Advancing Informal STEM Learning (AISL)

PROGRAM SOLICITATION
NSF 21-599

REPLACES DOCUMENT(S):
NSF 20-607

National Science Foundation

Directorate for Education and Human Resources
    Research on Learning in Formal and Informal Settings

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

January 18, 2022

IMPORTANT INFORMATION AND REVISION NOTES

Important Information

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, research 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.

Revision Notes

1. NEW: All submitters must use Resarch.gov or Grants.gov to submit their proposal.
2. NEW: The project description narrative is limited to 15 single-spaced pages.
3. NEW: There will be a separate solicitation for the Informal STEM Learning Resource Center.
4. REMINDER: **All proposals must articulate clear rationales describing why a project is primarily informal and how it adds value to the informal STEM learning community.**
5. REMINDER: The AISL program prefers collaborative proposals to be submitted using the single-entity option. For collaborative proposals uploaded as separate submissions from multiple organizations, the minimum one-year budget amount is $75,000 for each organization for each project year.

Any proposal submitted in response to this solicitation should be submitted in accordance with the revised *NSF Proposal & Award Policies & Procedures Guide* (PAPPG) (NSF 22-1), which is effective for proposals submitted, or due, on or after October 4, 2021.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Advancing Informal STEM Learning (AISL)

Synopsis of Program:

The **Advancing Informal STEM Learning** (AISL) program seeks to advance new approaches to and evidence-based understanding of the design and development of STEM learning opportunities for the public in informal environments; provide multiple pathways for broadening access to and engagement in STEM learning experiences; advance innovative research on and assessment of STEM learning in informal environments; and engage the public of all ages in learning STEM in informal environments.

The AISL program supports six types of projects: (1) Pilots and Feasibility Studies, (2) Research in Service to Practice, (3) Innovations in Development, (4) Broad Implementation, (5) Literature Reviews, Syntheses, or Meta-Analyses, and (6) Conferences.

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.

- Address Questions to the Program, telephone: (703)292-8616, email: DRLAISL@nsf.gov

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

- 47.076 --- Education and Human Resources

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 58 to 99

Pending availability of funds, it is anticipated that about 10-18 Pilots and Feasibility awards, 8-10 Research in Service to Practice awards, 10-11 Innovations in Development awards, 2-4 Broad Implementation awards, 8-10 Literature reviews, syntheses, and/or meta-analyses awards, and 12-18 Conference awards will be made. AISL will also fund 4-13 awards made through the EAGER, RAPID, Research Coordination Networks (RCN) mechanisms, and 4-14 CAREER awards and REU supplements. In addition, one Resource Center will be funded in FY22 (see separate solicitation).

Anticipated Funding Amount: $32,000,000 to $44,000,000

Limits for funding requests of AISL proposals under this solicitation are as follows: (1) Pilots and Feasibility projects: up to $300,000 with durations up to two years; (2) Research in Service to Practice projects: from $300,000 to $2,000,000 with durations from two to five years; (3) Innovations in Development projects: $500,000 to $3,000,000 with durations from two to five years; (4) Broad Implementation projects from $1,000,000 to $3,000,000 with durations from three to five years; (5) Literature Reviews, Syntheses, or Meta-analyses projects up to $250,000 with durations of up to two years; and (6) Conferences up to $250,000 with durations of up to two years.

Eligibility Information

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E. Unaffiliated individuals are not eligible to submit proposals in response to this solicitation.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or co-PI: 3

An individual may be included as a Principal Investigator (PI) /co-PI on no more than three (3) proposals submitted to the program deadline.

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:**

    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):

   January 18, 2022

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: Standard NSF award conditions apply.

Reporting Requirements:

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

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I. INTRODUCTION

About the Advancing Informal STEM Learning Program

CONTEXT

Over the last several decades there has been a growing understanding and acknowledgment that learning occurs across the lifespan and in places and spaces beyond schools or the school day. Developments in technology continue to influence the ways and means for learning, including 24/7 access to information, tools for learning collaboratively, personalization of learning, and authentic/deeper contributions to scientific processes and studies. The social context of science is also changing. The public's trust in the scientific enterprise means that questions of knowledge, evidence, and distinguishing among knowledge, views, and values are ever-present in media and in our daily discussions and deliberations (Dickel, 2016; NAS, 2015). Further, people expect to have a stronger voice in science. This social context has contributed to a changing role of science in people's lives, which has resulted in the shifting dynamics of learning (e.g., do-it-yourself movement, public participation in scientific research, access to low cost, high quality sensors, and other tools to conduct one's own investigations), and interest in the interconnections and interdisciplinarity of science with other disciplines (e.g., science, technology, engineering, the arts, and mathematics). In addition, advances in brain research, cognition, and other domains have stimulated interest in expanding notions of how early in life the learning of science, technology, engineering, and mathematics (STEM) can occur. There is unequal distribution of and access to quality STEM learning experiences for individuals, families, and communities. Likewise, the sectors that comprise the informal STEM education field (e.g., mass media, museums/zoos/aquaria, afterschool, science outreach, citizen science, cyber-enabled learning, science communication, among others) have professionals of varying knowledge and capacities with respect to teaching and learning STEM.

Almost any environment can support informal science learning, such as a home, a museum, a library, a street, or a virtual or augmented reality game. Information networks, mobile media, and social networks transform educational possibilities and create opportunities for seamless learning environments. Informal learning environments are, in principle, accessible to all learners, and evidence suggests they have particular potential for supporting learners from underrepresented groups (National Research Council, 2009). These settings offer learners direct access to compelling phenomena in the natural and designed world, and powerful representations of those phenomena. Ubiquity, digital networks, and lack of formal accreditation procedures mean that anyone with appropriate expertise can facilitate STEM learning in the informal world.

PROGRAM GOALS

The AISL program is situated within the Division of Research on Learning in Formal and Informal Settings (DRL). DRL's mission is to cultivate and catalyze fundamental and applied research and development (R&D) to improve the learning of science, technology, engineering, and mathematics for the nation. In support of this mission, AISL seeks to (a) advance new approaches to and evidence-based understanding of the design and development of STEM learning in informal environments; (b) provide multiple pathways for broadening access to and engagement in STEM learning experiences; (c) advance innovative research on and assessment of STEM learning in informal environments; and (d) engage the public of all ages in learning STEM in informal environments.

