictive intelligence, poised for breakthroughs by collaboration across disciplines.
- **A high-level view of the project.** A description (visual) of how the identified subproject(s) and other pieces fit the GC selected for the project, providing a bird's-eye view of the Center-scale project envisioned.
- **A research agenda.** A research agenda for one or more targeted project(s) including a range of objectives and research approaches that are clearly integrated under the coordinated vision of the GC. Proposals in which specialized research groups pursue independent projects that are not integrated in the GC are NOT encouraged. The research approaches for sub-projects must be innovative with potential to advance the involved disciplines.
- **Diverse, multi-disciplinary, and potentially multi-organizational team.** A collaborative culture that values and benefits from shared research and interdisciplinary training is highly encouraged. Teams should be designed to achieve the goals of the GC, and to demonstrate commitment to diversity and inclusion in composition and leadership. Budgets should be commensurate with the project roles and goals. The role of each team member must be clearly described and justified. Team members may be from a single organization or multiple organizations.
- **A plan for scaling to center operations**. A plan that outlines activities to develop communities and capacity for a full Center operation through diverse activities, such as visioning, workshops, education, and training to overcome disciplinary boundaries, development of partnerships, and engagement of stakeholders most appropriate for a Center vision.

Additionally, as described in Section V.A. Proposal Preparation Instructions below, all proposals must include a Project Management Plan as a Supplementary Document. This plan should promote the synergistic nature of the project. The proposed scientific structure must clearly enable integrative activities and ensure cohesiveness of both research and education elements. The team should include strong project management expertise, including a time-phased, milestone-driven management approach to monitor and assess the disciplinary integration.

The PIPP Phase I Development program is not intended to be an extension for research projects on infectious diseases that can be submitted to existing core or special programs in single directorates or divisions across NSF. Proposals should span research across the BIO, CISE, ENG and SBE directorates, and be compelling across the subdisciplines spanned. **Specifically, proposals submitted in response to this solicitation will address critical problems relating to predictive intelligence for pandemic prevention, and they must integrate a combination of innovative computational, engineering and systems-level techniques or tools.** Research may target pathogens of either terrestrial or aquatic systems and organisms, including diseases of animals and plants, at any scale from specific pathogens to inclusive environmental systems. Proposals targeting pathogens driving public health or agricultural system concerns are strongly encouraged.

Investigations that are outside the scope of this PIPP announcement include:

- Projects limited to specialized research groups pursuing independent projects that are not synthetically integrated across the identified GC;
- Projects that do not identify an over-arching GC problem motivated by PIPP;
- Projects that do not engage teams with balanced participation from computer and information science, biology, engineering, and social, behavioral, and economic sciences as relevant to the identified GC problem;
- Projects that fail to delineate the role and expertise of participants from different disciplines; and/or
- Projects that do not discuss associated risks and mitigation plans.

The PIPP Phase I Development initiative broadly welcomes, but does not require, that projects include international collaborations. It is expected that any non-U.S. participants will secure support from their own national programs. However, international subawards may be included if the investigators bring unique research and training expertise and/or resources not available in the U.S. Information about international subawards is available in PAPPG Chapter I.E.6.

III. AWARD INFORMATION

Anticipated Type of Award: Continuing Grant or Standard Grant

Estimated Number of Awards: 25 to 30

Up to a total of $25 million is available in FY 2022 for 25-30 eighteen-month PIPP Phase I Development Grants.

Anticipated Funding Amount: $25,000,000

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

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- 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.
- Minority Serving Institutions (MSIs) are encouraged to apply.

Who May Serve as PI:

Proposing teams should demonstrate, among the PIs and co-PIs, balanced participation from computer and information science, biology, engineering, and social, behavioral, and economic sciences as relevant to the identified Grand Challenge problem.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or co-PI: 1

An individual may be designated as PI or co-PI on at most one project team submitting to this solicitation. In the event that an individual exceeds this limit, proposals will be accepted based on earliest date and time of proposal submission, i.e., the first proposal involving that individual as a PI or co-PI will be accepted, and the remainder will be returned without review. No exceptions will be made.

If a proposal involves multiple organizations, it must be submitted as a single proposal with subawards: separately submitted collaborative proposals are not permitted and will be returned without review.

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 Research.gov or Grants.gov.

- Full Proposals submitted via Research.gov: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the *NSF Proposal and Award Policies and 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) 292-8134 or by e-mail from nsfpubs@nsf.gov. The Prepare New Proposal setup will prompt you for the program solicitation number.
- 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) 292-8134 or by e-mail from 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.

Cover Sheet. Titles must begin with "PIPP Phase I", followed by a colon, then the title of the project.

Collaborative Proposals. If a proposal involves multiple organizations, it must be submitted as a single proposal with subawards: separately submitted collaborative proposals are not permitted and will be returned without review.

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.

