A Vision for a National SMETE Digital Library (NSDL)

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The NSDL will be a gateway to high quality science, mathematics, engineering and technology education (SMETE) materials for use by students and teachers at all levels. The NSDL will provide the services of a traditional library such as the intelligent retrieval of relevant information, indexing and online annotation of resources, and archiving. In addition, the NSDL will have new capabilities, such as access to virtual collaborative work areas, hands-on lab experiences, tools for analysis and visualization, remote instruments, large databases of real-time data, and simulated environments. By providing broad access to a rich collection of teaching and learning resources in a digital environment, the NSDL will encourage and support improvements in the quality of SMET education for all students, grades K-16, and be a resource for lifelong learning. The NSDL will be delivered using the emerging technological capabilities of the Internet.

The NSDL will be the infrastructure, comprehensive in scope, to provide millions of users and providers access to a vast array of resources and services. This infrastructure will include the central management function of the NSDL, the development of standards for quality control and intellectual property management of digital resources, and the establishment of policies and practices for guaranteed stability and archiving of materials. The development of this infrastructure will require significant effort coordinated under the auspices of a new NSF program to develop the NSDL.

Program Management and Coordination

The NSF program to develop the NSDL is managed by NSF through the Directorate for Education and Human Resources and its Division of Undergraduate Education. The membership of the management Steering Committee is currently drawn from both the research and education directorates. The collaboration of research and education directorates will ensure identification of high-quality content across NSF-supported disciplines; the continued collaboration with the computer science research directorate (CISE) will ensure access to technical expertise on emerging technologies developed through CISE programs.

In addition to a coordinated effort within the NSF, there is also considerable coordination with other federal organizations. The White House Office of Science and Technology Policy (OSTP) has asked the National Park Service, the Institute of Museum and Library Services, the Smithsonian Institution, and the Library of Congress to coordinate their efforts in developing digital libraries and resources for education. The plans for the NSDL are consistent with cross-agency plans that will be the subject of a forthcoming report commissioned by the Institute of Museum and Library Services.

Programmatic Plan for Development of the NSDL

The NSDL effort builds on work supported through the multi-agency Digital Library Initiatives in 1998 and 1999. The program announcement for Phase II of the Digital Library Initiative (DL-II) included a special emphasis for planning testbeds and applications in undergraduate education. The review of proposals received in response to this program component was conducted in consultation and coordination with CISE program staff. This process resulted in three awards in 1998 and five awards in 1999. The earlier awards supported prototyping of specialized content designed to exploit the unique capabilities of digital libraries; the later five awards are developing prototypes for the NSDL's architecture and systems. Informed by a series of workshops (see Appendix B) and funded projects, the development of the NSDL has progressed beyond DL-II activities.

Further progress toward the NSDL requires a specialized program that adequately describes the vision, features, and expected outcomes for the NSDL as it relates to education at all levels and provides high visibility for the effort in the

community at-large. The goal of the program is to establish the NSDL, with plans for long-term support for maintenance, improvement, and expansion. Toward this end, the specific objectives of the program are to identify and develop for the NSDL:

- technical specifications,
- user services,
- management strategies,
- collections of resources, and
- user communities.

The plan to develop the NSDL has three phases designed to achieve these objectives:

Phase I (approximately $13 million)---During this phase, support will be provided to multiple projects to develop and test prototype models of aspects of the NSDL. The projects will address issues regarding quality control, user access and services, and intellectual property. The projects collectively will help to define user requirements and to develop technical specifications for the final NSDL.

Phase II (approximately $25 million)--- The actual implementation of the NSDL will result from the user requirements and the preliminary evaluation of the models that emerge from Phase I. In fact, the selections made as a result of the phase I process will define the operating parameters for Phase II. In Phase II, a single awardee (possibly involving a consortia of the Phase I awardees) will implement the primary portal through which users will enter the NSDL to access resources and services. NSF funding will support the management of the NSDL, implementation of user services, and collection development (including protocols for tagging resources with metadata and development of indexing taxonomies to facilitate searches). As a result of this phase, the Library's central system will be operational, but have limited content and services.

Phase III (approximately $22 million)--- Materials development will not be supported by this program. However, this phase will provide support to multiple individual projects to develop coherent collections of high-quality educational materials and services for access through the NSDL. Emphasis will be placed on interoperability between collections so that individual users will be able to quickly access and experience the rich breadth and depth of materials and services provided through the NSDL and its affiliated institutions.

This vision of the NSDL is subject to the final approval by the National Science Board, which governs the activity of the National Science Foundation and to the appropriation of funds by the U. S. Congress.

Examples of how the NSDL would be used by students and teachers:

As part of a geology class project, a group of ***undergraduate students*** *uses the NSDL to access a database of the oxygen content in icecores taken in Antarctica and statistical analysis tools to produce their own research findings.*

A ***college faculty*** *member scheduled to teach an introductory genetics course for the first time uses the NSDL to find information about the latest textbooks being published. In preparing her online syllabus, she is able to download at no charge and incorporate several simulation modules illustrating the principles of genetics developed by a faculty member at another institution.*

Undergraduate students *preparing to be high school science teachers use the NSDL to work through a set of 3-D animated lab exercises illustrating molecular structures for their chemistry course. They then modify them for use in high school classes.*

Teachers, administrators, and parents *in a school system investigate alternative middle school mathematics curricula to identify those most closely aligned with local learning objectives and suited for adoption.*

An ***elementary teacher*** *in North Carolina has her* ***students*** *use the NSDL to access data about principles of flight from the Smithsonian Institution's National Air and Space Museum collections to enable them to prepare online reports in collaboration with students in a sister class in Alaska.*

A curriculum developer at a ***community college*** *uses the NSDL to pull together video clips and hands-on lab exercises to develop an online course for computer technician training.*

High school students *use the NSDL to access an online mathematics package to visualize and solve graphing problems. The exercises are generated randomly for each student, and each student receives immediate feedback and coaching about their progress. The teacher is able to access a progress report for each student.*

Students *in an advanced placement high school physics class are able to reserve the use of a telescope for an hour each week to make real-time astronomical observations.*