

# Using the Rules of Life to Address Societal Challenges (URoL:ASC)

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## PROGRAM SOLICITATION NSF 23-512

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National Science Foundation

Directorate for Biological Sciences

Office of Integrative Activities

Office of International Science and Engineering

Directorate for Mathematical and Physical Sciences

Directorate for Social, Behavioral and Economic Sciences

Directorate for Computer and Information Science and Engineering

Directorate for Geosciences

Directorate for Engineering

Directorate for STEM Education

Directorate for Technology, Innovation and Partnerships

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

February 15, 2023

## IMPORTANT INFORMATION AND REVISION NOTES

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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 *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) that is in effect for the relevant due date to which the proposal is being submitted. The NSF PAPPG is regularly revised and it is the responsibility of the proposer to ensure that the proposal meets the requirements specified in this solicitation and the applicable version of the PAPPG. Submitting a proposal prior to a specified deadline does not negate this requirement.

## SUMMARY OF PROGRAM REQUIREMENTS

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### General Information

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**Program Title:**

Using the Rules of Life to Address Societal Challenges (URoL:ASC)

**Synopsis of Program:**

**Using the Rules of Life to Address Societal Challenges (URoL:ASC)** will support use-inspired research that builds on knowledge from previous investments in the NSF "Big Ideas", including in the Understanding the Rules of Life program. The Big Ideas were designed to position the Nation at the cutting edge of global science and engineering by bringing together diverse disciplinary perspectives to support convergent research (see details [here](#)). The goal of the *Understanding the Rules of Life Big Idea* was to develop predictive understanding of how key properties of living systems emerge from interactions of factors such as genomes, phenotypes, and evolving environments. Examples of projects that have examined some of these rules can be found [here](#). Following from the fundamental principles revealed from these and related projects, an important goal of the current solicitation is to **use** the predictive capability of rules of life to address some of the greatest challenges we currently face as a society.

Through **use-inspired research** using [convergent, multidisciplinary approaches](#), URoL:ASC seeks to apply lessons learned from studying rules of life across a broad array of living systems to tackle pressing societal concerns. These concerns include but are not limited to: climate change and associated risks, including geohazards, extreme events, and loss of biodiversity; environmental degradation, including impacts on land and water resources; inequalities in availability of and access to essential natural assets; lack of sustainability, including for food, energy,

and waste production; and threats from pandemic disease, among others.

This solicitation differs in key respects from previous solicitations associated with the Understanding the Rules of Life Big Idea. First, rather than a focus on **discovering** rules of life, here we seek ideas about how such rules might be **used** for societal benefit. Second, underscoring this shift in focus, proposals should begin with a description of the expected outcomes of the research, e.g., the broader impacts, followed by details on the intellectual underpinnings of the convergent research plan. Third, proposers must adopt a co-production strategy that involves

both producers and users of the research outcomes in all phases of the research<sup>1,2</sup>, e.g., in the design, implementation, evaluation, and dissemination of the research impacts (see [NSF Strategic Plan](#)). Fourth, projects must integrate innovative education and training activities aimed at fostering convergent research. Fifth, projects should actively promote diversity, equity, inclusion, and accessibility in all activities by involving members of underrepresented groups, such as the Missing Millions (see [National Science Board Vision 2030 Report](#)) and including women and members of groups who are underrepresented in science, technology, engineering, and mathematics (STEM), as PIs, co-PIs, postdoctoral researchers, students, and other personnel. Participation is encouraged from PIs or co-PIs from a broad range of institutions, including (see below) predominantly undergraduate institutions (PUIs), minority-serving Institutions (MSIs) that are not among the nation's most research-intensive institutions, other institutions classified in the [Carnegie Classification of Institutions of Higher Education](#) as R2, D/PU, or M1-3, and institutions in jurisdictions [eligible](#) for the Established Program to Stimulate Competitive Research (EPSCoR).

As in previous Big Idea solicitations, this new activity, URoL:ASC, is a cross-directorate NSF program. Proposals in response to this solicitation must be submitted to the Emerging Frontiers (EF) Division in the Directorate for Biological Sciences (BIO). Review will be managed by a multidisciplinary, cross-directorate team of program officers.

