

Discovery Research PreK-12 (DRK-12)

PROGRAM SOLICITATION

NSF 23-596

REPLACES DOCUMENT(S):

NSF 20-572



National Science Foundation

Directorate for STEM Education
Research on Learning in Formal and Informal Settings

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

November 08, 2023

Second Wednesday in November, Annually Thereafter

IMPORTANT INFORMATION AND REVISION NOTES

1. NEW: Added Partnership Development project type
2. Emphasized a programmatic commitment to research in the Teaching Strand as STEM workforce development.
3. Emphasized communication / dissemination plans as one component of [knowledge mobilization or the reciprocal exchange or translation of knowledge between fields, stakeholders, etc.](#)
4. Moved Assessment from a project strand to a project type.
5. Updated all project type descriptions.

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

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Discovery Research PreK-12 (DRK-12)

Synopsis of Program:

The goal of the Discovery Research PreK-12 program (DRK-12) is to catalyze research and development that enhances all preK-12 teachers' and students' opportunities to engage in high-quality learning experiences related to the sciences, technology, engineering, and mathematics (STEM). The program's objectives are to: (1) build knowledge about how to develop preK-12 students' and teachers' STEM content knowledge, practices, and skills; (2) support collaborative partnerships among STEM education researchers, STEM education practitioners and school leaders with the goals of extending relevant scientific literatures while developing more effective practice; and (3) build the field of STEM education by supporting knowledge synthesis, interdisciplinary interactions across fields and stakeholders, and the development of novel and robust ways of assessing teacher and student learning, engagement, and skills. Outcomes of DRK-12 projects can include but are not limited to promising, evidence-based products that can be used by others to support the success of all teachers and all students (e.g., curriculum, teaching and research tools, and models of collaboration).

The program solicits proposals along two strands: (1) Learning and (2) Teaching. While these strands certainly overlap and have synergy, proposals should identify one strand that is most consistent with the proposal's objectives and research questions (e.g., are the project's methods and outcomes focused primarily on teacher development and teaching or student development and learning?). Research project types under both Strands include exploratory, design and development, impact, implementation, measurement and assessment, and synthesis studies. The program also supports other project types including Partnership Development Grants and Workshops/Conferences.

Successful proposals demonstrate how they build on fundamental research in STEM education and on previous or current applied research and development efforts. They also explain their theoretical and empirical justification (e.g., Why is the project designed as it is?) and outline related specific aims and methods with potential to yield new understandings of STEM teaching and learning contexts, processes, and

outcomes. The program welcomes proposals focused on teaching and learning in any STEM field(s) and on priorities identified in the National Science Foundation's [strategic plan](#). Efforts focused on facilitating the reciprocal exchange or mobilization of knowledge between the research and preK-12 formal education professional communities are strongly encouraged (see this Dear Colleague Letter https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf23078).

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.

- Inquiries can be made to, telephone: (703) 292-8620, email: DRLDRK12@nsf.gov

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

- 47.076 --- STEM Education

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 50 to 60

It is anticipated that in FY 2024 the distribution of awards by funding levels will be as follows: Partnership Development, about 10 awards; Level I research, about 10-12 awards; Level II research, about 20-25 awards; Level III research, about 5-7 awards, and Workshop/Conference and Synthesis, about 3-5 awards, pending availability of funds.

Anticipated Funding Amount: \$50,000,000

Pending availability of funds, NSF anticipates approximately \$50,000,000 will be available for the FY2024 competition.

The level of funding requested for **research** projects should align with the aims and scope of the proposed work, and the capacity of the interdisciplinary team to conduct the proposed project type. Proposals should provide clear justifications for the requested level of funding. Funding level ranges for research projects are as follows:

- Level I = requests up to \$450,000 with a duration of up to three years;
- Level II = up to \$3,000,000 with a duration of up to four years; and
- Level III = up to \$5,000,000 with a duration of up to five years.

Funding levels for other project types are as follows:

- Partnership Development proposals are up to \$100,000 for one year;
- Synthesis proposals are up to \$600,000 and three-years duration;
- Workshop /Conference proposals are up to \$200,000 and one-year duration.

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:

There are no restrictions or limits.

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):

November 08, 2023

Second Wednesday in November, Annually Thereafter

Proposal Review Information Criteria

Merit Review Criteria:

National Science Board approved criteria apply.

Award Administration Information

Award Conditions:

Standard NSF award conditions apply.

Reporting Requirements:

Standard NSF reporting requirements apply.

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I. INTRODUCTION

The DRK-12 program invites applied research and development proposals, set within the context of formal preK-12 education, with potential to generate high quality and generalizable scientific evidence, and promote success for all teachers, and their students, in all STEM fields of study. Projects should result in research-informed and field-tested outcomes and products that inform teaching and learning. Teachers and students who participate in DRK-12 studies are

expected to enhance their understanding and use of STEM content, practices, and skills. The program invites proposals that address immediate challenges facing preK-12 STEM education and proposals that anticipate radically different structures and functions of preK-12 teaching and learning.

