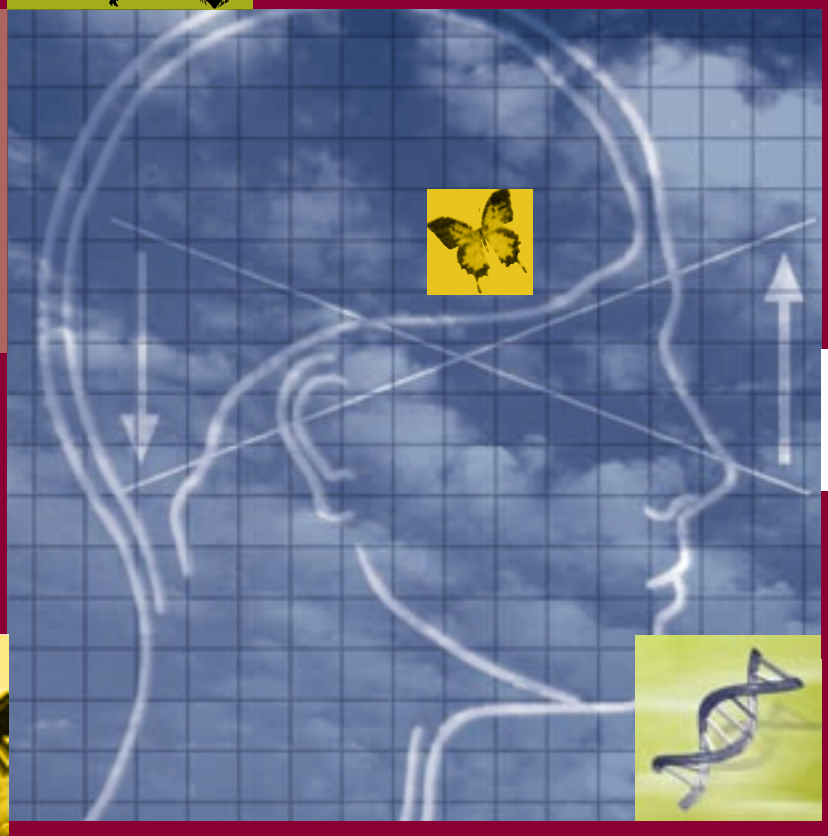
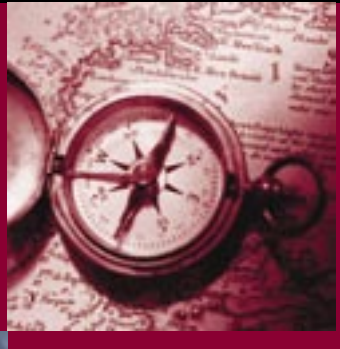