The AISL program's priorities are: (1) Maximizing Strategic Impact, (2) Enhancing Knowledge-Building, (3) Promoting Innovation, (4) Advancing Collaboration, (5) Strengthening Infrastructure and Building Capacity, and (6) Broadening Participation. Through these priorities, described in more detail throughout the solicitation, the program contributes to STEM engagement and literacy, workforce development, and educational success. It may also narrow the gap between the advancements in scientific discovery and the public's understanding of science.

II. PROGRAM DESCRIPTION

What is informal science, technology, engineering and mathematics (STEM) learning?

It is "lifelong learning in science, technology, engineering, and math (STEM) that takes place across a multitude of designed settings and experiences outside of the formal classroom" (Center for the Advancement of Informal Science Education website). For more information see the Center for the CAISE website, www.informalscience.org

AISL program investments should be of interest and utility to public audiences, informal STEM practitioners, and decision-makers. **All proposals must articulate clear rationales describing why a project is primarily informal and how it adds value to the informal STEM learning community**.

The products of AISL investments may include, but are not limited to, exhibitions and programs in museums, zoos, aquaria, botanic gardens/arboreta, planetariums, nature centers, parks, libraries, and other environments; science communication; after-school and out-of-school time (OST) programs; radio, television, film, or media programs or series; Do-It-Yourself (DIY)/maker initiatives; opportunities for the public to engage in research including crowdsourcing and citizen science; on-line and other digital experiences (e.g., games, simulations, social media, mobile computing, distributed networks, and massive online open courses); and research findings that articulate what works, for whom, why, and in what contexts.

Given that almost any environment can support informal science learning, there is an opportunity to understand how learners can be supported to make bridges between what they learn in one setting and what they learn in another setting. Thus, projects may choose to include how informal learning practices connect with STEM-related frameworks and curricula, college and career readiness standards, or other educational settings.

Audiences for AISL Projects

AISL projects engage participants drawn from both public and professional audiences.

Public audiences may include learners of any age, educational level, geographic, or cultural background, including those from groups underrepresented in STEM or underserved in STEM, including geographic regions and economically challenged communities. The AISL program is keenly interested in projects that support understanding issues of access to informal STEM learning opportunities for individuals/groups from populations typically underrepresented in STEM, people in rural as well as urban communities, adults across the lifespan, early childhood, and intergenerational and family groups.

Professional audiences are individuals involved in any aspect of research or development of STEM learning by the public in informal environments. Audiences could include STEM educators, evaluators, education and learning researchers, technologists, media professionals, or STEM professionals doing outreach in informal settings. Graduate students and post-docs may also be included as professional audiences.

Proposals may focus on public audiences, professional audiences or both. Proposals should be clear about their audience(s) and how the project's design and STEM learning component(s) are relevant and appropriate for the proposed audiences and age levels.

STEM content areas

A note about STEM-related fields and STEM-related occupations: STEM is an acronym for science, technology, engineering, and mathematics; STEM includes the social, behavioral, and economic sciences. The term "STEM-related fields" is used in this solicitation to refer to these disciplines, their many sub-disciplines, and related fields that require knowledge and skills related to one or more STEM disciplines.

Content may focus on any areas of STEM that NSF supports, including interdisciplinary learning and learning that positions STEM within meaningful personal, cultural or societal frameworks. The proposals should discuss the STEM content area(s) in sufficient depth to provide a clear understanding of concepts, topics, processes, and associated skills that are conveyed to the audience. Topics should be relevant to the age levels of proposed audience(s). Projects may integrate STEM and art or the humanities, as long as the primary goal is to enhance STEM learning in informal environments.

Priorities

This section describes six priorities that the AISL program believes are essential for achieving its goals. These priorities are also strategies to incorporate as approaches to the work. Every project does not need to address every priority. Thus, proposals should be clear about how the priorities are being addressed. These priorities should be addressed at the level appropriate to the proposal type and amount of funding requested.

1. **Maximizing Strategic Impact.** Strategic Impact refers to how a project addresses important areas for continued development and advances the informal STEM learning field overall (not simply the project impact for the target audiences or communities). *Strategic* suggests planned intent or focus and should address the question: What approach or model does the project offer for advancing the field or a sub-component of the field? Proposers should think about who is needed on the project to ensure that a strategic focus is fostered.

   To be strategic, impact must go beyond project-level impact. How could others in the field be able to implement the approach or model created/investigated as a result of the project? Note that strategic impact can be achieved regardless of the size of the organization (or the population of the communities that they serve) or the size of the target audience.

2. **Enhancing Knowledge-building.** AISL projects are expected to build knowledge with respect to informal STEM education. Projects must describe and make a strong case for how a project advances the knowledge base of the informal STEM learning field through research, evaluation, or a combination of research and evaluation. The theoretical and empirical justification for the proposed project must be clearly articulated. Knowledge generation may focus on developing, testing, and/or implementing innovative research, models, resources, and tools for informal learning environments. Foci of investigations may include, for example, "what is happening," "to what extent," "why," "how," "what works for whom," and "under what circumstances." The "Discover Research" tab on the informalscience.org website may be helpful in finding current research, literature reviews, research agendas, etc. related to learning STEM in informal settings.

   Projects should build from the current literature and practice. Projects may also consider building from or critiquing relevant research agendas or literatures about informal STEM learning that have been developed in recent years. This may be one way projects can contribute to the development of the field. Some current frameworks are available at http://www.informalscience.org/research/what-important-gaps-informal-stem-education-research

   Definitions of research and evaluation vary across the field of informal STEM education. It is not the goal of this solicitation to set definitions for these approaches. Instead, the AISL program seeks to advance the collective understanding of learning STEM in informal environments and to provide appropriate means for communicating what has been learned. Thus, each proposal should identify how it builds knowledge. It should make a case for how it is doing so, using appropriate resources from research and evaluation (CAISE, 2011; Friedman, 2008; IES and NSF, 2013). Support for evaluation is available at the "Design Evaluation" tab on the informalscience.org website.

   With respect to learning, proposals must describe measures of learning outcomes for the target audiences, including how the chosen measures are appropriate for the proposed work and of practical interest and utility to practitioners and decision makers. Recent reports encourage measuring learning outcomes in such terms as interest, engagement, attitude, motivation, behavior, identity, persistence and 21st century skills (Friedman, 2008; National Research Council 2009, 2012, 2015). The AISL program recognizes the complexities of measuring STEM learning in informal environments. The program welcomes innovative and exploratory assessment methods that draw from knowledge and practice of learning across environments.

