UW – Green Bay Research Council

Research Scholar
Cover Page

Name: Scott Ashmann

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Address: Wood Hall 416C

Department: Professional Program in Education

Unit: Professional Studies

Project Title: National Science Foundation (NSF) Grant Proposal with the Einstein Project

Proposals should include:

☐ **Proposal Narrative**

- ☐ A 5-6 page, double-spaced description of the proposed project with four sections:
  - a) A thorough narrative about the project itself
  - b) An explanation of the relationship of the project to existing scholarship (including relevant citations, as applicable)
  - c) An indication of how the project would contribute to the faculty member's professional development and overall program of research
  - d) A detailed description of the final product that would result from the Research Scholar's work

☐ **Proposed Timeline**

- ☐ A 1-page proposed timeline for completion of the project (with markers of progress and some product to be completed within the semester and, if appropriate or necessary, a final product to be completed by the end of the following semester).

☐ **Curriculum Vitae**

- ☐ A 2-page abbreviated vita limited to relevant research experience

☐ **Approval from Department Chair**

National Science Foundation (NSF) Grant Proposal with the Einstein Project

Submitted by Scott Ashmann

March, 2008

Description of the Proposed Project

For the past four years, I have been using kits from the Einstein Project in Green Bay as a part of my elementary science methods course (EDUC 325). The Einstein Project is a non-profit organization that partners with schools and communities to provide leadership and support for science education in Wisconsin. The Einstein Project leases hands-on science kits and accompanying educational materials to regional school districts. These eight to twelve week units contain enough materials for an entire class. As kits are returned to the Einstein Project's science resource center, they are restocked and refined through a teacher-student evaluation process. The Einstein Project is the only entity of its kind in the state of Wisconsin and is a national model for systemic change in science education.

In addition to using the kits in my course, I have completed an evaluation study of the influence of using the kits on Wisconsin fourth grade standardized science test scores. This quantitative study has produced three overall conclusions that are solidly substantiated by the data gathered in this study. All strengthen the case for the use of a hands-on science curriculum in elementary classrooms and show signs of academic success for underrepresented student populations in the sciences:

1. The findings from this study strongly support a positive influence of the use of Einstein Project materials on state standardized 4th grade science test scores, based on comparisons between Einstein Districts and State scores and Einstein Districts and randomly selected Non-Einstein Districts.

2. Furthermore, the findings show that the use of Einstein Project materials helps to close the achievement gap for students with disabilities, students with limited English proficiency, and minority students.
3. In addition, female students, students with disabilities, students with limited English proficiency, and Asian students from Einstein Districts were found to significantly outperform their counterparts from Non-Einstein Districts.

These initial findings indicate that there is something promising going on in the classrooms where Einstein materials are being used, at least with respect to test scores. However, as with all good research, more questions were generated than answered by this initial study. In particular, no data were gathered from inside the classrooms where these Einstein materials were being used. Thus, this leads to more questions such as:

- What teaching strategies do teachers using these kits utilize?
- What methods of assessment are being used in conjunction with these kits?
- What challenges do teachers encounter when using these kits in K-8 classrooms?
- How are these challenges addressed?
- How do teachers engage students with important scientific concepts and big ideas when using the hands-on activities provided in these kits?
- How does the completion of the activities in the kits influence students' attitudes toward science?
- What are students learning about the nature of science?
- How is science being taught in regional school districts that do not use the Einstein kits?

These questions and more have been generated by the initial quantitative study, but the nature of this research methodology does not allow for an adequate investigation of these issues. A classroom-based qualitative study is needed. The creation of a grant proposal that explores at least some of these questions would be the goal of the time afforded by the Research Scholar Program course release. I have identified a National Science Foundation (NSF) program that matches this research topic.

The National Science Foundation's Discovery Research K-12 (DR-K12) program seeks to enable significant advances in kindergarten through grade 12 (K-12) student and teacher learning of the science, technology, engineering, and mathematics (STEM) disciplines through research about, and development and implementation of, innovative resources, models, and technologies for use by students, teachers, and policy makers. Activities funded under this solicitation begin with a research question or hypothesis about K-12 STEM learning or teaching; develop, adapt, or study innovative resources, models, or technologies; and demonstrate if, how, for whom, and why their implementation affects learning.

My work with the Einstein Project fits very nicely with the Discovery Research K-12 program solicitation from the NSF. The NSF has identified two strands for research studies, one of which is to research contextual challenges. (Please see Appendix A for a more detailed explanation of these strands.) The questions identified above match the description of the contextual challenges that are central to the NSF's concerns in STEM education. In addition, I participated in a NSF-sponsored webinar in December, 2007, during which time I asked a program director about this idea for a proposal. He was very supportive and thought this idea was a perfect fit for this NSF program.

The Relationship of This Project to Existing Scholarship

In January, 2002, President Bush signed into law the *No Child Left Behind Act*. One of the provisions of this Act is that a highly qualified teacher will be placed in each classroom across the country. This was not a concern for some subject matters where an abundance of well qualified teachers exists. However, this is not the case in science where the demand for highly qualified teachers is at a premium (see *Eight questions on teacher recruitment and retention: What does the research say?* by Allen, 2005). This is particularly true for rural school districts (that historically have had a difficult time attracting and retaining teachers) and in elementary schools (where many teachers lack a solid knowledge base to teach the sciences).

Current science education reform documents, such as those produced by the American Association for the Advancement of Science (e.g., *Science for All Americans*, 1990; *Benchmarks for Science Literacy*, 1993) and the National Research Council (e.g., *National Science Education Standards*, 1996), call for a shift in science teaching from an emphasis on rote memorization, the completion of standardized worksheets, and multiple choice tests to an emphasis on problem solving, investigations, and engagement with important scientific concepts and ideas. This new emphasis is called an *inquiry* approach to teaching science (see *Inquiring into Inquiry Learning and Teaching in Science* by Minstrell and van Zee, 2000) and is the approach upon which the Einstein materials is based. Since this approach to teaching science is relatively new (within the past 15 years), many areas of research concerning effective practices have yet to be explored. The Einstein Project grant would investigate key issues in elementary science teaching, such as the questions listed above.

Contribution of This Project

Related to My Overall Program of Research

During my career as a science educator, my teaching and research efforts have centered on the professional development of science teachers and the preparation of pre-service science teachers. This NSF grant opportunity supports these efforts. Two questions have been the focus of my recent research interests:

- What are effective teaching strategies in science?
- Can the same or similar strategies be used across subject matters and grade levels?

This grant opportunity is intricately linked to this overall research program and would enhance my understanding of effective teaching and learning strategies in the sciences.

Related to My Professional Development

This is my fifth year as a faculty member at UWGB. Like all other faculty, I have been asked to teach four courses per semester, serve on various committees, advise students, meaningfully contribute to the operation of our Program, and serve the needs of community organizations that ask for my expertise. All of these demands leave precious little time for engaging in research, which I truly enjoy. Working on this grant proposal would provide me the opportunity to hone my research skills, investigate an area of key interest to me, and generate findings that could be useful not only to local entities, but disseminated to a national audience as well. The interactions with K-12 teachers would provide insights into their current careers that would be very useful in my work with the preparation of our teacher candidates in the Professional Program in Education.

Successful completion of this grant could also snowball into other grant and publication opportunities.

Description of the Final Product

There is one final product that would result from my work: A NSF grant proposal for a qualitative evaluation and curriculum development study of the Einstein Project kits (approximately $2 million over a five year period). This proposal will consist of descriptive and framing information, research and development methodology, a research design, dissemination plan, evaluation plan, a description of key personnel, a discussion of the connection between the proposal and prior work that was supported by the NSF, and a budget. The proposal submission deadline is January 19, 2009. For a complete description of the requirements for this proposal, please see Appendix A, the Discovery Research K-12 Program Solicitation (NSF 08-502).