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<sup>1</sup> Djenontin, I.N.S., Meadow, A.M. The art of co-production of knowledge in environmental sciences and management: lessons from international practice. *Environmental Management* **61**: 885 (2018). <https://doi.org/10.1007/s00267-018-1028-3>

<sup>2</sup> Iwaniec, D.M. et al., The co-production of sustainable future scenarios. *Landscape and Urban Planning* **197**: 103744 (2020). <https://doi.org/10.1016/j.landurbplan.2020.103744>

#### 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.

- Clifford Weil, Program Director, NSF/BIO, telephone: (703) 292-4668, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Ellen M. Carpenter, Program Director, NSF/EDU, telephone: (703) 292-5104, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Angel Garcia, Program Director, NSF/MPS, telephone: (703) 292-8897, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Justin Lawrence, Program Director, NSF/GEO, telephone: (703) 292-2425, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Hector Muñoz-Avila, Program Director, NSF/CISE, telephone: (703) 292-4481, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Erik Pierstorff, Program Director, NSF/TIP, telephone: (703) 292-2165, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Aleksandr Simonian, Program Director, NSF/ENG, telephone: (703) 292-2191, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Trisha Van Zandt, Program Director, NSF/SBE, telephone: (703) 292-7437, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@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
- 47.74 --- Biological Sciences
- 47.75 --- Social Behavioral and Economic Sciences
- 47.76 --- STEM Education
- 47.079 --- Office of International Science and Engineering
- 47.083 --- Office of Integrative Activities (OIA)
- 47.084 --- NSF Technology, Innovation and Partnerships

## Award Information

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

**Estimated Number of Awards:** 10 to 15

**Anticipated Funding Amount:** \$28,000,000

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

## Eligibility Information

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#### 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.

#### Who May Serve as PI:

**A minimum of one PI and one co-PI must be named on a proposal, representing expertise in different disciplines pertinent to at least two of the following directorates:** Biological Sciences (BIO), Computer and Information Science and Engineering (CISE), STEM Education (EDU), Engineering (ENG), Geosciences (GEO), Mathematical and Physical Sciences (MPS), Social, Behavioral, and Economic Sciences (SBE), and Technology, Innovation and Partnerships (TIP) at the National Science Foundation. **More than one investigator from within one discipline is permitted, as long as the minimum described above is also met.** Expertise may be demonstrated by earned degrees from disciplines, current departmental and center affiliations, or experience, such as papers published in that disciplinary field or research supported by a relevant NSF Directorate(s). Proposals should also explicitly state a minimum of two NSF directorates that map to their proposal in the "Convergent Research Plan" section of the Project Description.

#### Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

There are no restrictions or limits.

## Proposal Preparation and Submission Instructions

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### 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](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](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:**

Other budgetary limitations apply. Please see the full text of this solicitation for further information.

### C. Due Dates

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

February 15, 2023

## Proposal Review Information Criteria

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### 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

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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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Over the past several years, NSF's Understanding the Rules of Life Big Idea has supported a series of new research programs designed to use convergent, multidisciplinary approaches to elucidate rules of life at different levels: "minimal rules" (building a synthetic cell), "rules of complexity" (epigenetics), "rules of interaction" (microbiomes), and "rules of emergence" (emergent networks). Many of the projects supported by this Big Idea share common features: they address a fundamental question that crosses disciplines, including the life sciences; they cross different scales, for example, spatial, temporal, levels of biological organization, and complexity; they produce results that will be broadly generalizable beyond the system under investigation, so that a rule can be formulated; and they enable forecasting change in a biological system in the context of other systems including Earth, human, natural, and/or human-engineered systems. The predictive capability of rules of life, such as those discovered from these and other prior studies, now offers the opportunity to take the next step and **use** what has been learned about these rules to address some of the greatest challenges facing life on Earth.

## II. PROGRAM DESCRIPTION

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The goal of the URoL:ASC program is to support use-inspired research that tackles pressing societal challenges. Principles that govern living systems, their architecture, metabolism, physiology, communication, and regulation provide valuable insights into how those systems effectively interact with each other and with the environment. Cells, organisms, ecosystems, and biomes all develop mechanisms to utilize and share resources, recycle nutrients and materials, and adapt to environmental perturbations, both individually and collectively, thereby addressing challenges similar to those faced by society today.

