

NSF 24-567: Molecular Foundations for Sustainability: Sustainable Polymers Enabled by Emerging Data Analytics (MFS-SPEED)

Program Solicitation

Document Information

Document History

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National Science Foundation

Directorate for Mathematical and Physical Sciences
Division of Chemistry
Directorate for Technology, Innovation and Partnerships
Innovation and Technology Ecosystems



Procter & Gamble



PepsiCo



BASF



Dow



IBM Corp.

Letter of Intent Due Date(s) (required) (due by 5 p.m. submitting organization's local time):

December 05, 2024

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

January 16, 2025

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Important Information And Revision Notes

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:

Molecular Foundations for Sustainability: Sustainable Polymers Enabled by Emerging Data Analytics (MFS-SPEED)

Synopsis of Program:

The Molecular Foundations for Sustainability: Sustainable Polymers Enabled by Emerging Data Analytics program (MFS-SPEED) is a cross-directorate funding call in response to The National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2021 and the 2022 CHIPS and Science Act. It is supported by the NSF Directorates for Mathematical and Physical Sciences (MPS) and Technology, Innovation, and Partnerships (TIP), and five industry partners: Procter & Gamble, PepsiCo, BASF, Dow, and IBM.

The goal of MFS-SPEED is to support fundamental research enabling the accelerated discovery and ultimate manufacturing of sustainable polymers using state-of-the-art data science, and to enhance development of a cross-disciplinary workforce skilled in this area. In particular, through this solicitation the research community is encouraged to address the discovery and elaboration of new sustainable polymers or sustainable pathways to existing polymers by the creation and use of a data-centric environment where research projects are:

1. focused on new approaches to predicting structure and properties of polymers and advanced soft materials,
2. with insights enabled by data analytics including Artificial Intelligence/Machine Learning;
3. This includes more efficient, scalable preparation of monomers and polymers using existing or new synthetic routes
4. and this call aims to train a technical workforce that leverages data analytics to create sustainable polymers and soft materials.

Molecular Foundations for Sustainability: Sustainable Polymers Enabled by Emerging Data Analytics (MFS-SPEED,) research grants – Awards will be supported in FY24/25 up to \$2M per award for up to a three-year grant period, commensurate with the scope and team size. This program seeks to fund collaborative team research that transcends the traditional boundaries of individual disciplines to achieve the program goals.

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.

- Kenneth Moloy, telephone: (703) 292-8441, email: NSFMFS@nsf.gov
- Tomislav Pintauer, telephone: (703) 292-7168, email: NSFMFS@nsf.gov
- Kenneth R. Carter, telephone: (703) 292-2335, email: NSFMFS@nsf.gov
- David Darwin, telephone: (703) 292-4728, email: NSFMFS@nsf.gov

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

- 47.049 --- Mathematical and Physical Sciences
- 47.084 --- NSF Technology, Innovation and Partnerships

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 4 to 6

Approximately 5 awards are anticipated, each up to \$2M total and up to 3 years in duration, subject to the availability of funds and quality of proposals received.

Anticipated Funding Amount: \$9,500,000

The total funding amount includes a \$500,000 in-kind contribution from IBM in the form of Access to Accelerated Discovery services (SaaS, Software as a Service).

The budget should be commensurate with the scope of the proposed research. Estimated program budget, number of awards and average award size/duration are subject to the availability of funds.

Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research laboratories, professional societies and similar organizations located in the U.S. that are directly associated with educational or research activities.
- Tribal Nations: An American Indian or Alaska Native tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges as a federally recognized tribe pursuant to the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. §§ 5130-5131.

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: 1

An investigator may only serve as a PI, co-PI or Senior Personnel on only **one proposal**, including sub-awardees, submitted in response to this solicitation. If an investigator exceeds this limit, the proposal received within the limit will be accepted based on earliest date and time of proposal submission. The remainder will be returned without review. This limitation includes proposals submitted by a lead organization and any subawards included as part of a proposal involving multiple organizations.

Number of PIs per proposal: Minimum of 2

Given the multidisciplinary nature of research encompassed by MFS-SPEED, proposals must involve the participation of at least two investigators, e.g., one PI and one or more co-PIs. The proposals must demonstrate a collaboration between the investigators with synergistic approaches to the problem addressed by MFS-SPEED, with at least one of them having data science expertise and bringing significant data analytics to the proposed research. Investigators with expertise in macromolecular chemistry,

polymer chemistry, and/or polymer physics are particularly encouraged to build teams. Attention to recyclable, upcyclable, and/or biodegradable polymers is encouraged, as is systems thinking (see <https://www.whitehouse.gov/wp-content/uploads/2023/08/NSTC-JCEIPH-SCST-Sustainable-Chemistry-Federal-Landscape-Report-to-Congress.pdf>). Proposals with industry participation (e.g., as a co-PI through a GOALI proposal or as non-funded senior personnel) are encouraged.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Submission of Letters of Intent is required. Please see the full text of this solicitation for further information.
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**
 - Full Proposals submitted via Research.gov: *NSF Proposal and Award Policies and Procedures Guide* (PAPPG) guidelines apply. The complete text of the PAPPG is available electronically on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=pappg.
 - Full Proposals submitted via Grants.gov: *NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov* guidelines apply (Note: The *NSF Grants.gov Application Guide* is available on the Grants.gov website and on the NSF website at: https://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide).

