

National Science, Technology, Engineering, and Mathematics Education Digital Library (NSDL)

Program Solicitation

NSF 08-554



National Science Foundation

Directorate for Education & Human Resources
Division of Undergraduate Education

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

May 27, 2008

(optional)

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

June 27, 2008

REVISION NOTES

In FY2008, the NSDL program will accept proposals in four tracks: *Pathways*, *Services*, *Targeted Research*, and *NSDL Resource Center*. Within the first three tracks the program will accept **proposals for large grants** in 1) the *Pathways* track, 2) a new sub-track: *Pathways - Stage II*, and 3) specific sub-tracks of *Services* - including a single *Technical network services* project to provide technical infrastructure support across the NSDL network. The *NSDL Resource Center* will provide collaboration assistance across all projects; undertake strategic partnership development on behalf of projects particularly with respect to non-academic entities; coordinate and, in some cases, perform thematic research and evaluation studies related to the program; synthesize findings across the portfolio; and disseminate findings of the accomplishments of the NSDL program. **Proposals for small grants** that extend or enhance efforts supported by awards from all tracks within the NSDL program, except the *NSDL Resource Center*, will also be accepted. See the full text of this solicitation for more details.

SUMMARY OF PROGRAM REQUIREMENTS

General Information

Program Title:

National Science, Technology, Engineering, and Mathematics Education Digital Library (NSDL)

Synopsis of Program:

This program aims to establish a national network of learning environments and resources for science, technology, engineering, and mathematics (STEM) education at all levels. The program has four tracks: *Pathways* projects are expected to provide stewardship for the content and services needed by major communities of learners. *Services* projects are expected to develop services that support users and resource collection providers that enhance the impact, efficiency, and value of the NSDL network. *Targeted Research* projects are expected to explore specific topics that have immediate applicability to collections, services, and other aspects of the development of the NSDL network. The *NSDL Resource Center* will provide collaboration assistance across all projects; undertake strategic partnership development on behalf of projects particularly with respect to non-academic entities; coordinate and, in some cases, perform thematic research and evaluation studies related to the program; synthesize findings across the portfolio; and disseminate findings of the accomplishments of the NSDL program. In FY2008, within the first three tracks the program will accept **proposals for large grants** in 1) the *Pathways* track, 2) a new sub-track: *Pathways - Stage II*, and 3) specific sub-tracks of *Services* - including a single *Technical network services* project to provide technical infrastructure support across the NSDL network. In all tracks, except for the *NSDL Resource Center*, the program will also accept **proposals for small grants** that extend or enhance results from existing services, collections, or targeted research activity so as to enlarge the user audience for the NSDL network or improve

capabilities for the user.

Cognizant Program Officer(s):

- Lee L. Zia, Lead Program Director (Mathematical Sciences), 835N, telephone: (703) 292-5140, email: lzia@nsf.gov
- Warren W. Hein, Assistant Lead Program Director (Physics/Astronomy), 835 N, telephone: (703) 292-4644, email: whein@nsf.gov
- Stephen C. Cooper, Program Director (Computer Science), 835 N, telephone: (703) 292-4645, email: scscooper@nsf.gov
- Timothy V. Fossum, Program Director (Computer Science), 835 N, telephone: (703) 292-5141, email: tfossum@nsf.gov
- Herbert H. Richtol, Program Director (Chemistry), 835 N, telephone: (703) 292-4648, email: hrichtol@nsf.gov
- Curtis T. Sears, Program Director (Chemistry), 835 N, telephone: (703) 292-4639, email: csears@nsf.gov
- Jill K. Singer, Program Director (Geological Sciences), 835 N, telephone: (703) 292-5323, email: jksinger@nsf.gov
- Sheryl A. Sorby, Program Director (Engineering), 835 N, telephone: (703) 292-4647, email: ssorby@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: 20 to 31 (2 to 4 Pathways; 2 to 4 Pathways - Stage II; 4 to 6 Services; 10 to 15 Small grants; 1 Technical network services; 1 Resource Center).

Anticipated Funding Amount: \$12,250,000 (approximately) in FY2008, subject to the availability of funds.

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:

An individual may serve as the Principal Investigator (PI) on no more than one proposal, including collaborative proposals, submitted in the FY2008 competition, but may serve as a co-PI on multiple proposals.

Proposal Preparation and Submission Instructions

A. Proposal Preparation Instructions

- **Letters of Intent:** Submission of Letters of Intent is optional. Please see the full text of this solicitation for further information.
- **Preliminary Proposal Submission:** 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 under this solicitation.
- **Indirect Cost (F&A) Limitations:** Not Applicable
- **Other Budgetary Limitations:** Other budgetary limitations apply. Please see the full text of this solicitation for further information.

C. Due Dates

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

May 27, 2008

(optional)

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

June 27, 2008

Proposal Review Information Criteria

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: Standard NSF reporting requirements apply.

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I. INTRODUCTION

Innovative projects supported by NSF and many other organizations have developed numerous examples of rich, learner-centered educational materials and environments. Features include the use of sophisticated graphics tools for animation and visualization of scientific, engineering, and mathematical concepts; computational tools for modeling and simulation; remote access to scientific equipment; analysis of large, real-time or archived data sets; and network-supported collaboration. During this time the World Wide Web has shown great potential for enabling access to the very best of these new learning materials and environments. The highly linked, dynamic information architecture of the Web mirrors the interconnected nature of knowledge, enables the inclusion of new high-quality materials and practices, supports annotation and community commentary, promotes the integration of research and education, and encourages learners to become active participants in expanding their educational experience. In addition, advances in grid and mobile Internet technologies, the presence of powerful commercial search engines, and more recently the rise of social networking technologies and participatory culture sites are now challenging the traditional social constructs and contexts of learning. Finally, open source, open content licensing agreements (e.g. <http://creativecommons.org/>) and new kinds of open courseware resources are creating a fresh climate for educational innovation.

However, Web-based collections of resources can exhibit significant shortcomings as tools for teaching and learning. For example, it is often difficult to determine from a lengthy list of links how well an individual item suits a particular learner's needs. When resources are located, they can exhibit uneven reliability or stability particularly if they incorporate additional software elements for animations, audio, or video. In addition, the audience for these collections often lacks the support and expertise needed to select an appropriate resource, incorporate it into a coherent learning experience, and evaluate the impact of the new approach.

While the principles of interoperability and reusability of learning resources or "learning objects" are gaining visibility, their widespread application remains more promise than reality; and the construction of new learning objects with executable content from "building block" component pieces (e.g., Java applets or application software macros) demands additional planning, testing, and coordination to achieve an impact on learning. A great deal of new content requires a higher level of organization and aggregation than traditional learning objects. Sequences of tested activities in materials such as inquiry learning environments or video and audio of entire courses add value to individual components. These sequences and combinations need to be integrated with existing collections.