Our nation needs a diverse STEM workforce to retain its global competitiveness, but millions of talented individuals are missing from that workforce. NSF seeks to empower these [Missing Millions](#) by making strategic investments into practical ways to promote a scientifically literate U.S. population that is well prepared for the economy and challenges of the 21st century. Consistent with this goal, the DRK-12 Program welcomes proposals aiming to advance opportunities for all students and teachers to develop their STEM talent. To support equity of investments across diverse geographic areas of our Nation including rural, urban and suburban communities, the program strongly encourages collaborative proposals involving organizations in EPSCoR jurisdictions (see <https://new.nsf.gov/funding/initiatives/epscor/state-websites>). The program also encourages proposals from a range of institution types including school districts and their partners, minority-serving institutions, primarily undergraduate institutions with educator preparation programs, and other organizations focused on preK-12 STEM education. Projects funded by the program should demonstrate a well-rounded understanding of the day-to-day work and expertise of educators in formal teaching and learning contexts, the talents and needs of the nation's diverse student population and their communities, and national, state, or district priorities.

Projects are expected to contribute to practice and theory through the communication / dissemination of promising products or approaches for use by others. Dissemination / communication plans should go beyond traditional researcher-focused avenues (e.g., peer-reviewed publications and other forms of scholarly dissemination). Strong communication plans will identify specific audiences to be served/engaged and describe specific mechanisms for connecting with those audiences. Strong plans will also state how audiences will be able to interact with the knowledge shared. Ideally, plans will include opportunities for two-way communication between audiences and the research team. Metrics for assessing the project's reach or impact are strongly encouraged (e.g., downloads, views, etc.). Project budgets should account for dissemination/communication costs.

II. PROGRAM DESCRIPTION

A. Program Characteristics and Priorities

Situated at the intersection of fundamental and applied research and development, the DRK-12 program supports research projects that seek to transform and strengthen formal preK-12 STEM education through innovative approaches, tools, and practices. Studies at the intersection of fundamental and applied research will address both generalizable scientific knowledge and applied classroom strategies (Stokes, 1997). As a research program, DRK-12 aims to support continuous accumulation of knowledge about STEM teaching and learning, in particular knowledge that is relevant to, or is instrumental for, practical innovations.

Innovations can include but are not limited to teacher preparation and professional development programs, potentially transformative teaching practices, curriculum development, development and testing of formative or summative assessment systems, instructional technologies, models of collaborative partnerships between teachers and researchers, and combinations of approaches that improve STEM learning and learning environments for students and their teachers, and provide the foundation to generalize to other contexts. Proposals are encouraged to adapt ideas, concepts, theories, practices and test them across contexts and populations. Proposals can address any STEM subject matter; interdisciplinary proposals that focus on two or more STEM domains are welcomed. The DRK-12 program invests in projects with potential to immediately address longstanding challenges, inequities, and opportunities in formal education. It also invests in proposals that anticipate and provide the foundation for preK-12 STEM education as it could be in future decades.

Given the importance of early learning in students' STEM trajectories, the program is particularly interested in supporting research and innovations that promote high-quality and innovative STEM education in the preschool years and early elementary grades. Proposals that focus on this developmental span are encouraged to draw from knowledge and practice of teaching and learning in out-of-school and informal settings, such as families and community organizations, to enhance preK-12 formal education. DRK-12 proposals must have clear implications for and ties to learning in formal K-12 settings. Proposals situated solely in informal contexts will be returned without review. Proposals situated in informal contexts should be submitted to the [Advancing Informal STEM Learning](#) program.

Finally, the program welcomes proposals that connect prekindergarten (PreK) through grade 12 formal education to STEM workforce development. Proposers choosing to focus on workforce development should note the following differences between the Teaching and Learning strands. Proposals submitted to the Teaching Strand that choose to focus on workforce development aspects such as teacher preparation, learning, and continuing education should align their aims and content to professional teaching and curricular standards. Proposals submitted to the Learning Strand that focus on workforce development should demonstrate how the proposed approach is developmentally appropriate and relates to preK-12 learning standards, and metrics of college- and career-readiness.

B. DRK-12 Program Strands

DRK-12 proposals must be submitted to one of the program's two strands: Learning or Teaching. The program recognizes that there is overlap and interdependence among the two strands; however, each proposal should have a clear, foregrounded focus on only one strand. Information on current DRK-12 projects can be found at <https://cadrek12.org/> and at NSF Award Search (<https://www.nsf.gov/awardsearch/>).

