NSDL : Builders : Creation : Achievements

NSDL is a highly complex, ambitious project that has been—and will continue to be—groundbreaking in a number of areas.

—Diana Oblinger, Chair,
NSDL National Visiting Committee

Deploying the Library

The initial release of NSDL.org was unveiled at the NSDL Annual Meeting in December 2002. This release included 118 collections from NSDL projects and other contributors. It established a basic foundation for NSDL library and community services.

Included in the initial library release were a variety of basic user services. The central library service contains a metadata repository of resource descriptions from all contributing collections, and users coming to NSDL.org can search and browse these descriptions. Users also have access to news, featured library collections, and special exhibits. In addition, a virtual reference desk service, called AskNSDL, allows users to pose questions via e-mail to a distributed group of experts and to search for frequently asked questions and resources on various topics.

Building a Technical Infrastructure

NSDL's primary technical goals include serving as a laboratory for technical innovation and applying new technologies to the building of high quality collections, services, and partnerships (see Figure 1 on page 6). As a result, the library's technical infrastructure is designed to provide basic user support, as well as a framework to assist NSDL partners in developing enriched services and collections. To further facilitate resource contribution and reuse, the NSDL community is employing common technical standards and information structures that enhance the library's accessibility for developers and users alike.

Tech Terms Explained

Metadata
Standardized descriptions of digital and physical resources—such as the title, author, subject, and text or multimedia format—that aid in the discovery and comprehension of those resources. Usually defined as "data about data."

Open Archives Initiative (OAI)
An initiative intended to supply and promote an independent framework for exchanging metadata that can be used by communities that are publishing content on the web.

Simple Digital Library Interoperability Protocol Developer Services (SDLIP)
A protocol for integrating multiple, heterogeneous information services.

Shibboleth
A computer program that enables exchange of information about users in a way that preserves their privacy and is secure.

uPortal
A system for building customized web interfaces.

Technologies for Resource Contribution and Discovery

- A centralized metadata repository holds descriptions of content for collections and individual resource items within collections. Archives of the metadata repository allow teachers and learners to reliably return to resources over time.

- The NSDL Search Service provides users with the ability to search for educational resources using words and phrases, and to conduct field-specific searches, filter searches, and enter double quoted phrases in search queries. Search results display the total number of hits for a given query and relevant NSDL partner and collections logos in addition to resource information.

Common Technology Standards and Protocols

- NSDL supports eight metadata standards enabling the integration of resources across many collections and scientific disciplines, the Open Archives Initiative, Shibboleth, uPortal, and SDLIP.

- A portal framework enables partners building specialized portals to share and reuse components.

- An OAI server interface allows collection and library builders to obtain NSDL metadata and access an index of the metadata repository.

- Authentication services allow collections to restrict access to members or subscribers if they so choose.

Screenshot of NSDL.org

Technologies that Support Community Collaboration

- The Community Communications Portal web site contains general information, documentation for developers, virtual workspaces, historical documents, and mail lists for discussions where community members can contribute to the growth of the library.

Supporting Collaborative Processes

The NSDL community consists of large, discipline-diverse, and distributed user groups made up of partner communities that create, aggregate, and contribute digital resources. NSDL provides services to collaborator communities that may, in turn, provide those services through their own web sites, perhaps packaged with additional content selected to meet their specialized users' needs. Long-term goals for NSDL include supporting an environment in which end users can also be contributors and to encourage the development of communities of practice for knowledge-sharing.

The NSDL Annual Meeting is an important avenue for the establishment of collaborative efforts. In addition to providing the stage for the public debut of NSDL.org, the 2002 meeting focused on community issues such as sustainability, evaluating library content and quality, and integrating NSDL into formal and informal learning environments, including priorities unique to K-12 education.