B. Budgetary Information

- **Cost Sharing Requirements:**

Inclusion of voluntary committed cost sharing is prohibited.
- **Indirect Cost (F&A) Limitations:**

Not Applicable
- **Other Budgetary Limitations:**

Not Applicable

C. Due Dates

- **Letter of Intent Due Date(s) (required)** (due by 5 p.m. submitting organization's local time):

December 05, 2024
- **Full Proposal Deadline(s)** (due by 5 p.m. submitting organization's local time):

January 16, 2025

Proposal Review Information Criteria

Merit Review Criteria:

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

Award Administration Information

Award Conditions:

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


Reporting Requirements:

Standard NSF reporting requirements apply.

I. Introduction

Mitigating climate change, reversing the deterioration of ecosystems, and improving resiliency of our planet are urgent global challenges. Sustainable Chemistry, the ability to manufacture high-value molecules and materials at commercially relevant scale from available and renewable raw materials, while using sustainable energy sources, and then disassemble those molecules into non-toxic and environmentally safe substances when no longer needed, is critical in addressing these global challenges and calls for collaborative efforts of the scientific and engineering communities. Creating innovative solutions in the realm of Sustainable Chemistry and successful translation of basic science discoveries to commercialization and wide-spread use requires a paradigm shift where scientific discoveries across disciplinary boundaries must be pursued in the context of functioning systems/models and systems-level approaches. Synergistic cross-disciplinary expertise is expected to open up important new avenues to address these global challenges.

The National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2021 and the 2022 CHIPS and Science Act calls out Sustainable Chemistry as an important research topic area, urging NSF to establish a program to support chemistry research and education activities (<https://www.congress.gov/bill/117th-congress/house-bill/4346/text>) Sustainable Chemistry is also the subject of a recent report issued by the Sustainable Chemistry Strategy Team (SCST) under the auspices of the Joint Subcommittee on Environment, Innovation, and Public Health (JEEP) through the White House Office of Science and Technology Policy (<https://www.whitehouse.gov/ostp/news-updates/2023/08/02/nstc-sustainable-chemistry-report/>). In parallel, Sustainability, as it pertains to the chemical industry, is expected to play a prominent role in the future US economy and is discussed in detail in the 2022 NASEM report "The Importance of Chemical Research to the U.S. Economy (2022)" (ISBN 978-0-309-68863-5; DOI 10.17226/26568). In response to the societal needs and scientific advances, the Division of Chemistry (CHE) at National Science Foundation (NSF) establishes the Molecular Foundations for Sustainability (MFS) Program to promote collaborative research, workforce development, and partnerships needed to build a sustainable future.

In November 2022, the University/Industry Demonstration Partnership (UIDP), 16 large companies, and a similar number of academic leaders with interests in sustainable chemistry engaged in an NSF-funded workshop titled "Increasing Chemical Company Engagement in Federally Funded Research Opportunities" (https://www.nsf.gov/awardsearch/showAward?AWD_ID=2236626&HistoricalAwards=false). This broad group of chemistry and materials science experts representing public and private research domains rallied around a common motivation: to transform and accelerate sustainable polymer design using emerging digital tools. Achieving this vision would elevate American competitiveness by unleashing the discovery of superior and sustainable polymer chemistries, tackling major societal challenges from plastics wastes, and training a skilled workforce on much-needed combinations of chemistry and data science skills. The workshop results have been published in a publicly available report titled "Aligning Interests in Support of Chemistry Research" (<https://uidp.org/custom-type/chemistry-workshop-report/#disclaimer-21436> .

Building on societal needs and community input, the Molecular Foundations for Sustainability: Sustainable Polymers Enabled by Emerging Data Analytics program (MFS-SPEED) is a cross-directorate funding call supported by the NSF's Directorates for Mathematical and Physical Sciences (MPS) and Technology, Innovation, and Partnerships (TIP) to leverage and advance the discoveries supported by the MFS Program.


The goal of MFS-SPEED is to support fundamental research enabling the accelerated discovery and ultimate manufacturing of sustainable polymers using state-of-the-art data tools, and to enhance development of a workforce skilled in this subject area.