The enormous potential for use-inspired research to help solve such challenges has been the subject of many recent NSF-sponsored workshops on a range of topics, including: feeding the planet sustainably, creating a world without waste, mitigating climate change, innovating for adaptive sustainable health (reports can be found [here](#)); re-thinking innovative solutions from nature (abstract can be found [here](#)), stewarding an integrated biodiversity-climate system, achieving a sustainable future, harnessing microbiomes for societal benefit, and leveraging artificial intelligence (AI) and data science to predict mechanisms (link [here](#)). Use-inspired URoL:ASC research refers to basic and translational research that has use for society in mind. We use the phrase "use-inspired" rather than "applied" to emphasize that this solicitation seeks to support work that goes beyond merely applying known techniques. Ideally there is a virtuous cycle between foundational and use-inspired research, where foundational results provide a starting point for use-inspired research, and the results from use-inspired research can be generalized and made foundational.

URoL:ASC projects must be multidisciplinary. Studies have shown that a convergent, multidisciplinary research framework — like those inherent to the NSF Big Ideas and to this URoL:ASC program—holds great promise for addressing grand, societally relevant problems (e.g., see this [report](#)). Successful projects will be built **across the intersection of scientific disciplines pertinent to at least two of the following NSF directorates**: Biological Sciences (BIO), Computer and Information Science and Engineering (CISE), STEM Education (EDU), Engineering (ENG), Geosciences (GEO), Mathematical and Physical Sciences (MPS), Social, Behavioral, and Economic Sciences (SBE) and Technology, Innovation and Partnerships (TIP). More than one investigator from within one discipline is permitted, as long as the minimum described above is also met. Working across broad disciplines has clear benefits; as experts from different scientific backgrounds pursue common research challenges, their knowledge, theories, methods, data, research communities, and languages become increasingly intermingled or integrated. New frameworks, paradigms, or even disciplines can form, leading to sustained interactions across multiple communities. URoL:ASC projects should show strong connections across the contributing disciplines, while demonstrating innovation in the integrated research approaches being applied to address the societal challenge.

URoL:ASC projects must emphasize a co-production process that involves producers and users of the knowledge in substantial partnership through all phases of the project, from design to eventual outcomes. In this context, users might include those most likely to benefit from outcomes of the research, perhaps by virtue of their association with communities that have been disproportionately and negatively impacted by the particular challenge. Such groups might include, but are not limited to, indigenous people whose unique perspective and knowledge can prove beneficial in defining and devising solutions to challenges that impact their communities, as well as other communities who are members of the Missing Millions and underrepresented in STEM. The benefits of co-production strategies, especially when coupled with elements of social and behavioral research on humans, are to help ensure that outcomes are accessible to relevant communities, feasible to implement, and thereby likely to produce actionable knowledge that will be acted upon. URoL:ASC proposals should make explicit the synergy across such integrated strategies. Letters of collaboration from users involved in co-production are strongly encouraged.

URoL:ASC projects must include a robust, integrated education and training component that emphasizes effective and sustainable training paradigms that are inclusive, equitable, and accessible to all and that aim to produce a new generation of STEM researchers and other STEM practitioners reflective of the diversity of peoples and cultures in the Nation. Education and training plans should have a convergent focus that draws from a range of approaches, including integrating and applying knowledge from research on STEM learning and learning environments, broadening participation in STEM fields, AI-driven education, and STEM workforce development. The plans should aim to prepare the next generation of scientists to navigate, communicate, and collaborate across multiple, diverse scientific fields and with public users of STEM research outcomes. Training for students and postdoctoral scholars should provide them with the skills to overcome barriers posed by terminology, language, and cultural differences between fields and among people; interpret a variety of data types with rigor; interrogate hypotheses that transcend narrow systems or sub-disciplines; engage in use-inspired research through collaboration with team members in co-producing knowledge and other products, such as patents; and communicate how the results of their research will have or have had societal benefit.

URoL:ASC Projects must demonstrate commitment to establishing a climate of inclusion, equity, and accessibility to broaden participation by involving broadly diverse groups of individuals, including those who are underrepresented in STEM, e.g., women, minorities, veterans, and those with disabilities, as PIs, co-PIs, postdoctoral researchers, students, or other personnel. Proposals are encouraged from PIs or co-PIs from a broad range of institutions, including PUIs, MSIs that are not among the nation's most research-intensive institutions, other institutions that are classified as R2, D/PU, or M1-3 (see [Carnegie Classification of Institutions of Higher Education](#)), and institutions in jurisdictions [eligible](#) for EPSCoR.