Teaching Strand

Effective STEM learning requires a well-prepared, skilled, and knowledgeable STEM teacher workforce. As advances in STEM continue to unfold, teachers need support to learn about new discoveries in the STEM disciplines and how to integrate contemporary and dynamic content from STEM fields into their classroom practice. The DRK-12 program invites proposals that advance current understanding of pre- and in-service teachers' knowledge, beliefs, and practices related to STEM content and that demonstrably enhance teaching practice. The overarching goal of the Teaching Strand is to contribute to the development of a science of teaching that addresses the complexity of how people facilitate other people's STEM learning.

Submissions to the Teaching Strand should describe how the proposed innovation or approach aligns with current STEM education frameworks (e.g., curriculum, pedagogies, standards). In doing so, proposals should also provide a compelling argument for how the innovation or approach would be an *improvement* relative to current practice, and why and how it would lead to improved teacher practices and related outcomes for teachers and students.

Teaching Strand proposals should focus primarily on teacher knowledge, beliefs, and practices as the unit of analysis. Student learning outcomes can be assessed and framed as evidence of the effectiveness of innovative approaches to supporting teacher practice.

Focal areas of interest to the program include but are not limited to the following:

- Enhancing understanding of attributes of effective teaching within and across STEM content areas, in specific contexts, and at various levels of professional development.
- Developing better understanding of how to support teachers' ability to engage with and build the capacity of all students, particularly those from groups that have been traditionally under-served and/or underrepresented in STEM fields.
- Articulating the contributions of, and dynamics among, stakeholders in the formal STEM education and education research ecosystems including teachers, school counselors, and families.
- Designing and testing ways of translating promising research findings into usable knowledge for teaching practice.
- Translating teacher knowledge and practice into usable knowledge for research.
- Proposals focused on research and development activities to advance innovative approaches to support and sustain high-quality STEM teaching in rural preK-grade 12 schools.

NOTE: Proposal budgets should offer fair remuneration for teacher participants in their support costs. Any local school district caps on teacher remuneration should be stated in the budget justification.

Learning Strand

Like their teachers, students need support to learn about new discoveries in the STEM disciplines and how to integrate contemporary and dynamic STEM content into their developing understandings of the world and their place in it. The program invites proposals that seek to understand how and why novel and potentially transformative STEM education innovations or approaches may improve student learning and interest in STEM. Further, the program invites proposals that aim to provide *all* students with STEM learning experiences that prepare them to understand and use scientific information, to serve their communities, and prepare students for potential post-secondary education opportunities and workforce participation.

Proposals submitted to the Learning Strand should describe how the proposed STEM education innovation or approach aligns with current curricular frameworks, understandings of child and youth development, and evidence of how students engage with and learn STEM content. Moreover, proposals should demonstrate how a proposed innovation would be an *improvement* relative to students' current opportunities to learn.

Learning Strand proposals should focus primarily on student learning and other characteristics as the unit of analysis. Teacher professional development and related outcomes can also be assessed and framed as part of the innovation's efforts to support student outcomes.

Areas of interest to the program include but are not limited to the following:

- Emerging contexts and tools for learning STEM concepts and skills.
- Inquiries of how to blend classroom learning with digital tools to supplement or extend resources in the local context.
- Studies of the cognitive, affective, and other relevant foundations of student STEM learning (e.g., social, embodied, etc.) and how these dimensions operate in concert.
- Examining implementation of innovations across contexts with attention to who was and was not served by the innovation.
- Advancing understanding of how to build on the knowledge, skills and potential that students bring to their formal schooling.
- Developing and studying approaches to help students, particularly those students who are from groups that have been and are currently under-served and/or underrepresented in STEM fields, see themselves as someone who could belong in STEM.
- Studies of how to develop preK-12 students' data literacy skills.
- Proposals focused on attracting students to any STEM field(s) and to [NSF priority areas](#) including microelectronics, semiconductors and emerging industries/technologies; and climate and clean energy.
- Research and development that seeks to identify barriers rural students face in accessing high-quality STEM education, and development of innovative approaches to improving the participation and advancement of rural preK-grade 12 students in STEM studies.

C. DRK-12 Research Project Types

Under each Strand (Teaching and Learning), the program welcomes a range of research project types. The research project type descriptions in this section may help applicants sharpen the focus of their project. They represent the kinds of research that might be done, ranging from exploratory work to efforts at scale. Successful projects will identify an important area of need or opportunity and build on prior research. Proposals should use contemporary and rigorous research designs and analytic techniques that align to their proposal's aims and scope of work. While the program emphasizes the need to understand what works, for whom, and under what conditions, proposals should also offer insights into *how and why* innovations and approaches do and do not work. Such explanatory foundations are critical to expanding learning opportunities across different contexts, developmental levels, etc.