Conclusion

Over the years, competition for NSF funds has increased dramatically. Federal budget restrictions have limited available funds, and decreased funding at colleges and universities has required more faculty to secure outside funding for their research agendas, thus increasing the number of applicants for each grant competition. Non-research institutions (like UWGB) lack the internal capacity of large research universities to be consistently successful in garnering federal research funds. Therefore, an opportunity like that afforded by a course release to provide an invaluable resource (i.e., time) for the creation of a successful grant proposal would be highly beneficial, not only for my own research agenda, but also to put UWGB in the spotlight of a significant federal agency.

NSF Grant Proposal with the Einstein Project
Proposed Timeline

Month	Activities	Progress Markers
September 2008	Prepare a preliminary budget for the proposal, after meeting with all principal stakeholders. Write a description of the goals and a corresponding rationale for the project. Develop a description of anticipated products that will be based on the findings from this study. Create a work plan for the five-year grant period.	September 30, 2008: Draft of budget, goals, products, and work plan.
October 2008	Create a description of the design and development activities for creating and adapting K-12 resources, models, and technologies while specifying the framework that will guide the design, the curricular goals, the learning models underlying the development, the focal areas, and the steps and components of the design process. Develop an explanation of how particular and relevant design approaches will be incorporated.	October 31, 2008: Draft of the descriptions of the research design
November 2008	Create a description of the design for studying the implementation and testing of the resources, models, and technologies on particular groups of learners, including details about the learner audiences with which materials will be used, along with the settings, the proposed number of learners who will work with the resources, models, and technologies, and the instruments to be used to measure implementation, learning, and impact.	November 30, 2008: Completed descriptions of the research design
December 2008	Develop an evaluation plan to determine if and how the goals of the project have been achieved. Create a dissemination plan for the sharing of the project's findings and the anticipated products. Gather vitas of key personnel. Write a description of the connection between this proposal and prior work that was sponsored by the NSF. Create a Project Summary, which includes a statement of objectives and methods to be employed. Prepare a final budget.	December 31, 2008: Completed dissemination and evaluation plans, descriptions, summary, and budget.
January 2009	Put finishing touches on the proposal. Complete all required paperwork for submission. Gather appropriate signatures. Submit proposal by deadline.	January 19, 2009: NSF deadline for proposal submission

ABBREVIATED CURRICULUM VITAE

SCOTT A. ASHMANN

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Wood Hall 416, UW-Green Bay
2420 Nicolet Drive
Green Bay, WI 54311-7001
(920) 465-2052

Education:

Ph.D. in Curriculum, Teaching, and Educational Policy with an emphasis in Science Education from Michigan State University in August, 2003

Master's degree in Geosciences from Mississippi State University. Anticipated date of completion is August, 2011.

Master's degree in Administrative Leadership with an emphasis in Adult and Continuing Education programs from the University of Wisconsin - Milwaukee in August, 1997

Bachelor's degree in Chemistry and Education and a minor in Science and Environmental Change from the University of Wisconsin - Green Bay in May, 1988

Certification: Wisconsin Teacher Certification No. 27-601 Broadfield Science, 27-610 Chemistry, and 27-625 Physics

Current Position:

8/03-Present Assistant Professor, Science Education
University of Wisconsin-Green Bay Green Bay, WI
- Teaching undergraduate and graduate courses in science education, environmental education, and research methodology

Publications:

Ashmann, S. (in press) An application of *The Two Cultures* to environmental education. Oxford University's Forum on Public Policy.

Ashmann, S. (in press). What influences learning opportunities for mentor teachers during a teacher candidate's internship?: The role of a teacher's frame. *Journal of Science Teacher Education.*

Ashmann, S., Zawojewski, J., & Bowman, K. (2006). Integrated mathematics and science teacher education courses: A modelling perspective. *Canadian Journal of Science, Mathematics and Technology Education, 6*(2), 189-200.

Anderson, C. W., Ashmann, S., Secada, W. G., & Williams, T. (2003). Seeking community. In A. Gamoran, C. W. Anderson, P. A. Quiroz, W. G. Secada, T. Williams, & S. Ashmann, *Transforming Teaching in Math and Science: How Schools and Districts Can Support Change*. New York: Teachers College Press.

Gamoran, A., Anderson, C. W., & Ashmann, S. (2003). Leadership for change. In A. Gamoran, C. W. Anderson, P. A. Quiroz, W. G. Secada, T. Williams, & S. Ashmann, *Transforming Teaching in Math and Science: How Schools and Districts Can Support Change*. New York: Teachers College Press.

Duggan-Haas, D., Enfield, M. & Ashmann, S. (2000, March). Rethinking the presentation of the National Science Teachers Association standards for science teacher preparation. *Electronic Journal of Science Education, 4* (3). Available: http://unr.edu/homepage/jcannon/ejse/ejse.html

Selected Research Experiences:

9/02-9/06 Associate Editor
School Science and Mathematics journal.

2/03-7/03 Consultant
Purdue University West Lafayette, IN
- Developed, implemented, and evaluated model-eliciting tasks used in mathematics and science high school classrooms in an urban setting.

5/01-8/02 Research Assistant
Michigan State University East Lansing, MI
- Assisted with the collection and analysis of data and with the coordination of a research study sponsored by the National Science Foundation concerning leadership in mathematics and science education.

Recent Research Grants:

2006 Recipient of a Grants-in-Aid of Research award from the UW-Green Bay Research Council for $300 for travel associated with my research presentation at the School Science and Mathematics Association Annual Conference in Missoula, Montana in October, 2006

2004 Recipient of a $5000 grant from the Wisconsin Environmental Education Board to evaluate the use of Wisconsin's Model Academic Standards for Environmental Education in rural secondary schools in CESA 7 & 8

2003 Recipient of a Grants-in-Aid of Research award from the UW-Green Bay Research Council for $600 for my project entitled, *A First-Year Physics Teacher's Experience Involving Teaching for Understanding*

UNIVERSITY of WISCONSIN
GREEN BAY

March 26, 2008

Research Council
University of Wisconsin-Green Bay

Dear Research Council Members,

I understand that Scott Ashmann has submitted a proposal to the Research Council for the Fall 2008 Research Scholar Program. After reading this proposal, I fully support its mission to develop a grant proposal that will be submitted to the National Science Foundation in January, 2009. The purpose of this grant proposal will be to investigate the teaching and learning processes that occur in elementary school science classrooms. The primary comparison will be between classrooms that utilize materials from the Einstein Project with those that do not.

Not only does this proposal reflect the mission of the Professional Program in Education to explore the ways in which science is being taught in Northeastern Wisconsin elementary schools, but I believe this will be a rewarding experience for Professor Ashmann as well. To this end, I support his request for a 3 credit course release for the Fall 2008 semester.

If you have any questions, please contact me at kaufmant@uwgb.edu or (920) 465-2003.

Sincerely,

Jim Kaufman

Timothy U. Kaufman
Chair
Professional Program in Education

Scott Ashmann

Scott Ashmann
Applicant
Assistant Professor, Science Education

Appendix A

Discovery Research K-12 (DR-K12)

Program Solicitation
NSF 08-502

Replaces Document(s):
NSF 06-593

National Science Foundation

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

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

January 28, 2008

January 19, 2009

REVISION NOTES

In furtherance of the President's Management Agenda, NSF has identified programs that will offer proposers the option to utilize Grants.gov to prepare and submit proposals, or will require that proposers utilize Grants.gov to prepare and submit proposals. Grants.gov provides a single Government-wide portal for finding and applying for Federal grants online.