Assessing Community Needs

Given the distributed nature of library building and development, effective communication and collaboration practices are crucial for ensuring that the whole of NSDL is greater than the sum of its parts. Communications and collaborations within NSDL are supported by a rich array of mechanisms, including technical tools and services, opportunities for face-to-face interactions, and community participation in decision-making processes. These mechanisms must serve the NSDL community's current and emerging needs. To that end, a survey of project investigators was conducted in 2003 to measure the perceived effectiveness of NSDL-wide communications, collaborations, and other facets of library building and organizational activities.

Communications Infrastructure

Survey respondents overwhelmingly reported that the NSDL Annual Meeting serves as a highly effective communications forum. Many respondents indicated that the overall NSDL communications infrastructure is moderately effective in supporting their project in accomplishing its goals. Cited as the two biggest barriers to use of the existing communications infrastructure were lack of time and the perception that the information their project needs is lacking.

Collaboration

Eighty percent of respondents reported collaborating on other NSDL projects during the past six months. Projects that collaborated usually worked with one to three other NSDL projects. A small number of projects appeared to be mega-collaborators, working with ten or more NSDL projects during the past six months. Cited as the largest barriers to collaboration were lack of time and not knowing other projects' goals or activities.

Governance

More than eighty percent of respondents reported interacting with one or more NSDL organizational groups (such as the five standing committees). Half of the respondents perceived such groups to be moderately effective at establishing policies, setting priorities, and providing direction for the operation and growth of NSDL. Cited as the largest barriers to participation were lack of time and uncertainty about how the groups expect participants to contribute.
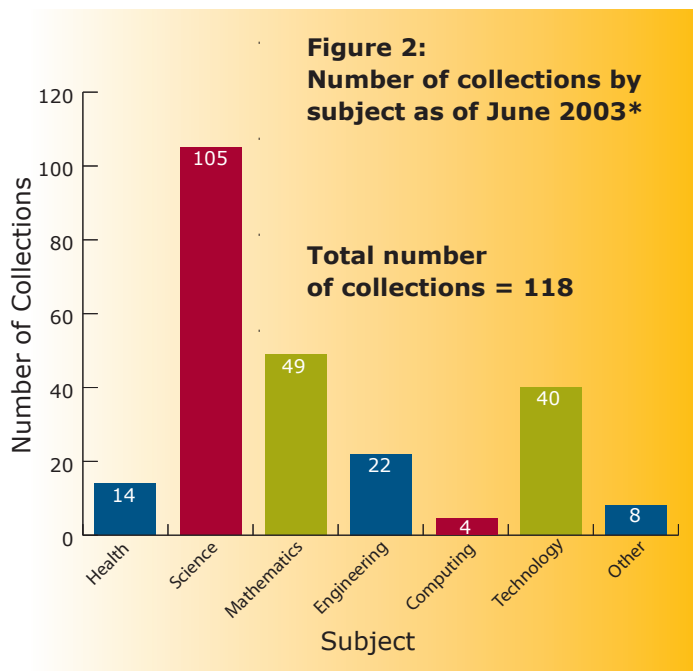
Motivations

People are motivated to participate in NSDL communications, organizational groups, and library-building activities for a variety of reasons. An inspiring eighty-four percent of respondents reported participating because they want to help establish NSDL. Other factors cited as motivating participation included the desire to exchange knowledge with other projects and to ensure that the results of their projects are used within NSDL and by other NSDL projects.

