

Science of Learning Centers (SLC)

Program Solicitation

NSF 03-573



National Science Foundation

Directorate for Social, Behavioral, and Economic Sciences
Directorate for Biological Sciences
Directorate for Computer and Information Science and Engineering
Directorate for Education and Human Resources
Directorate for Engineering
Directorate for Geosciences
Directorate for Mathematical and Physical Sciences
Office of International Science and Engineering
Office of Polar Programs

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

August 05, 2003
Required for Centers

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

August 05, 2003
Catalyst Full Proposals

September 17, 2003
Center Full Proposals

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

Science of Learning Centers (SLC)

Synopsis of Program:

The Science of Learning Centers program (SLC) offers awards for large-scale, long-term Centers that will extend the frontiers of knowledge on learning and create the intellectual, organizational, and physical infrastructure needed for the long-term advancement of learning research.

Centers will be built around a unifying research focus and will incorporate a diverse, multidisciplinary environment involving appropriate partnerships with academia, industry, all levels of education, and other public and private entities.

Catalyst awards will also be made during the initial years of the program. Catalyst awards are designed to enable partnership-building and research activities leading to the creation of new Centers.

NSF plans to convene one or more workshops during the Spring of 2003 to educate potential applicants and to answer questions about the SLC Program. Details will be posted on the NSF website (<http://www.nsf.gov/slc/>) as they are known.

Cognizant Program Officer(s):

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

- 47.074 --- Biological Sciences
- 47.070 --- Computer and Information Science and Engineering
- 47.076 --- Education and Human Resources
- 47.041 --- Engineering
- 47.050 --- Geosciences
- 47.049 --- Mathematical and Physical Sciences
- 47.078 --- Office of Polar Programs
- 47.075 --- Social, Behavioral and Economic Sciences

Eligibility Information

- **Organization Limit:** None Specified.
- **PI Eligibility Limit:** None Specified.
- **Limit on Number of Proposals:** None Specified.

Award Information

- **Anticipated Type of Award:** Standard or Continuing Grant or Cooperative Agreement
- **Estimated Number of Awards:** 25 to 30 - including 3 to 5 Center awards and 20 or more Catalyst awards. Catalyst awards will be standard or continuing grants. Center awards will be cooperative agreements.
- **Anticipated Funding Amount:** \$20,000,000 for new awards made under this solicitation during the two-year period FY 2003 - FY 2004, pending availability of funds.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Submission of Letters of Intent is required, due by 5 p.m. proposer's local time . Please see the full text of this solicitation for further information.
- **Full Proposal Preparation Instructions:** This solicitation contains information that supplements the standard Grant Proposal Guide (GPG) proposal preparation guidelines. Please see the full text of this solicitation for further information.

B. Budgetary Information

- **Cost Sharing Requirements:** Cost Sharing is not required.
- **Indirect Cost (F&A) Limitations:** Not Applicable.
- **Other Budgetary Guidelines:** Other budgetary guidelines apply. Please see the full text of this solicitation for further information.

C. Due Dates

- **Letters of Intent (*required, due by 5 p.m. proposer's local time*):**
August 05, 2003
Required for Centers
- **Full Proposal Deadline Date(s)** (due by 5 p.m. proposer's local time):
August 05, 2003
Catalyst Full Proposals
September 17, 2003
Center Full Proposals

Proposal Review Information

- **Merit Review Criteria:** National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

Award Administration Information

- **Award Conditions:** Standard NSF award conditions apply.
- **Reporting Requirements:** Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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I. INTRODUCTION

The Science of Learning aims to understand what learning is and how it is affected at all levels, ranging from the digital to the societal. The science of learning emerges from the intersections of diverse disciplines across the biological, cognitive, computational, mathematical, physical, and social sciences, engineering, and education. Areas include psychological, social and pedagogical aspects of learning, the biological basis of learning, machine learning, learning technologies, and mathematical analyses and modeling of all of these. This growing body of knowledge is extending our understanding of learning and connecting learning research to the scientific, technological, educational, and workforce challenges of our time.

The Science of Learning Centers program (SLC) offers awards for large-scale, long-term Centers that will extend the frontiers of knowledge on learning and create the intellectual, organizational, and physical infrastructure needed for the long-term advancement of learning research. Centers will be built around a unifying research focus and will incorporate a diverse, multidisciplinary environment involving appropriate partnerships with academia, industry, all levels of education, and other public and private entities.

Catalyst awards will also be made during the initial years of the program. Catalyst awards are designed to enable partnership-building and research activities leading to the creation of new Centers. These are likely to include workshop and planning activities, as well as exploratory research aimed at establishing proofs of concept and initial collaborative research outputs.