In response to this program solicitation, proposers may opt to submit proposals via Grants.gov or via the NSF FastLane system. 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 the NSF FastLane system. Chapter II, Section D.3 of the Grant Proposal Guide provides additional information on collaborative proposals.

A realignment in NSF's Directorate for Education and Human Resources (EHR) has merged the Division of Research, Evaluation, and Communication (REC) and the Division of Elementary, Secondary, and Informal Education (ESIE) into a new division, the Division of Research on Learning in Formal and Informal Settings (DRL).This revision reflects efforts to increase coordination and coherence across the DRL programs. This revision of the Discovery Research K-12 (DR-K12) solicitation represents a restructuring in order to simplify and add coherence to the call for proposals. The three components with their collective seven sub-components in the previous solicitation have been replaced with two major strands. These are: *Contextual Challenges* and *Frontier Challenges*. Both strands will focus on research and development related to resources, models, and technologies that enable significant advances in K-12 student and teacher learning of STEM disciplines. Within these strands, the program calls for three types of projects:

1. *Full research and development projects* address the research, design, development, and testing of resources, models, and technologies for K-12 students or teachers. Some will be research and development projects to produce innovative resources, models, and technologies. Others will undertake research on existing resources, models and technologies to inform design and implementation.

2. *Exploratory projects* are concerned with studying and clarifying a phenomenon of interest and allow researchers and developers to undertake preliminary work to clarify constructs, assemble theoretical or conceptual foundations, or perform analytic or empirical preparatory work before requesting funding for a full-scale project.

3. *Synthesis projects* are small grants for the synthesis of existing knowledge on a topic of critical importance in the area of K-12 STEM resources, models or technologies.

In addition to the projects within the strands listed above, DR-K12 will also support 2 other types of projects:

The DR-K12 Resource Network will be a center-like entity to provide technical assistance for projects, synthesize findings across the portfolio, disseminate findings of the accomplishments of the DR-K12 program, and to undertake thematic research and evaluation studies related to the program.

A few well-focused *Conference and Workshop proposals* related to the goals of the DR-K12 program may be supported. Proposals may be submitted at any time, generally at least one year in advance of when the conference would be held. All conference proposals should provide for an evaluation of the impact of the conference done 18 months after the conference is completed.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Discovery Research K-12 (DR-K12)

Synopsis of Program:

The Discovery Research K-12 (DR-K12) program seeks to enable significant advances in K-12 student and teacher learning of the STEM disciplines through research about, and development and implementation of, innovative resources, models, and technologies for use by students, teachers, and policy makers. Activities funded under this solicitation begin with a research question or hypothesis about K-12 STEM learning or teaching; develop, adapt, or study innovative resources, models, or technologies; and demonstrate if, how, for whom, and why their implementation affects learning.

This solicitation calls for proposals that are responsive to either the *Contextual Challenges* strand or the *Frontier Challenges* strand. The former invites proposals that address the more immediate and pressing challenges facing K-12 STEM education at the national level. The latter anticipates opportunities for the future and supports initiatives on the frontiers of knowledge which challenge existing assumptions about learning and teaching within or across STEM fields, envision needs of learners in 10 to 15 years, and consider new and innovative ways to reach learners. Within these strands, the program calls for full research and development projects, exploratory projects, and synthesis projects. A DR-K12 Resource Network will be funded to support these efforts in FY 2008. In addition, conferences related to the mission of the DR-K12 program are also supported.

Cognizant Program Officer(s):

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

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

- 47.076 --- Education and Human Resources

Award Information

Anticipated Type of Award: Standard Grant or Continuing Grant or Cooperative Agreement

Estimated Number of Awards: 46 to 66 per year. It is anticipated that about 15-20 Full Research and Development awards, 15-20 Exploratory awards, 10-15 Synthesis awards, and 5-10 Conference and Workshop awards will be made in FY 2008 and FY 2009 and 1 DR-K12 Resource Network award in FY 2008, pending availability of funds.

Anticipated Funding Amount: $50,000,000 each year in FY 2008 and FY 2009 for new awards made under this solicitation, pending availability of funds. Full research and development project funding would not exceed $4,000,000 with

duration of up to 5 years. Exploratory projects would range from $100,000 to $150,000 per year with duration of up to 3 years. Synthesis project funding would not exceed $250,000 with duration of up to 2 years. DR-K12 Resource Network proposals are permitted to request up to $1,000,000 per year for duration of up to five years in FY 2008 only. Conference/ Workshop proposals are permitted to request up to $100,000 for a duration of up to 2 years.

Eligibility Information

Organization Limit:

None Specified

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI:

None Specified

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Not Applicable
- **Full Proposals:**
  - Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg.
  - 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: http://www.nsf.gov/bfa/dias/policy/docs/grantsgovguide.pdf/)

B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required by NSF.
- **Indirect Cost (F&A) Limitations:** Not Applicable
- **Other Budgetary Limitations:** Not Applicable

C. Due Dates

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

  January 28, 2008

  January 19, 2009

Proposal Review Information Criteria

Merit Review Criteria: National Science Board approved criteria apply.

Award Administration Information

Award Conditions: Standard NSF award conditions apply

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

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I. INTRODUCTION

About the National Science Foundation and the Directorate for Education and Human Resources

The National Science Foundation (NSF) is charged with promoting the vitality of the nation's science, technology, engineering and mathematics (STEM) research and education enterprises. As part of this mission, the Directorate for Education and Human Resources (EHR) has primary responsibility for providing national and research-based leadership in STEM education. EHR promotes four goals in fulfilling this responsibility:

1. Prepare the next generation of STEM professionals and attract and retain more Americans to STEM careers.
2. Develop a robust research community that can conduct rigorous research and evaluation that will support excellence in STEM education and that integrates research and education.
3. Increase the technological, scientific and quantitative literacy of all Americans so that they can exercise responsible citizenship and live productive lives in an increasingly technological society.
4. Broaden participation (individuals, geographic regions, types of institutions, STEM disciplines) and close achievement gaps in all STEM fields.

To reach these goals, the Directorate sponsors programs in the Divisions of Research on Learning in Formal and Informal

Settings (DRL), Undergraduate Education (DUE), Graduate Education (DGE), and Human Resource Development (HRD).

About the Division of Research on Learning in Formal and Informal Settings

DRL invests in projects to improve the effectiveness of STEM learning for people of all ages. Its mission includes promoting innovative research, development, and evaluation of learning and teaching across all STEM disciplines by advancing cutting-edge knowledge and practices in both formal and informal learning settings. DRL also promotes the broadening and deepening of capacity and impact in the educational sciences by encouraging the participation of scientists, engineers, and educators from the range of disciplines represented at NSF. Therefore, DRL's role in the larger context of Federal support for education research and evaluation is to be a catalyst for change—advancing theory, method, measurement, development, and application in STEM education. The Division seeks to advance both early, promising innovations as well as larger-scale adoptions of proven educational innovations. In doing so, it challenges the field to create the ideas, resources, and human capacity to bring about the needed transformation of STEM education for the 21st century.

Because NSF is the premier Federal agency supporting basic research at the frontiers of discovery in the STEM fields, DRL takes as a central principle that new and emerging areas of STEM must figure prominently into efforts to improve STEM education at all levels and in all settings. Its programs should reflect this through the integration of cutting-edge STEM content and the engagement of STEM researchers in all DRL initiatives.

The Division's programs offer a set of complementary approaches for advancing research, development, and field-based improvement strategies.