To facilitate proposal planning, as hallmarks for success, URoL:ASC proposals **must** include the following elements in the Project Description **and** in the relevant supplementary documents described below in Section V:

1. Provide a clear explanation of the broader impacts of the research, specifically including the expected societal impact, what segment(s) of society will be affected, and how impact will be assessed.
2. Provide a detailed description of the intellectual merit of the research, identifying a rule(s) of life around which the proposed research is oriented, or which the research addresses, and including a compelling, convergent, use-inspired research plan with deep integration across disciplines and with diversity, equity, inclusion, and accessibility principles embedded in the research.
3. Describe the collaborative team with emphasis on their complementary scientific expertise and how their participation contributes to the project goals for diversity, equity, and inclusion. Diversity may be attained by inclusion of individuals from a variety of career stages and members of underrepresented groups such as women, minorities, and those with disabilities. This diversity should extend to the team leadership.
4. Provide a description of how co-production of knowledge approaches will be incorporated to ensure that the project research design, implementation, evaluation, and dissemination will be conducted in authentic partnership with individuals and communities most impacted by this research.
5. Provide explicit ideas for multidisciplinary ways to train the next generation of scientists, to engage and develop the Missing Millions who are underrepresented in STEM, and to enhance diversity, equity, inclusion, and accessibility for full participation in, and equitable benefit from, the proposed research.

Within the above framework, there are many research opportunities for using rules-of-life lessons, including about how key properties of living systems emerge from interactions of factors such as genomes, phenotypes, and evolving environments--to address pressing questions that impact all of society. A wide range of truly imposing **challenges** are relevant to using the rules of life; examples include, **but are not limited to**:

- Stewarding an integrated biodiversity-climate system.
- Achieving a sustainable future (encompassing topics like feeding the planet sustainably, renewable energy for all, bringing population growth and resource use into balance, and creating a circular bioeconomy).
- Harnessing microbiomes for societal benefit.
- Leveraging artificial intelligence and data science to put biological complexity to beneficial societal use.
- Understanding and disrupting the biological and human behavioral networks of pandemic disease.
- There is a similarly wide array of **potential projects** that could be envisioned to address such challenges. Below are examples of some that would fall within this solicitation. This list is meant to be illustrative and should not be construed as limiting.
- Use knowledge of the rules governing short- and long-term, bio-diverse responses to fluctuating availability and quality of water to improve how water resources are managed, stored, and equitably distributed.
- Use knowledge of the diversity of fundamental cellular and organismal mechanisms for sensing and adapting to environmental stress to devise natural, biotechnological or hybrid food supply chain systems that are resilient to climate change.
- Use novel, artificial intelligence methods to devise strategies for mitigating the spread of antibiotic resistance by inferring, interpreting, and applying knowledge of how interactions among genetic factors, microbiome composition, and environment influence microbial evolution.
- Use principles whereby biological systems process waste to identify the trade-offs between biotechnological and natural solutions to waste management, while leveraging economic and ecological principles to improve efficiency, reduce energy use, and redefine 'waste' in a manner that is likely to be societally adopted.
- Use knowledge of microbial capacity to sense, and integrate cellular responses to, external small molecules to create synthetic microbiomes that can detect and quantify the presence of environmental toxins and inform natural, biotechnological or hybrid approaches for remediation.
- Use insights from plant, animal, and microbial systems--such as those associated with flocking, symbiosis, and recognition of self vs. non-self--to examine, model, and potentially mitigate negative impacts of homophilic behavior and its effects, e.g., polarization, xenophobia, and inequity, in human social systems.

Projects may be laboratory, field, and/or simulation and theory based and may include a focus on terrestrial, aquatic, marine or polar organisms and ecosystems. Projects are encouraged to extend laboratory, experimental, theoretical, or other research approaches beyond well-established model systems, individual populations, and controlled environments, and should address how the systems under study will be used to impact the targeted societal challenge and how the impact will be assessed.

Outreach activities that successfully overcome societal communication barriers are encouraged. Efforts could include, for example, educating the general public about the research, developing citizen science activities, etc., as driven by the team's expertise and interests, and the needs of the community. Plans to assess the success of such efforts should be included.