NSF plans to convene one or more workshops during the Spring of 2003 to educate potential applicants and to answer questions about the SLC Program. Details will be posted on the NSF website (<http://www.nsf.gov/slc/>) as they are known.

II. PROGRAM DESCRIPTION

A. Goals and Key Features

The goals of the SLC program are to advance the frontiers of all the sciences of learning through integrated research; to connect this research to specific scientific, technological, educational, and workforce challenges; and to enable research communities that can capitalize on new opportunities and discoveries and respond to new challenges.

To realize these goals, Science of Learning Centers will incorporate all of the following key features. Catalyst projects, which are necessarily more limited in duration and scope, are expected to incorporate many but not all of the same key features:

- A long-term vision that extends the frontiers of the science of learning and broadens its impact on society;
- A strategic plan to realize that vision, suitable for up to 10 years of support at \$3 to \$5 million per year of NSF-contributed funding;
- An integrated, multidisciplinary research program focused on a clear intellectual core and connected to scientific, technological, educational and/or workforce challenges;
- Diverse teams at all organizational levels of the center, inclusive of women and men, underrepresented minorities, and persons with disabilities;
- Partnerships with schools, industry, international partners, professional societies and/or other appropriate external entities that involve significant exchanges of people and ideas;
- Mechanisms to share resources and disseminate ideas among the Center, its partners, and broader audiences of researchers, educators and the public;
- Innovative educational, research, and career development opportunities for all participants;
- A director and leadership team qualified to implement the Center's strategic plan and manage the Center;
- An active external advisory committee representing a broad range of expertise and interests;
- Experimental, computational, and/or other equipment and facilities needed to enable a robust research and learning environment.

B. The Science of Learning

The science of learning integrates a broad range of research traditions. The program is open to many possible approaches, placing high value on creativity, integration of theoretical and empirical work, innovative models of research and research transfer (including integration with educational practice), and inventive uses of technology. The following discussion of possible approaches is not intended to limit the breadth or scope of research appropriate for the program. It is anticipated that Centers and Catalysts will draw from many research areas such as (but not limited to) the following:

- Biological foundations of learning including molecular, cellular, physiological, and behavioral processes;
- Feedback networks, which might involve problems such as molecular recognition, neuronal potentiation and depression, or visualization of signals and messengers;
- The neural basis of learning in humans and other species;
- Machine learning, learning algorithms, knowledge representation, robotics, adaptive systems, and computational simulation of cognitive systems;
- Language, communication, and symbol systems;
- Visualization and representation of complex phenomena and multidimensional data;
- Analogical reasoning, mathematical reasoning, causal analysis, general and domain-specific aspects of mathematical and scientific problem-solving, creativity, and intelligence;
- Learning of disciplinary content including assessment, structure of disciplinary knowledge, pedagogical content knowledge, learning in formal and informal educational settings, and equitable access to learning;
- Learning of strategies for synthesizing solutions to open-ended or ambiguous problems such as those that occur in engineering design;
- Motivational, emotional, and social contexts of learning, including the roles of developmental, sociocultural, economic, political, historical, and environmental factors, and indigenous knowledge systems;
- Learning technologies, including intelligent tutoring systems, visualization tools, computer-supported collaborative environments, digital libraries, and real-time assessment tools;
- Mathematical, statistical, and computational modeling in any of the research areas mentioned above;
- Development of new tools and technology to support the science of learning.

C. Scope and Focus

Centers. The National Science Foundation supports activities that vary widely in scope. Centers represent a level of effort and organization at the high end. Centers provide a rich environment in which multidisciplinary research thrives, collaborations and partnerships flourish, and students are introduced to research at the frontiers of science.

Catalysts. SLC Catalyst awards will support limited-duration research and partnership-building activities, both domestic and international, that contribute directly to the future establishment of Centers. Proofs of concept and other collaborative research outputs will be a key element of feasibility for many developing research groups; thus, it is anticipated that research will be a significant component of most Catalysts. Catalyst projects are also aimed toward assessing needs, developing effective working relationships, and establishing organizational capital and critical intellectual mass. Activities directed at these objectives might include workshops, conferences, and prospectively oriented meta-analyses and studies.

Research. Every Center and Catalyst must be organized around a unifying research focus, appropriate to its own strengths and creative vision, that extends the frontiers of research on learning and builds on a broad base of relevant bodies of knowledge. The SLC program is open to a wide range of potential research foci and approaches, spanning across all areas of the science of learning.