1. **Exploratory.** Exploratory Studies provide investigators with opportunities to investigate STEM education problems that establish the basis for design and development of STEM education innovations or approaches. Exploratory Studies allow researchers to establish initial connections to or among the outcomes of interest related to STEM teaching and learning. Studies must also provide a well-specified, empirically supported, conceptual framework or theory of change that describes the innovation or approach's assumptions, central design features, anticipated effects that these features elicit, and explanations that relate features to effects. A theory of action may include factors associated with STEM teaching and learning outcomes or with moderating or mediating features of the innovation or approach. The theory of action should also provide a basis derived from empirical evidence for pursuing a Design and Development, Impact, or Implementation and Improvement Study, or the need for further research. The research plan for an Exploratory Study must include the research questions, research design, study sample, data collection procedures, measures to be employed and their technical accuracy, and proposed data analysis. DRK-12 Exploratory Study proposals are consistent Exploratory types of research and development in the Common Guidelines for Educational Research and Development https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf13126.

2. **Design and Development.** Design and Development Studies research and develop new or improved STEM education innovations or approaches to achieve specific goals related to teaching or learning. Studies exist along a continuum from development of a prototype or early version of the proposed STEM education innovation or approach to refinement of an existing prototype of a STEM education innovation or approach. Design and Development Studies should provide a strong justification for development or refinement of the proposed innovation or approach. The proposal should articulate the key components of the innovation or approach and present a theory of change which describes how the theory influences the selection of questions to investigate and gathering of evidence to guide the design.

The research plan for a Design and Development Study must clearly articulate the methods for developing or refining the innovation or approach, the methods for collecting evidence on the feasibility that end users will be able to implement the innovation or approach in an authentic education or learning setting, and the methods for obtaining pilot data on the promise of the innovation or approach for achieving the expected outcomes. The description of the pilot study must include the research questions, research design, counter-factual condition (where applicable), study sample, data collection procedures, measures to be employed and their technical adequacy, power analysis (where applicable), and proposed data analysis. DRK-12 Design and Development Study proposals are consistent with the Design and Development type of research and development in the Common Guidelines for Educational Research and Development.

3. Impact Studies. This work expands the evidence of promise from previous studies to provide more rigorous evidence of the strength of the STEM education innovation or approach to achieve its intended outcomes. This is accomplished through efficacy or effectiveness studies. An *efficacy* study examines the impact of a STEM education innovation or approach under ideal conditions, while an *effectiveness* study examines that impact under normal educational contexts and settings.

Proposals for Impact Studies should provide a clear description of the STEM education innovation or approach to be tested, the problem the innovation or approach is attempting to address, how the innovation or approach is an improvement over other approaches to the problem and why the innovation or approach is appropriate and well-suited for an efficacy or effectiveness study. The proposal should present a detailed theory of change and describe how the theory influences the selection of appropriate variables to be studied. The proposal should document existing evidence that supports the promise of the innovation or approach. Such evidence must go beyond pre-post data to include evidence from a study with an equivalent comparison group.

The research plan for an Impact Study must clearly articulate the research questions, research design, counter-factual condition, study sample and recruitment plan, data collection procedures, measures to be employed and their technical adequacy, relevant power analysis, and proposed data analysis. The power analysis and data analysis must reflect the design choices and if appropriate, account for multi-level or nested research design. The power analysis should justify all design parameters and provide sufficient detail for replication. The analytic models should be justified and described in sufficient detail so they could be replicated. The sharing of data from Impact studies should allow for others to reproduce the results when conducting the same or similar analyses, which should be addressed in the Data Management Plan of the proposal. Impact study proposals should include plans for preregistration in an appropriate publicly available registry.

DRK-12 Impact Study proposals are consistent with the Efficacy and Effectiveness Studies type of research and development in the Common Guidelines for Educational Research and Development. In addition, studies should be described in sufficient detail so that other researchers can replicate the research as discussed in the Companion Guidelines on Replication and Reproducibility in Education Research.

4. Implementation and Improvement Studies. Implementation and Improvement studies aim to strengthen the capacity of an organization to reliably produce valued STEM education outcomes for diverse groups of students. These studies require deep engagement and collaboration of researchers and practitioners on problems of practice that are co-defined and of value to researchers and education agencies, such as a school district or community of schools. Implementation and Improvement studies may examine implementation in the local context; employ rapid changes in implementation with short-cycle methods; address organizational structures and processes and their relation to innovation; test working theories to learn whether specific changes produce improvement; and reform the system in which the approach is being implemented. The methods associated with these studies vary and should be consistent with the goals of the project. Implementation and Improvement Studies must clearly articulate the shared goal of the researcher/practitioner collaborators; the conceptual frameworks for implementation and improvement in the educational system; and the methodological approach for the study.

5. Measurement and Assessment. Focused on assessment *for* STEM teaching and learning or *of* STEM teaching and learning, these proposals should carefully specify the STEM constructs, target population, and intended use of the measurement instrument. The approach for developing the measurement instrument and protocols must be clearly detailed and justified. A plan for demonstrating how the measure will allow for valid and reliable inferences of the constructs being assessed is critical. Fairness must be considered and when appropriate, demonstrated in all facets of the development, testing, and use of the measurement instrument.