Projects that would be supported normally through regular core programs of the participating NSF Directorates and Offices are discouraged. Proposals that are not responsive to this solicitation or that fall outside the purview of NSF will be returned without review, as described in the PAPPG:

" NSF does not normally support technical assistance, pilot plant efforts, research requiring security classification, the development of products for commercial marketing, or market research for a particular project or invention. **Biological** research on mechanisms of disease **in humans**, including on the etiology, diagnosis, or treatment of disease or disorder, **is normally not** supported. Biological research to develop animal models of such conditions, or the development or testing of procedures for their treatment, also are not normally eligible for support. However, research with etiology, diagnosis- or treatment-related goals that advances knowledge in **engineering, mathematical, physical, computer, or information sciences** is eligible for support. Bioengineering and assistive information technology research to aid persons with disabilities also are eligible. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels, and Antarctic research stations. See "[Funding](#)" and "[Awards](#)" on the NSF website for additional information."

### III. AWARD INFORMATION

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The Program estimates an FY2023 Budget of \$28,000,000 and expects to make 10-15 awards. Estimated program budget, number of awards and average award size are subject to the availability of funds.

#### Limitation of Awards

URoL:ASC proposal total budget requests **may not exceed \$3 million** to support a project plan **up to five years in duration**, although the program anticipates funding projects with a range of budgets and durations.

## IV. ELIGIBILITY INFORMATION

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### 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.

### Who May Serve as PI:

**A minimum of one PI and one co-PI must be named on a proposal, representing expertise in different disciplines pertinent to at least two of the following directorates:** Biological Sciences (BIO), Computer and Information Science and Engineering (CISE), STEM Education (EDU), Engineering (ENG), Geosciences (GEO), Mathematical and Physical Sciences (MPS), Social, Behavioral, and Economic Sciences (SBE), and Technology, Innovation and Partnerships (TIP) at the National Science Foundation. **More than one investigator from within one discipline is permitted, as long as the minimum described above is also met.** Expertise may be demonstrated by earned degrees from disciplines, current departmental and center affiliations, or experience, such as papers published in that disciplinary field or research supported by a relevant NSF Directorate(s). Proposals should also explicitly state a minimum of two NSF directorates that map to their proposal in the "Convergent Research Plan" section of the Project Description.

### Limit on Number of Proposals per Organization:

There are no restrictions or limits.

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

There are no restrictions or limits.

### Additional Eligibility Info:

This program encourages participation of PIs or co-PIs from a broad range of institutions, including (see below) predominantly undergraduate institutions (PUIs), minority-serving Institutions (MSIs) that are not among the nation's most research-intensive institutions, other institutions classified in the [Carnegie Classification of Institutions of Higher Education](#) as R2, D/PU, or M1-3, and institutions in jurisdictions [eligible](#) for EPSCoR. If PIs are unclear about the status of their institution, they are encouraged to reach out to the program officers in advance.

#### Primarily Undergraduate Institutions (PUIs):

PUIs are accredited colleges and universities (including two-year community colleges) that award Associates degrees, Bachelor's degrees, and/or Master's degrees in NSF-supported fields but have awarded 20 or fewer Ph.D./D.Sci. degrees in all NSF-supported fields during the combined previous two academic years.

#### Minority Serving Institutions (MSIs):

MSIs, as defined by the [U.S. Department of Education](#), include historically Black colleges and universities (HBCUs), Hispanic-serving institutions (HSIs), tribal colleges or universities (TCUs), and other institutions that enroll a significant percentage of underrepresented minority students. These other institutions include Alaska Native-serving institutions, Native Hawaiian-serving institutions, predominantly Black Institutions, Asian American and Native American Pacific Islander-serving institutions, and Native American-serving non-tribal institutions.

#### EPSCoR Institutions:

EPSCoR institutions include those in jurisdictions (state, territory, or commonwealth) [eligible](#) for NSF investments to enhance research competitiveness by strengthening STEM capacity and capability aimed at contributing to the national and global STEM research enterprise.

## V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

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### A. Proposal Preparation Instructions

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**Full Proposal Preparation Instructions:** Proposers may opt to submit proposals in response to this Program Solicitation via 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](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](mailto: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](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](mailto:nsfpubs@nsf.gov).

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

Collaborative Proposals. All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via Research.gov. PAPPG Chapter II.D.3 provides additional information on collaborative proposals.

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

### Special instructions for submitting to this solicitation

#### Proposal Preparation Instructions

**Where to submit:** Proposals must be submitted to BIO/Emerging Frontiers (EF). Once received the proposals will be managed by a cross-disciplinary, multi-directorate team of NSF Program Officers.