Through the NSDL program, NSF seeks to enable the discovery, collaborative selection, organization, and effective usage of quality learning and teaching resources appropriate for educators and learners at all levels. The NSDL network of learning environments and resources should readily provide reusable, shareable, and interoperable learning objects that enable teachers and learners at all levels to select, use, and evaluate materials suited to their needs, both within and across traditional STEM disciplinary boundaries. Such materials should include assessment and evaluation tools and results from user tests. They should harness new understandings about pedagogy, curriculum, and the processes of learning that are founded on a solid research base. The resource collections, services, and infrastructure of NSDL should facilitate the development and dissemination of new tested materials and methods, recommender systems that leverage the aggregate data from all users' experiences to recommend related resources, customized guidance systems that profile individual users, and supports for continual improvements in STEM education at all levels.

To realize this vision, the NSDL program began first by supporting projects focused on the development or enhancement of resource collections, implementation of digital library services, and a small set of targeted research investigations. In more recent years, the program introduced the concept of Pathways projects that take responsibility for stewardship for the educational content and services needed by a broad community of learners, e.g. in disciplines, such as mathematics or biology, or in educational sectors, like community colleges. While projects focused on collection development or stewardship are still appropriate, this solicitation especially invites projects to investigate the relationship between design of collections and their utilization by instructors and students. Projects that enable testing of the impact of collections and resources for instructors on teachers' activities, and that investigate the impact of the resources in the collections on student learning are especially welcome.

II. PROGRAM DESCRIPTION

The goal of the National Science, Technology, Engineering, and Mathematics Education Digital Library (NSDL) program is to create and develop a network of digital environments and resources for STEM learning. The ultimate test of the utility of this network is whether its services

demonstrably meet the needs of students and teachers at all levels -- pre-K to 12, undergraduate, graduate, and lifelong learning. It should serve individual teachers as well as groups of teachers who jointly want to improve their instruction. It should also serve both the individual learner seeking understanding, and groups of learners engaged in collaborative exploration of concepts; and should support formal and informal modes of learning. It should also function as a forum where resource users may become resource providers. It is vital that NSDL offer value-added resources and services that go beyond what is currently available in a highly competitive environment of rapid technological innovation for standard search services offered by both established commercial providers and newer arrivals.

In addition to retrieval of relevant information, NSDL projects may offer users access to virtual collaborative work areas, tools for analysis and visualization, remote instrumentation and observation platforms, large databases of real-time or archived data, simulated or virtual environments, and other new capabilities as they emerge. The NSDL network should enable the dynamic use of materials and tools that are supplied by diverse providers of resource collections and services, ranging from large groups of cooperating vendors or publishers, to individual professors or teachers, and even student bloggers. The learning environments created should increase the usability and impact of all resources by giving learners and teachers at all levels – both individually and in collaborative groups – the tools and services: i) to search for and discover content relevant to their needs along with evidence of its effectiveness, ii) to assemble and test curricular and learning modules from component pieces in a flexible manner, and iii) to gather evidence of impact and communicate experiences to the community.

To maximize the utility of its resources, the NSDL program is also concerned with the development of a comprehensive cyberlearning infrastructure. Features should include practices and policies for community-based review, methods for combining new and existing resources into effective learning experiences, methods for logging and interpreting student and teacher actions, and other mechanisms that assure the quality and usability of resources. For example, teachers may consider recommendations of learning and teaching resources more relevant if teachers with experience profiles and learning contexts similar to their own recommend their use. Likewise, practices and policies are needed for collections management issues such as archiving, preservation, and deaccessioning. Other infrastructure concerns include: i) the articulation of standards that promote stability, interoperability, and reusability of a wide variety of learning objects, ii) effective ways to handle intellectual property issues that focus on maximizing the value of content, iii) login and authentication systems, iv) archiving services, and v) digital rights management systems.

Following from the basic mission of making digital objects fully useful in the support of STEM learning, NSDL is deeply concerned with developing and understanding mechanisms that facilitate utilization of its network of digital resources by students and teachers. These efforts should harness new understandings about pedagogy, curriculum, and the processes of learning, and they should investigate the impact that the digital tools and services of the NSDL network have on teacher practice and on student learning.

Finally, the long term impact of the network of learning resource collections and services assembled under the NSDL program will depend largely on how well funded projects can leverage related efforts and demonstrate value to significant audiences so as to achieve sustainability after the period of NSF funding.

It is of the essence of the NSDL program that it should serve to multiply the impact on learning of digital resource collections and services. Similarly it seeks synergy with efforts supported by NSF and sister government agencies, the private sector, professional societies, and others working to improve education in science, technology, engineering, and mathematics nationwide. New NSDL projects are expected to coordinate their work with those of current NSDL projects and other educational digital collection efforts, such as the Digital Library Federation, the Gateway to Educational Materials, projects supported by the Institute of Museum and Library Services, or projects funded under the joint NSF and Library of Congress sponsored National Digital Information Infrastructure and Preservation Program.

NSDL activities are distinct from original content development supported by other NSF programs such as the Course, Curriculum, and Laboratory Improvement program, the materials development aspects of programs in the NSF Division of Research on Learning in Formal and Informal Settings (DRL), and similar curriculum and materials development programs funded by NSF or other agencies. NSDL projects start from the assumption that materials, resources, modules, and other digital learning objects are developed. Similarly, proposals that are primarily digitization or conversion projects are not appropriate for the NSDL program. Prospective proposers who have questions are encouraged to contact the NSDL program at due-nsdl-program@nsf.gov.

PROGRAM TRACKS

In FY2008, the NSDL program will accept proposals in four tracks: *Pathways*, *Services*, *Targeted Research*, and *NSDL Resource Center*. Within the first three tracks the program will accept **proposals for large grants** in 1) the *Pathways* track, 2) a new sub-track: *Pathways - Stage II*, and 3) specific sub-tracks of *Services* - including a *Technical network services* project to provide technical infrastructure support across the NSDL network. The *NSDL Resource Center* will provide collaboration assistance across all projects; undertake strategic partnership development on behalf of projects particularly with respect to non-academic entities; coordinate and, in some cases, perform thematic research and evaluation studies related to the program; synthesize findings across the portfolio; and disseminate findings of the accomplishments of the NSDL program. In developing proposals, substantive interactions are strongly encouraged among all types of NSDL stakeholders, such as pre-K to 12 schools, two-year colleges, four-year colleges, universities, professional societies, public or community libraries, museums, industrial and business concerns (including commercial publishers), and other non-profit and for-profit organizations.