6. Syntheses. Synthesis studies may be in the form of a literature review, qualitative or mixed methods meta-synthesis and/or meta-analysis. Proposals should demonstrate a command of the breadth and depth of the literature on the question, issue, or topic. This background should be used to make a case for the amount, type, and relevance of available literature in conducting the synthesis. The literature search procedures, selection procedures (methods, search criteria, etc.), inclusion criteria (e.g., population, theoretical frameworks, study participants, measures, publication types, etc.) and screening methodologies should be discussed. For meta-analysis and meta-synthesis proposals, applicants should discuss what analysis package will be used and how the relevant data will be stored after the conclusion of the project.

For meta-analysis proposals, authors should discuss all aspects of the quantitative synthesis, including, but not limited to effect size estimation, data transformations, meta-analytic models, moderators, and sensitivity analyses. Proposals should be sufficiently detailed and explicit with respect to methods such that the proposal can serve as a review protocol or pre-analysis plan in addition to allowing for replication and reproducibility by others.

For qualitative or mixed methods meta-synthesis proposals, authors should clearly describe the coding and analysis process. Proposals should address how the synthesis will address findings from different methodological approaches. Proposals should discuss the strategies that will be employed to establish trustworthiness and credibility throughout the study, as well as the transparency of the process.

Note: Synthesis proposals are up to \$600,000 and three-years duration.

D. Other DRK-12 Project Types

In addition to original research proposals, DRK12 also welcomes and supports proposals that involve partnership development and workshops/conferences that explicitly advance research and development in the Teaching and Learning strands. Investigators of the proposal types below are strongly encouraged to contact a program officer prior to submission to discuss their idea(s). Proposers are also encouraged to consider how their proposed work furthers the priority of supporting knowledge mobilization for preK-12 formal STEM learning and teaching (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf23078).

- **NEW: Partnership Development.** Partnership Development proposals can request up to \$100,000 for one year. Connections and co-design among district and school administrators, teachers, researchers, and other community stakeholders are critical infrastructure in applied research and development efforts that are situated in formal education settings. Partnership Development projects must include school partners and researchers. **Projects are expected to lead to the development of a research and development project that is responsive to the DRK-12 solicitation.** Activities within the scope of this project type include, but are not limited to, multidisciplinary workshops, stakeholder meetings, project planning and explorations regarding the positioning and capacity of the team to work together to advance formal PreK-12 STEM teaching and learning. Proposals should articulate how and why they seek to intentionally build new, or expand existing, collaborations as well as a clear statement of how the activities will result in, or contribute to, DRK-12 research and development program goals. Proposals should provide a clear plan and/or framework for fostering relationship development, power sharing, respectful decision-making, and identifying future proposed projects that ensure reciprocal benefits. Proposals should have a formal mechanism to assess the project's progress and describe the steps that will be taken to effectively provide feedback on what's working and not working in the planning and partnership processes, and how to make improvements in the functioning of the team to progress toward DRK-12 program goals. The Project Description is limited to 8 pages. Submissions that exceed this limit will be returned. Funding of partnering organizations must be requested via subawards. Separately submitted collaborative proposals will not be accepted.
- **Workshops & Conferences.** Workshop/Conference proposals are up to \$200,000 and one-year duration. Proposals can be submitted at any time; there is no specific due date for Workshop & Conference proposals. Proposals should focus on an issue of importance to DRK-12 program priorities as well as a clear statement of how the activities will result in, or contribute to, DRK-12 research and development program goals. The program invites

proposals that bring together researchers and school partners to identify and/or advance critical research agendas of broader importance to preK-12 STEM education. Convenings focused on facilitating the reciprocal exchange of knowledge and expertise between STEM researchers and preK-12 education professionals are particularly welcome. Other areas of interest include the integration of advanced and emerging technologies into preK-12 STEM classrooms and supporting preK-12 STEM education's capacity to respond to emerging societal grand challenges. Proposers are encouraged to consider multi-stage convenings (rather than a single event concentrated over several days) that allow time for collective knowledge building and diverse modes of participation. Proposals should address the need for the work, why it is timely, and the expected contributions to understanding or advancing the question, issue, or topic. Further, proposals should demonstrate a command of the literature and/or practice on the question, issue, or topic. Participant expertise and selection should be discussed. Conference proposals should include a conceptual framework, draft agenda, possible participants in terms of their expertise, and the outcomes or products that will result. For general guidance about conferences, follow the guidance for preparing Conference Proposals contained in PAPPG Chapter II.F.9. The "Conference" type of proposal should be selected in Research.gov or Grants.gov.

E. Selected Resources. DRK-12 and other programs (described below) fund resource and infrastructure centers to provide technical assistance to their current and prospective PIs.