3. **Promoting Innovation.** In a manner similar to NSF programs that fund projects at the frontiers of STEM research, AISL seeks to fund projects at the frontiers of STEM learning in informal environments that will advance the state-of-the-art. Depending on the discipline or sector, innovation may be framed in different ways and serve different purposes. Innovation may build on or extend current work or it might take that work in a totally different direction. In the informal education field, innovation might address immediate challenges and opportunities; anticipate different structures, functions, and purposes of informal STEM education; challenge existing assumptions about learning and learning environments; or envision the future needs of diverse learners, educators, and STEM professionals in the U.S. In addition, personalized learning options and participatory learning environments are expanding and broadening participation in STEM. The pervasiveness and accessibility of digital technologies raises interesting questions for understanding learning across contexts (e.g., home, work, school, etc.) and learning ecosystems.

   Projects can demonstrate innovation in many ways, including new models for research and practice, new types or combinations of deliverables, improvements in the deliverables, or their deployment in a different manner. Research could help articulate the underlying processes of practice or build consensus in the field around a particular innovation. Since innovation often carries risk, the PI must be able to demonstrate an understanding of possible risks entailed and how they will be managed. It is important to specify the proposed project's innovation as determined by the PI team.

4. **Advancing Collaboration.** To achieve more significant outcomes than would otherwise be possible, projects should leverage resources of partners. The term "collaboration" is used to cover a wide variety of activities: collective impact, partnerships, interdisciplinary work, networks, alliances, etc. Collaborations of all kinds are already important and frequently necessary for work in the informal STEM education field.

   "Advancing Collaborations" as a priority in the AISL program signals the need for a more focused, reflective approach to building collaborations. Collaborations among practitioners, STEM researchers, and STEM education or learning researchers and evaluators should be an integral component of all projects. Projects are encouraged to include, when appropriate, collaborators who are not typically involved in informal STEM learning. Collaborations may also include multiple experts working on similar issues from varied or nuanced approaches. Collaborations can be among individuals, within institutions, or across institutions. Examples of potential collaborators or partners include: practitioners; research scientists; learning researchers; evaluators; graduate and undergraduate students; content or context specialists; co-designers; advisors; presenters who engage directly with public audiences; community groups; industry/business; academic institutions; or non-government organizations (NGOs).

   In some cases, projects may explicitly target the improvement of the knowledge base, innovation, and dissemination of findings about collaborations in informal settings and/or in R&D related to learning in informal settings. AISL encourages exploration of new approaches/models or testing of approaches/models of collaboration that are used in other areas.

5. **Strengthening Infrastructure and Building Capacity.** As part of AISL's efforts to advance the field of informal STEM education, it invests in projects that seek to build infrastructure and/or capacity in the field. These efforts often focus on the following, though this is not an inclusive list of approaches: widely sharing research and other improvement-focused resources; developing and/or studying models related to informal STEM education; providing focused professional development or professional development resources related to informal STEM learning; and developing or supporting collaborations, connections, and professional networks within and across sectors of informal STEM education, or even more broadly.

6. **Broadening Participation.** The National Science Foundation (NSF) is charged with promoting the vitality of the nation's science and engineering research and education enterprises. As an NSF broadening participation emphasis program, the AISL program contributes to NSF's mission by supporting projects to engage professionals and the public from populations typically underrepresented in the STEM fields. Projects focused on young people can contribute to informing how the nation prepares this increasingly diverse cohort for rapidly changing occupations in STEM-related fields. Projects focused on professionals can contribute to research on STEM learning outcomes, organizational capacity, and field-wide mechanisms for expanding access to STEM resources and experiences. AISL is particularly interested in receiving proposals from organizations that serve individuals from populations typically underrepresented in STEM-related fields. Furthermore, AISL welcomes proposals that are consistent with the goal of developing STEM talent and workforce from all sectors and groups in our society (e.g., NSF INCLUDES). Collaborations are encouraged between AISL proposals and existing NSF INCLUDES projects, provided the collaboration strengthens both projects.

   For projects in which broadening participation is a primary goal, additional review criteria apply. **Proposers should state clearly whether their proposal has a primary focus on broadening participation.** Reviewers will be asked to evaluate the details of the broadening participation plan based on the following Solicitation-Specific Review Criteria:

   - To what extent does the proposal identify the characteristics and needs of the targeted underrepresented groups (public or professional) to be served?
   - To what extent does the proposal include explicit plans or strategies for addressing or accommodating the specific interests, community or cultural perspectives, and educational needs of participants of the identified underrepresented groups?

   For projects for which broadening participation is a secondary focus, it is still expected that the proposal will demonstrate knowledge of and

collaboration with the target communities.

AISL Project Types

The AISL program supports six types of projects: (1) Pilots and Feasibility Studies, (2) Research in Service to Practice, (3) Innovations in Development, (4) Broad Implementation, (5) Literature Reviews, Syntheses, or Meta-analyses, and (6) Conferences.

The range of project types available serve different functions and support varied strategies for guiding proposed work. The first project type, *Pilots and Feasibility Studies*, is for investigating approaches to STEM learning and design of learning environments or problems that establish the basis for future research, design, and development of models or approaches. The next three project types, *Research in Service to Practice, Innovations in Development,* and *Broad Implementation*, provide opportunities to more fully explore questions and issues for which there are preliminary findings, significant literature, or a practice base. Proposers are cautioned against trying to do too much within a single project. Consider whether the proposed work is in the theory-building, theory-refining, or ready-to-scale stage. The last two project types, *Conferences* and *Literature Reviews, Syntheses, or Meta-analyses*, offer additional mechanisms for building capacity, advancing informal STEM learning, and synthesizing knowledge. Information on current AISL projects can be found at https://www.informalscience.org/projects/funding/nsf-aisl or in the NSF Award Search by clicking here.

1. **Pilots and Feasibility Studies**

   Projects can be funded for up to $300,000 total and up to two years in duration. The AISL program anticipates funding 10-18 per year.

   These projects offer opportunities for practitioners and researchers to investigate issues in and approaches to informal STEM learning and to establish the basis for future research, design, and development of innovations or approaches. Such initial exploratory development work and pilot or feasibility studies should produce evidence, findings, and/or prototype deliverables that help the team make critical decisions about future work. These proposals may include high risk strategies or methods that need exploration (piloting) before further research and development is justifiable.