In the context of this funding opportunity, the term polymers includes traditional thermoplastics and thermosets as well as water soluble polymers (ionic and nonionic) used in applications where properties such as surface energy and rheology modification are important. Sustainable refers to materials produced from building blocks, reagents, and catalysts that

are renewable, operate at optimal efficiency, employ renewable energy sources, and with reduced waste; this includes the intentional design, manufacture, use, and end-of-life management of these materials and products across their lifecycle that do not adversely impact human health and the environment, while promoting circularity, meeting societal needs, are scalable and contribute to economic resilience, and aspire to perpetually use elements, compounds, and materials without depletion of resources or accumulation of waste. Depending on their use and disposal, particular focus is on polymers that biodegrade in the receiving environment or polymers that can be upcycled/recycled into valuable materials. MFS-SPEED seeks to accelerate the discovery of sustainable polymers through the disruptive and innovative application of new and emerging data and chem- and polymer informatic tools such as artificial intelligence (AI), machine learning (ML), and systems-level approaches. The creation of a workforce skilled in the use of AI/ML and related tools to solve chemical and materials manufacturing problems is another MFS-SPEED goal.

MFS-SPEED complements existing research activities in the current research areas in sustainable chemistry and sustainable polymers, both within NSF and other federal agencies, but focuses on the integration of new and emerging data tools to enable more rapid, efficient discovery and development, and thus impact on the economy and environment. MFS-SPEED proposals should provide a clear vision of the application area impacted by the research and can include ties to industry to enable rapid adoption of new discoveries. They should provide a vision statement describing the new capabilities that could be enabled by the proposed research, and the potential industrial, educational, and societal benefits.

Sustainability must be addressed in all proposals. Important considerations toward this end include, but are not limited to, renewable and/or bio-based raw materials (monomers), modification of naturally occurring polymers/materials, polymer re- or upcycling, polymer biodegradability, the fate and movement of polymers and their degradation products in the environment, and energy efficiency. Polymer properties remain critical to their eventual utility and thus also should be addressed.

Polymer informatics and data approaches should address the digitization of polymer structures, data structuring and analytics, and prediction of parameters relevant to both sustainability and structure-property/polymer physics. To these ends, MFS-SPEED emphasizes research on data infrastructure tools to advance polymer informatics (digitization of polymer structures, data structuring and analytics, common methods and measures frameworks, structure and property prediction, software tools), models for the computational description of polymeric structures and properties (e.g. BigSMILES, <https://olsenlabmit.github.io/BigSMILES/> ) including linear, branched, cross-linked, networked, and water-soluble polymers), prediction of polymer structures from automated interpretation of analytical data, and new, validated AI/ML tools that enable development of novel sustainable polymers.

All proposals should describe the implications of the proposed activities on the education of a skilled technical workforce, especially at this intersection of chemical/polymer research and data/modeling. The development of a skilled workforce operating at this interface is critical to the accelerated discovery of new sustainable polymers and should be addressed. All teams responding to this solicitation must include a "Educational and Workforce Impact" section describing how the project addresses this need and the expected impact of the grant.

The results of this program, when translated to practice, should advance the U.S. polymer manufacturing industry, enable new capabilities and enhance U.S. competitiveness in developing new products. This initiative will educate and train students with the skills needed for a paradigm shift in these industries. Results will help the manufacturing enterprise minimize environmental impact; reduce energy consumption in both the manufacturing and use; manage waste; and optimize design, fabrication, and the use of resources.

MFS-SPEED proposals should demonstrate the need for sustained support of a multidisciplinary team using a convergent research approach. Inclusion of minority-serving institutions (<https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html>) and organizations from EPSCoR states (<https://new.nsf.gov/funding/initiatives/epscor/state-websites>) is encouraged. Proposals must describe why the project team is appropriate to realize the project goals and how the team will ensure effective collaboration. A compelling rationale must be presented for a multiorganization structure of the project. Therefore, proposers responding to this solicitation must include a "Project Management and Collaboration" section.

Proposals may take advantage of significant efforts underway to improve the nation's competitiveness in sustainable polymers and materials. For example, proposals may leverage activities of other initiatives in the U.S. government and in Industry. Proposers are also encouraged to leverage existing educational programs within or outside of NSF in creative ways

II. Program Description

II. A. PROGRAM DESCRIPTION

MFS-SPEED aligns with national priorities in emerging technologies, namely, advanced engineering materials, artificial intelligence, advanced manufacturing, and biotechnology. MFS-SPEED further supports OSTP's (Office of Science and Technology Policy) multi-agency research and development priorities including sustainable chemistry as identified in a recent report by the NSTC (National Science and Technology Council).

MFS-SPEED will support activities that significantly accelerate the discovery-to-use timeline in sustainable polymers by applying new and emerging data analytics to advance the design, development, or manufacturability (i.e., properties relevant to manufacturing, process-property relationships, property performance metrics, scalable synthesis routes, economic feasibility, supply chain considerations, or life cycle issues) of sustainable polymers with desirable properties or functionality. Accordingly, MFS-SPEED will drive the development of new tools and approaches, and their integration with experiment, theory, computation, data analytics, and AI/ML to achieve its objective. NSF and the participating companies are seeking efforts that will focus strictly on data science directed towards polymer and soft matter sustainability in precompetitive, fundamental research space. This program intends to address the gap between how polymer/soft matter research is conducted today and how it needs to be conducted in the future to allow for the grand challenges around sustainability to be addressed.