The Community for Advancing Discovery Research in Education (CADRE) is the current and primary resource network for the DRK-12 program. Its primary aim is to support and connect researchers and developers in K-12 STEM education. Resources made available by CADRE to the STEM education research community are available at <https://cadrek12.org/>. The NSF Proposal Toolkit may be of particular interest to those who are new to NSF <https://cadrek12.org/resources/nsf-proposal-writing-resources>.

The DRK-12 program also supports the Evidence Quality and Reach (EQR) Hub works to strengthen STEM education researchers' cutting-edge knowledge of advanced research methods and ability to translate research knowledge to multiple and diverse stakeholder audiences. The EQR Hub offers learning events, services, and resources related to research methods; knowledge translation; and diversity, equity, and inclusion to current and prospective DRK-12 grantees. The Hub develops and implements virtual webinars and workshops, convenes communities of practice, and engages in individualized consultations with DRK-12 projects. More information is available at <https://cadrek12.org/eqr-hub>.

While resources on the CADRE and EQR Hub websites may be most pertinent to proposal preparation for the DRK-12 program, these additional centers may also be useful:

1. [Advancing Informal STEM Learning \(AISL\) Equity Resource Center](#)
2. The [Center for Integrative Research in Computing and Learning Sciences \(CIRCLS\)](#) supports research on emerging technologies for teaching and learning.
3. [EDU Core Research - Resource Coordination Hub \(ECR Hub\)](#)
4. NSF INCLUDES has several hubs. For more information, see the NSF INCLUDES Coordination Hub and National Network: <https://www.includesnetwork.org/home>
5. The [STEM Learning and Research Center \(STELAR\)](#) is supported by the Innovative Technology Experiences for Students and Teachers (ITEST) program.

Other Funding Opportunities

The programs listed below may also be of interest; see individual solicitations for due dates.

- [Advancing Informal STEM Learning \(AISL\)](#) <https://new.nsf.gov/funding/opportunities/advancing-informal-stem-learning-aisl>
- [Dear Colleague Letter: Research to Improve STEM Teaching, Learning, and Workforce Development for Persons with Disabilities](#) https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf21114
- [Faculty Early Career Development \(CAREER\)](#) https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503214
- [Improving Undergraduate STEM Education \(IUSE\)](#) https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=505082
- [Racial Equity in STEM](#) https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf22634
- [Robert Noyce Teacher Scholarship Program \(Noyce\)](#) https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5733
- [Research Coordination Networks \(RCN\)](#) https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=11691

References

National Science Board – Vision 2030 (<https://www.nsf.gov/nsb/publications/2020/nsb202015.pdf>)

NSF 2022-2026 Strategic Plan (https://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf22068)

III. AWARD INFORMATION

Anticipated Funding Amount: \$50,000,000

Pending availability of funds, NSF anticipates approximately \$50,000,000 will be available for the FY2024 competition.

The level of funding requested for **research** projects should align with the aims and scope of the proposed work, and the capacity of the interdisciplinary team to conduct the proposed project type. Proposals should provide clear justifications for the requested level of funding. Funding level ranges for research projects are as follows:

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- Partnership Development proposals are up to \$100,000 for one year;
- Synthesis proposals are up to \$600,000 and three-years duration;

Workshop /Conference proposals are up to \$200,000 and one-year duration.

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:

There are no restrictions or limits.

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.E.3 provides additional information on collaborative proposals.

See PAPPG Chapter II.D.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.

Required Sections of a Proposal

See PAPPG Chapter II.D.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.

1. Cover Sheet: Mark the Human Subjects box as pending, approved, or exempted (with exemption subsection 2 indicated). This box should not be left blank for any project involving teacher and student participants. An exemption to this requirement includes Syntheses proposals that use completed research projects as their data sources. The Human Subjects box should be marked as pending if an IRB is either (1) reviewing the project plan and has not yet determined a ruling of "approved" or "exempt", or (2) the project plan has not yet been submitted to an IRB for review.

To avoid delays in processing award recommendations, it is strongly recommended that PIs begin the process of obtaining appropriate Institutional Review Board (IRB) approvals or exemptions as needed for projects involving human subjects. No awards will be made without such approvals or exemptions.

2. Project Summary. Each proposal must have a summary of the proposed project not more than one page in length. It should consist of three sections:

Overview: Proposals should provide an overview of the central issue or purpose of the project.

The first sentence of the Project Summary should specify the Strand (Learning or Teaching) addressed and the project type. Project type options include one of the six Research Project Types specifically: Exploratory; Design and Development; Impact; Implementation and Improvement; Measurement and Assessment; and Synthesis. Other project types include Partnership Development and Workshop/Conferences. For example,

- This three-year Exploratory project in the Teaching strand seeks to ...
- This two-year Synthesis project in the Learning strand aims to ...
- This Partnership Development proposal in the Teaching strand would ...

