

To Fund or Not to Fund: Finding Funding Opportunities and the Challenges of Writing a Competitive Grant Proposal

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Disciplinary Programs in the Division of Mathematical Sciences

- Algebra, Number Theory and Combinatorics
- Analysis
- Applied Mathematics
- **Computational Mathematics**
- Foundations
- Geometric Analysis, Topology and Foundations
- **Mathematical Biology**
- **Statistics and Probability**



Special DMS Programs

- **Focused Research Groups in the Mathematical Sciences (FRG)**
- **Research Training Grants (EMSW21—RTG)**



Focused Research Groups (FRG)

The purpose of the FRG activity is to allow groups of researchers to respond to recognized scientific needs of pressing importance, to take advantage of current scientific opportunities, or to prepare the ground for anticipated significant scientific developments in the mathematical sciences.

Groups may include, in addition to mathematical scientists, researchers from other science and engineering disciplines appropriate to the proposed research. The activity supports projects for which the collective effort by a group of researchers is necessary to reach the scientific goals.

Projects should be scientifically focused and well-delineated. It is not the intent of this activity to provide general support for infrastructure.

Projects should also be timely, limited in duration to up to three years, and substantial in their scope and impact.



Focused Research Groups (FRG)

Titles of Recent Awards

- ❖ **Modeling and Computation of Objective Structures in Materials Science and Biology**
- ❖ **Metalloproteins: Computational Challenges, Methods, and Tools**
- ❖ **Stochastic Models for Intracellular Reaction Networks**
- ❖ **Dynamics of Elastic Biostructures in Complex Fluids**
- ❖ **Inverse Problems in Transport Theory**
- ❖ **Fluctuation Effects in Near-Continuum Descriptions of Discrete Dynamical Systems in Physics, Chemistry and Biology**



Research Training Groups (EMSW21-RTG)

Provides groups of researchers having related research goals in the mathematical sciences with funds to foster research-based training and education. The groups may include researchers and students from different departments and institutions, but the research-based training and education activities must be based in the mathematical sciences.

Addressing all stages (from undergraduate through postdoctoral) of student involvement in RTG proposals is extremely important. Proposals that focus on only one stage will be viewed as less competitive unless a compelling argument is made justifying such a course.

The group of a successful proposal will have collaborating faculty with a history of research accomplishments. This group should have a history of working with students and/or postdoctoral investigators, and they should present a good plan for recruiting students who are U.S. citizens, nationals, or permanent residents into their program. The RTG program is not meant to establish a group, but to enhance the training activities of a well established one.



Research Training Groups (EMSW21-RTG)

Titles of Recent Awards

- ❖ **Complex Biological Systems Across Multiple Space and Time Scales**
- ❖ **Mathematics of Materials: Model Development, Analysis, Simulation and Control**
- ❖ **Numerical Mathematics for Scientific Computing**
- ❖ **Biodynamics at Boston University**
- ❖ **Training, Mentoring & Research in the Mathematics of Stochastic Analysis and Applications**
- ❖ **Enhanced Training and Recruitment in Mathematical Biology**



Interagency Programs

- **Joint DMS/NIGMS Initiative to Support Research at the Interface of the Biological and Mathematical Sciences (DMS/NIGMS)**
- **Collaborative Research in Computational Neuroscience (CRCNS)**
- **Physical and Engineering Sciences in Oncology (PESO)**



Joint DMS/NIGMS Initiative to Support Research at the Interface of the Biological and Mathematical Sciences (DMS/NIGMS)

- This competition is designed to support research using sophisticated mathematical techniques and involving significant mathematical challenges to answer biological questions in areas supported by NSF/DMS and NIH/NIGMS.
- A direct relationship between a biological application and the mathematical work is expected.
- Research teams that include scientists from both the life sciences community and the mathematical sciences community are encouraged. *Proposals from individual investigators will need to make the case that the individual has expertise in both fields.*
- Successful proposals will either identify innovative mathematics or statistics needed to solve an important biological problem or involve the formulation and analysis of new mathematical models whose analysis poses significant mathematical challenges



Collaborative Research in Computational Neuroscience (CRCNS)

- **Computational neuroscience provides a theoretical foundation and a rich set of technical approaches for understanding complex neurobiological systems, building on the theory, methods, and findings of computer science, neuroscience, and numerous other disciplines.**
- **Through the CRCNS program, participating organizations of the National Science Foundation (NSF), the National Institutes of Health (NIH), and the German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF) support collaborative activities that will advance the understanding of nervous system structure and function, mechanisms underlying nervous system disorders, and computational strategies used by the nervous system.**