The nature of the activities addressed by this initiative requires a transformative interdisciplinary approach to discovering new, sustainable polymers and soft matter. MFS-SPEED will address this challenge by supporting interdisciplinary teams to conduct research that leverages new and emerging data analytics to advance polymer informatics, while educating, training, and promoting a diverse and inclusive future workforce skilled at this multidisciplinary interface and building a cohort of researchers committed to establishing consistent practices for workflows, analysis, and data sharing.

Proposers to this solicitation will address sustainable polymers via one or more of three important areas: (1) application of AI, ML, and other modern data analysis techniques to polymer chemistry, structure, and properties with the goal of identifying promising areas for further interrogation; such approaches should both result in a broadly applicable ontology to allow modeling of polymers and also be validated by appropriate analytical methods to ensure robustness of developed techniques and models; (2) development of data architecture approaches to polymer informatics that ensures that data that is not published is not lost but rather managed and retained in a platform that allows it to be shared, accessed, and leveraged for future precompetitive, fundamental research; and (3) leverage experts in a variety of fields to develop best practices around the development of consistent standards that can be applied to the analysis of polymer chemistry and polymer physics; these standards can include but should not be limited to monomer properties, polymer biodegradability, long chain oligomer or polymer safety and toxicology, environmental fate, polymer properties and performance, and predictive determination of highly complex aggregation.

All proposed programs need to discuss approaches to building the polymer-data science workforce (4) – these programs can include but should not be limited to PhD-level industrial internships, faculty-industry researcher exchange programs, joint PhD research programs, and undergraduate capstone projects. To institutionalize the paradigm shift of infusing data science and proven data approaches into fundamental polymer research, recipients will disseminate the approaches developed as part of the award in educational journal articles and the sharing of data and code produced in these projects.

Focus on Sustainability

Sustainability here implies a use-inspired approach to optimizing the efficacy of materials in the economy, including considerations such as process energy efficiency, life cycle, and technoeconomic analysis. Also included are


considerations of carbon footprint, biodegradability/environmental fate and mobility, and toxicity, with a molecular circularity in mind. As stated in the recent OSTP Sustainable Chemistry Report (August 2023, <https://www.whitehouse.gov/wp-content/uploads/2023/08/NSTC-JCEIPH-SCST-Sustainable-Chemistry-Federal-Landscape-Report-to-Congress.pdf>), sustainability includes systems larger than only a specific molecule, polymer or reaction, but also includes downstream materials development, processing, net energy inputs, environmental impact, and economics.

A data-driven approach to the sustainability of polymer production is a key motivating factor. The desired outcomes as they relate to polymer chemistry and physics are important in their own right, but advances in foundational knowledge in this area are even more important in the context of sustainability. The proposed program will create a cross-functional platform that can catalyze and accelerate change to disrupt current approaches and develop more environmentally friendly, sustainable materials. For sustainable impact, outcomes should be translatable at scale to facilitate U.S. economic competitiveness in sustainable materials production.

The partnering companies involved in this program are committed to using sustainability as a call to action and desire to see academic researchers propose big data research approaches that will have broad societal impact with transformative results. This program does not seek to merely continue existing research. Rather, it seeks to incentivize a paradigm shift that enables data analysis and discovery applied to fundamental chemistry to become a platform for a sustainable future and tackles the research challenges at the more complex, system-level that goes beyond those supported by the existing NSF disciplinary programs.

Data Architecture

Universities possess vast quantities of data, and the hypothesis is that interrogating this data will accelerate innovation with an emphasis on sustainability. This includes data that are not published and held in inaccessible places such as notebooks, retired lab equipment, or individual computers, yet is nonetheless valuable. This program seeks to both incentivize a shift in culture to acknowledge that non-optimal, negative, or “uninteresting” lab results, should be retained and leveraged and to develop tools to support data retention and leverage. Applying AI/ML tools will allow for data to be analyzed in new ways. In addition to developing a methodology and culture of retaining data, this program seeks to bolster the use of techniques that will develop actionable findings from the information repository.

MFS-SPEED proposals must provide a plan for comprehensive data management that ensures transparency, data sharing, and open-source software, including an explicit statement of which open-source license(s) and repositories, if applicable, will be used. This requires that the data and findings of any MFS-SPEED grant are made available in a robust and dependable way that outlasts the lifetime of the project and is responsive to the FAIR (<https://www.go-fair.org/fair-principles/> ) principles where all generated data is Findable, Accessible, Interoperable, and Reusable. Teams/PIs are encouraged to consider broader aspects of data infrastructure and building a cohort of researchers committed to establishing standard best practices for data sharing in polymer science. To this end, proposers should be aware of and track efforts by NSF and other federal agencies to emphasize shared data infrastructure and the democratization of these resources (<https://new.nsf.gov/news/democratizing-future-ai-rd-nsf-launch-national-ai>).