The opening sentences of the project summary should clearly state the STEM discipline or disciplines being addressed and the developmental or grade level(s) of participants, if appropriate.

Intellectual Merit: The statement on intellectual merit should describe the potential of the proposed activity to advance knowledge by including the (1) theoretical or theory-building approach, (2) research questions or problem statement, and (3) methodological approach.

Broader Impacts: 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.

3. Project Description: The Project Description is limited to 15 pages (except in the case of the 8-page limit for Partnership Development proposals) and must comply with all formatting requirements of the most current PAPPG. Proposals funded under this solicitation must focus on research and development related to PreK-12 STEM learning or teaching.

Proposals must address the following elements in the page limitations of the project description, in any order:

- **Importance:** The proposal must clearly show how the proposed project addresses critical STEM educational needs and has potential for broad impact. The proposal should provide a rationale for how the project will improve STEM education for teachers and their students and advance knowledge. Proposals should explain how products or findings might ultimately be implemented in schools, in either the immediate or long term. The proposal should address how the proposed innovations or approaches differ from existing practice and why the proposed project has potential to improve education processes and outcomes beyond what current practice provides.
- **Results from prior NSF support.** The proposal must describe results of prior NSF support for related educational projects in which the PI or co-PI have been involved, as outlined in the PAPPG (NSF 23-1).
- **Research and Development Design.** DRK-12 supports several types of research and development efforts. Refer to Section II.C for guidance on each research project type supported by the program. Partnership Development and Workshop/Conference proposals should refer to the guidance provided in Section II.D.
- **Mechanisms to Assess Success of the Project.** All DRL projects are subject to a series of external, critical reviews of their designs and activities (including their theoretical frameworks, data collection plans, analysis plans, and reporting plans). Peer review of the proposed project and ongoing post-award monitoring by NSF staff are two types of external critical review that apply to all DRL projects. Proposals must describe appropriate mechanisms to assess success through project-specific external review and feedback processes. These mechanisms might include an external review panel or advisory board proposed by the project or a third-party evaluator. Mechanisms to assess success should be sufficiently independent, rigorous, and timely as to influence the project's activities and improve the quality of its findings. Successful proposals will (1) describe the expertise of the external reviewer(s) or advisory board; (2) explain how that expertise relates to the goals and objectives of the proposal; (3) identify a specific set of questions that frames the feedback or review; and (4) specify how the PI will report and use results of the project's external, critical review process.
- **Communication / Dissemination.** Projects are expected to contribute to practice and theory through the communication / dissemination of promising products or approaches for use by others. Dissemination / communication plans should go beyond traditional researcher-focused avenues (e.g., peer-reviewed publications and other forms of scholarly dissemination). Strong dissemination plans will identify specific audiences to be served/engaged and describe specific mechanisms for connecting with those audiences. Plans should also state how audiences will be able to interact with the knowledge shared. Ideally, plans will include opportunities for two-way communication between audiences and the research team. Metrics for assessing the project's reach or impact are strongly encouraged (e.g., downloads, views, etc.). Project budgets should account for communication costs.
- **Expertise.** DRK-12 proposals generally involve interdisciplinary teams. Projects typically include STEM education researchers, development experts, school district personnel, experienced teachers, STEM researchers, statisticians, psychometricians, learning scientists and informal learning experts, and policy researchers, as appropriate. When feasible, proposals should include new researchers and developers (e.g., beginning scholars, postdoctoral associates, and graduate students) as part of the project team as a means of building a more diverse community of researchers, designers, and developers. The proposal should include a brief narrative describing the expertise of personnel and their roles and responsibilities relative to the proposed work, including those responsible for the external review.
- **Broader Impacts.** Please note that per guidance in the PAPPG, the Project Description must contain, as a separate section within the narrative, a section labeled "Broader Impacts". Proposers can decide where to include this section within the Project Description.

4. References Cited: Any literature cited should be specifically related to the proposed project and listed in accordance with Chapter II.D.2e of the PAPPG in a separate section from the Project Description. In addition, the Project Description should make clear how each reference has played a role in the motivation for, or design of, the project.

5. Budgets & Budget Justification: Proposal budgets and project durations should be determined by the scope of the activities and prepared in accordance with the guidance in the PAPPG and this solicitation. Budgets cannot exceed a maximum request of \$5M, nor a project duration of over five years. All budgets, both proposer and subaward budgets (if applicable), must be accompanied by budget justifications that include itemizations corresponding to each Research.gov or Grants.gov budget line item and provide sufficient detail as to justify the expense and its relevance to achieving the project goals. Each budget justification, both for the proposer and each subawardee (if applicable), may be up to five pages in length. Budgets and budget justifications submitted to this solicitation should reflect an equitable distribution of funds based on the project scope and substantively value the range and types of participation in the project. For proposals with subawards, each subaward must include a separate budget and budget justification. The budget justification should include the basis for selecting the subawardee, an itemization and explanation of expenses, and consist of no more than five pages.