**Proposal Title:** Titles of proposals should begin with "URoL:ASC:" followed by a substantive title.

**Project Description (up to 15 pages):** For all proposals, the project description must:

- **Begin with a section (titled Broader Impacts)** clearly describing the societal challenge, the expected, beneficial, societal impact of the research, what segment(s) of society will be affected, and how impact will be assessed.
- **Follow with a section (titled Intellectual Merit: Convergent Research Plan)** presenting a compelling, convergent, use-inspired research plan to address the societal challenge, with deep integration across disciplines and with diversity, equity and inclusion principles embedded in the research.
  - Explicitly identify a rule(s) of life around which the proposed research is oriented or to which the research is addressed.
  - The proposed research plan must tackle critical, cross-cutting questions that are larger in scope than typical proposals to NSF Core Programs.
  - The proposed research should include a range of specific aims and use-inspired research approaches that are clearly integrated under a coordinated vision. Convergent research requires an open and inclusive culture, wherein practitioners become conversant across disciplines and develop a common set of concepts, metrics, and understanding of goals.
  - The proposal must involve two or more diverse and complementary disciplines (each corresponding to those supported by distinct NSF directorates) and include a description of and an explicit plan for how approaches and researchers from these disciplines (e.g., biological sciences, chemistry, computer science, education, engineering, geology, mathematics, physics, behavioral and social sciences, among others) will be integrated via multidisciplinary efforts to use the indicated rule(s) of life to address the indicated societal challenge.
- Describe the collaborative team with emphasis on their complementary scientific expertise and how their participation contributes to the project goals for diversity, equity, and inclusion. Diversity may be attained by inclusion of individuals from a variety of career stages and members of underrepresented groups such as women, minorities, and those with disabilities. This diversity should extend to the team leadership.
  - Describe how the project research design, implementation, evaluation, and dissemination, as well as knowledge co-production, will be conducted in authentic partnership with individuals and communities most impacted by this research.
  - Provide explicit ideas for multidisciplinary ways to train the next generation of scientists, to engage and develop the Missing Millions, and to enhance diversity, equity, and inclusion for full participation in, and equitable benefit from, the proposed research.
  - PIs may wish to consult the Dear Colleague Letter, "A Broader Impacts Framework for Proposals Submitted to NSF's Social, Behavioral, and Economic Sciences Directorate"(NSF 21-059) for suggestions on writing a strong Broader Impacts section. In addition, **strong Broader Impacts descriptions should include assessment of those impacts.**

#### Budget:

- Budgets should be well-justified and commensurate with the research activities proposed
- Proposals Requiring Research Facilities: Budgets should include all costs charged to the project for platforms and facilities supporting the proposed research, except those facilities separately supported by NSF (e.g., research aircraft or field equipment). PIs are responsible for filing the appropriate requests for major research platforms; a copy of the request must be included as a supplementary document.
- For proposals with international collaborators, the collaborators are encouraged to seek support from their respective funding organizations. Funding guidelines for involving international collaborators allow the following expenses to be included in the NSF budget:
  - Travel expenses for U.S. scientists and students participating in exchange visits integral to the project.
  - Project-related expenses for international partners to engage in research activities while in the U.S. as project participants.
  - Project-related expenses for U.S. participants to engage in research activities while abroad.

**Data Management Plan (up to two pages):** Each proposal must include, as a Supplementary Document, a data management section with the specific details of Findable, Accessible, Interoperable and Reusable (FAIR) data standards, electronic dissemination, and preservation. Public access and timely release of project results should be clear and routine. Materials, data products, and other resources generated by the project should be fully released within a reasonable time frame, consistent with NSF and community standards. These include, for example, sequences of all types, materials, tools, images, software, publications, videos and other media, and teaching curricula. Of particular importance (where applicable) are: plans for data collection and analysis; plans for dissemination of data and archiving, including a named time for when data will become publicly available; details of collaborative efforts; information about necessary permits; and information about access to resources that are not immediately under the investigator's control (e.g., museum collections, research sites, computing facilities). The data management plan must not exceed two pages. Further information about data management plans can be found in the [PAPPG](#).