   The proposal needs to explicitly identify the critical risks/challenges that will be addressed and state how the project will inform future work of the PI and team and, if successful, may lead to *Research in Service to Practice*, *Innovations in Development*, or *Broad Implementation* proposals. *Pilots and Feasibility Studies* should not be viewed as small-scale versions of these other proposal types. In addition, because the NSF EAGER proposal type can be similar to this category, proposers are encouraged to read about the EAGER type of proposal in the PAPPG (Chapter II.E.2) and talk to an AISL program officer (PO).

   The AISL Pilots and Feasibility Studies proposals are consistent with the Early Stages and Exploratory type of research and development in the Common Guidelines for Educational Research and Development (IES and NSF, 2013).

2. **Research in Service to Practice**

   Projects can be funded for $300,000 to $2 million and from two to five years in duration. The AISL program anticipates funding 8-10 per year.

   The Research in Service to Practice (RSP) project type focuses on research that advances knowledge and the evidence base for practices, assumptions, broadening participation, or emerging educational arrangements in STEM learning in informal environments, including the science of science communication (NAS, 2017). For these proposals it is important for practice to inform the research as well as having research inform practice. Genuine partnerships between researchers and practitioners are required, such that the project is important and relevant to both research and practice.

   Research takes many forms and occurs at different scales. While the range for funding is quite broad, proposers should consider small and medium scale investigations depending on the nature of research questions and focus.

   Proposals submitted under this project type:

   - must include a review of the literature and the underlying theoretical framework that informs the research plan. Proposals should detail research methods, including sampling, qualitative, quantitative, or iterative design-based data collection and analysis plans, as appropriate.
   - may be qualitative or quantitative; involve methodological advances; develop or adapt assessment instruments or scales; use large databases; aggregate data across multiple or distributed settings; focus on post-hoc analyses of existing data; or conduct longitudinal studies that shed light on the impact of STEM learning activities on participants, institutions, or systems.
   - may test the reproducibility of important findings. AISL particularly encourages projects that provide research findings and recommendations that are useful for informal STEM education practitioners, researchers, and decision-makers.

   These types of projects often include a range of data to be collected and analyzed. To ensure clarity about the connections between the research questions, data, and analysis, consider including a table summarizing this information.

   Research in Service to Practice proposals are consistent with the Design and Development type of research and development in the Common Guidelines for Educational Research and Development.

3. **Innovations in Development**

   Projects can be funded for $500,000 to $3 million and from two to five years in duration. The AISL program anticipates funding 10-11 per year.

   The Innovations in Development project type is expected to result in deliverables such as exhibits, media products, afterschool programs, etc., and in innovative models, programs, technologies, assessments, resources, or systems for an area of STEM learning in informal environments. As R&D projects, proposals should describe activities for the design and development of new or improved innovations or approaches to achieve specific goals related to STEM learning, engagement, and capacity building. These proposals build on evidence from the team's or the field's prior research, design, practice, and development work. It is understood that innovations take many forms and occur at different scales. While the range for funding is quite broad, proposers should consider small and medium scale innovations depending on the nature of what is being innovated.

   An explicit theoretical framework as well as either a logic model or theory of action should guide projects. In addition, proposals must articulate a plan and process for the design, development, implementation, and evidence-building components (based on research, evaluation, or both) of the proposed work. Iterative, design-based research approaches are encouraged, if appropriate.

   Innovations in Development proposals are consistent with the Design and Development type of research and development in the Common Guidelines for Educational Research and Development.

NOTES: Innovations in Development proposals differ from *Research in Service to Practice* proposals in that *Innovations in Development* projects focus on and leverage the development of a product, model, tool, or resource to better understand and inform practice. **These deliverables are expected to have a service life beyond NSF funding.**

On the other hand, *Research in Service to Practice* projects have at their core a compelling research question about practice, about how people learn, and/or about specific learning environments. For this project type, most of the focus and effort are centered on the research. If products are developed, there is no expectation that they will have a lifetime after the completion of the research.

4. **Broad Implementation**

   Projects can be funded for $1 million to $3 million and from three to five years in duration. The AISL program anticipates funding 2-4 per year.

   The Broad Implementation project type supports the expansion or reach of models, programs, technologies, assessments, resources, research, or systems that have a **documented record of success, innovation, or evidence-based knowledge building**. The focus is on making innovations or approaches succeed when they are implemented at a larger scale. Sources of evidence may include summative evaluation or research data that indicate readiness for distribution to a broader population or new setting(s) and should be summarized in the proposal narrative.

   When thinking about the focus for expansion, consider: geography, age, socio-economic status, cultural or linguistic group, race and ethnicity, gender, disability, learning setting, or another dimension. Where appropriate, investigators are encouraged to emphasize individuals from underrepresented or underserved groups as a target audience for a component or for the entire focus of the project.

   Proposals must articulate a plan and process for the design, development, implementation, and evidence-building components of the proposed scaling work. Project design may address innovative integration, incremental improvements, adaptations, or trials under typical conditions. Iterative, design-based, and improvement research approaches are encouraged. Proposals should discuss how evidence will be collected to understand the mechanisms enabling broad implementation.

   Broad Implementation proposals are consistent with the Design and Development or Efficacy and Effectiveness types of research and development in the Common Guidelines for Educational Research and Development.

5. **Literature Reviews, Syntheses, or Meta-analyses**

   Projects can be funded for up to $250,000 and are usually two years in duration. Investigators are strongly encouraged to contact a PO prior to submission to discuss your idea(s). The AISL program anticipates funding up to 10 projects within this category per year.

   AISL supports capacity building through literature reviews, syntheses, and meta-analyses directly related to the goals of the AISL program. Proposers should be clear about which type of proposal they are submitting. A proposal should focus on a question, issue, or topic of critical importance to the AISL program, including researchers and practitioners invested in learning outside of formal education contexts.

   Proposals should demonstrate a command of the literature on the question, issue, or topic, both breadth and depth. This background should be used to make a case for the amount, type, and relevance of available literature to conduct the literature review, synthesis, or meta-analysis. Literature selection processes (methods, search criteria, etc.) and quality and inclusion criteria (peer review, conference work, reports, evaluations, other) should be discussed. Investigators are permitted, but not required, to propose workshops and other meetings as one of the means of doing the work or as part of diffusing the knowledge that is developed from these projects.