These survey results are being used to inform improvements to NSDL's collective organizational structures, communications and collaboration channels, and library-building services. Overall, these results indicate that NSDL has made significant progress in establishing its organizational structures and fostering a shared sense of purpose amongst distributed projects. In the future, existing communications channels can be improved through the provision of more timely and up-to-date information.
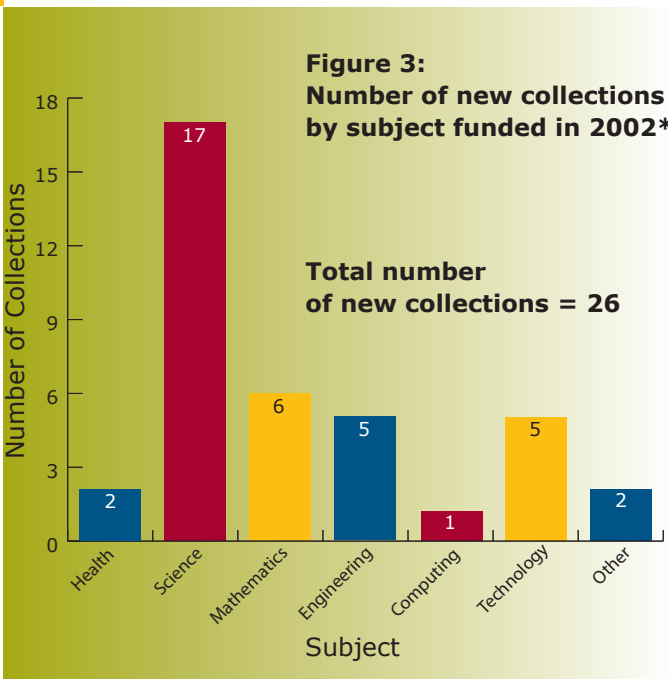
Developing Collections

As of June 2003, users can access 118 collections and more than 230,000 resources through the NSDL metadata repository. The repository contains information-rich descriptions of collections and resources that users can search and browse via keyword, resource type, and media format. The repository serves a diverse array of subjects and audiences. As shown in Figure 2, many NSDL collections address multiple disciplines and are included in more than one subject category.

Figure 2:
Number of collections by subject as of June 2003*

Total number of collections = 118

Number of Collections

Subject	Value
Health	14
Science	105
Mathematics	49
Engineering	22
Computing	4
Technology	40
Other	8

*Many collections serve multiple subjects.

In response to the 2002 NSDL Program Solicitation, twenty-six new collections-development projects were funded. Figure 3 shows that these new projects support a wide spectrum of STEM subjects. Additionally, a collections outreach plan was established to encourage collections holders not directly funded by the NSDL program to contribute to the metadata repository.
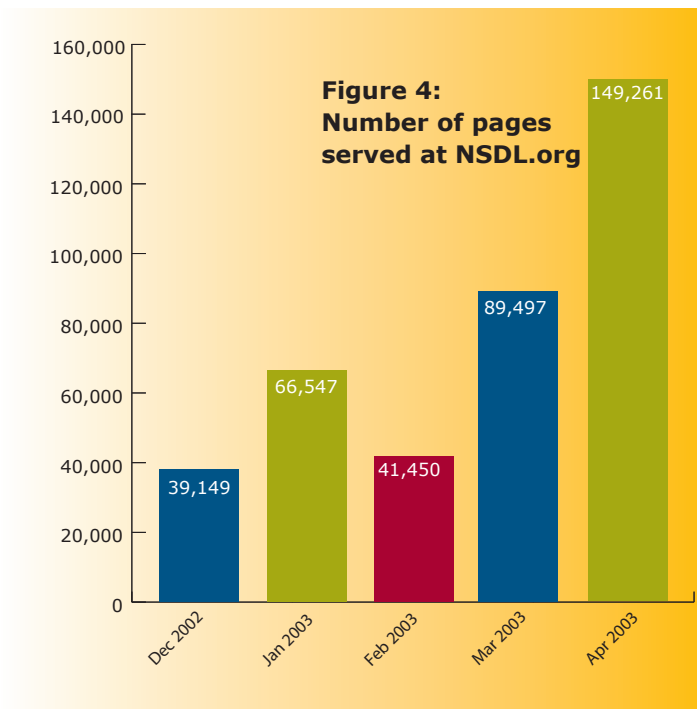
Periodic collections assessment is critical for ensuring that the NSDL metadata repository is responsive to and representative of a broad user base. NSDL analyzes the metadata repository for depth and breadth of coverage across disciplines, audiences, and resource types. A working group within the Educational Impact and Evaluation Committee developed a strategy for automating this periodic collections assessment to provide timely feedback to NSF and the NSDL community.