- The Discovery Research K-12 (DR- K12) program seeks to enable significant advances in K-12 student and teacher learning of the STEM disciplines, through research and development of innovative resources, models, and technologies for use by students, teachers, administrators and policy makers.

- The Research and Evaluation on Education in Science and Engineering (REESE) program aims at advancing research at the frontiers of STEM learning, education, and evaluation, and at providing the foundation knowledge necessary to improve STEM teaching and learning at all educational levels and in all settings.

- The Informal Science Education (ISE) program builds on educational research and practice and seeks to increase interest in, engagement with, and understanding of STEM by individuals of all ages and backgrounds through self-directed STEM learning experiences.

- The Information Technology Experiences for Students and Teachers (ITEST) program seeks to engage students and teachers in the creative use of information technologies within the context of STEM learning experiences in school and other learning settings.

Each of these programs is intended to improve the capacity of their respective fields to further STEM learning. They are central to NSF's strategic goals of *Learning* and *Discovery*, helping to cultivate a world-class, broadly inclusive STEM workforce, expanding the scientific literacy of all citizens, and promoting research that advances the frontiers of knowledge.

All research and development activities within DRL aim at generating knowledge, informing practitioners, and transforming practice in STEM education. DRL's programs are designed to complement each other within a cycle of innovation and learning (see Figure 1) that forms the conceptual framework for its programs (adapted from RAND, 2003; NSF EHR, 2005; American Statistical Association, 2007). All DRL programs are concerned with all five components of the cycle, to different degrees. Programs whose primary emphases relate to particular components appear in larger type.

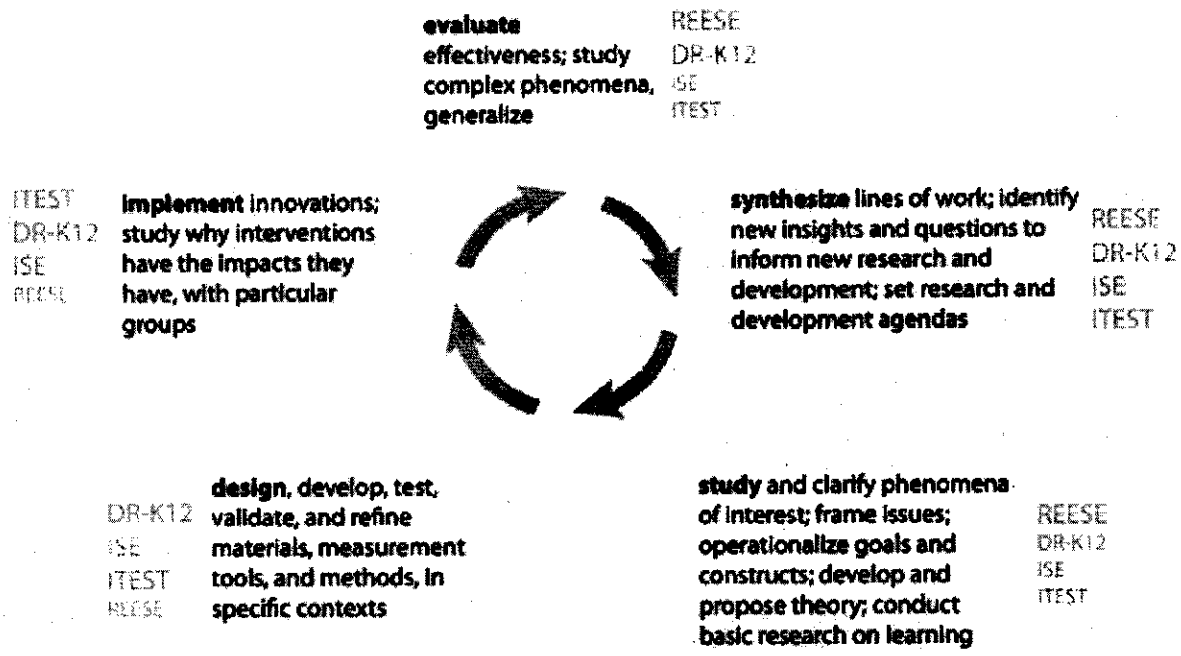

Figure 1. DRL Cycle of Innovation and Learning
(Note: Programs whose primary emphases relate to particular components appear in larger type.)

Each part of the cycle, represented by the activities of DRL's programs, forms the vital and compelling foundation for advancement of the next. From challenging the STEM educational and research communities with innovative ideas, to conducting the pioneering and pragmatic research necessary to advance those goals, to developing world-class instructional materials and resources for teachers to advance their knowledge of STEM teaching and learning, to engaging all citizens and residents of the United States in learning and as future technologists, scientists and engineers, DRL is providing the ideas, resources, and human capacity to advance STEM learning and education in the 21st Century.

The major distinction between DR-K12 and REESE is that DR-K12 focuses specifically on issues of *K-12 learning and teaching.* Projects will involve a *substantial development component,* or *will study the implementation of particular resources, models and technologies for the purpose of informing future design and implementation* – the **design** and **implement** components of the cycle. REESE focuses primarily on *building theory and knowledge through research and evaluation,* across learning contexts and ages – the **study** and **evaluate** components in the cycle. The outcomes of DR-K12 projects will be resources, models, or technologies that are grounded in or informed by research or practice, as well as research findings about the implementation and impact of K-12 STEM education resources, models and technologies. The primary outcomes of REESE projects will be research findings, methods, and theoretical perspectives.

References

American Statistical Association (2007). *Using statistics effectively in mathematics education research.* Retrieved July 9, 2007 from http://www.amstat.org/research_grants/pdfs/SMERReport.pdf.

National Science Foundation (2005). *The mathematics education portfolio brief,* (NSF 05-03). Retrieved July 9, 2007 http://www.nsf.gov/pubs/2005/nsf0503/nsf0503.pdf.

RAND Mathematics Study Panel (2003). *Mathematical proficiency for all students: Toward a strategic research and development program in mathematics education.* (MR-1643.0-OERI) Santa Monica, CA: RAND.

II. PROGRAM DESCRIPTION

The goal of the DR-K12 program is to enable significant advances in K-12 student and teacher learning of the STEM disciplines through the development and study of resources, models, and technologies. All activities funded under this solicitation must begin with a research question or hypothesis about K-12 STEM learning and teaching. Projects to develop or adapt innovative resources, models, or technologies, and demonstrate if, how, for whom, and why their implementation affects learning, are welcome. In addition, DR-K12 accepts proposals for research projects that study the implementation, role and impact of particular resources, models, and technologies on learning, with the goal of informing future design and implementation. The program supports full research and development projects, exploratory projects, synthesis projects, conferences and workshops. A DR--K12 Resource Network will also be funded.

In DR-K12, *resources* include instructional materials (such as curriculum modules, replacement units, or supplementary materials) and instructionally related materials (such as web-based materials or videos). *Models* comprise curricular frameworks, curricular learning progressions, teacher education or professional development program design frameworks, standards, and other guides for learning and teaching. *Technologies* include various, possibly yet unimagined, innovative learning opportunities such as computer software, calculator activities, labware, web-based experiences, on-line gaming initiatives, or portable digital media activities.

DR-K12 projects should advance our knowledge of effective instruction and curriculum design. DR--K12 anticipates that some of the resources, models or technologies produced or studied through funded projects may provide a basis for future comprehensive curriculum initiatives for teachers or students, or for scaling-up in various ways.

A. **Full Research and Development Projects, Exploratory Projects and Synthesis Projects**

DR-K12 proposals for full research and development projects, exploratory projects, and synthesis projects must be responsive to either the Contextual Challenges strand or the Frontier Challenges strand.