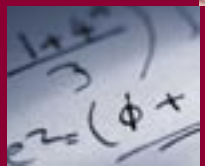
2004 Annual Report

Highlighting Successful Strategies for Growth

NSDL

THE NATIONAL SCIENCE DIGITAL LIBRARY





2004 Annual Report

Highlighting Successful Strategies for Growth

Contents

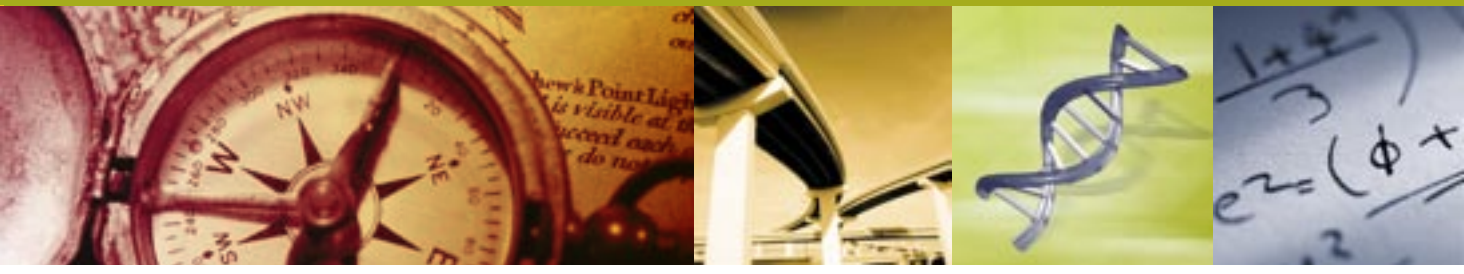
Acknowledgments

Special thanks to the NSDL Educational Impact and Evaluation Committee, chaired by Anita Coleman and Laura Bartolo. Working closely with NSDL staff, the committee contributed valuable time and expertise to the creation of this publication.

About NSDL

The National Science Digital Library (NSDL) Program was launched by the National Science Foundation in 2000 to establish an online library of exemplary resources for science, technology, engineering, and mathematics (STEM) education and research. NSDL provides organized access to collections and services from resource contributors that represent the best of public and private institutions including universities, museums, commercial publishers, government agencies, and professional societies. NSDL supports teaching and learning at all levels with materials ranging from journal articles and lesson plans to interactive animations, and from real-time data sets and technology-based tools to ask-an-expert services.

With a mission to support national improvements in STEM education and an emphasis on innovation, NSDL began in the fall of 2000 to build the technical infrastructure of the Library, coordinate access to resources from a wide range of providers, and build relationships with key stakeholders in the research and education communities. Access to aggregated NSDL collections and services began with the launch of the NSDL.org web site in December 2002.



The Year in Summary 2003-2004

The past year marked an important transition for NSDL. As basic technical and organizational scaffolds for the Library were established and made public, NSDL concentrated on growing its community of users and contributors by supporting their engagement with the Library in a variety of educational environments, as well as increasing efforts to identify models for sustaining the Library in the future. As a result, NSDL is expanding as a center of educational innovation in digital libraries and a community center for groups focused on digital library-enabled teaching and learning.

Making NSDL resources available through multiple access points in addition to the NSDL.org web site has been one strategy for expanding the Library's community of users. To do this, the NSDL Middle School Portal (page 4) was developed this year by Eisenhower National Clearinghouse to demonstrate NSDL educational utility for a specific targeted audience. Alliances also were established to make NSDL resources accessible through popular search engines as well as other government and private sector portals (page 11). To increase the impact of NSDL in a range of educational settings, strategic efforts were initiated to build awareness. These included featuring information about NSDL in exhibits, presentations, workshops, and professional meetings throughout research and education communities across science, mathematics, and technology disciplines.

The Library continued to serve as a center for improvements in STEM education, in part by supporting interactions between K–12 teachers and university faculty that led to changed instructional methods and increased student interest in science and engineering topics (page 8). By leveraging innovative technology that provides a framework to analyze and synthesize information found through NSDL, students can engage in thoughtful online inquiry about a range of science and technology topics (page 10).

The Library's achievements are the results of collaborative efforts throughout the NSDL community and beyond. A series of workshops was convened over the last year that combined the expertise of the NSDL community with cutting edge researchers in government and industry to explore issues critical to the Library and related institutions. Topics included: involving Library users in developing NSDL (page 6); developing an evaluation strategy for NSDL (page 7); reusing NSDL content for STEM education (page 9); extending the use of STEM content with scientific markup languages (page 10); and exploring options for sustaining NSDL (page 12).

The Library's successes for 2004 represent progress throughout the NSDL community in many strategic areas. This Annual Report serves as an overview document to celebrate all that we have learned and achieved. For each of the activities highlighted in this publication, there are many more that are equally laudable.

Engaging Diverse Communities

The long-term viability of NSDL will depend on its ability to establish a broad base of users and supporters who are invested in the Library's continued success. As a result, a priority for NSDL in 2004 has been to raise awareness of NSDL through relationship-building with key groups of stakeholders and to promote the Library, its resources, and its contributing projects. In 2003–2004, a range of strategies were implemented that dramatically increased general knowledge of NSDL, which include making NSDL resources available through many targeted access points, increasing NSDL presence at national meetings, supporting services and technology that facilitate connections between existing NSDL communities, and participating in national and international working groups within the education, science, and technology communities.