Physical and Engineering Sciences in Oncology (PESO)

- **Significant advances may be expected as the result of continued investments in inter- and multi-disciplinary research at the intersection of the physical/engineering and life sciences that focus on unraveling the cause and origin of cancer cell formation.**
- **Researchers have the opportunity to submit proposals to advance the understanding of cancer processes (e.g. initiation and progression, invasion and metastasis, heterogeneity or resistance, etc.) at various temporal and/or spatial scales with perspectives from physical sciences and engineering.**
- **Considering these opportunities and areas of needed knowledge, competitive proposals submitted in response to this announcement should (1) develop novel non-traditional physical and engineering sciences based approaches, materials, or platforms to understand and/or control cancer; (2) generate unique sets of physical measurements that can provide insight into molecular mechanisms of oncogenesis, metastasis, drug resistance or other aspects of cancer that could eventually lead to more effective disease treatment; (3) develop and evaluate theoretical approaches (using simulation or control theory, for example) to provide a comprehensive and dynamic understanding of cancer.**



NSF Wide Interdisciplinary Research Programs

- **Computational and Data-Enabled Science and Engineering in Mathematical and Statistical Sciences (CDS&E-MSS)**
- **Unsolicited Proposals at the Interface of the Biological, Mathematical, and Physical Sciences**
- **Cyber-enabled Discovery & Innovation (CDI)**
- **Grant Opportunities for Academic Liaison with Industry (GOALI)**
- **Human and Social Dynamics (HSD)**
- **Quantitative Environmental and Integrative Biology (QEIB)**



CDS&E-MSS

- The CDS&E-MSS program accepts proposals that confront and embrace the host of mathematical and statistical challenges presented to the scientific and engineering communities by the ever-expanding role of computational modeling and simulation on the one hand, and the explosion in production of digital and observational data on the other.
- The goal of the program is to *promote the creation and development of the next generation of mathematical and statistical theories and tools* that will be essential for addressing such issues.
- The program will support fundamental research in mathematics and statistics whose primary emphasis will be on meeting the aforementioned computational and data-related challenges.
- The program encourages submission of proposals that include multidisciplinary collaborations or the training of mathematicians and statisticians in CDS&E.



Unsolicited Proposals at the Interface of the Biological, Mathematical, and Physical Sciences

Divisions within the Directorate for Mathematical and Physical Sciences (MPS) have seen increasing numbers of proposals in recent years that focus on biological systems at all levels of biological organization, ranging from the sub-cellular level to the environment.

At the same time, divisions in the Directorate for Biological Sciences (BIO) are receiving significantly more proposals that incorporate approaches and address questions that have traditionally been the domain of the mathematical and physical sciences.

BIO and MPS therefore recognize that it is vital for biological, mathematical, and physical scientists to increase their collaborations, both in new research efforts and in ongoing research projects, to advance the frontiers of discovery and innovation.



Unsolicited Proposals at the Interface of the Biological, Mathematical, and Physical Sciences

While many strong, vibrant interactions currently exist between the two directorates, this letter is to remind our research communities that MPS and BIO strongly encourage proposals from interdisciplinary research teams that involve collaborations among investigators from the biological, mathematical, and physical sciences and foster new interactions that span interfaces between MPS and BIO. Areas of potential mutual interest to MPS and BIO include:

- Physical and chemical mechanisms and mathematical/statistical theories that underlie biological processes
- The physical, chemical, mathematical and statistical basis of biology involving one or more levels of biological interaction or complexity
- The physical, chemical, genetic, and epigenetic principles that constrain how living systems adapt to changing environments



GOALI (*Grant Opportunities for Academic Liaison with Industry*)

Grant Opportunities for Academic Liaison with Industry (GOALI) aims to synergize university-industry partnerships by making project funds or fellowships/traineeships available to support an eclectic mix of industry-university linkages. Special interest is focused on affording the opportunity for:

- * Faculty, postdoctoral fellows, and students to conduct research and gain experience in an industrial setting;**
- * Industrial scientists and engineers to bring industry's perspective and integrative skills to academe; and**
- * Interdisciplinary university-industry teams to conduct research projects.**

This solicitation targets high-risk/high-gain research with a focus on fundamental topics, new approaches to solving generic problems, development of innovative collaborative industry-university educational programs, and direct transfer of new knowledge between academe and industry. GOALI seeks to fund research that lies beyond that which industry would normally fund by themselves.