Education. NSF seeks to foster the integration of research and education. When appropriate, SLCs are expected to contribute to learning in K-12 educational settings. SLCs are also expected to establish a culture for the education of graduate and undergraduate students, enriching education at all levels by integrating research findings into new courses, course modules for insertion into existing courses, and new degree programs or degree options, where appropriate. All SLCs must evaluate their curricular contributions and disseminate those that are successful. The cumulative SLC Program should deepen understanding of learning in educational contexts and how research advances can most effectively become integrated into the broadest array of educational settings.

Partnerships. Given the complexity of research efforts in the science of learning, it is expected that projects will typically be multi-faceted and require a group of collaborating investigators representing diverse perspectives and expertise. These collaborative efforts must be designed to advance the field beyond what might be possible through separate, independently conducted projects. Each member of such a collaborative team should bring a unique element to the project, resulting in a whole that is greater than the sum of its parts. Centers should also encourage partnerships that extend beyond traditional disciplinary and institutional boundaries, including international collaborations, partnerships with school districts and other educational institutions, and collaborations with appropriate industrial partners.

D. Management and Organization

Management. A Center's capacity to organize its efforts coherently and strategically will be a key to its success. Its director and senior management must be able to develop and lead a team to fulfill a clearly articulated shared vision. The director is responsible for the management, staffing, and resource allocation of the Center; for administering the award in accordance with NSF policies and the terms of the grant or cooperative agreement; for serving as the liaison between the Center and a national network of SLC directors; and for arranging for external evaluation of the Center's activities. Management structure should be tailored to the Center's individual strategic needs. Management concerns play a less critical role in Catalyst applications because of the limited scope and duration of those projects.

Oversight. Each Center will maintain an external advisory group selected by Center management, which will meet at least once per year to provide guidance and advice. The advisory group will ensure that the Center's activities are consistent with its vision, goals, and objectives, and will provide oversight for evaluations of the Center's activities. Members of this group may not have financial, institutional, or collaborative connections to the Center. Oversight of Catalyst projects will be more similar to that of other NSF grants, and does not need to involve a formal advisory group.

Diversity. The leadership, faculty, and students involved in a Center or Catalyst, as well as external participants and advisory group

members, are expected to be inclusive of women and men, underrepresented minorities and persons with disabilities. Institutional partnerships are also encouraged to be diverse, including smaller institutions, minority-serving institutions, community colleges, and other institutions that have not been well-represented in NSF's portfolio.

SLC National Network. The directors of Science of Learning Centers will serve as members of a national liaison team for the SLC program. The directors are responsible for developing, implementing, and maintaining a liaison structure with active participation of each Center. This network is charged with addressing the Centers' common goals, problems and opportunities; facilitating exchanges and cooperation among Centers; coordination and avoidance of duplication of effort between Centers; working in cooperation with NSF staff on the development of databases and other appropriate infrastructure for monitoring and evaluation of the Centers; and reporting on new findings and the evolving state of the art in science of learning research. Annually, a chair of the network will be elected by participating members and will serve a one-year term. Principal Investigators of Catalyst projects will also participate during the initial years of the SLC National Network.

III. ELIGIBILITY INFORMATION

The categories of proposers identified in the [Grant Proposal Guide](#) are eligible to submit proposals under this program announcement/solicitation.

IV. AWARD INFORMATION

Estimated program budget, number of awards and average award size/duration are subject to the availability of funds. Center awards will be cooperative agreements. Catalyst awards will be standard or continuing grants.

Centers. Annual budgets of most Science of Learning Centers are expected to be in the \$3 million to \$5 million range, scaled as appropriate to the Center's activities. Larger budgets may be proposed in exceptional cases according to the scope of the anticipated programs and the capacity of the proposing group. Proposed budgets must be well justified by the range of activities to be undertaken and their potential for broad impact. Applicants are advised to consult with an SLC Program Officer before proposing a center with a budget that falls outside the \$3 million to \$5 million range.

Initial support for Centers will be for five years. During the fourth year of operation the SLC may submit a renewal proposal for continued support. The renewal proposal will undergo merit review, and the SLC's achievements and future plans will be evaluated comprehensively. Centers that are successful in passing the fourth-year review will be renewed for another five years, commencing at the beginning of the sixth year. Centers that pass the fourth-year review will continue to be reviewed by NSF annually. Centers that do not pass the fourth-year review will be phased-out over a one-year period at a reduced level of support. The maximum potential duration for NSF funding of a Science of Learning Center is ten years. Continuing support of a Center is contingent each year on favorable annual reviews of the Center's activities and on the availability of funds.