6. **Conferences**

   Projects can be funded for up to $250,000 and are usually two years in duration. Investigators are strongly encouraged to contact a PO prior to submission to discuss your idea(s). For general guidance about conferences, follow the PAPPG guidance under for preparing Conference Proposals (PAPPG Chapter II), in addition to the AISL-specific guidance below. The AISL program anticipates funding up to 18 projects within this category per year.

   Conference proposals should demonstrate a command of the informal STEM literature and/or practice of the question, issue, or topic. Participant expertise and selection should be discussed. Conference proposals should include a conceptual framework for the conference, draft agenda, possible participant list, and the outcomes or products that will result.

   All proposals in this category should address the need for the work, why it is timely, and the expected contributions to understanding or advancing the question, issue, or topic. All projects should generate a product usable by researchers and/or practitioners and indicate how these product(s) serve the AISL program priorities described earlier in this document.

   NOTE: For *Conferences* with budgets over $75K, proposals should be submitted for review by the deadline dates listed at the beginning of this solicitation. Conferences with budgets under $75K are evaluated on an ad hoc basis and may be submitted at any time (not only to the competition deadline), generally at least one year in advance of when the event would be held. Investigators are strongly encouraged to contact a Program Officer prior to submission.

About EHR and DRL

The Advancing Informal STEM Learning (AISL) is one of six programs in the Division of Research on Learning in Formal and Informal Settings (DRL) in the Directorate for Education and Human Resources (EHR). Each program can be accessed from the DRL Web Page

The contributions of AISL projects to advancing knowledge and the evidence base in STEM education differ from the EHR Core Research program (ECR). AISL's research and development investments focus on the *translation* of foundational and early stage research to research, design, development, and implementation of STEM learning in informal environments. As such, AISL contributes to the knowledge base that advances our understandings of or has ultimate use in informal settings.

Investments by EHR/DRL contribute to the three categories that together form the foundation for EHR's strategic framework toward the fulfillment of the EHR mission. Within each of these categories, EHR/DRL will continue to build and emphasize its research and development activities.

- Learning and learning environments: Investments in this category seek to develop understanding of the cognitive, affective, and non-cognitive foundations of STEM learning; to study emerging contexts and tools for learning STEM concepts and skills; and to build environments that promote new, high-impact learning opportunities for tomorrow's scientists and engineers, as well as the public and students living in an increasingly technology-

oriented society.

- Broadening participation and institutional capacity in STEM: Programs in this category capitalize on the Nation's diversity in order to increase the scientific workforce by engaging and building capacity in all people in STEM learning and professional training, particularly those from groups that have been traditionally underrepresented in STEM fields.
- STEM workforce: Workforce investments are intended to improve the education and preparation of a STEM workforce that will be ready to capitalize on unprecedented advances in technology and science, and to address future global, social, and economic challenges. This framework positions the directorate to respond more readily to emerging opportunities created by new technologies, improvements in the STEM education evidence base, administration priorities, and other national or societal needs.

For more information on EHR see: https://www.nsf.gov/dir/index.jsp?org=EHR

Other Funding Opportunities

The NSF programs listed below may also be of interest; see individual solicitations for descriptions and due dates:

Computer Science for All (CSforAll: Research and RPPs)

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505359

EHR Core Research (ECR)

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504924

Faculty Early Career Development (CAREER)

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503214

Future of Work at the Human-Technology Frontier: Core Research (FW-HTF)

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505620

Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science (NSF INCLUDES)

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505289

Innovative Technology Experiences for Students and Teachers (ITEST)

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5467

Navigating the New Arctic (NNA)

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505594

Racial Equity in STEM Education

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505910

Research on Emerging Technologies for Teaching and Learning (RETTL)

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504984

Research Experiences for Undergraduates (REU)

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5517

Research Coordination Networks (RCN)

https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=11691

The goal of the RCN program is to advance or create new directions in research and practice by funding investigators with diverse expertise and who share a common interest in an important question, issue, or topic.

RCN awards do not directly support research or development activities. RCNs fund the development of networks and relationships, such that researchers and practitioners discuss and advance their research and practice activities across theoretical frameworks, methodological approaches and/or disciplinary, organizational, geographic, and international boundaries. The question, issue, or topic provides relevance and coherence to the network.

The AISL program welcomes submissions of RCN proposals that advance AISL goals through the sharing of ideas, knowledge, and practices. RCNs are an additional avenue for considering strategic impact, advancing effective collaborations, and broadening participation. See the RCN solicitation for further details. Speak to an AISL program officer if considering this proposal mechanism. RCN proposals are due on the AISL deadline. They are for up to $500,000 and a duration of five years.

Quantum Information Science and Engineering (QISE)

https://www.nsf.gov/mps/quantum/quantum_research_at_nsf.jsp

QISE builds on quantum mechanics and information theory to understand and utilize the fundamental quantum properties of light and matter for computation, information processing, communication, sensing and metrology. QISE applies the best understanding of the sub-atomic world—quantum theory—to generate new knowledge and technologies. Through developments in QISE, the United States will improve its industrial base, create jobs, and provide economic and national security benefits.

Competitive AISL proposals submitted to NSF that support or contribute to the development of the nation's QISE workforce may be considered for possible

QISE funding through NSF's agency-wide investments in quantum research and education.

See the NSF QISE site for further details.

Resources

The following sites are potential resources for prospective PIs.

- The Center for Advancement of Informal Science Education (CAISE) is a cooperative agreement with the NSF AISL program designed to strengthen and advance the field of informal STEM education and its infrastructure by providing resources for NSF principal investigators, ISE professionals, and STEM researchers. See http://informalscience.org/nsf-aisl for more information.
- The Center for Integrative Research in Computing and Learning Sciences (CIRCLS) supports research on emerging technologies for teaching and learning at NSF. See https://circls.org for more information.
- The Community for Advancing Discovery Research in Education (CADRE) is the resource network for the DRK-12 program. CADRE's mission is to support and connect researchers and developers in K-12 STEM education. To explore the resources of CADRE see http://cadrek12.org/
- The STEM Learning and Research Center (STELAR) is supported by the ITEST program. STELAR's mission is to build capacity and magnify the results of ITEST projects in order to deepen the impact of the ITEST program. For more information see http://stelar.edc.org/
- NSF INCLUDES is one of the NSF 10 Big Ideas. For the U.S. to remain the world leader in STEM innovation and discovery, it must identify and develop talent (from all sectors) to become STEM professionals. For more information, see the NSF INCLUDES Coordination Hub and National Network: http://www.includesnetwork.org/home/

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Institute of Education Sciences, U.S. Department of Education, and the National Science Foundation (August, 2013). Common Guidelines for Education Research and Development: A Report from the Institute of Education Sciences, U.S. Department of Education, and the National Science Foundation.