GOALI (Grant Opportunities for Academic Liaison with Industry)

Titles of Recent Awards

- ❖ **Molecular Modeling of Confined Nano-Phases and Nano-Porous Materials (Westvaco)**
- ❖ **Development of Combinatorial Polymeric Substrates for Efficient Screening of Protein Adsorption (BD Technologies)**
- ❖ **Multi-Functional Composites for Load-Bearing Skeletal Applications (Teleflex Medical)**
- ❖ **Multicomponent Molecular Transport in Nanoporous Materials (ExxonMobil)**
- ❖ **Multicomponent Population Balance Modeling of Pharmaceutical Granulation (Merck)**



Training Programs

- **MPS AGEP-GRS Dear Colleague Letter**
- **Graduate Research Fellowship Program (GRFP)**
- **Mathematical Sciences Postdoctoral Research Fellowship (MSPRF)**
- **Integrative Graduate Education and Research Traineeship Program (IGERT)**
- **Course, Curriculum, and Laboratory Improvement (CCLI)**
- **Research Experiences for Undergraduates (REU)**
 - **Sites**
 - **Supplements**
- **Math and Science Partnership (MSP)**



MPS AGEP-GRS Dear Colleague Letter

AGEP-GRS introduces a new mechanism by which a current MPS research awardee is able to support one (additional) Ph.D. student in an ongoing MPS-funded research project. The goal is to create an opportunity to engage additional students in research, to develop a positive learning environment for students, and to improve diversity and retention at the doctoral level within the mathematical and physical sciences.

- ***Anticipated Type of Award:*** One-year (twelve-month) supplements for a single Ph.D. student to currently active MPS awards; renewable for a total support period of up to three years, contingent upon the duration of the active MPS research award and satisfactory progress of the student towards completion of the Ph.D.
- ***Eligibility:*** A request for AGEPS-GRS funding may be made by the PI of a currently active MPS research award. Instrumentation acquisition awards, REU awards and large awards governed by cooperative agreements (e.g., facilities, institutes, and centers) are not eligible. The PI must also be affiliated with an academic unit of an institution participating in an active AGEPS project.





GRFP

(Graduate Research Fellowship Program)

The purpose of the Graduate Research Fellowship Program (GRFP) is to ensure the vitality of the scientific and technological workforce in the United States and to reinforce its diversity. The program recognizes and supports outstanding graduate students in the relevant science, technology, engineering, and mathematics (STEM) disciplines who are pursuing research-based master's and doctoral degrees. NSF Fellows are expected to become knowledge experts who can contribute significantly to research, teaching, and innovations in science and engineering.

The Graduate Research Fellowship provides three years of support for graduate study leading to research-based master's or doctoral degrees and is intended for students who are in the early stages of their graduate study. The Graduate Research Fellowship Program (GRFP) invests in graduate education for a cadre of diverse individuals who demonstrate their potential to successfully complete graduate degree programs in disciplines relevant to the mission of the National Science Foundation.

- U.S. Citizen, National or Permanent Resident;
- Individuals are typically eligible to apply: During the senior year of college, after graduating from college and prior to entering graduate school during the first year of graduate school, or prior to completing the first term of the second year of graduate school.

MSPRF

(Mathematical Sciences Postdoctoral Research Fellowship)

The purpose of the Mathematical Sciences Postdoctoral Research Fellowships (MSPRF) is to support future leaders in the mathematical sciences by enabling them to participate in research environments that will have maximal impact on their future scientific development.

- U.S. Citizen, National or Permanent Resident;
- May not have held the doctoral degree more than two years as of January 1 of the year of the award;
- Must propose research in the mathematical sciences;
- May not have previously received a Federal research grant;
- May not submit a research plan duplicated in another NSF proposal.



IGERT (*Integrative Graduate Education and Research Traineeship Program*)

- **The Integrative Graduate Education and Research Traineeship (IGERT) program has been developed to meet the challenges of educating U.S. Ph.D. scientists and engineers who will pursue careers in research and education, with the interdisciplinary backgrounds, deep knowledge in chosen disciplines, and technical, professional, and personal skills to become, in their own careers, leaders and creative agents for change.**
- **The program is intended to catalyze a cultural change in graduate education, for students, faculty, and institutions, by establishing innovative new models for graduate education and training in a fertile environment for collaborative research that transcends traditional disciplinary boundaries.**
- **It is also intended to facilitate diversity in student participation and preparation, and to contribute to a world-class, broadly inclusive, and globally engaged science and engineering workforce.**



CCLI (Course, Curriculum, and Laboratory Improvement)

The Course, Curriculum, and Laboratory Improvement (CCLI) program seeks to improve the quality of science, technology, engineering, and mathematics (STEM) education for all undergraduate students.