Catalysts. Catalyst awards will have a maximum duration of two years, and are expected to vary considerably in overall budget depending on the scope of planned activities. Budgets of up to \$250,000 over two years might be appropriate for modest research activities, whereas smaller budgets would be expected for conference, workshop, or planning activities. Up to an additional \$50,000 per Catalyst proposal may be included in the proposal budget specifically for the purpose of establishing substantive linkages with foreign counterparts that will lead to the establishment of a Center with an international component. Projects requiring higher levels of support may be more appropriate for funding by other programs (See Section IX. Other Programs of Interest).

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent (required, due by 5 p.m. proposer's local time):

Applicants for SLC Center awards must submit a letter of intent before submitting a full proposal. Letters of intent should be submitted by e-mail to slc-intent@nsf.gov no later than the date specified in the "Due Date(s)" section of this Program Solicitation. The subject of the e-mail should be, "LOI: " followed by the last name of the principal investigator and the title of the Center project. The body of the letter should consist of three numbered parts:

1. a descriptive title of the proposed project;
2. names and roles of the principal investigator and other senior personnel (Co-PIs and Collaborators) along with their institutions, if applicable; and
3. a brief statement of scientific approaches and objectives (250 words or less).

This information will be used by NSF staff in planning the review process. Because letters of intent will not be distributed for peer review, there will be no feedback from NSF staff regarding the content of these letters.

Full Proposal Instructions:

Although proposals for SLC Center and Catalyst projects will differ in length, purpose, and emphasis, they will share the following common elements:

- **Vision.** A concise description of the project's vision within the context of the SLC principal goals, including the overall aims and the strategy for accomplishing them. The vision statement should be guiding rather than constraining and adaptable to change over the lifespan of the project.
- **Current State of Knowledge.** A description of the current state of research, education, and related activities upon which the proposed activities will build.
- **Research and Education Activities.** A detailed discussion of the proposed research, education, and related activities, including prospective partnerships with K-12 educators and/or other entities, plans for attracting and retaining high quality U.S. students, and strategies to increase participation of women and members of under-represented groups to participate in SLC research and education activities.
- **Management Plan.** A clear description of how project activities will be organized, including leadership, participants and their roles, and partners and their roles. This should include a timeline with anticipated dates for release of outcomes and the proposed Center's policies on Intellectual Property Rights.
- **Evaluation and Assessment.** A description of resources to be allocated for project evaluation, benchmarks to assess the project's progress toward its scientific, educational, and management goals, and a strategy for ongoing evaluation to improve project operations.
- **Facilities, Equipment, and other Resources.** A description of the organizational and institutional resources available to perform the effort proposed.
- **Sustainability.** For Center projects, a brief discussion of plans and anticipated resources to sustain the Center's activities beyond the period of NSF support.

In addition to the common elements listed above, proposals may address international aspects, as appropriate. Because of the great amount of research in learning being done abroad that could enhance and complement U.S. research efforts, and because of the need to train a globally competent workforce, NSF encourages submission of proposals that include substantive collaborations with foreign counterparts that will enable both synergistic research and the opportunity for U.S. students and postdocs to gain international research experience.

Center Proposals should be prepared in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG) as modified below. The complete text of the GPG is available electronically on the NSF Website at: <http://www.nsf.gov/cgi-bin/getpub?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.

1. Cover Sheet. Indicate the solicitation number in the program announcement/solicitation block on the proposal Cover Sheet, and select **SLC Center** as the Program in the Unit Selection List.
2. Project Summary. Within the one-page project summary, include a description of the Center's vision and key components, and

the names of the principal investigators and participating institutions.

3. Detailed List of Participants. This list will be used by NSF to determine potential conflicts of interest. Therefore, please include only those individuals with significant involvement with the Center. Head the list with the proposal title, the lead institution, and other partnering institutions. Provide an alphabetical list of participating investigators, liaison officers, and advisory board members, including foreign counterparts, who have been designated in the proposal. Include each individual's title, role in the Center, disciplines, and departmental and institutional affiliations. This list must be submitted as a Supplementary Document in FastLane.
4. Project Description (30 page limit). This section should include the Vision, Current State of Knowledge, Research and Education Activities, Management Plan, Evaluation and Assessment, Institutional Commitment, and Sustainability elements described above. It should indicate the value added by organization of these activities as a center as well as a summary of relationships among activities, including the role of each investigator.

Catalyst Proposals should be prepared in accordance with the GPG, in a form appropriate to the research and/or partnership-building activities being proposed. The common elements described above should serve as a guide but are not meant to be constraining. Catalyst proposals should be clear about project deliverables and how the proposed activities will contribute to the subsequent establishment of a Center. The Project Description should not exceed 15 pages.