NSF 13-126 (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf13126)

FAQs: NSF 13-127 (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf13127)

National Academies of Sciences, Engineering, and Medicine. (2017). *Communicating Science Effectively: A Research Agenda*. Washington, DC: The National Academies Press. http://nap.edu/23674

National Research Council (2009). *Learning Science in Informal Environments: People, Places, and Pursuits* Washington, D. C.: The National Academies Press.

http://www.nap.edu/openbook.php?record_id=12190

National Research Council (2012). *Education for Life and Work: Developing transferable knowledge and skills in the 21st century*. Washington, D.C.: The National Academies Press.

http://www.nap.edu/openbook.php?record_id=13398

National Research Council (2015). *Identifying and Supporting Productive STEM Programs in Out-of-School Settings*. Washington, D. C.: The National Academies Press. http://www.nap.edu/openbook.php?record_id=21740

III. AWARD INFORMATION

Pending availability of funds, it is anticipated that about 10-18 Pilots and Feasibility awards, 8-10 Research in Service to Practice awards, 10-11 Innovations in Development awards, 2-4 Broad Implementation awards, 8-10 Literature reviews, syntheses, and/or meta-analyses awards, and 12-18 Conference awards will be made. AISL will also fund 4-13 awards made through the EAGER, RAPID, Research Coordination Networks (RCN) mechanisms, and 4-14 CAREER awards and REU supplements. In addition, one Resource Center will be funded in FY22 (see separate solicitation).

Pending availability of funds $32-$44M in FY 2022 is anticipated for new awards made under this solicitation. (1) Pilots and Feasibility projects: up to $300,000 with durations up to two years; (2) Research in Service to Practice projects: from $300,000 to $2,000,000 with durations from two to five years; (3) Innovations in Development projects: $500,000 to $3,000,000 with durations from two to five years; (4) Broad Implementation projects from $1,000,000 to $3,000,000 with durations from three to five years; (5) Literature Reviews, Syntheses, or Meta-analyses projects up to $250,000 with durations of up to two years; and (6) Conferences up to $250,000 with durations of up to two years.

IV. ELIGIBILITY INFORMATION

Who May Submit Proposals:

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the *NSF Proposal & Award Policies & Procedures Guide* (PAPPG), Chapter I.E. Unaffiliated individuals are not eligible to submit proposals in response to this solicitation.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

There are no restrictions or limits.

Limit on Number of Proposals per PI or co-PI: 3

An individual may be included as a Principal Investigator (PI) /co-PI on no more than three (3) proposals submitted to the program deadline.

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.

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.

REMINDERS:

- Use both this solicitation and the NSF PAPPG in preparing the proposal for submission.
- PIs may also benefit from the informalscience.org tabs of "Develop Projects," "Discovery Research," and "Design Evaluation" when preparing proposals.
- For collaborative proposals uploaded as separate submissions from multiple organizations, the minimum budget amount is $75,000 for each project year for each organization.
- AISL submitters must use Research.gov or Grants.gov to submit their proposal.

The following instructions supplement guidelines in the PAPPG and NSF Grants.gov Application Guide.

1. **Cover Sheet**

    It is assumed that proposals submitted to AISL have the potential for conducting research on human subjects. Thus, a box should be checked on the Cover Sheet with respect to the status of the project's IRB application. Proposers should refer to the NSF Proposal and Award Policies and Procedures Guide (PAPPG) for further information related to Human Subjects' research.

    When completing the Cover Sheet, proposers are asked to identify the nature and type of proposal being developed. ***This reference to proposal type is different from the AISL proposal types described above.*** For AISL project types P*ilots and Feasibility Studies*, *Research in Service to Practice*, *Innovations in Development*, *Broad Implementation*, or *Literature Reviews, Syntheses, or Meta-analyses*, select RESEARCH as the NSF proposal type. For the AISL project type *Conferences,* select CONFERENCE as the NSF proposal type.

2. **Project Summary**

    Each proposal must have a summary of the proposed project not more than one page in length. The Project Summary should be informative to other persons working in the same or related fields, and, insofar as possible, understandable to a broad audience within the scientific domain. It should not be an abstract of the proposal.

    The Project Summary consists of three sections:

1. Overview
   - The first sentence must identify the AISL project type: Pilots and Feasibility Studies, Research in Service to Practice, Innovations in Development, Broad Implementation, or Conferences, Literature Reviews, Syntheses, or Meta-analyses, or Conferences. For Literature Reviews, Syntheses, or Meta-analyses, indicate which kind is being proposed.
   - The Overview includes a description of the activity that will result if the proposal is funded and a statement of objectives and methods to be employed.
2. Intellectual Merit: a statement on the intellectual merit of the proposed activity
   - The statement on intellectual merit should describe the potential of the proposed activity to advance knowledge-building.
3. Broader Impacts: a statement on the broader impacts of the proposed activity.
   - The statement on broader impacts should describe the potential of the proposed activity to benefit society and contribute to the achievement of specific, desired societal outcomes.

The discussion of how your project aligns with one or more of the AISL priorities (e.g., strategic impact, knowledge-building, innovation, collaboration, infrastructure and capacity building, and broadening participation) may be a part of either Intellectual Merit, Broader Impacts, or both.

3. **Project Description (Narrative)**

In addition to the requirements outlined in the NSF PAPPG and this solicitation, the first sentence of the Project Description, like the Project Summary, must identify the AISL project type.

The narrative is limited to 15 single-spaced pages. It must include the following information, preferably using the section headings labeled below.

Please note that per guidance in Chapter II of the NSF PAPPG, the Project Description must contain a separate section within the narrative labeled "Broader Impacts." This section should provide a discussion of the Broader Impacts of the proposed activities. Proposers may decide where to include this section within the Project Description.