NOTE: Proposal budgets should offer fair remuneration for teacher participants in their support costs. Any local school district caps on teacher remuneration should be stated in the budget justification.

6. Facilities, Equipment & Other Resources: 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.2.g). The description should be narrative in nature and **must not include any quantifiable financial information.**

7. Senior Personnel Documents

- **Biographical Sketches:** In accordance with the guidance contained in the PAPPG, a separate biographical sketch must be provided for each individual designated as senior personnel on the project.
- **Current and Pending Support:** In accordance with the guidance contained in the PAPPG, current and pending support information must be separately provided for each individual designated as senior personnel on the project.
- **Collaborators and Other Affiliations Information:** Collaborators & Other Affiliations (COA) information specified in the PAPPG should be submitted using the instructions and spreadsheet template found at <https://www.nsf.gov/bfa/dias/policy/coa.jsp>.

8. Data Management Plan: All data collected for DRK-12 projects must accord with the NSF Data Management Guidance, which may be found here: <https://new.nsf.gov/funding/data-management-plan>. Data Management Plans will be reviewed by panelists and program directors and should be written with sufficient clarity and detail to support proposal processing and the merit review process. Generic Plans should be avoided. The Data Management Plan (not to exceed two pages) should describe the data, metadata, samples, software, curricula, documentation, publications, and other materials generated during the proposed research. The Data Management Plan should reflect the best practices and standards for the proposed research and types of data being generated, whether experimental, computational, text-based, media or physical materials. DRK-12 expects its awardees to describe how data and related materials are generated to allow others to reproduce the findings and/or replicate the study. Further the Plan should support the sharing of data, products and methods in such a way that others can understand, validate, and replicate the research findings.

9. Postdoctoral Mentoring Plan: Each proposal that requests funding to support postdoctoral researchers must upload under "Mentoring Plan" in the supplementary documentation section, a description of the mentoring activities that will be provided for such individuals. In no more than one page, the mentoring plan must describe the mentoring that will be provided to all postdoctoral researchers supported by the project.

10. Other Supplementary Documentation:

- **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. Proposals submitted with an Appendix will be returned without review.
- **Letters of Collaboration:** Letters of collaboration from project consultants, advisors, distributors, and organizational partners are encouraged. Such letters should follow the requirements for Letters of Collaboration given in Chapter II of the PAPPG. However, Letters of Support or Endorsement from persons or institutions 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.**
- **List of All Project Personnel:** In addition to guidance provided in the PAPPG on required Special Information and Supplementary Documents, please provide a list of all project personnel in the Supplementary Document section. Include current, accurate information for all personnel and institutions involved in the project. NSF staff will use this information in the merit review process to manage reviewer selection. That is, anyone listed as senior personnel will be excluded from the pool of eligible reviewers. The list should include all PIs, co-PIs, senior personnel, paid/unpaid consultants or collaborators, subawardees, postdoctoral researchers (if known), and project-level advisory committee members. This list should be numbered and include (in this order) Full name, Organization(s), and Role in the project, with each item separated by a semi-colon. Each person listed should start a new numbered line. For example:

1. Mary Smith; XYZ University; PI
2. John Jones; University of PQR; Senior Personnel

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

Other Budgetary Limitations:

Budget Preparation Instructions:

DRK -12 generally does not fund equipment that is normally found in schools, universities, and research and development organizations, such as computers. Requests for equipment must be accompanied by justification for its importance to the operation of the project.

The budget should include a request for funds to cover the cost of attendance of the Principal Investigator at a biennial awardees meeting in the Washington, DC area.

DRK -12 does not provide scholarships for undergraduate, pre-service, or other students.

C. Due Dates

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

November 08, 2023

Second Wednesday in November, Annually Thereafter

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 Research.gov 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 *Leading the World in Discovery and Innovation, STEM Talent Development and the Delivery of Benefits from Research - NSF Strategic Plan for Fiscal Years (FY) 2022 - 2026*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

A. Merit Review Principles and Criteria

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.D.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.D.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.

B. Review and Selection Process

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

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will generally be completed and submitted by each reviewer and/or panel. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements or the Division of Acquisition and Cooperative Support for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

Notification of the award is made to *the submitting organization* by an NSF Grants and Agreements Officer. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process.)

B. Award Conditions

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.

Administrative and National Policy Requirements

Build America, Buy America

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

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

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through [Research.gov](#), for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via [Research.gov](#) constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using [Research.gov](#). This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

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

VIII. AGENCY CONTACTS

Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.

General inquiries regarding this program should be made to:

- Inquiries can be made to, telephone: (703) 292-8620, email: DRLDRK12@nsf.gov

For questions related to the use of NSF systems contact:

- NSF Help Desk: 1-800-673-6188
- 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.

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.

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