Increasing Awareness and Use

In 2003-2004, NSDL concentrated on increasing its presence at national conferences for K–12 and post-secondary STEM education, libraries, museums, and general science. NSDL presented workshops, papers, posters, and exhibits at more than 20 major conferences. In addition, volunteers from the NSDL community represented NSDL at regional and discipline-specific academic conferences to familiarize diverse audiences with NSDL as a key piece of the national educational infrastructure.

These efforts are critical in reaching NSDL's three key audiences:

- *Developers:* institutions and individuals who are currently involved in building NSDL, including content and technology developers from the community of funded projects and beyond.
- *Users:* individuals interested in STEM education in both formal and informal settings, including K–12 schools, institutions of higher education, museums, libraries, and the home.
- *Supporters:* institutions that provide assistance through financial, political, infrastructural, and promotional means, including the National Science Foundation, other government agencies, corporate sponsors, congressional representatives, foundations, publishers, educational institutions, and the media.

One Library, Many Portals

Creating targeted entry points for audiences at specific educational levels or disciplines is part of NSDL's strategy for engaging new communities. One such entry point is the NSDL Middle School Portal, being developed by Eisenhower National Clearinghouse (ENC), as a demonstration of NSDL's educational utility for middle schools. The Middle School Portal assembles relevant resources from among existing NSDL collections, including materials that may not have middle school as a primary audience. Materials are repurposed for teachers seeking to augment their content knowledge, familiarity with current research, and instructional methods. Leveraging ENC's expertise in mapping content to state and national standards, this new web site enhances the descriptive record, or metadata, of select NSDL resources to support searching by grade level and content standard. The Middle School Portal is a model for a new series of NSDL projects initiated with the 2004 Program Solicitation, to be known as Pathways. Pathways Projects will act as curators for specific communities and will demonstrate the value of NSDL in a variety of educational settings. These specialized web sites support a "One Library, Many Portals" philosophy that draws on the strengths of different groups within the NSDL community to better serve the wide range of Library users via audience-specific options that complement NSDL.org.

The NSDL Middle School Portal provides educators with materials designed to enhance teaching at the middle school level, including classroom resources, activities, and instructional methods. Created by ENC, the Middle School Portal is the first of NSDL's funded targeted web sites.

To reach potential audiences through the popular online portals they are already using, NSDL became a partner in the Content Acquisition Program (CAP) of the commercial search engine Yahoo!. NSDL allows its database of information about NSDL resources to be indexed directly by Yahoo! search technology. As a result, NSDL web pages are displayed in Yahoo! search results, and NSDL is highlighted in the Yahoo! directory. In the first two months of using CAP, over 63,000 visits were directed to NSDL via Yahoo!. In addition, the National Science Foundation (NSF)'s web site provides an entry point to NSDL collections, capturing the needs of researchers and the scientific community. NSF will feature a subset of NSDL resources on their web site as part of their next release to better serve this community.

Eisenhower National Clearinghouse (ENC)
http://www.enc.org

Yahoo! directory
http://dir.yahoo.com/Science/Reference

National Science Foundation (NSF)
http://www.nsf.gov

Facilitating Connections between Communities

NSDL supports STEM education by serving as a bridge between the scientific and education communities. By facilitating access to background content and leading research, as well as real data and analytical tools, NSDL can enhance student and public understanding of the scientific process and its relevance in everyday life. NSDL also offers learners a means to communicate directly with scientific and technical professionals. AskNSDL, the Library's virtual reference service, developed by the Information Institute at Syracuse University, serves as a means to connect learners who have science, mathematics, and technology questions with experts who provide answers and suggest additional resources. Anyone can browse previously answered questions or submit a question online. Questions are fielded by a team of volunteers including professional scientists, librarians, and educators. Responses to questions are returned via email within a few days.