Solicitation-Specific Review Criteria: Proposers should state clearly whether their proposal has a primary focus on broadening participation. For AISL projects with a primary focus on broadening participation, proposer can decide where to include the information that addresses the following questions:

- To what extent does the proposal identify the characteristics and needs of the targeted underrepresented groups (public or professional) to be served?
- To what extent does it include explicit plans or strategies for addressing or accommodating the specific interests, community or cultural perspectives, and educational needs of participants of the identified underrepresented groups?

A. *Project Rationale*

Provide a rationale for the project with respect to **strategic impact, knowledge-building, innovation**, **collaborations, infrastructure and capacity building, and broadening participation**, as appropriate and described above, such that the value of the proposed project is clear. Be sure to address the relevance of **informal STEM learning and learning environments** to the project, as described above.

Results from prior NSF support. Describe results of relevant prior NSF support for projects in which the PI or co-PI have been involved, such that reviewers can judge the quality and impact of that work. Refer to the PAPPG for specifics about what must be included.

Please highlight whether this proposal is based on a previous AISL *Exploratory Pathways*, *Collaborative Planning*, or *Pilots and Feasibility Studies* project.

B. *Project Design*

Describe the research foci, methods and analyses, project deliverables and plan for implementation, STEM content area(s), audience(s), and specific information relevant to the AISL project type. For Innovations in Development, Broad Implementation, Literature Reviews, Syntheses, or Meta-analyses, and Conferences, proposals should include a discussion of a strategy for reaching a broad audience along with an estimate of the number of individuals to be served.

C. *Communication Plan*

All AISL proposals must include a creative communication strategy for dissemination of findings of the research and education activities to professional and other interested communities including, where appropriate, practitioners, public audiences, scholars, and local, regional and national decision makers. While the potential results of the proposed research are expected to be of sufficient significance to merit peer-reviewed and wide publication, approaches that reach broader audiences are strongly encouraged. Proposals should identify the key elements of a communication plan, e.g., target audiences and identification of the channels, media, and, technologies appropriate for reaching specific audiences.

NOTE: The Communication Plan focuses on findings, not the expected numbers in attendance by the public or professionals in the learning experience deliverables like exhibits, after-school programs, professional development workshops, online experiences, etc. Anticipated attendance numbers should be included in the discussion of Project Deliverables.

D. *Evaluation*

The AISL program seeks to advance the collective understanding of learning STEM in informal environments and to ensure that federal investments in AISL awards are evaluated with respect to alignment with the funding intent and the quality of the resulting work. *All AISL project proposals are required to specify the evaluative processes they would employ to achieve the following **two** goals*:

1. Support iterative improvement. Evaluative processes should ensure that a project benefits from appropriate, rigorous, external input throughout the life of the project. Such input is essential for project monitoring, management, and continuous quality improvement. External feedback should enrich (and potentially challenge) the team's perspectives.
2. Promote accountability. Evaluative processes should address questions such as: Is the project addressing its stated goals? What is the quality of the work?

These requirements are consistent with the External Feedback component of the Common Guidelines for Educational Research and Development.

This solicitation **does not** intend to be prescriptive with respect to how the goals are achieved. Instead, the following describes some possibilities to provide a springboard from which proposers can design evaluative processes that best align with their projects. The extent of the evaluation activities should be appropriate to achieving the project's goals, given the project's size and scope.

Evaluation and knowledge-building:

Some projects seek to achieve AISL's knowledge-building criterion through evaluation. (Others propose research studies to build knowledge, and use evaluation primarily to monitor progress against timelines, ensure fidelity of implementation, etc.) Projects that use evaluation to achieve AISL's knowledge-building criterion need to describe how their approaches to evaluation achieve three goals: (1) support iterative improvement, (2) promote accountability, and (3) build knowledge with respect to advancing understanding of learning STEM in informal environments. Plans for a study addressing the third goal, culminating in a summative evaluation report or similar product, are required as part of the overall evaluation plan. Such proposals are encouraged to illustrate the coherence among the proposal goals or hypotheses of the project, the evaluation methods, and the knowledge the projects seek to build for the field. The evaluation plan may include front end, formative, remedial or iterative, and summative components, as appropriate to achieving the project's goals. The summative evaluation component must be sufficiently independent and rigorous to generate evidence of the impact of the project with respect to its intended outcomes.

Evaluation for iterative/continuous improvement:

Some projects employ iterative cycles of evaluation (e.g., front end, formative, remedial) to inform work during the development and implementation of project activities. (This is often the case for proposals submitted to the *Innovations in Development* or *Broad Implementation* types; it may also be important for proposals submitted to other project types.) Such evaluations should be sufficiently independent and rigorous to (1) influence the project's activities at appropriate junctures to improve the quality of its processes and outcomes and (2) determine (near the completion of the project) whether the project addressed its intended outcome goals. (If the project also uses evaluation to achieve AISL's knowledge-building criterion, the results from the iterative evaluative processes may be included in the final summative evaluation report. If other strategies are proposed to satisfy AISL's knowledge-building criterion, insights from evaluative processes may be presented in a separate report or similar product.)

External advisory boards and third-party evaluators:

Third-party evaluators and advisory board members typically contribute to the accountability component of project evaluations. External advisory boards and/or third-party evaluators may also be used to provide the project team with feedback (on both as-needed and annual bases) on a range of issues, including the project's research methods and analysis; how to improve engagement with a project's target audiences; and how to effectively bridge boundaries in collaborations.

Regardless of the approach taken for evaluation, the project should *specify*:

- the rationale for the evaluation approaches taken;
- how the approaches achieve the project's evaluation goals, ensure iterative improvement, accountability, and, if appropriate, build knowledge;
- the expertise of those serving in these roles and how that expertise relates to the goals and objectives of the proposal;
- which member(s) of the project team will be responsible for managing and implementing which evaluative activities; and
- how the PI will incorporate results of the project's external, critical review process into the ongoing management of the project.

For more information about evaluation, see the *Common Guidelines for Education Research and Developments* and the *Design Evaluation* section at www.informalscience.org.

E. *Project Management*

All AISL proposals need to explicitly address **collaboration**, as described above, and in terms of the numbered items below. It should be clear how the project maximizes the collaborative effort.