1. *Contextual Challenges* Strand

This strand invites proposals that address some of the more immediate and pressing challenges facing K-12 STEM education at the national level.

Please note: *Contextual Challenges* strand proposals are limited to one or more of the following topics only.

a. *Contextual Challenge:* How can assessment of relevant STEM content improve K-12 teaching and learning?

In an era of emphasizing accountability in K-12 education, and with mathematics and science as core curricular areas for assessment, the resources, models, and technologies that enable the assessment of STEM content must keep pace with the demands of policy and instruction. There are a number of pressing issues in this domain, perhaps most central being the question of whether K-12 assessments - those embedded in classroom instruction, those used in classrooms as summative measures, or those used in higher stakes, large-scale assessments at the district, state, or national level - are well aligned with the content and learning goals held by teachers and policy makers. For instance, assessing the full scope of mathematical or scientific proficiency (e.g. as defined in NRC 2001, 2006) in valid and reliable ways presents conceptual, psychometric, and practical challenges. Areas where additional research and development advances are necessary include the exploration of how new forms of assessment can be implemented (see NRC, 2001), the creation of tools that allow classroom assessment to be consistent with research-based knowledge about student STEM learning (NRC, 2003), and models for state assessment systems that incorporate multiple strategies and forms and organize content around "big ideas" (NRC, 2006).

There are parallel issues about teacher assessment, including challenges to better define the nature and characteristics of assessments used in the processes of identification of teacher candidates, licensure, professional advancement, and evaluation. Fundamental research and development issues about what kinds of skills, knowledge, and performances are needed in order for teachers to enable STEM learning in their students are unresolved, and further development of tools for assessing those skills, knowledge, and performances is needed. In addition, tools for teacher self-assessment might be developed.

DR-K 12 seeks proposals to address issues of assessment for both students and teachers, and encourages work in the following specific areas: the assessment of science learning in the elementary and middle grades; formative and instructionally embedded assessments in K-12 STEM; and teachers' knowledge of science and technology for teaching. Proposals addressing assessment issues beyond these areas are also eligible.

The resources, models, and technologies that might be produced, adapted, and studied could include assessment items, tasks, or instruments; assessment blueprints; domain definitions; test specifications; or validation methods. Analyses of assessment tools or frameworks, comparison of effects of different assessment approaches, and syntheses of relevant research to help assessment developers and policy makers are eligible. Interdisciplinary collaborations are especially encouraged.

b. *Contextual Challenge:* How can the learning of significant STEM content be achieved to ensure public literacy and workforce readiness?

The imperative of ensuring a STEM-literate populace and a STEM-ready workforce has never been more prominent in national discourse. This creates enormous pressures on the K-12 system to make wise decisions about curricular emphases in the STEM disciplines. The STEM content of the nation's K-12 schools is influenced by a complex mix of disciplinary traditions, history, practices, standards and assessments. With increasingly dynamic and cyber-enabled contexts for learning, as well as changing requirements for what it means to be a STEM-literate adult or to be prepared to elect STEM related careers, there are implications for continual renewal and reconsideration of the K-12 STEM curriculum. Currently, detailed state standards specify the content to be addressed by grade level in mathematics and science, and possibly other STEM areas, and innovations in curricular emphasis and content are especially challenging. Efforts to propose the STEM curricular content that will best prepare students for entry into the technological workforce, taking into account the curricular shifts made possible or necessitated by the cyber infrastructure, are needed. DR-K12 is interested in research and development efforts that address the practice of moving more advanced content to earlier grades and/or of introducing cutting-edge STEM content based on disciplinary research into K--12 classrooms appropriately. Proposals to do this must describe how these ideas will aid students in developing a coherent and ever-more sophisticated understanding of how the STEM disciplines are investigated.

DR-K12 encourages proposals in the following areas: student and teacher readiness for algebra in the middle grades; teaching complex STEM concepts and processes to younger learners; learning STEM practices and modes of inquiry through virtual laboratory and other inquiry experiences; and building on classroom diversity to broaden access to significant STEM learning. Proposals addressing other K-12 instructional issues are also allowed. Proposals that are concerned with introducing more abstract or complex STEM concepts and processes or cutting-edge research-based content into the K-12 curriculum must address how curricular coherence and foundational preparation will be ensured, and how these proposed curricular additions will fit within typical curricular arrangements.

Projects in this domain might develop and study innovative instructional materials, course models, curricular learning progressions, teacher education or professional development models, or technology-based resources such as virtual laboratories, large data sets or networked scientific activity. Research syntheses that would support practitioners and policymakers concerned with promoting STEM learning are welcome. Collaborations with NSF researchers in the STEM disciplines are encouraged.

2. *Frontier Challenges* Strand

In contrast with the *Contextual Challenges* strand, the *Frontier Challenges* strand explicitly

anticipates opportunities for the future. Research and development on the frontiers of knowledge often challenge existing assumptions about learning and teaching within or across STEM fields. Such research and development requires a vision of schools that are dramatically more responsive to, and more effective with, the diversity of learners they will serve, and where methods of learning and doing STEM can be supported with collaborative and interactive tools for cyber-enabled learning. Projects should address the anticipated needs of learners in 10 to 15 years and consider new ways to reach learners through expansion of the current classroom boundaries that define formal education today.

DR-K12 seeks proposals to develop and study K-12 STEM resources, models, and technologies for K-12 STEM learning that have the potential to transform current practice and learning in ways that broaden the boundaries of schools and disciplines. Through the *Frontier* projects, DR-K12 challenges scholarly communities to put forward groundbreaking ideas, concepts, theories, and modes of research and development to generate and study innovative resources, models and technologies for STEM education. The program also encourages the development and use of measurement and methodological technologies needed to understand the impact of innovations on learning environments with an eye toward the future. Resources, models, and technologies developed under this strand are not expected to be completed for 3-5 years and only then will be ready for testing and implementation, probably in relatively limited and specialized settings. Syntheses could be developed that anticipate the critical areas emerging in STEM and the need for a more technologically advanced society whose access and capabilities will continue to grow and change in the digital age. Frontier research and development is by its nature uncertain, so high-risk/high-gain proposals are welcome.

Please note: *Frontier Challenges* strand proposals are limited to one or more of the following topics *only*.

a. *Frontier Challenge:* How can all students be assured the opportunity to learn significant STEM content?

   Students in the nations schools have become more diverse with respect to their cultural, economic and educational backgrounds making the classroom a more diverse and challenging environment for students and teachers. Creative and ground-breaking approaches to ensuring their access to, and success in high-quality STEM education are critical to responding to national calls for a STEM-literate society. Current mandates for increasing U.S. STEM competitiveness and capacity to participate in the global economy recognize the importance of a K-12 STEM education system that broadens access to successful participation in the STEM disciplines to all students. We seek proposals to develop and study innovative resources, models, and technologies that can accelerate the nation's capacity to enable more students to have access to the most important ideas, concepts, and processes of STEM content. Projects should be specifically directed both at deepening learning and expanding access to learning. Projects to develop and/or study resources, models and technologies to enhance teachers' capabilities for working with a diverse student population are encouraged. Efforts intended to increase student interest in STEM careers of the future are eligible.

   Resources, models, and technologies funded for development and study might include the following: computer-based tools; materials with potential for motivating and engaging a wide diversity of students; support materials to enrich and accelerate learning; resources to enable prospective and practicing teachers to draw on the diversity of their classrooms as an asset; and other innovative solutions to the long-term challenge of making deeper STEM content accessible to more students and providing all students with a coherent view of how STEM disciplines are investigated and applied. Syntheses of research and practice that would further or support efforts to enable all students to learn STEM content are also encouraged.

b. *Frontier Challenge:* What will support STEM teachers' practice and development in an era of cyber-enabled learning?