In the first three tracks the program will also accept **proposals for small grants** to build on outcomes from prior projects either directly funded by NSDL or related to the goals of NSDL. Small grants are especially encouraged for projects that: exploit the Fedora-based architecture of NSDL or the current collaborative communication capabilities of NSDL to create value-added services for teachers or learners (e.g. annotation or rating functions); enhance utilization of collections of digital learning objects; provide for assessment of the impact on student learning; provide mechanisms to engage the collective intelligence of a user audience to advance the understanding, reliability, and effective use of digital learning materials; or increase the likelihood of sustainable activity.

TRACKS	Emphasis	Large grants	Small grants
<i>Pathways</i>	Provide stewardship for the content and services needed by major communities of learners	X	X
-- Pathways - Stage II	Ensure expansion and stability of an earlier <i>Pathways</i> effort or similar activity	X	X
<i>Services</i>	Develop tools and applications for users and resource collection providers that enhance the impact, efficiency, and value of the NSDL network	see sub-tracks	
-- Integrated services	Enhance overall capabilities of the NSDL network to meet the needs of its user and developer communities including the need to demonstrate impact of content and resources	X	X
-- Selection services	Increase the amount of high-quality STEM educational content known to the NSDL network	X	X
-- Usage development workshops	Promote the use of the NSDL network and its resources by various learner communities	X	X
-- Technical network services	Provide technical support, and maintain and upgrade the infrastructure underpinning the NSDL network	single award	n/a
<i>Targeted Research</i>	Explore specific topics having immediate applicability to collections, services, and other aspects of the development of the NSDL network	n/a	X
<i>NSDL Resource Center</i>	Provide cross-project collaboration assistance; undertake strategic partnership development; coordinate thematic research and evaluation studies; synthesize and disseminate program findings	single award	n/a

Proposals for *Pathways* and *Services* projects must describe prospects for continuing to make project capabilities available beyond the period of NSF funding. This description should include a long-term management plan, and proposed projects should have a tangible, long-term commitment from a stable organization. Open source and open content models are particularly encouraged. Sustainability is also often fostered through partnerships involving academic, business, government, and other organizations. Cost recovery and for profit models are welcome, although the evaluation of a project's long-term management plan will be strongly informed by the goal of making the full library's resources available to potential users at a cost that will not limit their use. Cost models should be tested with users and shown to be sustainable over the life of the materials.

It is important that proposals provide evidence of familiarity with and understanding of the current state of development not only of NSDL, but also other leading providers of access to digital educational resources. A project's stewardship should contribute to the overall value of NSDL, as it serves to facilitate the development and dissemination of both new and tested materials and methods supporting continued improvements in STEM education. Websites that provide information about ongoing projects and activities are listed at the end of this solicitation.

Pathways Track

The *Pathways* track supports projects that organize digital resources so as to serve the needs of an identifiable STEM education community. Proposers of a *Pathways* track should make evident how the resources to be organized within the pathway enable STEM education that is inquiry-driven, active, engaging, and effective. Moreover, these should be representative of larger realized or potential collections or holdings of resources, and they should offer special characteristics and strengths to the users of NSDL. *Pathways* should not only collect resources but look forward; they should anticipate and provide value-added services needed by the targeted learning community. Proposers should articulate how their work will make the resources more available and more useful not only to the primary audience, but where appropriate to an expanded audience.

A project supported in this track also accepts a stewardship role on behalf of NSDL for the educational content and/or the services needed by a broad community of learners, e.g. educators in disciplines, such as physics or chemistry, or K-12 teachers seeking authoritative rich media educational content. Responsibilities for stewardship include:

- maintaining criteria and mechanisms to identify, select, and annotate high-quality and relevant digital content as it continues to become available, and to generate appropriate metadata for such content;

- providing all item-level metadata to the central NSDL data repository (see the *NSDL metadata requirements* described below);
- documenting the ways students and teacher use resources and demonstrating that the NSDL adds value to learning and teaching using accepted research designs;
- sustaining the currency of the aggregated educational resources, either by acquiring/linking, or deaccessioning;
- archiving that preserves the usability of digital content as the underlying information technology systems evolve.

Potential audiences include: the users of subjects and concepts within a broad STEM domain; the educational community associated with a grade band; or users and providers of professional expertise in areas such as assessment or evaluation. Proposals to address audiences formed by the intersection and/or combination of the preceding examples are also possible, as well as proposals that identify other broad audiences defined by a coherent set of content and user needs. In all cases projects should indicate clearly the attributes of the audience(s) being targeted and the most pressing needs and areas of stewardship to be addressed. In FY2008 priority will be given to projects that clearly serve the needs of audiences not currently met by the ongoing *Pathways* efforts. (See References section below for more information on these ongoing projects.)

Pathways providers are expected to marry the potential of information technology advances and digital library research with the best practices of human expertise to fulfill their stewardship responsibilities. It is anticipated that projects will primarily adapt and implement existing services and approaches, rather than develop new technologies. Opportunities to leverage technologies across the *Pathways* projects will be particularly important to exploit. Evaluation of the effectiveness of the project in carrying out its stewardship role should be informed by the degree to which users can consistently find appropriate pathways or connections to the resources that meet their specific learning needs.

Pathways - Stage II

Projects in this *Pathways* sub-track will have accomplished the major stewardship goals set out above for an identifiable audience of learners, and would use Stage II support to ensure the expansion and stability of the original *Pathways* effort. In addition to existing NSDL *Pathways* projects entering the final year of their award, this sub-track is also open to projects and organizations that have developed mature digital collection enterprises without NSDL support, providing they fulfill functions comparable to what existing *Pathways* offer for their well-defined educational audiences.

Stage II proposals should clearly outline the accomplishments of the project to date and relate them to key *Pathways* priorities, including a detailed description of their ongoing stewardship activities. Applicants should also review the collections that the project makes available, and chart the growth of usage of the materials and services provided by the project. Projects should show how use of the materials impacts teaching and learning, analyze the cost/benefit structure where feasible, and document how users customize the resources to their needs. Where appropriate, the proposal should describe how the project has worked successfully toward the shared goals of the NSDL, and how the project has acquired and maintained partners that have contributed to its success.