**Postdoctoral Researcher Mentoring Plan (up to one page, if applicable):** Each proposal that requests funding to support postdoctoral researchers must include, as a supplementary document, a description of the mentoring activities that will be provided for such individuals. In no more than one page, the mentoring plan must describe the mentoring that will be provided to all postdoctoral researchers supported by the project, irrespective of whether they reside at the submitting organization, any subawardee organization, or at any organization participating in a simultaneously submitted collaborative project. Proposers are advised that the mentoring plan may not be used to circumvent the 15-page project description limitation.

Examples of mentoring activities include but are not limited to: career counseling for careers in as well as outside academia; training in preparation of grant



proposals, publications and presentations; guidance on ways to improve teaching and mentoring skills; guidance on how to effectively collaborate with researchers from diverse backgrounds and disciplinary areas; and training in ethical and responsible professional practices. The proposed mentoring activities will be evaluated as part of the merit review process under the Foundation's broader impacts merit review criterion. Further information about postdoctoral researcher mentoring plans can be found in the [PAPPG](#).

#### Other Supplementary Documents:

- **Project Management Plan and Role of Project Personnel** (up to five pages): Proposals **must include** a separate supplementary document, titled "Project Management Plan", that specifies how the disciplines are integrated in their research approach. Key individuals who are associated with each of the selected disciplines must be identified. A clear description of the role and expertise of each investigator, what each person brings to the project team, reporting relationships, means of communication and interaction among the members of the project team, oversight and accountability mechanisms, and metrics to evaluate the success of the project.

Project team criteria:

- Expertise may be demonstrated by earned degrees from disciplines, current departmental and center affiliations, or experience, such as papers published in that disciplinary field or research supported by a relevant NSF Directorate(s). Proposals should explicitly state a minimum of two NSF directorates that map to their proposal in the "Convergent Research Plan" section of the Project Description. For example, a team consisting of a geneticist, a microbiologist, and an ecologist would not be considered responsive to this requirement.
- The project team should be diverse. Teams and their leadership should include a diversity of types of participants, including individuals from a variety of career stages and members of underrepresented groups such as women, minorities, and those with disabilities. Proposals from teams led by individuals who are underrepresented in STEM research, particularly in the disciplinary areas of the proposed research, are strongly encouraged.
- The project must include representatives of the communities most impacted by this research as co-production partners in the design and implementation of the research, as well as in evaluation and dissemination of the outcomes.
- The role of each team member must be clearly described and justified in the management plan. Team members may be from a single organization or multiple organizations. A collaborative culture that values and benefits from shared research and multidisciplinary training is highly encouraged. Teams should be designed to achieve the goals of the proposed work.
- The research team must provide evidence that it is ready to engage in convergent research. This evidence may include specialized knowledge residing in the research team that is pertinent to the problem, previous project collaborations, joint publications of the PIs and co-PIs, and/or co-development of research infrastructure.
- **Student Training Plan** (up to two pages, if applicable): If students are involved in the project, the proposal must include a robust, integrated education and training plan. The URoL:ASC Program encourages the development of a diverse, multidisciplinary, globally engaged, scientific workforce capable of communicating and transforming our understanding of how rules of life can be used to address societal challenges. Projects are encouraged to provide new learning and research experiences and to use best practices in training students at all levels — including high school, undergraduate, graduate, and/or postdoctoral—to become independent STEM practitioners, able to contribute substantially to URoL:ASC convergent research.

The future of science is highly multidisciplinary and as such, projects should train their students in broad research competencies by promoting intellectual and methodological cross-fertilization and encouraging a multidisciplinary perspective towards use-inspired research. Training that enables individuals to overcome disciplinary barriers and succeed in multidisciplinary research should be fully integrated into the project, as needed. **A plan to evaluate training outcomes should be included.**

Projects that involve students should demonstrate a collaborative effort aimed at enhancing the contributions of individuals from groups that are underrepresented and under-served in STEM. Communities (both public and professional) from which underrepresented students will be recruited should be described. The proposal should include explicit plans or strategies for addressing or accommodating the specific interests, community or cultural perspectives and the educational needs of students of the identified underrepresented groups.