As part of the 2004 National Excellence in Science, Technology, and Mathematics Education (ESTME) Week, co-sponsored by the National Science Foundation and the U.S. Department of Education, NSDL was featured on the ESTME Week web site as a resource for students and teachers. In preparation, NSDL undertook a major campaign to recruit AskNSDL experts. These efforts added 311 experts from 40 states and 8 countries representing STEM professions in research, academia, industry, and government. During ESTME Week 2004, these experts responded to 719 questions received primarily from K–12 students.

AskNSDL
http://nsdl.org/asknsdl

ESTME Week
http://www.estme.org

Involving Library Users in Developing NSDL

The National Science Foundation-sponsored NSDL workshop entitled *Participant Interaction in Digital Libraries* was hosted by the Math Forum at Drexel University in February 2004. The meeting brought together 35 representatives from NSDL and other experienced online community development practitioners to find new and innovative ways to develop user participation in digital libraries for education.

Workshop discussions examined challenges common to many educational digital libraries—such as growing a base of users, contributing meaningfully to educational reform, and long-term sustainability—as well as the potential for development practices that directly engage participants to address these challenges. The Digital Library for Earth System Education (DLESE), Eisenhower National Clearinghouse (ENC), Math Forum, and the Multimedia Educational Resource for Learning and Online Teaching (MERLOT) shared their experience around the importance of participant involvement in the growth and development of their respective web sites.

The workshop generated some important recommendations for digital libraries to involve participants in library-building activities. Adopting a strategic, centrally organized participant involvement model could result in the growth of active communities of practice around NSDL.

Participant Interaction in Digital Libraries
http://pidlworkshop.comm.nsdl.org

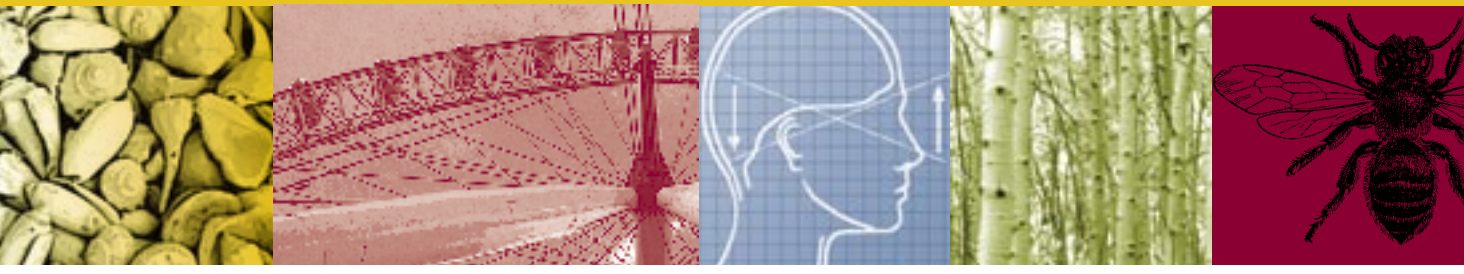
Digital Library for Earth System Education
http://dlese.org

Math Forum
http://mathforum.org

Multimedia Educational Resource for Learning and Online Teaching
http://merlot.org

Supporting Improvements in STEM Education

NSDL, the National Science Foundation's online library, seeks to improve the way Americans learn about science, technology, engineering, and math. In community-designed initiatives to develop evaluation strategies, through individual digital libraries' activities, and in partnership with teachers and students nationwide, NSDL is meeting that challenge.



Assessing NSDL's Educational Potential

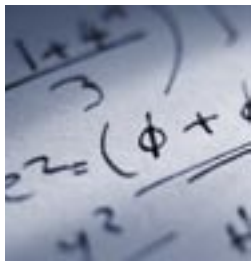
To fulfill its mission for supporting improvements in STEM education, NSDL must understand its current and potential use in a variety of educational settings and evaluate its progress to inform ongoing improvements to the Library. Data gathered through surveys and focus groups with NSDL projects in December 2002 highlighted the need for a strategy to provide guidance for important research questions on educational impact, related key theories, prior research, and appropriate research methodologies. This work was launched in October 2003 when NSDL's Educational Impact and Evaluation Committee convened a workshop on *Developing a Strategy for Evaluating the Educational Impact of NSDL*. Thirty-seven participants from NSDL projects and the National Science Foundation, as well as other digital library and educational evaluation experts, explored key questions about NSDL's potential to support educational improvement and the means by which the Library can begin to measure related outcomes.