Consistent Standards

To date, the methodology for quantifying polymer characteristics is not uniform. In the same way that molecular weight is consistent across laboratories across the world, there is a desire for the chemical properties of polymers and soft matter to be measured, analyzed, and cataloged in a consistent manner across labs so they can be accessible and readable by data analysis tools. Achieving this requires the development of general, standardized, and systematic workflows for using data analytics tools broadly in polymer science to address sustainability goals. The data analysis tools also need to be transferrable to other systems without significant recoding or reorganization. Such transferability would also allow for a future workforce skilled in, and comfortable with, the application of such tools, without the need for the deeper training required for their design from scratch. Developed code should be highly modular to facilitate addition, exchange, and adoption. The primary programming language should be one relevant to the broader technical community (such as Python or R) and code developed with proper version control (e.g., in GitHub). Projects should also consider repository (e.g., GitHub) and infrastructure maintenance and management, as well as the training of collaborators (students, partners, etc.) on software design principles (version control, testing, etc.).

Bolster the Chemistry-Data Science Workforce

Sustainability in polymer development and production requires a systems-level approach. Students may be attracted by this concept, but they need expertise in multiple areas to pursue it via a systems approach. A well-trained workforce will be well positioned to address a myriad of topics related to end-of-life optimization, life cycle analysis, decarbonization, biodegradability, or toxicity with a working knowledge of both chemistry and data science. Developing synergistic data analysis platforms that support such an endeavor requires a workforce that has dual capabilities in data science and polymer chemistry/physics.

II. B. ROLE OF INDUSTRY FUNDING PARTNERS

The companies listed in this solicitation (Procter & Gamble, PepsiCo, Dow, BASF, and IBM) commit to providing annual contributions to NSF for the purpose of funding proposals awarded under this solicitation. The reference to "industry partners" in this section refers specifically to these five entities and their role as funding partners in this solicitation. The contributions from these partners have been agreed upon based on a shared belief in the importance of making progress in the research, education, and workforce development goals identified in this program.

Prior to award, these industry partners may observe proposal panel reviews, but may not engage in or impact the panel proceedings. Panel observers will be required to agree to the same Conflict-of-Interests and Confidentiality Statement (NSF Form 1230P) required of reviewers. After completion of the merit review process, NSF will share with representatives of the industry partners the subset of proposals which are under consideration for funding by NSF, along with corresponding unattributed reviews and panel summaries where applicable. Proprietary or privileged information provided by the PI in the separate "Single Copy Documents" section of the proposal will not be shared with reviewers or industry partner representatives. NSF will take into consideration the input of all industry funding partners prior to making final funding decisions but will retain final authority for making all award decisions.

NSF will administer awards under the Program in accordance with standard NSF policies and procedures. All awards will be subject to standard NSF terms and conditions. Industry partners will not oversee the activities or use of funds by grantees under this Program but may engage with grantees as outlined below. Specifically, post-award, industry partners may make available direct contributions of resources including, but not limited to, software (prototypes or products), data sets, and/or other resources or infrastructure. No recipient will be required to use any industry partner's offered contributions.

After an award, an industry partner may also arrange to fund its own personnel as researchers to directly participate, part-time or full-time, with recipient project personnel. These arrangements will be optional and upon the mutual consent of the industry partner and respective recipient institutions. No recipient will be required to accept an industry partner researcher.

NSF will share annual and final annual project reports with industry partners after those reports have been reviewed and accepted by the cognizant NSF Program Officer.

The award terms and conditions will state that recipients shall grant to the sponsoring parties (NSF, and all the industry partners and their affiliates named in the award letter) a non-exclusive, worldwide, fully paid-up, non-transferable, sublicensable, irrevocable royalty-free license to all intellectual property rights in any inventions conceived or first reduced to practice in the performance of the Program work under the funding agreement. **[Note: the Bayh-Dole Act provides similar rights to the U.S. Government for patents on inventions made under federal funding.] The license to each industry partner will include its subsidiaries and contractors, at its discretion, to the extent that such use is specifically in connection with the industry partner's products and/or services.** Recipients shall grant the license to each industry partner named in the award letter unless the industry partner opts to decline the license. Such license shall not extend to recipients' background intellectual property; however, individual recipients and industry partners may negotiate, voluntarily, in good faith, a mutually acceptable resolution to background intellectual property, if desired, **though NSF shall neither enforce nor participate in any such negotiations between recipients and industry partners, nor will any funds provided by NSF to the recipient be contingent upon such negotiations.** No rights or licenses are granted by the industry partners. Recipients may delay the publishing of data and software describing

inventions to first permit the filing of patent applications. That said, NSF terms and conditions will require that recipients promptly publish all results, data, and software generated in performance of the research.

Proposals to this program may not list or describe any kind of agreed or assumed arrangement to use the contributions described above or any other collaborative arrangement with this solicitation's industry partners, beyond what is described in the eligibility section of this solicitation. Proposals that include such arrangements or collaborations with these partners will be returned without review. Exception: Proposers are not restricted from making use of the widely accessible products or services of industry partners.