Figure 3:
Number of new collections by subject funded in 2002*

Total number of new collections = 26

Number of Collections

Subject	Value
Health	2
Science	17
Mathematics	6
Engineering	5
Computing	1
Technology	5
Other	2

*Many collections serve multiple subjects.

Developing Collections *(Continued)*

In addition to providing unparalleled access to a broad spectrum of
scientific and educational resources, the metadata repository enables
digital library developers to build unique educational services that
leverage this diverse NSDL content. For instance, several peer-review
services are being developed and operated to help educators identify
high-quality educational resources. Other services are being developed
to contribute teaching tips and ideas for use of resources. These types
of services are intended to support educators in making effective use of
NSDL resources in their classrooms.

Measuring Library Use

The NSDL network serves scientists, educators, and learners through
a variety of library sites and services. To better understand how NSDL
is being used, usage data need to be collected for the NSDL.org web
site, the NSDL Communications Portal, and for participating library
sites. During 2002 and 2003, a number of processes were put in place
to collect usage data.

**Figure 4:
Number of pages
served at NSDL.org**

Month	Number of pages
Dec 2002	39,149
Jan 2003	66,547
Feb 2003	41,450
Mar 2003	89,497
Apr 2003	149,261

One way to measure usage is to count the number of pages served
during a calendar month. Over the 12-month period from June 2002
to May 2003, developers requested an average of 10,000 pages per
month from the Communications Portal. As shown in Figure 4,
NSDL.org use has grown considerably since its introduction in
December 2002.

Measuring usage across more than 100 library sites raises significant methodological and procedural challenges. A pilot study was conducted in spring and summer 2002 to investigate one approach to distributed usage measurements. Six sites participated in the pilot study: the NSDL Communications Portal, the Digital Library for Earth System Education (DLESE), Earth Science Information Partners (ESIP), iLumina, The Math Forum, and SMETE.org. Usage data were collected for a three-month period for each of the sites.

In each of the three months of the pilot, more than six million pages were served. The pilot results demonstrate that significant demand exists for digital library services and that it is important to measure usage across the entire NSDL network.

Accessible NSDL

NSDL strives to improve access to reliable science education resources for everyone. It makes accommodation for Internet and software accessibility issues that present barriers for users with certain disabilities. All NSDL collections and service providers are encouraged to follow the World Wide Web Consortium's Web Content Accessibility Guidelines and the Section 508 requirements for federal government accessibility. In addition, work is under way to provide tools and resources for NSDL community members to improve the accessibility of their services and collections.

## Providing Leadership in Technology-Based Education

NSDL members are playing leadership roles across a spectrum of key educational and research communities. The NSDL program, as a whole, is making significant contributions to the scientific knowledge base in digital libraries, educational technologies, and educational research. One measure of these contributions is the representation of NSDL and its partner projects at major professional conferences within these communities. For example,

- The Association for Computing Machinery and Institute of Electrical and Electronics Engineers Computer Society Joint Conference on Digital Libraries (JCDL) in 2002 featured technical sessions and panels devoted to the NSDL program and NSDL projects.

- At JCDL 2003, NSDL projects were again prominently featured in the technical presentations. Additionally, all the NSDL standing committees were represented in the poster session.

- NSDL was presented at the 2002 meeting of Web Wise, a digital library conference sponsored by the Institute of Museum and Library Services.

- At the 2002 American Educational Research Association (AERA) conference, an interactive demonstration featuring seven NSDL projects was given to the Advanced Learning Technologies Special Interest Group, whose members consist of prominent leaders in educational technology research.

- At the 2003 AERA conference, a panel was devoted to discussing NSDL as an emerging infrastructure for innovations in science education.

- NSDL representatives also discussed the progress being made by digital libraries in enhancing science education in a panel convened at the 2003 meeting of the American Association for the Advancement of Science.

- Practicing teachers received the opportunity to learn about and discuss NSDL at a workshop presented at the 2003 meeting of the National Science Teachers Association.

These presentation highlights barely scratch the surface of NSDL's reach within the scientific and education communities. Through the NSDL project network, hundreds of principal investigators from a variety of disciplines are writing scientific articles and making presentations about their own projects and the NSDL program within their specific disciplinary communities.