- **Letters of Collaboration:** If the project involves collaborative arrangements of significance, these arrangements should be documented through letters of collaboration. Letters of collaboration must be limited to stating the intent to collaborate and should not contain endorsements or evaluation of the proposed project. Letters of collaboration **must** follow the single-sentence format, as follows:

*"If the proposal submitted by Dr. [insert the full name of the Principal Investigator] entitled [insert the proposal title] is selected for funding by the NSF, it is my intent to collaborate and/or commit resources as detailed in the Project Description or the Facilities, Equipment or Other Resources section of the proposal."*

Requests for letters of collaboration should be made by the PI well in advance of the proposal submission deadline because they must be included at the time of submission. Please note that letters of recommendation for the PI or other letters of support for the project are not permitted. Further information about letters of collaboration can be found in the [PAPPG](#).

## B. Budgetary Information

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#### Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

#### Other Budgetary Limitations:

Other budgetary limitations apply. Please see the full text of this solicitation for further information.

## C. Due Dates

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

February 15, 2023

## D. Research.gov/Grants.gov Requirements

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### 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](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](mailto: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](mailto:support@grants.gov). The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

**Submitting the Proposal:** Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via 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

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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 *Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research - NSF Strategic Plan for Fiscal Years (FY) 2022 - 2026*. 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 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 the two standard review criteria established by the National Science Board, reviewers will address the following questions:

1. Does the proposal provide a clear explanation of the broader societal benefits of the research, specifically including the expected societal impact, what segment(s) of society will be affected, and how impact will be assessed?
2. Does the proposal include a clear description of the intellectual underpinnings of the project, specifically identifying a rule(s) of life around which the research is oriented, or which the research addresses, and including a compelling, convergent, use-inspired research plan with deep integration across disciplines and with diversity, equity, inclusion, and accessibility clearly embedded in the research?
3. Does the proposal describe the complementary scientific expertise of the collaborative team as well as how their participation contributes to the project goals for diversity, equity, inclusion, and accessibility?
4. Does the proposal provide a description of how co-production of knowledge approaches will be incorporated to ensure that the project research design, implementation, evaluation, and dissemination will be conducted in authentic partnership with individuals and communities most impacted by this research?
5. Does the proposal provide explicit ideas for multidisciplinary ways to train the next generation of scientists, to engage and develop the Missing Millions who are underrepresented in STEM, and to enhance diversity, equity, inclusion, and accessibility for full participation in, and equitable benefit from the proposed research?

## B. Review and Selection Process

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

Reviewers will be asked to 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 or the Division of Acquisition and Cooperative Support 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 an NSF Grants and Agreements Officer. 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) 292-8134 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=pappg](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg).

#### Administrative and National Policy Requirements

##### Build America, Buy America

As expressed in Executive Order 14005, *Ensuring the Future is Made in All of America by All of America's Workers* (86 FR 7475), it is the policy of the executive branch to use terms and conditions of Federal financial assistance awards to maximize, consistent with law, the use of goods, products, and materials produced in, and services offered in, the United States.

Consistent with the requirements of the Build America, Buy America Act (Pub. L. 117-58, Division G, Title IX, Subtitle A, November 15, 2021), no funding made available through this funding opportunity may be obligated for an award unless all iron, steel, manufactured products, and construction materials used in the project are produced in the United States. For additional information, visit NSF's [Build America, Buy America](#) webpage.

##### Special Award Conditions:

Grantees will be required to include appropriate acknowledgment of NSF support in any publication (including World Wide Web pages) for 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 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=pappg](https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg).

## 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:

- Clifford Weil, Program Director, NSF/BIO, telephone: (703) 292-4668, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Ellen M. Carpenter, Program Director, NSF/EDU, telephone: (703) 292-5104, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Angel Garcia, Program Director, NSF/MPS, telephone: (703) 292-8897, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Justin Lawrence, Program Director, NSF/GEO, telephone: (703) 292-2425, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Hector Muñoz-Avila, Program Director, NSF/CISE, telephone: (703) 292-4481, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Erik Pierstorff, Program Director, NSF/TIP, telephone: (703) 292-2165, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Aleksandr Simonian, Program Director, NSF/ENG, telephone: (703) 292-2191, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@nsf.gov)
- Trisha Van Zandt, Program Director, NSF/SBE, telephone: (703) 292-7437, email: [URoL-ASC@nsf.gov](mailto:URoL-ASC@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](mailto:fastlane@nsf.gov)
- Research.gov Help Desk e-mail: [rgov@nsf.gov](mailto: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](mailto:support@grants.gov).

## IX. OTHER INFORMATION

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The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF [Grants Conferences](#). Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on [NSF's website](#).

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