Developing a Strategy for Evaluating the Educational Impact of NSDL
http://eduimpact.comm.nsdl.org/evalworkshop

The workshop produced both near-term recommendations and long-range planning suggestions. Immediate needs were identified for NSDL to better understand how the resources of individual projects are currently being used in educational settings and to compile existing evaluation data from these projects. In addition, the preliminary workshop report highlights two important areas for evaluation activities as NSDL designs a long-term approach to assessing its impact: understanding the value of NSDL to major stakeholders and understanding NSDL's potential role as a "community inquiry lab" or "transformation engine" capable of promoting and sustaining innovations in science education, educational technology, and educational research methods.

Supporting an Educational Continuum

National improvements in STEM education must address the entirety of the school experience from preschool through graduate education. Student interaction with digital library resources inside and outside the classroom adds rich dimensions to classroom instruction. NSDL community work provides many examples of innovative partnerships between K–12 teachers and college-level faculty members that support STEM learning along this continuum. The Geotechnical Rock and Water (GROW) Digital Library, centered at the University of Arizona, is one such example. GROW encourages undergraduate and graduate students and teachers to use its collection of web-based resources to discover how civil engineering affects their everyday lives. GROW resources are also being used to enhance math and science teaching. As a result, educators using GROW are changing their instructional methods, and students are demonstrating increased interest in subject areas taught through GROW interactives resources.



Geotechnical Rock and Water (GROW) Digital Library
http://www.grow.arizona.edu

Facilitating Innovation in Digital Libraries

A significant part of NSDL's mission is to explore new ways to further the technological capabilities of all educational digital libraries. As a result, NSDL serves as a center for multidisciplinary research into new technical solutions and innovative implementation of existing technologies. In 2004, the NSDL community continued to explore methods for improving data storage, search, and access related to digital libraries and to promote intriguing new approaches for technology to meaningfully enhance the learning experience. Examples of ongoing technical work include support for user annotations, learning object reusability, collection maintenance, and information visualization as well as automated processes that help users discover appropriate materials such as graphical concept maps that link to NSDL resources.

Reusing NSDL Content for STEM Education

To support STEM education in the long term NSDL must provide digital learning resources that can be used and reused by teachers and learners. Reusable digital learning resources must be adaptable for multiple learning contexts and in multiple learning environments, allowing teachers to "plug and play." Modifying digital resources for reuse poses challenges that include determining intellectual property rights, retaining resources' original connotations when used in new contexts, and resolving technology issues produced in a rapidly changing electronic environment.

Reuse of NSDL resources can be improved if resource developers and digital libraries follow simple design guidelines. To that end, the Reusable Learning Project hosted four workshops during 2004, during which 90 participants learned methods for enabling digital library communities to create and manage content for reuse and repurposing. Participants discussed the multiple dimensions of reusability described in the project's Reusability Framework, and they reviewed Reusable Design Guidelines. These workshops provided resource developers with the knowledge and tools to improve the reusability of STEM digital learning resources in their digital libraries and across NSDL.

Reusable Learning Project
http://www.reusablelearning.org

Extending Content Use with Scientific Markup Languages

Digital libraries can be catalysts for new knowledge by providing the information and tools for researchers to build upon the findings of prior users, as well as by using existing information archives to inform new discoveries. Advances toward the Semantic Web promise revolutionary changes for the way science and engineering will be conducted in education, research, and industry by providing a common framework that allows data to be shared and reused across application, enterprise, and community boundaries. Scientific markup languages (MLs) are critical to the Semantic Web effort, and digital library developers across NSDL are already implementing MLs in newly developed STEM content.