When submitting a Catalyst proposal in the Fastlane system, indicate the solicitation number in the program announcement/solicitation block on the proposal Cover Sheet, and select **SLC Catalyst** as the Program in the Unit Selection List. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

Additional funds of up to \$50,000 per catalyst proposal may be included to support activities leading to inclusion of significant international collaborations in a future center. The project description should address the added value of the international collaboration and how the center's research and educational objectives will be advanced through international linkages, including the participation of students and junior researchers.

Proposers are reminded to identify the program announcement/solicitation number ((03-573)) in the program announcement/solicitation block on the proposal Cover Sheet. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.

B. Budgetary Information

Cost Sharing:

Cost sharing is not required in proposals submitted under this Program Solicitation.

Other Budgetary Guidelines:

Budgets for Centers and Catalysts should include travel funds for principal investigators to attend an annual SLC Principal Investigators' Meeting.

C. Due Dates

Proposals must be submitted by the following date(s):

Letters of Intent (required, due by 5 p.m. proposer's local time):

August 05, 2003
Required for Centers

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

August 05, 2003
Catalyst Full Proposals

September 17, 2003
Center Full Proposals

D. FastLane Requirements

Proposers are required to prepare and submit all proposals for this announcement/solicitation through the FastLane system. Detailed instructions for proposal preparation and submission via FastLane are available at: <http://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 announcement/solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this announcement/solicitation.

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. Proposers are no longer required to provide a paper copy of the signed Proposal Cover Sheet to NSF. Further instructions regarding this process are available on the FastLane Website at: <http://www.fastlane.nsf.gov>

VI. PROPOSAL REVIEW INFORMATION

A. NSF Proposal Review Process

Reviews of proposals submitted to NSF are solicited from peers with expertise in the substantive area of the proposed research or education project. These reviewers are selected by Program Officers charged with the oversight of the review process. NSF invites the proposer to suggest, at the time of submission, the names of appropriate or inappropriate reviewers. Care is taken to ensure that reviewers have no conflicts with the proposer. Special efforts are made to recruit reviewers from non-academic institutions, minority-serving institutions, or adjacent disciplines to that principally addressed in the proposal.

The National Science Board approved revised criteria for evaluating proposals at its meeting on March 28, 1997 ([NSB 97-72](#)). All NSF proposals are evaluated through use of the two merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

On July 8, 2002, the NSF Director issued [Important Notice 127](#), Implementation of new Grant Proposal Guide Requirements Related to the Broader Impacts Criterion. This Important Notice reinforces the importance of addressing both criteria in the preparation and review of all proposals submitted to NSF. NSF continues to strengthen its internal processes to ensure that both of the merit review criteria are addressed when making funding decisions.

In an effort to increase compliance with these requirements, the January 2002 issuance of the GPG incorporated revised proposal preparation guidelines relating to the development of the Project Summary and Project Description. Chapter II of the GPG specifies that Principal Investigators (PIs) must address both merit review criteria in separate statements within the one-page Project Summary. This chapter also reiterates that broader impacts resulting from the proposed project must be addressed in the Project Description and described as an integral part of the narrative.

Effective October 1, 2002, NSF will return without review proposals that do not separately address both merit review criteria within the Project Summary. It is believed that these changes to NSF proposal preparation and processing guidelines will more clearly articulate the importance of broader impacts to NSF-funded projects.

The two National Science Board approved merit review criteria are listed below (see the [Grant Proposal Guide](#) Chapter III.A for further information). 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 he/she is qualified to make judgments.

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 and original 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?

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.

Additional Review Criteria:

In addition to the proposal review criteria described above, the first three additional review criteria below apply to SLC Center Proposals. The fourth additional review criterion, "International Collaboration (if included)" applies to both SLC Center and Catalyst proposals that include international collaboration:

Value of the Center Mode

Are the identified research challenges of sufficient import, scale, and complexity to justify a Center-mode investment? Will the Center's educational programs make a special contribution to the achievement of a diverse, highly competent, and globally-engaged scientific and instructional workforce and of an educated citizenry? Will any proposed new instruments, shared experimental facilities, and/or databases be of significant value to a broad community of users? Will the Center's partnerships achieve significant intellectual exchange with the school, public, industry, federal, and/or international sectors and thereby foster science, technology, and education in service to society?

Integrative Nature of the Proposed Center

Are the research, educational, and knowledge transfer activities strategically integrated such that the whole is greater than the sum of the parts? Are the partners vital participants in an integrated whole?

Leadership, Management Plan, Impact of Institutional Support, and Budget

Do the Center director and the Center leadership team convincingly demonstrate the vision, experience, and capacity to manage a complex, multi-faceted, and innovative research, education, and knowledge transfer enterprise with adequate attention to infrastructural needs and linkages to partner institutions? What is the likely effectiveness of the proposed management plan, including the mechanisms for topic selection, resource allocation, progress evaluation, and project termination? Is the requested budget appropriate?