Proposers to this program should not directly contact industry partners with questions pertaining to their company's participation in this solicitation. All questions should be directed to the NSF program points of contact listed in the solicitation.

III. Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant

Estimated Number of Awards: 4 to 6

Approximately 5 awards are anticipated, each up to \$2M total and up to 3 years in duration, subject to the availability of funds and quality of proposals received.

Anticipated Funding Amount: \$9,500,000

The total funding amount includes a \$500,000 in-kind contribution from IBM in the form of Access to Accelerated Discovery services (SaaS, Software as a Service).

The budget should be commensurate with the scope of the proposed research.

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

IV. Eligibility Information

Who May Submit Proposals:

Proposals may only be submitted by the following:

- Institutions of Higher Education (IHEs) - Two- and four-year IHEs (including community colleges) accredited in, and having a campus located in the US, acting on behalf of their faculty members. Special Instructions for International Branch Campuses of US IHEs: If the proposal includes funding to be provided to an international branch campus of a US institution of higher education (including through use of subawards and consultant arrangements), the proposer must explain the benefit(s) to the project of performance at the international branch campus, and justify why the project activities cannot be performed at the US campus.
- Non-profit, non-academic organizations: Independent museums, observatories, research laboratories, professional societies and similar organizations located in the U.S. that are directly associated with educational or research activities.
- Tribal Nations: An American Indian or Alaska Native tribe, band, nation, pueblo, village, or community that the Secretary of the Interior acknowledges as a federally recognized tribe pursuant to the Federally Recognized Indian Tribe List Act of 1994, 25 U.S.C. §§ 5130-5131.

Who May Serve as PI:

There are no restrictions or limits.

Limit on Number of Proposals per Organization:

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Number of PIs per proposal: Minimum of 2

Given the multidisciplinary nature of research encompassed by MFS-SPEED, proposals must involve the participation of at least two investigators, e.g., one PI and one or more co-PIs. The proposals must demonstrate a collaboration between the investigators with synergistic approaches to the problem addressed by MFS-SPEED, with at least one of them having data science expertise and bringing significant data analytics to the proposed research. Investigators with expertise in macromolecular chemistry, polymer chemistry, and/or polymer physics are particularly encouraged to build teams. Attention to recyclable, upcyclable, and/or biodegradable polymers is encouraged, as is systems thinking (see <https://www.whitehouse.gov/wp-content/uploads/2023/08/NSTC-JCEIPH-SCST-Sustainable-Chemistry-Federal-Landscape-Report-to-Congress.pdf>). Proposals with industry participation (e.g., as a co-PI through a GOALI proposal or as non-funded senior personnel) are encouraged.

Additional Eligibility Info:

Guidelines for the Participation of Partner Companies and Affiliated Individuals in Proposals:

Guidelines for Partner Companies:

A partner company is not permitted to participate in proposals to the program.

Guidelines for Individuals Affiliated with Partner Companies:

Individuals affiliated with a partner company may participate in proposals to the program subject to certain limitations and allowances. These limitations and allowances apply to individuals who are currently employed by, consulting for, currently seconded to or on sabbatical with an industry partner, or on an active agreement to provide services for the company. Specifically:

- Such individuals may not participate in their capacity as affiliated with the company.
- Such individuals may participate if they (i) hold a primary appointment at another organization not partnered on the program (e.g., a primary academic appointment at an institution of higher education), as applicable to and defined by that organization, and (ii) do so strictly in their capacity at that other organization.
- Such individuals may participate if their submission is not derivative of their work affiliated with an industry partner. A confirmation letter from the supporting company stating that the proposed project is not derivative of their work with the industry partner must be submitted as a single copy document with the proposal.

V. Proposal Preparation And Submission Instructions

A. Proposal Preparation Instructions

Letters of Intent (required):

Letters of Intent are required and must be submitted via Research.gov no later than the date specified in this solicitation. LOIs must include the following:

1. Title of the proposal, preceded by the words "MFS-SPEED:";
2. Names and organizational affiliations of the Principal Investigator (PI) and co-PIs. Proposals must involve the participation of at least two investigators, e.g., one PI and one or more co-PIs.
3. The names of any other participating organizations; and
4. In the Project Synopsis section, a brief description of the specific goals of the proposal and how the proposed research is responsive to the MFS-SPEED solicitation.

Letters of intent are required for proposals to this solicitation. They are non-binding with respect to the team members, title, and specific goals of the research. The letters of intent will not be used as pre-approval mechanisms for the submission of proposals, and no feedback will be provided to submitters. The letters of intent will be used by NSF to assess requirements for proposal review.

Letter of Intent Preparation Instructions:

When submitting a Letter of Intent through Research.gov in response to this Program Solicitation please note the conditions outlined below:

- Submission by an Authorized Organizational Representative (AOR) is not required when submitting Letters of Intent.
- A Minimum of 1 and Maximum of 4 Other Senior Project Personnel are permitted
- A Minimum of 0 and Maximum of 10 Other Participating Organizations are permitted
- Submission of multiple Letters of Intent is not permitted

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.