   For the teachers of tomorrow, who will have grown up in the digital age, the extraordinary opportunities for continual teacher learning and growth,

and for the redefinition of teaching practice are already being defined. We seek proposals to build and investigate resources, models, or technologies for learning that can be foundational for lifelong teacher learning and for the transformation of STEM teaching practice. Particular groups of teachers, such as early career STEM teachers, or teachers who are moving from other STEM careers into teaching, may benefit especially from new resources. Projects addressing this issue should help preservice and/or inservice teachers acquire the skills, knowledge, confidence and tools they need tomeet the emerging educational challenges they will face in a context of rapidly changing technologies and evolving content in many areas of STEM. Projects should anticipate the future advantages and needs of students and teachers in the global environment and cyber infrastructure, where teacher learning can be self-directed and voluntary, and teaching practice can benefit in untold ways from near-instant access to an enormous array of resources, data, and expertise.

Possible resources, models, and technologies to be developed and/or studied in this area might include just-in-time online courses, digital library-type repositories, models for teacher networking or collaboration, storage and search systems, tools to allow immediate communication with peers, parents, and experts around the world, multi-dimensional diagnostic information about students, supports for streamlining assessment processes, mentoring systems, ways of using web-resources for teaching, or self-assessment tools. Synthesis projects that bring together current technology--enhanced resources and models to point to new directions and needs are allowed.

c. *Frontier Challenge:* How can the impact of K-12 STEM classroom **learning** be enhanced by effective integration with local and global resources and systems?

In recent years educational scholars both in formal and informal education have contended that schools could benefit from movement toward integrated learning systems that prepare students for life in a knowledge-based, innovation-driven world. Local and global communities have potential to playa vital role in improving access and developing a citizenry and a workforce dependent upon technological skills. In the near future, there will be unprecedented opportunities to expose students to new career fields, enable interaction with mentors and experts in STEM, and provide high-level STEM learning opportunities that complement and extend beyond the limits of the classroom.

Proposals addressing this challenge could establish collaborations with out-of-school, science-rich venues, such as university outreach programs, local industries, science centers, communities, and other science-education organizations. The resources, models, and technologies to be developed and studied here might include such things as: web-based STEM-learning activities, exploratory virtual environments, gaming and other immersive and interactive environments, visualization technologies, virtual instruments, simulations, or virtual collaboratories. Syntheses of relevant research to serve as a basis for development in this area is encouraged.

B. **DR-K12 Resource Network**

DR-K12 will fund one Resource Network as a cooperative agreement to support the goals of this program. The Resource Network will provide assistance for projects in such areas as research and development methods, implementation, and analysis procedures; synthesize findings across the DR-K12 portfolio of projects; and, promote national dissemination of the research and development contributions of the DR-K12 program. This Resource Network will help to build the DR-K12 community through: support of principal investigator meetings; workshops on such topics as development, pilot testing, validation, and research methods; promotion of instrument-sharing across projects; or other activities that address interests and concerns across the DR-K12 program. The Resource Network should conduct thematic research and evaluation studies related to the DR--K12 program. This may include plans for development of shared databases, suitable research designs to test various evaluative questions about themes within the program, or synthesis and analysis of instrumentation used in DR-K12 projects. We anticipate that the Resource Network will conduct and foster extensive, rigorous, research and development activities.

C. Conferences and Workshops

DR-K12 may support a few well-focused conferences or workshops related to the goals of the program. Budgets are expected to be related to the duration of the event and the number of participants, but the total cost will not exceed $100,000 for up to two years. Please see the Grant Proposal Guide Section II. D. for additional information about conference and workshop proposals. Proposals may be submitted at any time, generally at least one year in advance of when the conference would be held. Proposers should contact a program officer before submitting proposals for such events. All conference proposals should provide for an evaluation of the impact of the conference done 18 months after the conference is completed.

D. Additional Program Information Applicable to Proposals

Proposals for five types of projects are invited: full research and development projects, exploratory projects, synthesis projects, DR-K12 resource networks, and conference/ workshops.

Full research and development projects are concerned with the parts of the Cycle of Innovation and Learning (see Figure 1) focusing on **design, implementation**, and **evaluation**. Such projects would last up to five years, and funding will not exceed $4,000,000.

Exploratory projects are more focused on the study and design parts of the cycle in Figure 1. The purpose is to allow researchers and developers to undertake preliminary work to clarify constructs, assemble theoretical or conceptual foundations, or perform analytic or empirical preparatory work before requesting funding for a full-scale project. DRL hopes these explorations will produce empirical evidence that calls for further research or development. Exploratory projects test the reasonableness of ideas and feasibility of methods. Publishable papers are expected as an outcome. Exploratory projects would last up to 3 years and would range from $100,000 to $150,000 per year.

Synthesis projects are small grants for the synthesis of existing knowledge on a topic of critical importance to K-12 STEM resources, models or technologies. Syntheses proposals should identify areas where the knowledge base is sufficiently robust to support strong scientific claims, identify areas of importance to education research and development, and propose rigorous methods for synthesizing findings and drawing conclusions from a range of relevant literatures. Proposals should also identify and defend the criteria to be used for including or excluding studies. Investigators are permitted to propose workshops and other meetings in support of synthesis initiatives. Maximum award size for synthesis proposals is $250,000 for duration of up to two years.

DR-K12 Resource Network DR-K12 will fund one Resource Network as a cooperative agreement to support the goals of this program. The Resource Network will provide assistance for projects on research and development methods and analysis procedures, synthesize findings across the DR-K12 portfolio of projects, and promote national awareness of research and contributions of the DR-K12 program. This Resource Network will help to build the DR-K12 community through support of principal investigator meetings, workshops on development, pilot testing, validation, and methods; instrument sharing across projects; thematic research and evaluation studies related to the DR-K12 program; or other topics of interest and concern. This may include plans for development of shared databases, suitable research designs to test various evaluative questions about themes within the program, or synthesis and analysis of instrumentation used in DR-K12 projects. One Resource Network will be funded at a level of $1,000,000 per year, up to five years in FY 2008 only.

In addition to the projects listed above, **conferences and workshops** related to the mission of the program are also supported by the DR-K12 program.

References

Clements, D. H., (2007). Curriculum research: Toward a framework for "Research-based curricula". *Journal for Research in Mathematics Education, 38 (1): 35-70.*

National Research Council (2001). *Knowing what students know: The science and design of educational assessment.* Washington, DC: National Academy Press.

National Research Council (2003). *Assessment in support of instruction and learning: Bridging the gap between large-scale and classroom assessment.* Washington, DC: National Academy Press.

National Research Council (2004). *On evaluating curricular effectiveness: Judging the quality of K-12 mathematics evaluations.* Washington, DC: National Academy Press.

National Research Council (2006). *Systems for state science assessment.* Washington, DC: National Academy Press.

Wiggins, G.P., & McTighe, J. (2005). *Understanding by design (2nd Edition).* Upper Saddle River, NJ: Prentice Hall.

III. AWARD INFORMATION

Full research and development project funding would not exceed $4,000,000 with duration of up to 5 years. Exploratory projects would range from $100,000 to $150,000 per year with duration of up to 3 years. Synthesis project funding would not exceed $250,000 with duration of up to 2 years. DR-K12 Resource Network proposals are permitted to request up to $1,000,000 per year for duration of up to five years in FY 2008 only. Conference/ Workshop proposals are permitted to request up to $100,000 for a duration of up to 2 years. Estimated program budget, number of awards and average award size/ duration are subject to the availability of funds.