International Collaboration (if included)

Are the objectives of the international collaboration clearly defined? Are the international activities designed to achieve those objectives described? Is the benefit to the domestic research well justified? Are the benefits to training and education of students in the context of the international collaboration described?

B. Review Protocol and Associated Customer Service Standard

All proposals are carefully reviewed by at least three other persons outside NSF who are experts in the particular field represented by the proposal. Proposals submitted in response to this announcement/solicitation will be reviewed by Ad Hoc 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.

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 Director. In addition, the proposer will receive an explanation of the decision to award or decline funding.

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.

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 Division 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.A. 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 (NSF-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 agreement awards also are administered in accordance with NSF Cooperative Agreement Terms and Conditions (CA-1). Electronic mail notification is the preferred way to transmit NSF awards to organizations that have electronic mail capabilities and have requested such notification from the Division of Grants and Agreements.

*These documents may be accessed electronically on NSF's Website at http://www.nsf.gov/home/grants/grants_gac.htm. 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 is contained in the NSF *Grant Policy Manual* (GPM) Chapter II, available electronically on the NSF Website at <http://www.nsf.gov/cgi-bin/getpub?gpm>. The GPM is also for sale through the Superintendent of Documents, Government Printing Office (GPO), Washington, DC 20402. The telephone number at GPO for subscription information is (202) 512-1800. The GPM may be ordered through the GPO Website at <http://www.gpo.gov>.

C. Reporting Requirements

For all multi-year grants (including both standard and continuing grants), the PI must submit an annual project report to the cognizant Program Officer at least 90 days before the end of the current budget period.

Catalyst projects will be required to submit annual reports in accordance with the NSF Grant Proposal Guide.

Centers will be required to submit annual reports on progress and plans, which will be used as a basis for performance review and determining the level of continued funding. To support this review and the management of a Center, SLCs will be required to develop a set of management and performance indicators for submission annually to NSF. These indicators are both quantitative and descriptive and will be tailored to the focus and scope of individual Centers. Indicators may include, for example, the characteristics of Center personnel and students; sources of financial support and in-kind support; expenditures by operational component; characteristics of industrial and/or other sector participation; research and education activities; knowledge transfer activities; patents, publications, and descriptions of significant advances. Part of this reporting will take the form of a database which will be owned by the institution and eventually made available to an evaluation contractor. This database will capture specific information to demonstrate progress towards achieving the goals of the program.

Funded Centers will be expected to develop specific and concrete plans for sustainability of the Center's activities following the period of NSF support (which will be no more than a total of 10 years). This will become increasingly important and emphasized in annual reviews as the Center matures and as the end of NSF support can be anticipated.

Such reporting requirements will be included in the cooperative agreement which is binding between the awardee and NSF.

Within 90 days after the expiration of an award, the PI also is required to submit a final project report. Failure to provide final technical reports delays NSF review and processing of pending proposals for the PI and all Co-PIs. 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. This system permits electronic submission and updating of project reports, including information on project participants (individual and organizational), activities and findings, 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.

VIII. CONTACTS FOR ADDITIONAL INFORMATION

General inquiries regarding this program should be made to:

- Steven J. Breckler, Program Director/Cluster Coordinator, Directorate for Social, Behavioral & Economic Sciences, Division of Behavioral and Cognitive Sciences, 995 N, telephone: (703) 292-8728, fax: (703) 292-9068, email: sbreckle@nsf.gov
- Kenneth Whang, Program Director, Directorate for Computer & Information Science & Engineering, Division of Experimental and Integrative Activities, 255 S, telephone: (703) 292-5149, fax: (703) 292-9381, email: kwhang@nsf.gov
- Gregg Solomon, Program Director, Directorate for Education & Human Resources, Division of Research, Evaluation & Communication, 855 S, telephone: (703) 292-8333, fax: (703) 292-9046, email: gesolomo@nsf.gov
- Thomas W. Chapman, Division Director (Acting), Directorate for Engineering, Division of Chemical & Transport Systems, 525 N, telephone: (703) 292-8370, fax: (703) 292-9054, email: tchapman@nsf.gov