Such a network of investigators enables NSDL to reach a large and diverse base of educators and students. This highly distributed form of outreach helps to build the NSDL community by encouraging other investigators to develop collections and services for NSDL and by promoting the active use of NSDL resources by educators at all levels.
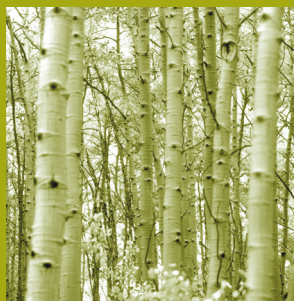
A critical activity for the Core Integration team's Education and Outreach group over the coming year will be to develop the processes and technical infrastructure that will enable the NSDL program to track important capacity-building and outreach efforts.
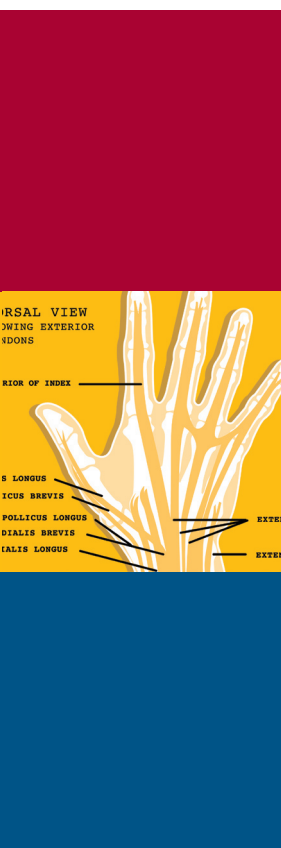
NSDL : Community : Collaboration : Growth

The Digital Library for Earth System Education (DLESE) has benefited greatly by being a part of the NSDL community. As a result of NSDL, there are technologies that can be shared, thus allowing each project to do more than it could alone.

–Mary Marlino, Director, DLESE Program Center

Core Integration (CI) Team

The Core Integration (CI) team provides day-to-day management for NSDL and is responsible for engaging the community, providing technology, and operating core services.

CI Principal Investigators

William Y. Arms
Cornell University

David W. Fulker
University Corporation for Atmospheric Research (UCAR)

Kate Wittenberg
Columbia University

CI Leadership

David W. Fulker (Executive Director)
UCAR

Kaye Howe (Deputy Director) UCAR

Diane Hillmann
(Library Service and Operations)
Cornell University

Susan Jesuroga (Project Relations)
UCAR

Carl Lagoze
(Technical Design and Development)
Cornell University

Michael Luby (Publisher Relations)
Columbia University

John Saylor (Collection Development)
Cornell University

Carol Terrizzi (Education and Outreach)
Cornell University

Susan Van Gundy
(Education and Outreach)
UCAR

National Visiting Committee

The National Visiting Committee is appointed by NSF to advise the CI team on high-level strategic and operational issues and to raise the visibility of NSDL in the external community.

Diana Oblinger (Chair)
Director of Higher Education,
Microsoft Corporation

Martin Blume Editor-in-Chief,
American Physical Society

Wade Ellis Mathematics Department
Chair, West Valley College

Ira Fuchs Vice President for Research
in Information Technology, Andrew W.
Mellon Foundation

Sandra Glass Independent
Philanthropy Advisor; Vice President
Emerita, W. M. Keck Foundation

William E. Kirwan Chancellor,
Maryland University System

Peter Lyman Professor and
Associate Dean, University of
California at Berkeley

Tom Moritz Director of the Library,
American Museum of Natural History

Alfred Moyé Former Director of
University Relations, Hewlett-Packard

Thomas Reeves Instructional
Technology Professor, University
of Georgia

Linda Roberts Founding Director
of Educational Technology, U.S.
Department of Education (1993–2000)

Bernard Rous Deputy Director and
Electronic Publisher, Association for
Computing Machinery

Abby Smith Director of Programs,
Council of Library and Information
Resources

Gerald Wheeler Executive Director,
National Science Teachers Association

Policy Committee

The Policy Committee advises the CI team, other NSF grantees, and NSF on operational strategies and implementation priorities. The Policy Committee acts on behalf of the NSDL Assembly (which consists of all the principal investigators for NSDL grants) to work with NSF and the CI team in coordinating the activities of the standing committees, task forces, and other aspects of the NSDL community.