- The program supports efforts to create, adapt, and disseminate new learning materials and teaching strategies, develop faculty expertise, implement educational innovations, assess learning and evaluate innovations, and conduct research on STEM teaching and learning.
- The program supports three types of projects representing three different phases of development, ranging from small, exploratory investigations to large, comprehensive projects.



REU

(Research Experiences for Undergraduates)

REU projects involve students in meaningful ways in ongoing research programs or in research projects specifically designed for the REU program. This solicitation features two mechanisms for support of student research:

- (1) REU Sites are based on independent proposals to initiate and conduct projects that engage a number of students in research. REU Sites may be based in a single discipline or academic department, or on interdisciplinary or multi-department research opportunities with a coherent intellectual theme. Proposals with an international dimension are welcome. A partnership with the Department of Defense supports REU Sites in DoD-relevant research areas.
- (2) REU Supplements may be requested for ongoing NSF-funded research projects or may be included as a component of proposals for new or renewal NSF grants or cooperative agreements.



MSP

(Math & Science Partnership Program)

- The Math and Science Partnership (MSP) program is a major research and development effort that supports innovative partnerships to improve K-12 student achievement in mathematics and science.
- MSP projects are expected to raise the achievement levels of all students and significantly reduce achievement gaps in the mathematics and science performance of diverse student populations.
- In order to improve the mathematics and science achievement of the Nation's students, MSP projects contribute to the knowledge base for mathematics and science education and serve as models that have a sufficiently strong evidence base to be replicated in educational practice.



Where to Find More Information

- **National Science Foundation Website**
 - www.nsf.gov
- **Solicitations**
 - **Search on acronyms, if known**
- **Contact a program officer in the directorate closest to your interests**



Proposal Development and Submission



A Good Proposal Is:

- **A Good Idea**
- **Well Expressed**
- **With a Clear Indication of Methods for**
 - *Pursuing the Idea*
 - *Evaluating the Findings*
 - *and Making Them Known to All Who Need to Know*



Research Development Strategies

Individual Investigator

- **Determine Your Long-Term Research Goals or Plan**
- **Develop Your Bright Idea**
 - *Survey the Literature*
 - *Contact Investigators Working on Topic*
 - *Prepare a Brief Concept Paper*
 - *Discuss With Colleagues/Mentors*
- **Prepare to Do the Research**
 - *Determine Available Resources*
 - *Realistically Assess Needs*
 - *Develop Preliminary Data*
 - *Present to Colleagues/Mentors/Students*



Research Development Strategies Individual Investigator (con't)

Determine Possible Funding Sources

Understand the Ground Rules

- Ascertain Overall Scope and Mission
- Read Carefully Announcement/Instructions
- Determine Where Your Project Fits
- Ascertain Evaluation Procedures and Criteria
- Talk With Program Officer:
 - *Your Proposed Project*
 - *Specific Program Requirements/Limitations*
 - *Current Program Patterns*
 - *Reviewing a Successful Proposal*

Coordinate With Your Institution/Research Office



Project Development Key Questions for Prospective Investigator

- 1. What Do You Intend to Do?**
- 2. Why Is the Work Important?**
- 3. What Has Already Been Done?**
- 4. How Are You Going to Do the Work?**



Project Development

Clear Problem Statement

- Needs to Be Met or Problem to Be Solved
- What You Want to and Can Accomplish

Significance of Proposed Work

- Background
 - *Relevant Literature*
 - *Gaps to Be Filled*
- Importance/Justification
 - *Discipline*
 - *Fields Outside of Discipline*
 - *Future (Long Term Context)*

Feasibility of Proposed Research

- Valid, Testable Hypothesis
- Qualifications of Investigators
- Available Resources
- Preliminary Data



Project Development (con't)

Experimental Plan

- Project Design
- Methodology (Feasible, Adequate, Appropriate)
 - *Innovations*
 - *Limitations*
 - *Difficulties Anticipated/Alternative Approaches*
- Sequence (Activities Schedule/Timeline)