Projects in this sub-track should provide a compelling plan for the use of Stage II funding, which must discuss the rationale and process for expanding the content and resource collections for which it provides stewardship and/or the services that the project will develop. Prospective applicants in this sub-track also need to provide market data or other evidence that these services and materials will satisfy a clear unmet demand of their target audience. To encourage a focus on the *Pathways'* users, projects are expected to conduct pedagogically sound workshops to support use and assessment of the impact of content and services. Projects should conduct workshops for teachers, educators, and developers, and should allocate not less than 25% of the proposed budget to such workshops and related outreach activities. Finally, a Stage II *Pathways* proposal must present a convincing sustainability plan. This section should review the sustainability activities accomplished in the first round of funding, and explain how additional support will bring the *Pathways* effort to a point where it will be able to recover operational and developmental costs from users or their sponsors after the Stage II NSDL support concludes. Proposers are strongly encouraged to develop their plans with a view towards coordinating efforts with other *Pathways* projects and NSDL as a whole.

Services Track

This track supports projects to increase the impact, reach, efficiency, and value of the NSDL collected resources. Priority will be given to efforts that have the greatest potential for broad impact across an array of other NSDL projects and offer mechanisms to assess that impact and demonstrate success. Projects that propose to use a web services framework should expect to provide web service definitions (e.g. WSDL) and appropriate web service interfaces (e.g. SOAP or REST) to aid in service discovery and use. In developing services, projects are encouraged to build on new Web 2.0 ideas and tools rather than replicating them. As in the *Pathways* track, *Services* track projects are expected to cooperate closely, both among themselves and across NSDL. Building on a standard platform and connecting through a common infrastructure enables such distributed services to increase in value.

In FY2008, the NSDL program will support two levels of funding within the *Services* track. Proposals for large grants may address any of four sub-tracks: **Integrated services**, **Selection services**, **Usage development workshops**, and **Technical network services** (see below for further details); or proposers may seek small grant support to define and describe activities that extend the impact of existing efforts in any of the first three of these sub-tracks. Integrated services projects could develop new services that can be incorporated directly into nsdl.org; selection services projects could plan to expand the content areas they are tagging and integrating into the NSDL data repository; workshop projects could target new communities of learners to enlarge the NSDL user base. Extensions to other types of services may also be proposed; however, subject to the availability of program funds, priority may be given to supporting projects that respond to these specific elements, or otherwise have wide applicability and strong potential to enhance the value of NSDL to users.

Integrated services

Integrated services projects enhance the overall capabilities of NSDL to meet the needs of its user and developer communities including the need to demonstrate impact of NSDL content and resources. Successful proposals must identify services that are not yet fully implemented by NSDL

and provide compelling arguments that they would be highly valued by user or developer communities in NSDL. For example, projects could leverage new social networking tools and sites, tailor them to educational audiences, and integrate them into NSDL. All projects in this component also will fulfill three key conditions of integration: (1) They must be able to operate on digital collection resources available through the NSDL data repository (NDR); cross-repository services that can also operate on materials from other sites and repositories are highly encouraged. (2) They must be implemented in such a way that they could be included in nsdl.org, the central NSDL portal; portable services that could also be integrated into other sites or libraries are highly encouraged. (3) They must be shared with NSDL under a license that permits reuse by others.

Strand maps, an existing NSDL tool that provides graphical representations of connections among concepts, illustrates the features of an integrated service. First, it is valuable, since such a tool can help educators and students comprehend and use educational resources, serving in effect as a concept- and standards-correlated "lens" through which a body of educational resources may be explored. Second, the service can be applied to collections resident in NSDL's NDR. And third, a version of this service that was originally developed for the Digital Library for Earth System Science (DLESE; <http://www.dlese.org>) has been generalized for use in NSDL, and it can be customized and incorporated into Web pages using a Web 2.0 JavaScript API.

Examples of potential services that are either not yet part of NSDL or not yet fully integrated into NSDL, but for which need has been voiced, include:

- community feedback and/or collaborative filtering mechanisms for recommending resources to users;
- design, implementation, and validation of evaluation metrics;
- mechanisms to associate commentary, recommendations, and other annotations with resources;
- provision of technical capabilities and expertise for sharing, reusing, and repackaging NSDL resources with those of traditional and new media publishers;
- development of personal user profile systems that support personalization services and respect privacy issues; and
- implementation of methods to determine usage patterns to inform design and evaluation.

Selection services

The aim of this type of services project is to increase the amount of high-quality STEM educational content known to NSDL. These resources may vary from individual learning object items such as images or simulation applets to an entire set of digital content available as a web site. A project in this sub-track is expected to use existing criteria endorsed by the target audience such as learning design principles. Projects should use valid, user tested processes for identifying and selecting content within a particular domain. Similarly, projects that seek primarily to develop new software technology are not appropriate. While Selection services do not necessarily have to be associated with expanding existing NSDL projects, it would be important for proposals to demonstrate familiarity with these efforts and to articulate their particular value added aspects. Selection services providers would also be expected to coordinate their efforts with relevant projects in the *Pathways* track once the funding period commences.

The selection process assumes that materials, resources, modules, and other digital learning objects are already in existence. The task of the Selection services provider is to select and tag this content, and to deposit item-level metadata into the central NSDL data repository and into other repositories, as appropriate (see the description below of the *NSDL metadata requirements*). Building on these selection efforts, the project or other providers may then develop and offer more extensive and value-added annotation and review of the suitability of the digital resources for particular user audiences. Furthermore, support for personalization of finding aids and other discovery tools can be enabled. Similarly, tools may be developed to help content developers combine resources from different providers or collections and present this specialized content to users. Proposers are especially encouraged to include activities that can contribute to understanding and evaluating teachers' use of digital educational resources and the impact of using digital resources on student learning.

Usage development workshops

These projects will support workshop series that promote the use of NSDL and its resources by various communities of learners. Examples of possible workshop emphases include development of leadership teams of faculty and librarians seeking joint expertise in the use of digital libraries that would in turn be shared with a local institutional or organizational audience; or assistance for teachers and students at K-12 schools or colleges having limited computer capability and technical support; or experiences to increase the library's usability for special populations such as young children or other users having limited experience with computer technology; or engagement of users of digital resources within a specific STEM domain.

Simultaneous with the development of a user base for NSDL, the workshops will permit the study of user information-seeking behavior and user interaction with specific NSDL content, for example in existing *Pathways* or earlier collection efforts. Projects should report feedback from these observations that can guide further development of NSDL and make its overall resources more useful. Of particular interest is the opportunity to gain insights into faculties' and teachers' use of digital resources for their own professional development and the effect students' use of digital educational resources has on their learning. Workshops should seek to improve both the capacity of individual users and the capacity of the larger community of learners. Such capacity would inform both research on building and sustaining user communities within the context of managed digital resource networks, and research on uses of digital materials to improve learning by students at all levels. As with the Selection services projects above, proposers are especially encouraged to include activities that can contribute to understanding and evaluating teachers' use of digital educational resources and the impact of using digital resources on student learning.