Cover Sheet:

Title: Proposal titles should begin with "MFS-SPEED:" then the title.

Project Description:

In addition to the content specified in the PAPPG, the Project Description must contain specific additional sections with the following titles required, as indicated, and described in the above Sections I and II. These sections will be reviewed in accordance with the Additional Solicitation Specific Review Criteria outlined in Section VI:

Project Management and Collaboration: The "Project Management and Collaboration" section must describe and rationalize why the project team is appropriate to realize the project goals and how the team will ensure effective, synergistic collaboration.

The required section labeled "Broader Impacts" must contain the following subsections. *(Please note that the section header for Broader Impacts must be on its own line with no other text on that line.)*

Education and Workforce Impact: The "Education and Workforce Impact" section must describe the expected impact of the grant on the education and development of a workforce with technical knowledge combining polymer chemistry/physics and cutting-edge data science approaches such as artificial intelligence (AI) and machine learning (ML).

Data Tools and Methods Access: MFS-SPEED supports data-intensive polymer informatics research. This requires that the data and findings of any MFS-SPEED grant are made available in a robust and dependable way that outlasts the lifetime of the project and is responsive to the FAIR principles where all generated data is Findable, Accessible, Interoperable, and Reusable. Investigators are strongly encouraged to think through the process of digital data creation and develop practices and a plan for sharing digital data. Access to the data tools and methods are of particular relevance to MFS-SPEED and must demonstrate responsiveness to the FAIR guidelines. It is additionally helpful if data is "AI-ready" and that machine learning models are made available along with their training data to be maximally useful to the research community. It is a reasonable expectation that digital data supporting published work will be freely available without request within a reasonable time from publication.

Letters of Collaboration:

Letters of collaboration should follow the recommended format specified in the PAPPG Chapter II.D.2. Proposers must not include letters of collaboration from any of the participating industry partners listed in this solicitation. Any proposal that deviates from these guidelines will be returned without review.

Single Copy Documents (if applicable):

Proposers may wish to include proprietary or privileged information as part of their proposals. Per PAPPG Chapter II.E.1, NSF defines such information as "patentable ideas, trade secrets, privileged or confidential commercial or financial information, disclosure of which may harm the proposer". While providing this information is not required, a proposer to the MFS-SPEED program who wishes to include proprietary or privileged information *must* provide all such information in the proposal as a Single-Copy Document. That is, this information shall not appear in other parts of the proposal. In keeping with NSF's practice, the Single Copy Document will not be shared with reviewers or industry partners.

While NSF will make every effort to prevent unauthorized access to such material, the Foundation is not responsible or in any way liable for the release of such material.

Note: Because proprietary or privileged information may only be specified in the Single Copy Document, PIs should not check the "Proprietary or Privileged Information" box on the Cover Sheet; that box applies only to such content appearing in the body of a proposal.

Proposers who are collaborating with, or supported by, one or more of the industry partners may participate in this program if their submission is not derivative from their work affiliated with the industry partner(s). A confirmation letter from the supporting company stating that the proposed project is not derivative of their work with the industry partner must be submitted with the proposal as a single copy document.

B. Budgetary Information

Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

C. Due Dates

- **Letter of Intent Due Date(s) (required)** (due by 5 p.m. submitting organization's local time):

December 05, 2024

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

January 16, 2025

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/ProposalPreparationand

For Research.gov user support, call the Research.gov Help Desk at 1-800-381-1532 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.

The NSF [Grants.gov Proposal Processing in Research.gov informational page](#) provides submission guidance to applicants and links to helpful resources including the NSF [Grants.gov Application Guide](#), [Grants.gov Proposal Processing in Research.gov how-to guide](#), and [Grants.gov Submitted Proposals Frequently Asked Questions](#). Grants.gov proposals must pass all NSF pre-check and post-check validations in order to be accepted by Research.gov at NSF.

When submitting via Grants.gov, NSF strongly recommends applicants initiate proposal submission at least five business days in advance of a deadline to allow adequate time to address NSF compliance errors and resubmissions by 5:00 p.m. submitting organization's local time on the deadline. Please note that some errors cannot be corrected in Grants.gov. Once a proposal passes pre-checks but fails any post-check, an applicant can only correct and submit the in-progress proposal in Research.gov.

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 and Sharing Plan and the Mentoring Plan, as appropriate.

Additional Solicitation Specific Review Criteria

Solicitation specific review criteria are provided in the MFS-SPEED solicitation as elaborations of the NSF Intellectual Merit and Broader Impacts criteria. These additional criteria will help focus attention on factors that increase the influence on the broader industry and highlight considerations unique to the goals of the program. Specifically,

- To what degree is the proposed project responsive to the MFS-SPEED program goals? Specifically, how effectively does the proposal apply the modern and emerging tools of data analytics to polymer informatics and systems-level, quantitatively-supported approaches to sustainability as described above?
- Education and Workforce Impact: How effectively does the proposal present a compelling argument that the project will equip students with the skills and knowledge to apply data science approaches to polymer chemistry and polymer physics problems?
- Project Management and Collaboration: Is the composition of the multidisciplinary team appropriate for the scope of the proposed activities and MFS-SPEED goals? Does the proposal convey a compelling case for synergy and effective communication/organization between the project participants?