Outcome and Assessment

- Data Analysis
- Interpretation of Anticipated Results
- Evaluation
 - *Assessment Activities*
 - *Check Points to Chart Progress*

Continuation

- Plan(s) for Continuation Beyond Grant Period
- Long Range Research Plan



Project Description

Utilize Available Expertise

- Peer/Mentor Input
- Pre-Submission “Reviewer” Comments
- Previous Submission Input
 - *Program Officer*
 - *Reviewers*
- Consultant Use on Project

Develop Ideas Clearly and Logically

- Put Essence of Work at Beginning, Not End
- Ensure Coherent Direction
- Organize to Permit Ease of Skimming
- Never Assume, “Reader Will Know What I Mean”



Project Description (con't)

Selectively Use Clarifying Materials to Accent Main Points

- **Well Designed Visuals**
- **Other Clarifying Materials**
- **Confine Supplementary Material to Appendix**

“Sell” Your Project

- **Write to Evaluation Criteria**
- **Address Special Requirements**
- **Convey a Sense of Enthusiasm for Your Work**



Project Description (con't)

Use Concise Scientific Writing Style

- **Simple Sentence Structure**
- **Avoid Acronyms and Jargon**
- **Page Limitation**

Allow Time for Thorough Editing and Proofing

Convey Image of Investigator's Work Through Proposal

Package Neatly, Not Slickly

Check for Completeness

Special Situations

- **Equipment Proposals**
- **Group Proposals**



Budgetary Guidelines

- **Amounts**
 - Reasonable for Work - Realistic
 - Well Justified - Need Established
 - In Line with Program Requests
- **Eligible Costs**
 - Personnel
 - Equipment
 - Travel
 - Other Direct Costs, Subawards
 - Indirect Costs
- **General Suggestions**
 - All Funding Sources Noted
 - Help from Research Office



Post Facto

- **Follow-Up with Program Officer**
 - Changed Circumstances
 - Proposed Work Affected by New Developments
 - Inquiries
- **Grant - Reward for:**
 - High Quality Research
 - Good Presentation
 - Outstanding Qualifications
 - Sustained Effort and Considerable Patience
- **Don't Despair!**
 - Perseverance Pays Off
 - NSF Awards Highly Competitive
 - Declination May Be Because of Budgetary Limitations
 - Resubmit - Try, Try Again



Getting Support In Proposal Writing

- **NSF Publications**
 - Program Announcements
 - Grant Proposal Guide
 - Web Pages
 - www.nsf.gov
- **Program Officers**
 - Incumbent
 - Former “Rotators”
- **Mentors on Campus**
- **Experienced Panelists**
- **Serve As Reviewer or Panelist**
- **Sponsored Research Office**
- **Read Successful Proposals**



Grant Proposal Guide

- **Provides Guidance for Preparation of Proposals**
- **Contains All Forms Necessary for Proposal Submission**
- **Specifies Process for Deviations Including:**
 - **Individual Program Announcements; and**
 - **By Written Approval of Cognizant AD or Designee**



Grant Proposal Guide (cont'd)

- **Describes Process for Withdrawals, Returns and Declinations**
- **Describes the Award Process and Procedures for Requesting Continued Support**
- **Identifies Significant Grant Administrative Highlights**
- **Provides Listing of Programs Providing Support**



NSF Merit Review

National Science Board approved criteria include:

- **Intellectual Merit**
- **Broader Impacts of the Proposed Effort**



What is the intellectual merit?

- **Potential Considerations:**
 - How important is the proposed activity to advancing knowledge and understanding within its own field or across different fields?
 - How well qualified is the proposer (individual or team) to conduct the project? (If appropriate, the reviewer will comment on the quality of prior work.)
 - To what extent does the proposed activity suggest and explore creative and original concepts?
 - How well conceived and organized is the proposed activity?
 - Is there sufficient access to resources?



What are the broader impacts?

- **Potential Considerations:**
 - How well does the activity advance discovery and understanding while promoting teaching, training and learning?
 - How well does the activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?
 - To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks and partnerships?
 - Will the results be disseminated broadly to enhance scientific and technological understanding?
 - What may be the benefits of the proposed activity to society?



Reasons for Funding a Competitive Proposal

- Likely high impact
- PI Career Point (tenured?/“established”/“young”)
- Place in Program Portfolio
- Other Support for PI
- Impact on Institution/State
- Special Programmatic Considerations (CAREER/RUI/EPSCoR)
- Diversity Issues
- Educational Impact
- “Launching” versus “Maintaining”