While it is expected that the majority of funds in Usage development workshop project budgets will be directed towards participant support costs, development of resources to be used by workshop participants may be requested. In all cases such materials should be made available via NSDL for use in subsequent workshops or by interested individuals or groups seeking to develop an understanding of the capabilities of NSDL. Furthermore, any materials and other resources developed by workshop participants should be suitably described with appropriate item-level metadata and contributed to NSDL (see the description below of the *NSDL metadata requirements*). Projects are expected to provide models for how their approaches can be applied to other learning communities sharing similar characteristics.

Technical network services

In FY2008, the NSDL Program will fund one project in this sub-track to assume responsibility for maintaining and upgrading the infrastructure underpinning NSDL and its primary website, nsdl.org. These services not only include basic search and browse capabilities, but also a new array of Web 2.0 functions, including Expert Voices (<http://www.nsf.gov/cgi-bin/good-bye?http://expertvoices.nsd.org/>) and RSS feeds. It will be essential for the team providing such services for NSDL to continue to support ongoing functions for sharing and reuse of NSDL collections in nsdl.org, such as metadata harvesting (see *NSDL metadata requirements*, below), and to keep the content in NSDL's data repository (NDR) growing and up to date. The Technical network services team will also maintain nsdl.org's high standards of stability and reliability, to ensure that end-users can interact effectively with the site.

The Technical network services project will collaborate closely with other *Pathways*, *Services*, and *Targeted Research* projects, and also with the *NSDL Resource Center* (see below). The implementation of NSDL's infrastructure using Fedora (see <http://www.nsf.gov/cgi-bin/good-bye?http://www.fedora-commons.org/>) makes possible the creation of a wide range of innovative new services to support developers as well as educators. A critical role for the Technical network services team will be to help facilitate discussions that will prioritize the implementation and design of such new services for NSDL. Once services are chosen for implementation, the team will also lead their development, in some cases assembling and testing the services in collaboration with other projects or the *NSDL Resource Center* (see below). Any new development work is expected to be accomplished cost-effectively by leveraging software tools and workflow practices that have been developed by both NSDL and other leading digital education consortia, and by effectively marshaling the collective intelligence of the larger educational technology developer community. Proposals for this project should include a business model that moves *NSDL Technical network services* toward financial self sufficiency.

Other services

Additional services supporting existing collection providers, *Pathways* projects, resource selection or workshop activity, or technical aspects of collection management might include:

- reliability and/or interoperability testing across different platforms for Java applets or other software-based resources;
- provision of user reports and other commentary associated with content;
- "middleware" to support acquisition and incorporation of content from different sources;
- specialized audio, image, and video search capabilities;
- specialized content-based searching.

To determine whether or not a candidate service has already been integrated into NSDL, prospective applicants are encouraged to review the set of NSDL *Services* projects referenced in the list of web resources at the end of Section II.

Targeted Research Track

In FY2008, proposers seeking small grant support are encouraged to define and describe activities that extend their project's direct applicability to one or both of the other two tracks or to technical aspects of collection management. Additionally, they may explore other aspects of NSDL including its impact on educational practice, changes in user behavior, and development of new learning environments. Examples include, but are not limited to:

- automated annotation of audio, image, or video resources;
- user interface implementation issues;
- identification and usage of principles of information architecture design;
- use of expert system principles to capture human librarians' experience, knowledge, and practice;
- analysis of user practices and trends in social networking and participatory development environments and their application to NSDL;
- research on hybrid systems that marry human and automated expertise to provide user services; and
- applications of simulation or virtual world technology for virtual assistants.

NSDL Resource Center

In FY2008, the NSDL program will award one Resource Center as a cooperative agreement. The Resource Center will: provide collaboration assistance across all projects in such areas as research and development methods, evaluation, implementation, and "webmetric" analysis procedures; engage in effective outreach and professional development regarding the use of digital learning resources; undertake strategic partnership development on behalf of projects particularly with respect to non-academic entities; coordinate and, in some cases, perform thematic research and evaluation studies related to the program; synthesize findings across the full range of NSDL projects; and promote both national and international dissemination of the research and development contributions of the NSDL program. In addition to these activities, the Resource Center will help to build the NSDL community through: support for principal investigator meetings; promotion of sharing of outcomes and findings across projects; or other activities that address interests and concerns across the NSDL program.

EXPECTATIONS FOR SHARED DEVELOPMENT OF NSDL

The success of NSDL in making the full richness of its resources and services useful for STEM education depends not only on technical excellence, thoroughness in collection building, and creativity in interface design and construction, but also on the development of a sense of common cause by all the projects. New awardees are expected to collaborate with one another and with previously funded projects. To

facilitate interaction among all projects, regular Principal Investigator (PI) meetings and workshops are held throughout the course of the NSDL program. Representatives of related projects not funded by the NSDL program are also invited to these meetings. New projects in particular are expected to attend the Annual Meeting.

To engage program PI's and other stakeholders in addressing essential infrastructure issues, and in assessing the impacts of its resources on learning, NSDL supports Workgroups in various areas of interest including, Accessibility and Diversity, Community Services, Content, Copyright, Educational Impact and Evaluation, K-12 Educational Standards and Alignment, Scientific Markup Languages, Sustainability, Technology, and Webmetrics. An active Policy Committee leads the development of emerging community initiated organizational principles and practices, and PIs are strongly encouraged to provide leadership in this larger community building effort.

NSDL METADATA REQUIREMENTS

The NSDL architecture supports storing and searching STEM resources based on XML metadata information, available resource textual content, and other information that provides context for the resources. All new and continuing content contributors are expected to supply item-level metadata records either for harvesting via the Open Archives Initiative (OAI) protocol, see <http://www.openarchives.org/OAI/openarchivesprotocol.html>, or else directly through a web services API that has been developed (see <http://nsdl.org/contribute> for details). For collections that do not use an existing standard metadata format, Dublin Core is recommended at a minimum, see <http://www.nsf.gov/cgi-bin/good-bye?http://dublincore.org/>. To provide better educational context for NSDL users, item-level metadata should include information corresponding to Audience and education Level (the elements in Dublin Core), and developers should use a currently available controlled vocabulary for Subject or post their vocabulary publicly. For K-12 focused collections, it is recommended that resources be correlated to state or national standards and, for Dublin Core metadata providers, that information be mapped to the conformsTo refinement for Relation in Dublin Core. Since Qualified Dublin Core carries this information most effectively, projects using Dublin Core metadata for OAI harvesting are expected to expose Qualified Dublin Core for harvesting in addition to the OAI mandated Simple Dublin Core. The NSDL Metadata Guidelines (see <http://www.nsf.gov/cgi-bin/good-bye?http://nsdl.org/collection/metadata-guide.php>) and the Institute of Museum and Library Services document, "A Framework of Guidance for Building Good Digital Collections," (<http://www.nsf.gov/cgi-bin/good-bye?http://www.niso.org/framework/Framework2.html>) both provide additional information. For projects with information about their content and services that is not easily expressed as Dublin Core or Qualified Dublin Core metadata, the NSDL data repository (NDR) supports storing and searching based on other XML metadata formats. In addition, for projects that maintain structural or other relationships among their resources, data, and metadata (e.g. resources organized in lesson plans and annotations or reviews of resources), the NDR supports storing and manipulating references to these resources, data, and metadata as well as arbitrary relationships among those references through the web-services API mentioned above (see <http://nsdl.org/contribute> for details).