Supplementary Documents:

Each proposal is required to include a ***Project Management Plan*** (2-page limit, to be submitted as a Supplementary Document). This document should include: 1) the specific roles of the PI, co-PIs, other senior personnel, and paid consultants at all organizations involved; 2) how the project will be managed across organizations and disciplines; 3) identification of the specific coordination mechanisms that will enable cross-organization and/or cross-disciplinary scientific

integration (e.g., meetings, graduate student exchanges, project meetings at conferences, use of videoconferences and/or other social media, use of common software repositories, etc.); 4) description of clear measures of success for the team, including developing capability and capacity for a potential Phase II Center; and 5) pointers to the budget line items that support these management and coordination mechanisms. **Proposals without a Project Management Plan will be returned without review.**

Immediately after submission of your proposal and receipt of the proposal number, send an email to: PIPP@nsf.gov with the below document as an attachment. The subject heading of the email should note the proposal number.

A single Microsoft PowerPoint slide summarizing the vision of your PIPP Development Grant proposal.

This slide will be used during review panel discussions. Remember to email this PowerPoint slide; do not submit via NSF systems.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Budget Preparation Instructions:

For all awards, one or more designated project representatives (PI/co-PI/senior personnel or NSF-approved replacement) must attend two meetings during the active award period (a virtual kick-off meeting during the early phase of the award and a meeting at the end of the fifteenth month to be held in the Washington, DC, area if possible, or virtually otherwise). Proposal budgets must include appropriate amounts for travel to these meetings.

C. Due Dates

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

  October 01, 2021

D. Research.gov/Grants.gov Requirements

For Proposals Submitted Via Research.gov:

To prepare and submit a proposal via Research.gov, see detailed technical instructions available at: https://www.research.gov/research-portal/appmanager/base/desktop?_nfpb=true&_pageLabel=research_node_display&_nodePath=/researchGov/Service/Desktop/ProposalPreparationandSubmission.html. For Research.gov user support, call the Research.gov Help Desk at 1-800-673-6188 or e-mail rgov@nsf.gov. The Research.gov Help Desk answers general technical questions related to the use of the Research.gov 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: https://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 Research.gov may use Research.gov 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 *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

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 other

underrepresented groups in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

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

Additional Solicitation Specific Review Criteria

In addition to Intellectual Merit and Broader Impacts, reviewers will be asked to consider the Integrative Value and Transformative Potential of each proposal:

- How well does the proposed project(s) address the grand challenge?
- Does the proposal bring together complementary expertise, build on leading-edge research across multiple disciplines, connect and contribute to a broader intellectual context of work, and develop synergistic links to related efforts as appropriate?
- Does the Project Management Plan 1) describe the specific roles of the PI, co-PIs, other senior personnel, and paid consultants at all organizations involved; 2) describe how the project will be managed across organizations and disciplines; 3) identify the specific coordination mechanisms that will enable cross-organization and/or cross-disciplinary scientific integration (e.g., meetings, graduate student exchanges, project meetings at conferences, etc.); 4) provide clear measures of success for the team, including developing capability and capacity for a potential Phase II; and 5) include pointers to the budget line items that support these management and coordination mechanisms?

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) 292-8134 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.

Special Award Conditions:

Grantees will be required to include appropriate acknowledgment of NSF support under the PIPP initiative 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's Predictive Intelligence for Pandemic Prevention (PIPP) program 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

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.

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:

- Mitra Basu, telephone: (703) 292-8649, email: PIPP@nsf.gov
- Katharina Dittmar, telephone: (703) 292-7799, email: PIPP@nsf.gov
- Rebecca Ferrell, telephone: (703) 292-7850, email: PIPP@nsf.gov
- Wendy Nilsen, telephone: (703) 292-2568, email: PIPP@nsf.gov
- Mamadou Diallo, telephone: (703) 292-4257, email: PIPP@nsf.gov
- Scott T. Acton, telephone: (703) 292-8910, email: PIPP@nsf.gov
- Joseph M. Whitmeyer, telephone: (703) 292-7808, email: PIPP@nsf.gov
- Admela Jukan, telephone: (703) 292-8950, email: PIPP@nsf.gov
- Joanna Shisler, telephone: (703) 292-5368, email: PIPP@nsf.gov
- Marcia E. Newcomer, telephone: (703) 292-4778, email: PIPP@nsf.gov
- Nakhiah C. Goulbourne, telephone: (703) 292-7715, email: PIPP@nsf.gov
- Goli Yamini, telephone: (703) 292-8910, email: PIPP@nsf.gov

For questions related to the use of FastLane or Research.gov, contact:

- FastLane and Research.gov Help Desk: 1-800-673-6188
- FastLane Help Desk e-mail: fastlane@nsf.gov
- Research.gov Help Desk e-mail: rgov@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.

PIs should send inquiries to PIPP@nsf.gov in place of contacting individual program directors.

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 https://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:** 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

  or telephone: (703) 292-8134
- **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 System of Record Notices, NSF-50, "Principal Investigator/Proposal File and Associated Records," and NSF-51, "Reviewer/Proposal File and Associated Records." 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:

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