- Mike Clarke, Program Officer, Directorate for Mathematical & Physical Sciences, Division of Chemistry, 1055 S, telephone: (703) 292-4967, fax: (703) 292-9037, email: mclarke@nsf.gov
- Anna Kerttula, Social Sciences Program Director, Office of the Director, Office of Polar Programs, 755 S, telephone: (703) 292-8029, email: akerttul@nsf.gov
- Soo-Siang Lim, Program Director, Directorate for Biological Sciences, Division of Integrative Biology & Neuroscience, 685 S, telephone: (703) 292-8423, fax: (703) 292-9153, email: slim@nsf.gov
- Mark Suskin, Program Manager, Directorate for Social, Behavioral & Economic Sciences, Office of International Science and Engineering, 935 N, telephone: (703) 292-8702, fax: (703) 292-9067, email: msuskin@nsf.gov
- Michael A. Mayhew, Program Director, Directorate for Geosciences, Division of Earth Sciences, 785 S, telephone: (703) 292-8557, fax: (703) 292-9025, email: mmayhew@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: (800) 673-6188, email: fastlane@nsf.gov

IX. OTHER PROGRAMS OF INTEREST

The *NSF Guide to Programs* is a compilation of funding for research and education in science, mathematics, and engineering. The *NSF Guide to Programs* is available electronically at <http://www.nsf.gov/cgi-bin/getpub?gp>. General descriptions of NSF programs, research areas, and eligibility information for proposal submission are provided in each chapter.

Many NSF programs offer announcements or solicitations concerning specific proposal requirements. To obtain additional information about these requirements, contact the appropriate NSF program offices. Any changes in NSF's fiscal year programs occurring after press time for the *Guide to Programs* will be announced in the NSF *E-Bulletin*, which is updated daily on the NSF Website at <http://www.nsf.gov/home/ebulletin>, and in individual program announcements/solicitations. Subscribers can also sign up for NSF's *Custom News Service* (<http://www.nsf.gov/home/cns/start.htm>) to be notified of new funding opportunities that become available.

Science of Learning Centers should build on the science of learning research portfolios supported by many of the Foundation's standing disciplinary programs, and they should include activities that promote the Foundation's interest in improving the quality of education in all fields of science, technology, engineering, and mathematics. This section identifies other NSF programs that connect in one of these ways to the goals of the SLC program.

- **Learning Research.** NSF supports multidisciplinary research incorporating fields such as design of learning environments, human-computer interactions, cognitive science and cognitive neuroscience, computational linguistics, child development, sociology and complex educational systems. In addition to the disciplinary-based programs listed later in this section, investments include the Interagency Education Research Initiative (**IERI**), Research on Learning and Education (**ROLE**) Program, and Developmental and Learning Sciences (**DLS**).
- **Learning Tools.** NSF programs support research, development, and testing of information technology-based tools that facilitate learning across many levels of formal and informal education and for both individuals and groups. New communication and information technologies show promise to enhance the delivery of education and offer the possibility of providing truly learner-centered, independent learning environments over an entire lifetime and at any convenient place and time. Among the programs currently supported at NSF is the National Science, Technology, Engineering and Mathematics Education Digital Library (**NSDL**), a prototype information technology-based tool designed to increase the quality, quantity, and comprehensiveness of Internet education resources. Learning technologies are also supported through Information Technology Research (**ITR**).
- **Education.** NSF promotes activities that link formal and informal Science, Technology, Engineering, and Mathematics (**STEM**) education and create connections across levels of formal education and workforce development. Investments in this area recognize that learning happens continuously and in many ways, and includes support in Elementary, Secondary, and Informal Education (**ESIE**), undergraduate Course, Curriculum, and Laboratory Improvement (**CCLI**), Assessment of Student Achievement in Undergraduate Education (**ASA**), Integrative Graduate Education and Research Traineeships (**IGERT**), and Graduate Teaching Fellowships in K-12 Education (**GK-12**).
- **Learning and Teaching.** The Centers for Learning and Teaching (**CLT**) program supports activities that link K-12 and higher

education to provide lifelong learning opportunities for the instructional workforce in contexts supported by information technology tools and by research on learning, science and mathematics. CLTs address the need to increase the quality of research on learning and teaching, to develop the next generation of science and mathematics education specialists, and to strengthen the competencies of the preK-16 instructional workforce.

- **Partnerships.** The Math and Science Partnership (**MSP**) program aims to engage the nation's higher education institutions, local, regional and state school districts and other partners in preK-12 reform by calling for a significant commitment by colleges and universities to improving the quality of science and mathematics instruction in the schools and to investing in the recruitment, preparation and professional development of highly competent science and mathematics teachers. MSP, as a major national effort, is an investment intended to serve *all* students so that learning outcomes can no longer be predicted based on race/ethnicity, socio-economic status, gender or disability.