RELATED FUNDING SOURCES

Although the purpose of the NSDL program is to support improvements in STEM education in the United States, the impact of the program has an increasingly important international dimension. Conversely, international digital library efforts may help achieve the goals of the NSDL program. Consequently, proposals to this program may be part of a larger effort that includes international elements funded by sources in this or other countries.

Proposals for basic research on the use of technology in education or other investigations relevant to NSDL's development may be supported by programs such as Advanced Learning Technologies (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12834) or Research and Evaluation on Education in Science and Engineering (REESE) (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=13667). Emerging grant opportunities also exist within the Human and Social Dynamics priority area (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=11678) or the Cyber-enabled Discovery and Innovation initiative (http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503163). Prospective proposers are encouraged to contact the NSDL program at due-nsdl-program@nsf.gov if they have questions about the match between their interests and the goals of NSDL versus these related programs.

REFERENCES

The references that follow provide additional information to prospective proposers about advances in information technology relevant to the NSDL program as well as summary documents regarding the current state of development and progress of NSDL.

Anderson, C., (2004). *The Long Tail*. Available at: <http://www.wired.com/wired/archive/12.10/tail.html>.

Anderson, C., (2006). *The Long Tail: Why the Future of Business is Selling Less of More*. New York: Hyperion.

Boyd, D.M. and Ellison, N.B., (2007). Social network sites: Definition, history, and scholarship. *Journal of Computer-Mediated Communication*, 13 (1), article 11. Available at: http://jcmc.indiana.edu/vol13/issue1/boyd_ellison.html.

Felfernig, A., Friedrich, G. and Schmidt-Thieme, L., (2007). Guest Editors' Introduction: Recommender Systems. *IEEE Intelligent Systems* 22(3): 18-21. Available at: <http://csdl2.computer.org/comp/mags/ex/2007/03/x3018.pdf>.

IEEE, (2007). *IEEE Intelligent Systems Special Issue on Recommender Systems, Volume 22(3)*. Los Alamitos, CA: IEEE Computer Society.

Shirky, C., (2005). *Ontology is Overrated: Categories, Links, and Tags*. Available at: http://www.shirky.com/writings/ontology_overrated.html.

Tapscott, D. and Williams, A.D., (2006). *Wikinomics: How Mass Collaboration Changes Everything*. New York: Penguin Group (USA).

The New Media Consortium and the EDUCAUSE Learning Initiative (2008). *The Horizon Report: 2008 Edition*. Austin, TX: New Media Consortium. Available at: <http://www.nmc.org/pdf/2008-Horizon-Report.pdf>.

The following references provide information regarding the current state of development and progress of NSDL.

A list of all projects funded by the NSDL program with links to abstracts is available at http://nsdl.org/resources_for/library_builders/projects.php. Each abstract also has contact information for the project's principal investigator(s).

For information about the current *Pathways* projects, see http://nsdl.org/resources_for/library_builders/index.php?pager=pathways.

To determine whether or not a candidate service has already been integrated into NSDL, see http://nsdl.org/resources_for/library_builders/projects.php and http://nsdl.org/resources_for/library_builders/tools.php?pager=tools.

For detailed technical information on the NDR Application Programmer Interface (API) that will guide the design and implementation of new NSDL integrated services, and on licensing options that will guide the choice of appropriate rights and permissions for integrated services, see <http://nsdl.org/contribute>.

To follow the activities of the NSDL community and its ongoing online exploration of key issues, see the Community Pages at http://nsdl.org/resources_for/library_builders/index.php.

For information about the various workgroups that are addressing issues such as Accessibility and Diversity, Community Services, Content, Copyright, Educational Impact and Evaluation, K-12 Educational Standards and Alignment, Scientific Markup Languages, Sustainability, Technology, and Webmetrics, see http://nsdl.org/resources_for/library_builders/nsdlgroups.php.

III. AWARD INFORMATION

NSF anticipates that approximately \$12.25 million will be available in FY2008 for awards made through this solicitation. The program expects to make approximately 20-31 awards, depending on the availability of funds and the quality of proposals received. The anticipated distribution of awards is as follows:

- *Pathways*: 2 to 4 new awards, up to \$2,550,000 each;
- *Pathways - Stage II*: 2 to 4 new awards, up to \$725,000 each;
- *Services*: 4 to 6 new awards, up to \$600,000 each;
- *Small grants*: 10 to 15 new awards, up to \$150,000 each.
- *Technical network services*: 1 new award, up to \$4,500,000.
- *NSDL Resource Center*: 1 new award, up to \$5,000,000.

Awards in the *Pathways* track may have a duration of up to 36 months and will be made as continuing grants. Awards in the *Pathways - Stage II* sub-track may have a duration of up to 24 months and will be made as either standard or continuing grants. Awards in the *Services* track may have a duration of up to 36 months and will be made either as standard or continuing grants. Awards in the *Small grants* track may have a duration of up to 24 months and will be made as standard grants. The awards for *Technical network services* and the *NSDL Resource Center* may have a duration of up to 48 months and each will be made as a cooperative agreement. The total budget for the *NSDL Resource Center* project may be up to \$5M. The total budget for the *Technical network services* project may be up to \$4.5M consisting of a yearly budget of up to \$1.5M in years 1 and 2 and then a cumulative budget of up to \$1.5M for years 3 and 4. This budget "rampdown" reflects the program's expectation that this activity gain self-sufficiency over the course of the grant period. The estimated program budget, number of awards, and average award size and duration are subject to the availability of funds.

IV. 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:

An individual may serve as the Principal Investigator (PI) on no more than one proposal, including collaborative proposals, submitted in the FY2008 competition, but may serve as a co-PI on multiple proposals.

Additional Eligibility Info:

The categories of proposers identified in the *Grant Proposal Guide* (see Chapter I, Section E) are eligible to submit proposals under this program solicitation.