B. Review and Selection Process

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

NSF will coordinate and manage the review of proposals in accordance with the standard NSF merit review process. As outlined in Section II.B. Role of Industry Funding Partners, industry partner representatives may serve as panel observers and relevant information about proposals and reviews of proposals may be shared with industry partners.

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 proposers whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new recipients 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.

Special Award Conditions:

Acknowledgement of Support:

Recipients will be required to include appropriate acknowledgment of NSF and industry partners support in reports and/or publications on work performed under an award. An example of such an acknowledgement would be: *"This material is based upon work supported by the National Science Foundation under grant no. (NSF grant number) and is supported in part by funds from federal agency and industry partners as specified in the Molecular Foundations for Sustainability: Sustainable Polymers Enabled by Emerging Data Analytics (MFS-SPEED) program."*

Industry Partner Engagement with Program Recipients:

Once the Program awards have been issued, each of the industry partners may engage with the recipients in the following ways:

- Proposers should plan that NSF or an NSF-funded coordination entity will facilitate a PI meeting(s) between NSF, industry partners, and recipients. Recipients must engage with NSF and/or the coordination entity on these activities throughout the duration of the grant. Industry partners agree not to disclose any non-public information presented or disclosed by recipients at such events to any non-recipient institution of higher education or organization outside of the company. Further, industry partners agree not to disclose any industry partner-owned non-public information to recipients.
- Provide software (prototypes or products), hardware (prototypes or products), and/or other such support to all recipients, although recipients will not be required to use these offered contributions.
- Provide resources (access to test and/or instrumentation facilities), non-proprietary data, and/or opportunities (e.g., seminars, internships) to all recipients, although recipients will not be required to accept or use these offered contributions.
- NSF requires recipients to submit annual project reports and, at the completion of the award, a final project report. Project reports are non-public information. NSF will share these reports with the industry partners after they have been reviewed and accepted by the cognizant NSF Program Officer. The industrial partner may opt to decline to receive these reports. Further, industrial partners agree not to disclose any non-public information in the project reports to any non-recipient institution of higher education or organization outside of the company.
- An industry partner may also arrange to fund its own personnel as researchers to directly participate, part-time or full-time, with recipient project personnel. These arrangements will be optional and upon the mutual consent of the industry partner and respective recipient institutions. Recipients are not required to accept an industry partner researcher.
- An industry partner may also request meetings or other modes of information exchange with recipients to discuss and share ideas or information. These arrangements will be optional and upon the mutual consent of the industry partner and respective recipient institutions. The scope and objectives of the project may not be changed without prior NSF approval.
- In addition to the required annual reports and the final annual project report, recipients may, but are not required to, share non-public information (e.g., research results, data, conclusions, research samples, code, models, and inventions) that are generated from the project with the NSF and industry partners. NSF and industry partners shall not disclose any non-public information until they become public or unless granted written permission to do so by the discloser.

Intellectual Property:

Recipients shall grant to industry partners named in the award letter, a non-exclusive, worldwide, paid-up, non-transferable, irrevocable royalty-free license to all intellectual property rights in any inventions conceived or first reduced to practice in the performance of the Program work under the funding agreement. [Note: the Bayh-Dole Act provides

similar rights to the U.S. Government for patents on inventions made under federal funding.] The license to each industry partner will include its subsidiaries and contractors, at its discretion, to the extent that such use is specifically in connection with the industry partner's products and/or services. Recipients shall grant the license to each industry partner named in the award letter unless the industry partner opts to decline the license. Such license shall not extend to recipients' background intellectual property; however, individual recipients and industry partners may negotiate, voluntarily, in good faith, a mutually acceptable resolution to background intellectual property, if desired, though NSF shall neither enforce nor participate in any such negotiations between recipients and industry partners, nor will any funds provided by NSF to the recipient be contingent upon such negotiations. No rights or licenses are granted by the industry partners. Recipients may delay the publishing of data and software describing inventions to first permit the filing of patent applications. That said, NSF terms and conditions will require that recipients promptly publish all results, data, and software generated in performance of the research.

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 annual project report, and a project outcomes report for the general public.

Failure to provide the required annual or final annual 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 annual 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:

- Kenneth Moloy, telephone: (703) 292-8441, email: NSFMFS@nsf.gov
- Tomislav Pintauer, telephone: (703) 292-7168, email: NSFMFS@nsf.gov
- Kenneth R. Carter, telephone: (703) 292-2335, email: NSFMFS@nsf.gov
- David Darwin, telephone: (703) 292-4728, email: NSFMFS@nsf.gov

For questions related to the use of NSF systems contact:

- NSF Help Desk: 1-800-381-1532
- 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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