Howard Burrows (Chair, May 2003–Present) Autonomous Undersea Systems Institute

Katherine Hanson (Vice Chair, May 2003–Present) Education Development Center, Inc.

Edward A. Fox (Chair, March 2002–May 2003), Virginia Polytechnic Institute and State University

Ellen Hoffman (Vice Chair, March 2002–May 2003), Eastern Michigan University

Yolanda Scott George American Association for the Advancement of Science

Gerard Hanley Multimedia Educational Resource for Learning and Online Teaching (MERLOT)

Flora McMartin Multimedia Educational Resource for Learning and Online Teaching (MERLOT)

William Mischo University of Illinois at Urbana-Champaign

Jeanne Narum Project Kaleidoscope (PKAL)

Len Simutis Eisenhower National Clearinghouse

Stuart Sutton University of Washington

Sebastian Uijtdehaage University of California at Los Angeles

Vivian Lee Ward National Health Museum

Standing Committees

The Policy Committee has chartered five standing committees to act on behalf of the entire NSDL community in significant topic areas.

Community Services

The activities of this committee assist library users and learners in defining services, processes, and standards that NSDL can use to increase the impact, reach, and efficiency of the library.

Marcia Mardis (Chair)
Merit Network, Inc.

Amy Chang (Co-Chair)
American Society for Microbiology

Content

This committee recommends and implements policies to ensure that NSDL content is high quality, is appropriate and consistent, has technical integrity, and is accessible for use by global audiences of learners at all levels.

Kimberly (Roempler) Lightle (Chair) Eisenhower National Clearinghouse

Sarita Nair (Co-Chair)
Educational Development Center, Inc.

Brandon Muramatsu (Secretary)
MERLOT

Educational Impact and Evaluation

This committee ensures that participatory and stakeholder evaluation principles are integrated into the design, development, and implementation of NSDL.

Tamara Sumner (Chair)
University of Colorado at Boulder

Sarah Giersch (Co-Chair)
Consultant
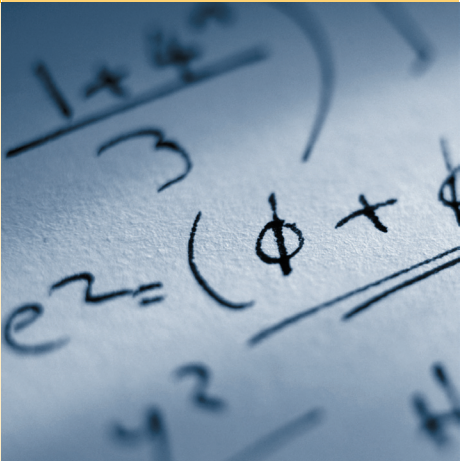
Technology

This committee identifies community technical needs and the means to translate those needs into deployable technology, including recommendations for technical standards and the technical integration of resources and services into NSDL architecture.

Timothy W. Cole (Chair)
University of Illinois at Urbana-Champaign

Sustainability

This committee exists to facilitate the development of an NSDL entity that will continue to thrive in the long term through collective action and diversified funding streams.

Dave McArthur (Chair)
Consultant

Paul Berkman (Co-Chair)
EvREsearch

Rachael Bower (Integration Officer)
University of Wisconsin at Madison

Highlights of Standing Committee Activities

Educational Impact and Evaluation Committee Activities and Pilot

Through an open, community-based participatory process, the Educational Impact and Evaluation Committee has taken important steps toward creating a shared vision for evaluation within NSDL. This consensus-based, participatory approach is crucial for conducting successful evaluation activities and addressing concerns within NSDL.