NSF Center-Scale Activities

NSF currently supports two center programs that are of similar scale to Science of Learning Centers:

- The **Science and Technology Centers (STC)** program funds important basic research and education activities and encourage technology transfer and innovative approaches to interdisciplinary activities. The STCs explore new areas and build bridges among disciplines, institutions, and other sectors. They offer the research community an effective mechanism to: embark upon long-term scientific and technological research activities; explore better and more effective ways to educate students; and develop mechanisms to ensure the timely transition of research and education advances made into service in society.
- The **Engineering Research Centers (ERC)** program provides an integrated environment for academe and industry to focus on next-generation advances in complex engineered systems, with synergy among engineering, science, and industrial practice. ERCs integrate research with education at both the graduate and undergraduate levels, producing curriculum innovations derived from the systems focus of the ERCs' strategic research goals. ERCs aim to build trusted partnerships with industry, develop shared infrastructure, and increase the capacity of engineering and science graduates to contribute to the U.S. competitive edge. They provide a system perspective for long-term engineering research and education, enabling fresh technologies, productive engineering processes, and innovative products and services.

Although they differ in their goals, these other Center activities provide important context for the intended scope, size, and duration of SLCs. The web sites of both programs may be useful resources for investigators seeking to learn from the best practices of other NSF centers.

NSF Office of International Science and Engineering

NSF recognizes the importance of enabling U.S. researchers and educators to advance their work through international collaboration, and of helping to ensure that future generations of U.S. scientists and engineers gain professional experience beyond this nation's borders early in their careers. For more information, visit the INT website at www.nsf.gov/sbe/int/start.htm.

NSF Discipline-Based Programs

The science of learning is supported by numerous programs and emphases across the Foundation. Principal Investigators are strongly encouraged to become familiar with these and other NSF programs that form the landscape of support for the sciences of learning:

Behavioral and Cognitive Sciences

- **Developmental and Learning Sciences**
- **Human Cognition and Perception**
- **Cognitive Neuroscience**

- Linguistics
- Social Psychology
- Geography and Regional Science
- Physical Anthropology
- Cultural Anthropology

Social and Economic Sciences

- Sociology
- Decision, Risk and Management Sciences
- Economics
- Innovation and Organizational Change
- Political Science
- Societal Dimensions of Engineering, Science, and Technology
- Science and Technology Studies
- Methodology, Measurement, and Statistics

Computer and Information Science and Engineering

- Human-Computer Interaction
- Digital Society and Technologies
- Knowledge and Cognitive Systems
- Robotics and Human Augmentation
- Collaborative Research in Computational Neuroscience

Biological Sciences

- Animal Behavior
- Behavioral Neuroscience
- Computational Neuroscience
- Developmental Neuroscience
- Sensory Systems
- Evolution of Developmental Mechanisms
- Developmental Mechanisms
- Neuronal and Glial Mechanisms
- Integrative Animal Biology

Mathematical and Physical Sciences

- Applied Mathematics
- Statistics
- Computational Mathematics
- Organic Chemical Dynamics
- Inorganic, Bioinorganic, and Organometallic Chemistry
- Experimental Physical Chemistry
- Theoretical Physical Chemistry
- Analytical & Surface Chemistry

Engineering

- Control, Networks, and Computational Intelligence
- Biomedical Engineering and Research to Aid Persons with Disabilities
- Operations Research
- Engineering Education
- Dynamic System Modeling, Sensing, and Control
- Robotics

Geosciences

- Geosciences Education
- Digital Library for Earth System Education

Polar Programs

- Arctic Social Sciences
- Arctic Research and Education Program
- Antarctic Biology and Medicine

ABOUT THE NATIONAL SCIENCE FOUNDATION

The National Science Foundation (NSF) funds research and education in most fields of science and engineering. Awardees are wholly responsible for conducting their project activities and preparing the results for publication. Thus, the Foundation does not assume responsibility for such findings or their interpretation.

NSF welcomes proposals from all qualified scientists, engineers and educators. The Foundation strongly encourages women, minorities and persons with disabilities to compete fully in its programs. In accordance with Federal statutes, regulations and NSF policies, no person on grounds of race, color, age, sex, national origin or disability shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving financial assistance from NSF, although some programs may have special requirements that limit eligibility.

Facilitation Awards for Scientists and Engineers with Disabilities (FASSED) provide funding for special assistance or equipment to enable persons with disabilities (investigators and other staff, including student research assistants) to work on NSF-supported projects. See the GPG Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

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 or (800) 281-8749

- **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; 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 applicant 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 needing information as part of the review process or in order to coordinate programs; 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," 63 Federal Register 267 (January 5, 1998), and NSF-51, "Reviewer/Proposal File and Associated Records," 63 Federal Register 268 (January 5, 1998). 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 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 this burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to: Suzanne Plimpton, Reports Clearance Officer, Division of Administrative Services, National Science Foundation, Arlington, VA 22230.

OMB control number: 3145-0058.