IV. ELIGIBILITY INFORMATION

The categories of proposers eligible to submit proposals to the National Science Foundation are identified in the Grant Proposal Guide, Chapter I, Section E.

Organization Limit:

None Specified

PI Limit:

None Specified

Limit on Number of Proposals per Organization:

None Specified

Limit on Number of Proposals per PI:

None Specified

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Full Proposal Preparation Instructions: Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg. Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from pubs@nsf.gov. Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

- 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: (http://www.nsf.gov/bfa/dias/policy/docs/grantsgovguide.pdf). 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) 292-7827 or by e-mail from pubs@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 the NSF FastLane system. Chapter II, Section D.3 of the Grant Proposal Guide provides additional information on collaborative proposals.

Cover Sheet. Complete this form with the appropriate information. Complete this form with the appropriate information and make sure to check the human subject box when appropriate. In the title section on the cover sheet please begin each title with the type of DR-K12 proposal being submitted. **R&D:** for Research and Development projects; **E:** for Exploratory projects; **S:** for Synthesis projects; **RN:** for DR-K12 Research Network projects; and **C:** for Conference /Workshop proposals (thus the title will read R&D: Title of project for Research and Development projects; E: Title of project for Exploratory projects; S: Title of project for Synthesis projects; RC: Title of project for DR-K12 Research Network projects; and C: Title of project for Conference / Workshop proposal).

Project Summary. The first sentence of the Project Summary must indicate what type of proposal (e.g., full research and development, exploratory, synthesis, resource network, or conference / workshop) is being submitted and when appropriate, which program strand/challenges are being addressed. Proposals in which the Project does not explicitly address the two National Science Board criteria of intellectual merit and broader impact will be returned without review.

Project Description. All activities funded under this solicitation must begin with a research question or hypothesis about K-12 STEM learning. Project descriptions are limited to 15 pages with 2.5-cm margins on all sides, and the narrative should be single-spaced and use a legible, 12-point font.

Competitive proposals for the DR-K12 solicitation must address all of the following elements in the 15 page project description of the full proposal:

1. **Descriptive and framing information**

   Proposals should clearly define the new ideas, research questions, or hypotheses being explored in the project, and articulate the rationale for pursuing these ideas. Project goals need to be clearly stated. Proposals that include development of resources, models, or technologies should describe the learning goals to be achieved, and the needs of students, practitioners or policymakers that are to be addressed. Projects designed to study resources, models, or technologies must make clear the research issues to be pursued and the potential contributions. Include theoretical, conceptual, research-based, or logical frameworks, foundations, or arguments that make a case for the importance of the research questions or the viability of the ideas. The frameworks should frame the project by establishing the questions, research methodology, and design and analysis plans. Provide a relevant literature review.

   Explain clearly the nature and anticipated format of the resources, models, or technologies that will be developed, adapted, or studied in the project as appropriate. For projects intending to design K-12 instructional materials, delineate the scope of the materials (e.g., a 3-week module for third grade science, a sequence of lessons on a mathematics topic that might span two grades, or a curriculum framework for a semester-long high school technology elective), and justify why the scope is appropriate for addressing the questions of interest. Explain what students are expected to learn through interaction with the materials. Provide an argument for why the approach is innovative and has potential to advance the field.

   Similarly, projects to develop , adapt, or study resources, models, or technologies to be used with teachers also must articulate the learning goals for teacher participants, the scope and content of the materials, and must justify why this approach is suitable for addressing the questions of interest.

   Projects that are undertaking research about existing resources, models, or technologies must present an argument for why the findings of the research will contribute to the improvement of the design and implementation of resources, models, or technologies, and why the particular materials being studied were selected. Research about resources, models, and technologies that have been developed previously with NSF funding is encouraged.

Synthesis study proposals must make a case for the importance of the topic.

2. **Research and development methodology**

For projects with a development component, describe the design and development activity for creating or adapting K-12 resources, models, or technologies. Specify the framework that will guide the design, the curricular goals, the learning models underlying the development, the STEM focal areas, and the steps and components of the design process. Explain how particular and relevant design approaches, such as universal design principles (e.g.,www.cast.org) or backward design (e.g. Wigggins & McTighe, 2005) will be incorporated. Describe how pilot testing or implementation of the materials with learners will be incorporated into the design process. Explain how the designers will understand how students or teachers interpret the materials, and what they learn from them. Provide plans for advance assessments, field testing, intermediate revision steps, research and redesign cycles, or validation process that will be used in the research and development process to inform subsequent revision and refinement of the resources, models, and technologies.

Projects undertaking research about existing resources, models, or technologies should clearly explain the research methodology to be employed. They should connect the methodologies to the research goals and questions, and argue why the methodologies are rigorous, relative to the particular context.

Synthesis projects must describe how materials will be located for consideration.

3. **Research design**

Describe the design for studying the implementation and testing of the resources, models, and technologies on particular groups of learners. Studies that examine extant resources, models, and technologies should argue how the research design will lead to findings that can inform future design, development, and implementation. Include details about the learner audiences with which materials will be used, along with the settings, the proposed number of learners who will work with the resources, models, and technologies, and the instruments to be used to measure implementation, learning, and impact. Indicate what evidence will be gathered and how the project will gather evidence to demonstrate the efficacy of, or understand the implementation of, the materials with diverse groups of learners. The types of claims the researchers hope to be able to make about the materials should be described, and the research design should be linked to the types of claims envisioned. Describe the research design and methodology (e.g., formative assessment, design experiments, teaching experiments, efficacy studies, small-scale summative research (see Clements, 2007), quasi-experimental comparisons, qualitative case studies, large-scale random trials, etc.), and explain why the research design is rigorous. A discussion of curriculum evaluation is provided in *On Evaluating Curricular Effectiveness* (NRC, 2004). Explain the data reduction and analysis procedures to be used.

Synthesis proposals should identify areas where the knowledge base is sufficiently robust to support strong scientific claims, identify areas of importance to education research, evaluation or practice, and propose rigorous methods for synthesizing findings and drawing conclusions from a range of relevant literatures. Proposals should identify the criteria to be used for including or excluding studies.

A successful *DR-K12 Resource Network* proposal demonstrates that the proposed staff has the ability to provide methodological assistance, synthesize results, disseminate program findings to multiple stakeholder audiences, and undertake complex research and evaluation activity that crosses multiple projects, including familiarity with issues of data collection, data sharing, and evaluation research design. Successful proposers must have the capacity to manage a national network, and must demonstrate deep and broad expertise in research, dissemination, and evaluation of learning and education. Resource Network proposals must describe and exhibit ways to provide assistance for projects in such areas as research and development methods, implementation, and analysis procedures; synthesize findings across the DR-K12 portfolio of projects; and, promote national dissemination of the research and development contributions of the DR-K12 program.

4. **Dissemination**

Outline plans for innovative approaches to dissemination. Include a description of anticipated contributions of the activity to teachers, schools, K-12 administrators, teacher educators, STEM education researchers, or policy makers. Projects are expected to plan for the production of materials that will be disseminated through the DR-K12 Resource Network as well as other means, and research reports written for publication in peer-reviewed sources.

5. **Evaluation**

All projects are expected to include an evaluation plan that will examine whether the project has met its goals. Both formative and summative evaluation should be incorporated, and proposals should describe how the distance and objectivity of the evaluation will be ensured. The summative evaluation must be conducted by an evaluator external to the project. All proposals should specify the evaluation questions and evaluation data to be gathered, who will be responsible for this activity, how the data will be interpreted and used, and how timely feedback will be provided to the project's leadership to allow for possible modifications to the project activities. When appropriate, project goals should include teacher or student learning outcomes, and assessment of progress toward those outcomes should be included in the project evaluation. All resources, models, and technologies developed must undergo independent review by qualified experts in the relevant STEM discipline (e.g., scientist, mathematicians, engineers) and in STEM pedagogy. Evaluation plans may be closely linked to research plans, and should contribute to an understanding of the factors that contribute to the project's successes and challenges in meeting its goals. Projects will have the opportunity to participate in special thematic evaluation studies to be undertaken by the DR-K12 Resource Network.