A key activity of the committee to date has been to design and conduct a pilot study involving six partner libraries (see page 15) to examine the following questions:

1. How are people using the libraries?
2. How are collections growing and changing?
3. How well are the distributed library-building and governance processes working?
4. What is the time and effort required, both centrally and at distributed sites, to participate in this evaluation? Do the results justify this effort?

The pilot study was successful in many areas: It provided preliminary data on library collections and how they are being used; it provided critical insights into issues and procedures with large-scale, distributed library evaluation; and it demonstrated that the standing committees can be an effective mechanism for projects to engage in cross-cutting activities.

Exploring Partnerships with Publishers

In October 2002, the Sustainability Committee sponsored a workshop at Columbia University that brought together representatives from educational publishing firms and the NSDL community. A basic premise of the workshop was that to fulfill its mission as a truly national digital library, NSDL must engage publishers and represent their proprietary resources alongside free and open items.

Representatives from both communities educated participants about the vision and activities of NSDL and the needs and business culture of publishers. NSDL offered important ideas about new content models and relationships with providers of small-scale digital products. Publishers discussed distributing digital content through NSDL and outlined ways NSDL collections could be part of educational publishers' ebooks and other digital materials. Potential NSDL-publisher partnership models were detailed in a summary white paper after the workshop:

> NSDL and educational publisher representatives recognized that differences in products, production processes, management practices, and business models might present challenges but also provide opportunities for innovative partnerships.

By the end of the day, participants agreed that both communities should continue to explore potential collaborations by forming a working group of nonprofit and commercial scientific publishers and NSDL representatives. Conversations with several educational publishers have continued subsequent to the workshop, and publishers clearly are committed to supporting NSDL and participating in its growth. This workshop provided an excellent foundation for future discussions and planning for mutually beneficial collaborations.

A Community of Builders

NSDL's broad vision is to give a variety of audiences access to collections, tools, and services that address the needs of all scientific and educational disciplines. In a few short years, NSDL has built a strong foundation to achieve this promise of a wealth of resources meeting diverse needs. To ensure that NSDL has a lasting impact, the library's efforts must continue to foster collaboration within and between the diverse partner communities that contribute information and ideas.

Through the NSDL program, NSF funds four tracks of competitive grants: core integration, collections, services, and targeted research (see page 4). As of the third grant cycle awarded in September 2002, NSDL's 118 funded projects represent seventy-four different institutions—including universities, government laboratories, professional societies, and educational nonprofits—in twenty-seven states and the District of Columbia. These projects support K-12 teachers, college and university faculty, professional researchers, policy makers, and students at all levels. Earth, life, space, and computer sciences as well as physics, mathematics, engineering, and economics are already being addressed in a rapidly expanding body of content disciplines. Despite the library's relative infancy, NSDL's collaborative efforts are already establishing a significant presence within the United States' scientific and educational systems.

Investigators within the NSDL community are pioneering new ways in which scientific information is accessed, shared, and utilized. For example,

- Projects such as the **Gender & Science Digital Library** and **Access NSDL** are examining critical issues of universal accessibility to technology-based resources.

- Both the **Digital Archive Network for Anthropology** and **eSkeletons.org** are providing access to high-resolution images that can be examined virtually and manipulated three-dimensionally.

- **Virtual Telescopes in Education** is networking astronomical observatories around the world to be operable remotely by a global community of student researchers.

- **StandardConnection** is developing methods to automatically map NSDL learning resources to state and national education standards.

- **Decentralized Image Retrieval for Education** is making it easier to search for images regardless of how the images are cataloged.

- Projects such as the **Digital Idea Keeper** and the **Data Discovery Toolkit** show promise for revolutionizing how users collect and synthesize the information they discover through NSDL.

- The **Digital Library for Earth System Education (DLESE)** is recognized as a leader in community-driven digital library development. DLESE's participatory design model engages users as contributors in every aspect of library-building, yielding a resource that is highly relevant to the earth science as well as the education communities.