V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS

A. Proposal Preparation Instructions

Letters of Intent (optional): A letter of intent (LOI) is requested, but not required, by May 27, 2008. The LOI should be submitted using the FastLane Letter of Intent module. Please provide the name of the Principal Investigator and the submitting organization, and indicate clearly whether the prospective proposal will address the *Pathways* track; the *Pathways - Stage II* sub-track; the Integrated services, Selection services, Usage development workshops, or Technical network services sub-tracks of the *Services* track; the *NSDL Resource Center*; or the *Small grants* opportunity to enhance or extend an existing NSDL activity.

Letter of Intent Preparation Instructions:

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

- Sponsored Projects Office (SPO) Submission is not required when submitting Letters of Intent
- A Minimum of 0 and Maximum of 4 Other Senior Project Personnel are allowed
- A Minimum of 0 and Maximum of 4 Other Participating Organizations are allowed
- Track for proposal (Pathways, Services, Small grants, or NSDL Resource Center) is required when submitting Letters of Intent
- Submission of multiple Letters of Intent is not allowed

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.

For full information about the NSF Proposal Review process including a discussion of the two NSF merit review criteria, Intellectual Merit and

Broader Impacts, see section VI of this solicitation. Proposers are reminded that they must address both merit review criteria in separate statements within the one-page Project Summary in accordance with GPG, Chapter II, Section C.2.b.

The following information supplements the standard GPG or NSF Grants.gov Application Guide proposal preparation guidelines:

The Project Description contains most of the information that determines whether or not a proposal is funded. Project descriptions should include:

- **Statement of Need.** For *Pathways* projects: Describe clearly the stewardship needs for the educational resources and services of the community of learners being addressed. For *Pathways - Stage II* projects: Describe clearly the successes of the original *Pathways* effort or its equivalent and how this next stage of support will enable it to add value and satisfy unmet needs of educators and learners. For *Integrated services* projects: How will the service operate on digital collection resources available through the NSDL's NDR? Similarly, if appropriate, how will the service engage other high-quality digital collection resources that are not yet part of the NSDL network? How will the service be implemented so that it can be included in the central NSDL portal? How will the service be shared under a license that permits reuse by others? For *Selection services* and *Usage development workshops* projects: What is the educator or learner demand that the project proposes to satisfy and what is the evidence that such a demand exists? For projects seeking *Small grant support* to extend or amplify the impact of current activities: What content areas are being expanded or enhanced and why? What are the particular user needs of the anticipated participants and why are these critical to NSDL? For *Small grants* focusing on *Other services* or *Targeted Research* projects, state clearly the demand for the enhanced service, or the additional problems or issues being researched. In all cases the proposal should demonstrate how the proposed work will build upon current results or capabilities of NSDL activities.
- **Target Audience.** Describe clearly the community or communities of learners whose needs will be addressed by the project. What aspect(s) of the user's experience with NSDL will be enhanced and/or extended by the project outcomes? What users will be affected and how, and what is the context of the anticipated usage. What is the setting of the project: for example, informal or formal education, life-long learning, and why is this vital to NSDL?
- **Project Goals.** State the overall goals and objectives for the project and how progress towards these goals and objectives will be assessed. What is the relationship of the project to the current state of development not only of NSDL, but also other leading providers of access to digital educational resources? How does the project enhance the value of the NSDL network by having a demonstrable impact on educators or learners?
- **Project Design.** Describe the overall approach and components of the project. How will the intended learners use the resources or services? How will the understanding gained from targeted research enhance the NSDL network's operation or its impact on learners? Where appropriate, applicants are strongly encouraged to provide links to examples or a prototype web site that illustrate any proposed functionality. For the *Technical network services* project: Describe the project team's knowledge of the work and products of the relevant NSDL working groups, including the Technology Committee. Also, describe how the project team would engage the technical expertise found both within the larger NSDL community and within other leading communities of creators and providers of innovative technologies that engage educators and learners in the processes of providing access to and use of digital educational resources.
- **Key Staff.** Provide a description of the roles, responsibilities, and qualifications of key personnel, consultants, and/or advisors. These should be tied to major project goals and objectives. For the *Technical network services* project: Describe the broad experience of the project team in digital repository development and maintenance, and also the relevant specific knowledge of the standards and tools that comprise the current NSDL infrastructure.
- **Timeline.** Where appropriate, include a timeline for development indicating major points of progress that are expected.
- **Dissemination.** Describe, as appropriate, how the outcomes and lessons learned from the project will be communicated broadly.
- **Evaluation.** Describe, as appropriate, the plans for evaluation, including the name and qualifications of any evaluator(s). Information about the evaluation strategy, process, and methods should also be provided. What evidence will be sought to inform the progress towards project goals and why is this of value? As a component of NSDL, how will usage of the services offered by the project be ascertained? What evidence of impact on educators and/or learners will be gathered and why?
- **Sustainability.** For *Pathways*, *Pathways - Stage II*, and the *Technical network services* projects, describe the plans to promote and sustain the project beyond the grant period.
- **For the NSDL Resource Center.** Proposers should demonstrate that the project team has the ability to provide collaboration and methodological assistance across the range of NSDL projects, identify patterns in project outcomes, synthesize results, disseminate program findings both nationally and internationally to multiple stakeholder audiences, and undertake strategic partnership development on behalf of projects particularly with respect to non-academic entities. Successful proposers must have the capacity to manage and lead a national network, and should demonstrate broad expertise in outreach and dissemination, and in coordinating research and evaluation studies that investigate how the NSDL network can multiply the impact on learning of digital resource collections and services. Proposals must describe and exhibit ways to provide assistance for projects relative to the activities described above.

In preparing this narrative, proposers should ensure that both the intellectual merit and broader impacts of the project are addressed equally.

A Project Data Form must be submitted as part of all proposals. The information on this form is used to direct proposals to appropriate reviewers and to determine the characteristics of projects supported by the Division of Undergraduate Education. Note: In FastLane, this form will show up in the list of forms for your proposal only after you have (1) selected the correct Program Announcement/Solicitation No. on the Cover Sheet and (2) saved the Cover Sheet. Take special care to identify the proper track for your proposal in Item 1 of the form. Grants.gov users should refer to Section VI.6. of the NSF Grants.gov Application Guide for specific instructions on how to submit the DUE Project Data Form.