6. **Expertise**

DR-K12 projects will generally involve interdisciplinary teams. In all cases, proposals must explain what expertise is needed for the work and how this expertise is incorporated in the project. Most projects should include STEM education researchers, development experts, experienced teachers, and STEM researchers; others may include statisticians, psychometricians, and policy researchers. When feasible, projects should include future researchers and developers (e.g., beginning scholars, postdoctoral associates, graduate students) as part of the project team, as a means of building research and development capacity in the field. Provide a brief narrative describing the key personnel expertise, relevant to the proposed work.

7. **Results from prior NSF support**

Describe the results of prior NSF support for related educational projects in which senior personnel have been involved. In cases where previous projects have resulted in findings, assessments and/or materials related to the proposed work, include a summary of the past project evaluation that provides compelling evidence of the quality and effectiveness of the materials developed.

Biographical Sketches (max. 2 pages)

All activities funded under this solicitation must include biographical sketches for all key personnel. Biographical sketches are limited to 2 pages with 2.5-cm margins on all sides and must use a legible 12-point font. Biographical sketches should be sufficiently detailed to show that the necessary expertise is available to conduct the project.

Special Information/Supplementary Documentation for DR-K12 Resource Network proposals only (max. 10 pages).

If applicable, DR-K12 Resource Network proposals may provide additional documents such as letters indicating support for the proposed project. Please note that reviewers are not required to read the supporting documents. Therefore, make certain that the project description provides sufficient information about the project that will enable reviewers to make informed judgments.

B. Budgetary Information

Cost Sharing: Cost sharing is not required by NSF.

Budget Preparation Instructions:

A careful and realistic budget in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG), and consistent with the proposed activities of the project should be included. The estimated budget for the total amount of money requested from NSF, with information on salaries and other expenses, including but not limited to, equipment (where allowable), participants, consultants, travel, subawards, and indirect costs must be provided. In the Budget Justification section include a budget narrative that describes and validates each of the expenses. In addition to the above budgetary items, the budget should include a request for funds to cover the cost of attendance of the PI at each year's annual awardee meeting in Arlington, VA.

C. Due Dates

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

  January 28, 2008

  January 19, 2009

D. FastLane/Grants.gov Requirements

- **For Proposals Submitted Via FastLane:**

  Detailed technical instructions regarding the technical aspects of preparation and submission via FastLane are available at: https://www.fastlane.nsf.gov/a1/newstan.htm. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail fastlane@nsf.gov. The FastLane Help Desk answers general technical questions related to the use of the FastLane 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.

  Submission of Electronically Signed Cover Sheets. The Authorized Organizational Representative (AOR) must electronically sign the proposal Cover Sheet to submit the required proposal certifications (see Chapter II, Section C of the Grant Proposal Guide for a listing of the certifications). The AOR must provide the required electronic certifications within five working days following the electronic submission of the proposal. Further instructions regarding this process are available on the FastLane Website at: https://www.fastlane.nsf.gov/fastlane.jsp.

- **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. The Grants.gov's Grant Community User Guide is a comprehensive reference document that provides technical information about Grants.gov. Proposers can download the User Guide as a Microsoft Word document or as a PDF document. The Grants.gov User Guide is available at: http://www.grants.gov/CustomerSupport. In addition, the NSF Grants.gov Application Guide provides additional technical guidance regarding preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: support@grants.gov. The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

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

VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

Proposals received by NSF are assigned to the appropriate NSF program and, if they meet NSF proposal preparation 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 who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with the 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 with the proposer.

A. NSF Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board (NSB)-approved merit review criteria: intellectual merit and the broader impacts of the proposed effort. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two NSB-approved merit review criteria are listed below. The criteria include considerations that help define them. These considerations are suggestions and not all will apply to any given proposal. While proposers must address both merit review criteria, reviewers will be asked to address only those considerations that are relevant to the proposal being considered and

for which the reviewer is qualified to make judgements.

What is the intellectual merit of the proposed activity?
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 the prior work.) To what extent does the proposed activity suggest and explore creative, original, or potentially transformative concepts? How well conceived and organized is the proposed activity? Is there sufficient access to resources?

What are the broader impacts of the proposed activity?
How well does the activity advance discovery and understanding while promoting teaching, training, and learning? How well does the proposed 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?

Examples illustrating activities likely to demonstrate broader impacts are available electronically on the NSF website at: http://www.nsf.gov/pubs/gpg/broaderimpacts.pdf.

NSF staff will give careful consideration to the following in making funding decisions:

Integration of Research and Education
One of the principal strategies in support of NSF's goals is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions provide abundant opportunities where individuals may concurrently assume responsibilities as researchers, educators, and students and where all can engage in joint efforts that infuse education with the excitement of discovery and enrich research through the diversity of learning perspectives.

Integrating Diversity into NSF Programs, Projects, and Activities
Broadening opportunities and enabling the participation of all citizens -- women and men, underrepresented minorities, and persons with disabilities -- 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.

B. Review and Selection Process

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

Reviewers will be asked to formulate a recommendation to either support or decline each proposal. 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 is striving to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. The time interval begins on the date of receipt. The interval ends when the Division Director accepts the Program Officer's recommendation.

A summary rating and accompanying narrative will be completed and submitted by each reviewer. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers, 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.

In all cases, after programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications and 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.

VII. AWARD ADMINISTRATION INFORMATION

A. Notification of the Award

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

B. Award Conditions

An NSF award consists of: (1) the award letter, 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 letter; (4) the applicable award conditions, such as Grant General Conditions (GC-1); * or Federal Demonstration Partnership (FDP) Terms and Conditions * and (5) any announcement or other NSF issuance that may be incorporated by reference in the award letter. 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 http://www.nsf.gov/awards/managing/general_conditions.jsp?org=NSF. Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from pubs@nsf.gov.

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag.

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 at least 90 days before the end of the current budget period. (Some programs or awards require more frequent project reports). Within 90 days after expiration of a grant, the PI also is required to submit a final project report.

Failure to provide the required annual or final project reports will delay NSF review and processing of any future funding increments as well as any pending proposals for that PI. 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 FastLane, for preparation and submission of annual and final project reports. Such reports provide information on activities and findings, project participants (individual and organizational) publications; and, other specific products and contributions. PIs will not be required to re-enter information previously provided, either with a proposal or in earlier updates using the electronic system. Submission of the report via FastLane constitutes certification by the PI that the contents of the report are accurate and complete.

The DR-K12 program is planning a program-wide monitoring process. Awardees may be expected to provide data for monitoring purposes.

VIII. AGENCY CONTACTS

General inquiries regarding this program should be made to:

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

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@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, MyNSF (formerly the Custom News Service) 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 Regional 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. MyNSF also is available on NSF's Website at http://www.nsf.gov/mynsf/.

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

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 40,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

Facilitation Awards for Scientists and Engineers with Disabilities provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at http://www.nsf.gov

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **For General Information (NSF Information Center):** (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**
  - **Send an e-mail to:** pubs@nsf.gov
  - **or telephone:** (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, NSF-50, "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and NSF-51, "Reviewer/Proposal File and Associated Records, " 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton
Reports Clearance Officer
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