1. Describe the composition, experience, and expertise of the project's Leadership Team, which, as appropriate for the project, may include senior personnel, subawardees, consultants, and others, in addition to the PI and co-PIs. The information provided should enable reviewers to judge the quality and capabilities of the project team.
2. Describe the key personnel which, as appropriate for the project, may include STEM professionals, collaborators, advisory board members, consultants, and contractors. Provide information on each sufficient enough so that reviewers may assess their quality and contributions to the proposed work.
3. Explain the project's management plan and make clear how the project team and partners will work collaboratively to achieve project outcomes.
4. Provide information on collaborations with individuals, organizations, and/or associations and discuss their contributions to the project. Examples of potential collaborators or partners include: practitioners, research scientists, learning researchers, evaluators, graduate and undergraduate students, content or context specialists, co-designers, advisors, or presenters who engage directly with public audiences; community groups, industry/business, academic institutions, NGOs.
5. Delineate a schedule or work plan with major milestones for key project tasks.

4. **Budgets**

All budget requests must be consistent with the project scope and duration and cannot exceed the maximum for each project type. All budgets, both proposer and subaward budgets, must be accompanied by budget justifications that include itemizations corresponding to each Research.gov or Grants.gov budget line items and provide sufficient detail as to justify the expense and its relevance to achieving the project goals. Requested equipment must be essential components of project deliverables. **If personnel expenses are entered for postdoctoral scholars (section B of the budget), a one-page postdoctoral mentoring plan is required in the supplementary documents or the proposal will not be accepted.**

Include under Travel the cost for the PI to attend a two-day meeting every other year at, or near, NSF.

Each subaward requires a complete set of proposal budgets accompanied by a budget justification that includes the basis for selecting the subawardee, as well as itemization of expenses and explanations.

5. **Other Sections of the Proposal**

References Cited: Any literature cited should be specifically related to the proposed project, and the Project Description should make clear how each reference has played a role in the motivation for, or design of, the project. The References section is distinct from, and in addition to, the Project Description section.

Biographical Sketches: Biographical information must be provided for each senior person listed on the budget, and other personnel with key qualifications important to the project. Biographical sketches should adhere to the format outlined in Chapter II of the PAPPG.

Current and Pending Support: Required for the PI, co-PIs, and senior project personnel. The proposal being submitted should be listed first and identified as pending.

Facilities, Equipment & Other Resources: In order to assess the scope of the project, all organizational resources necessary for the project must be described in the Facilities, Equipment and Other Resources section (See PAPPG Chapter II). The description should be narrative in nature and **must not include any quantifiable financial information**.

6. **Supplementary Documents**

Note: Supplementary Documents are distinct from Appendices, as stipulated in the PAPPG: *Appendices may not be included* unless a formal deviation has been authorized. See PAPPG Chapter II for more information about deviations.

Required Supplementary documents:

- Data Management Plan
- Postdoctoral Researcher Mentoring Plan (if applicable)

See PAPPG Chapter II for instructions for the preparation of these items. For more information and the instructions for the Data Management Plans for proposals submitted to the Directorate for Education and Human Resources (EHR) see: https://www.nsf.gov/bfa/dias/policy/dmp.jsp

Allowable Additional Supplementary Documents:

1. Letters of Collaboration from consultants, advisors, distributors, and organizational partners are encouraged. The requirements for the Letters of Collaboration are given in Chapter II of the PAPPG. Letters of Support or Endorsement from persons merely endorsing, but not involved with or making a substantial commitment to the project, are not allowed. **Proposals with Letters of Support or Endorsement will be returned without review**.
2. For projects with TV, film, radio, and exhibition products only, PIs may submit up to an additional 20 pages maximum for scripts or treatments of media productions, exhibit sketches, or floor plans. This additional documentation cannot be used to increase the 15-page Project Description limit.
3. For deliverables that involve media as a primary deliverable (e.g., television, film, radio) that cannot solely be represented on the printed page, or submitted in Supplementary Documents, they may be provided electronically. For instructions on how to submit such media files, notify the AISL program by sending a notice to drlaisl@nsf.gov once you have submitted the proposal and have your official NSF proposal number. NOTE: All media files must be received within 5 business days following electronic submission of the proposal. Submissions must be in either .mp3 or .mp4 format and may not exceed 250MB in size or 5 minutes in length.

Note: The Project Description must provide sufficient information for reviewers to make reasoned judgments about the proposed work. Reviewers may opt to read or listen to/view these additional materials, but are not required to do so.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Other Budgetary Limitations:

Funding for the following are not supported by this program: capital or general operating expenses; purchase of major or office equipment; vehicles; undergraduate tuition; paid advertising; admissions or similar fees; projects whose primary focus is health or medicine, or projects that are only about publishing books. In addition, funds for expenses related to school field trips, camps, science festivals, science fairs or competitions may be requested only if they are integral to support research and development efforts aligned with AISL priorities.

C. Due Dates

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

   January 18, 2022

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

The AISL program is interested in broadening participation in STEM as a component of a proposal's Intellectual Merit and/or Broader Impacts. In addition to considering the two general NSF Merit Review Criteria, for those projects in which broadening participation is a primary goal, reviewers will also be asked to evaluate the details of the broadening participation plan.

- To what extent does the proposal identify the characteristics and needs of the targeted underrepresented groups (public or professional) to be served?
- To what extent does the proposal include specific plans or strategies for addressing or accommodating the specific interests, community or cultural perspectives, and/or educational needs of participants of the identified underrepresented groups?

In addressing the solicitation-specific review criteria, AISL welcomes proposals that align with the goal of NSF INCLUDES to develop STEM talent from all sectors and groups in our society (one of the NSF Ten Big Ideas). Collaborations are encouraged between AISL proposals and existing NSF INCLUDES projects, provided the collaboration strengthens both projects.

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 be completed and submitted by each reviewer. 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.

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.

PIs are required to submit the final Summative Evaluation of or other knowledge-building product(s) from the project for posting to the web site http://www.informalscience.org (or other sites designated by AISL) as part of submission of the Final Report. Final reports will not be approved before the summative evaluation/knowledge-building products are posted for the project. PIs may be requested to provide additional project data for AISL program analysis and evaluation.

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:

- Address Questions to the Program, telephone: (703)292-8616, email: DRLAISL@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.

For administrative questions contact the Program by e-mail at DRLAISL@nsf.gov or phone at (703)292-8616

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.
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>   (NSF Information Center)**:**
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PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See 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:

Suzanne H. Plimpton
Reports Clearance Officer
Policy Office, Division of Institution and Award Support
Office of Budget, Finance, and Award Management
National Science Foundation
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