Organizations intending to submit simultaneous Collaborative Proposals (as described in GPG, Chapter II, Section D.3) must alert an NSDL program officer by e-mail (due-nsdl-program@nsf.gov) prior to the submission and must follow the instructions for electronic submission specified in GPG, Chapter II, Section D.3.b. The project titles of the related proposals must be identical and must begin with the words "Collaborative Project," and the combined budgets of the related proposals should conform to the anticipated individual award sizes specified for projects in Section III ("AWARD INFORMATION") above. These simultaneous Collaborative Proposals will be treated as a single proposal (with a single Project Summary, Project Description, and References Cited) during the review process. **All collaborative proposals submitted as separate submissions from multiple organizations must be submitted via FastLane.**

Instructions for *Small grant* support:

Requests should provide: 1) an up-to-date description of the state of development or progress of the current NSDL activity being extended or enhanced; 2) a detailed description of the proposed extensions or enhancements to the ongoing work and activities; 3) a clear analysis of how the proposed work fits into the larger picture of development for NSDL, so as to integrate with other projects, to reach a larger audience, or to improve the functionality and capability of user services; 4) a cogent justification of the value-added features of the work and; 5) a description of the method(s) and evidence that will be used to evaluate and determine whether or not the proposed work is meeting its objectives.

Additional Instructions for all proposals:

A Budget Justification of up to three pages must accompany the budget forms and provide details about budget line items. Proposals that involve subawards should include separate budget pages and a Budget Justification of up to three pages for each subawardee organization.

If Special Information or Supplementary Documentation is included with the proposal (see GPG, Chapter II, Section C.2.j), this section should be submitted as one or more PDF files using FastLane's "Supplementary Documents" function. (Paper documents should be electronically scanned and converted to PDF.) This optional section may also include letters of support in addition to the types of items listed in the GPG. For Grants.gov users, supplementary documents should be attached in Field 11 of the R&R Other Project Information Form.

B. Budgetary Information

Cost Sharing: Cost sharing is not required under this solicitation.

Other Budgetary Limitations: Anticipated maximum award sizes are specified in Section III ("AWARD INFORMATION") of the program solicitation.

In FY2008, NSF will begin to transition away from providing certain aspects of technical infrastructure and logistical support for all of NSDL through a cooperative agreement for a Core Integration activity, towards a community-based approach that makes these costs explicit within each project. As part of this transition, all proposals except those for *Small grants*, the *Technical network services* project, and the *NSDL Resource Center* should allocate 15% of the total budget request for a subcontract to a technical network services provider, the details of which will be determined during budget negotiations with NSF pending a decision to recommend funding. For expected award amounts, duration, and anticipated numbers of awards see Section III ("AWARD INFORMATION") above.

C. Due Dates

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

May 27, 2008

(optional)

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

June 27, 2008

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 where they will be reviewed if they meet NSF proposal preparation requirements. 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 of interest with the proposal.

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/broadierimpacts.pdf>.

NSF staff also 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:

Evaluation of NSDL proposals will also include consideration of:

- Impact. Is the need for the project convincingly argued? Does the project fill a definable gap for NSDL? Is the target audience clearly

identified, and what is the potential for the project to make a significant impact on that audience? Does the potential exist for the project to model a particularly creative approach to the provision of services that enhance learning with digital educational resources or to the stewardship of a usable body of digital resources?

- Plan. Is there a sound implementation plan that links clear project goals and objectives to roles and responsibilities of project personnel? Does the project demonstrate an understanding of the current state of technical development of NSDL, e.g. metadata harvesting protocols, standards for interoperability, or authentication protocols? If appropriate, does the project demonstrate an understanding of the current state of other innovative technical developments that can bring value to the NSDL network? Does the plan describe adequately how collaboration and integration with the ongoing activities of relevant grantees or other projects will be accomplished? Where applicable, what is the potential for project capabilities to remain available beyond NSF support?
- Personnel. Does the project team represent an appropriate mix of expertise and experience to accomplish the project goals? What is the evidence of the commitment and involvement of senior personnel in the project and its activities? Are the roles of various other personnel clear? If there are project partners, contributors, or other collaborators, what is the nature and strength of their commitment?
- Outcomes. Does the project offer access to expanded or enhanced capabilities not previously available through NSDL? Or is the project enabling a new user audience to access NSDL? Can this serve as a model for other user audiences? Does the project have a reasonable plan to scale up this access? Where applicable, is the project providing an opportunity for a new sector of the educational community to take part in selecting or otherwise contributing to NSDL's collections or providing a service?
- Contribution. How will the project's activities complement and add value to the growing NSDL community of users and developers? Is there potential for the project to bring new perspectives and approaches to solutions related to shared issues of networked resources and services development, e.g. needs and requirements of learners, new technical specifications, intellectual property concerns, or plans for sustainability? What is the potential for the project to engage new participants in achieving the goals of NSDL, e.g. business or industry, or the non-profit private sector?
- Evaluation. Where appropriate, has the project presented a reasonable plan to assess progress towards its goals and to evaluate the impact of the project on the intended audience? Are there innovative approaches proposed for evaluating learners' usage of networked digital resources and their efficacy in improving learning? Do these have the potential to be applied in new settings, e.g. for resources in other disciplines, or for user audiences beyond that originally targeted by the project? If applicable, does the project offer an opportunity to understand the potential applicability to NSDL of new information technologies?

B. Review and Selection Process

Proposals submitted in response to this program solicitation will be reviewed by 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 deadline or target date, or receipt date, whichever is later. 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.

VIII. AGENCY CONTACTS

General inquiries regarding this program should be made to:

- Lee L. Zia, Lead Program Director (Mathematical Sciences), 835N, telephone: (703) 292-5140, email: lzia@nsf.gov
- Warren W. Hein, Assistant Lead Program Director (Physics/Astronomy), 835 N, telephone: (703) 292-4644, email: whein@nsf.gov
- Stephen C. Cooper, Program Director (Computer Science), 835 N, telephone: (703) 292-4645, email: sccooper@nsf.gov
- Timothy V. Fossum, Program Director (Computer Science), 835 N, telephone: (703) 292-5141, email: tfossum@nsf.gov
- Herbert H. Richtol, Program Director (Chemistry), 835 N, telephone: (703) 292-4648, email: hrichtol@nsf.gov
- Curtis T. Sears, Program Director (Chemistry), 835 N, telephone: (703) 292-4639, email: csears@nsf.gov
- Jill K. Singer, Program Director (Geological Sciences), 835 N, telephone: (703) 292-5323, email: jksinger@nsf.gov
- Sheryl A. Sorby, Program Director (Engineering), 835 N, telephone: (703) 292-4647, email: ssorby@nsf.gov

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: fastlane@nsf.gov.
- Antoinette T. Allen, Computer Specialist, 835 N, telephone: (703) 292-4646, email: aallen@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
Division of Administrative Services
National Science Foundation
Arlington, VA 22230

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The National Science Foundation, 4201 Wilson Boulevard, Arlington, Virginia 22230, USA
Tel: (703) 292-5111, FIRS: (800) 877-8339 | TDD: (800) 281-8749

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