Markup languages allow authors, computer programs, and users to clearly and explicitly differentiate the various components of a document or information resource. Using MLs, an author or creator of a resource can label important elements in the resource (e.g., an author name, the name of a chemical element, a part of a mathematical equation), and computer programs and users can then better process and use the resource in pursuit of their specific educational or research objectives.

Responding to a call from the NSDL community for a broader discussion about scientific markup languages, NSF sponsored a one-day workshop in June 2004 for 40 participants from stakeholder communities in industry, scholarly publishing, research, and academia and representing the disciplines of biology, chemistry, earth sciences, engineering, mathematics, and physics. Through presentations and breakout sessions, the workshop began to identify common opportunities and challenges for MLs across domains. Participants also discussed the appropriate process and format for broadening discussions across domains and NSDL. Given its unique position as the center of digital library-enabled science education, NSDL will continue to support work on MLs as indicated in the themes and associated questions outlined in the workshop report.

Using Technology to Support Thoughtful Online Inquiry

Like a traditional library, one of the functions of digital libraries is to enable resource discovery. However, NSDL also provides services and tools that facilitate the direct application of resources to teaching and learning. One example is the Digital IdeaKeeper from the University of Michigan. IdeaKeeper is a downloadable software application designed to engage learners in thoughtful online inquiry by providing a framework to analyze and synthesize information found through NSDL during the resource discovery process. Currently, many students follow the haphazard "scan, cut, and paste" approach to finding and using online resources. IdeaKeeper helps students form questions, analyze resources in light of their original hypotheses, annotate and save useful web sites, review their research, and then assemble final written explanations based on their findings.

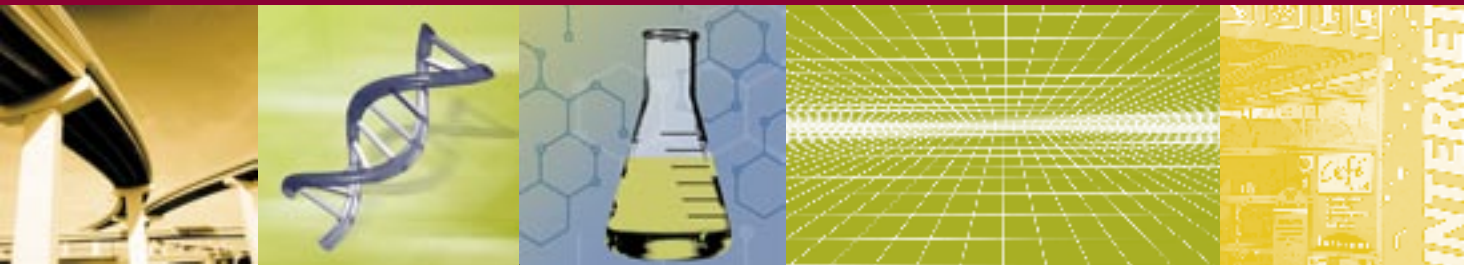
In 2004, Digital IdeaKeeper was tested in a pilot study with students using resources from the Digital Library for Earth System Education. This evaluation explored how the IdeaKeeper supports students with different aspects of online inquiry. Thirty-five 8th-grade students used the Digital IdeaKeeper in class for one week. Data analysis is currently in progress, but initial observations indicate that the IdeaKeeper helps students structure their inquiries and that it is useful for students to conduct and organize inquiry activities in a single, integrated software environment.

NSF/NSDL Workshop on Scientific Markup Languages
http://scimarkuplang.comm.nsdl.org

University of Michigan Digital IdeaKeeper
http://hice.org/ideakeeper

Ensuring the Future of NSDL

The efforts of the NSDL community in 2004 to engage diverse communities, support improvements in STEM education, and encourage innovation in digital libraries represent strategies to help ensure that NSDL is useful and important to its audiences well into the future. In the coming year, even greater attention will be focused on meeting the needs of educational audiences and on leveraging collaborative partnerships to expand and strengthen NSDL as a key component of the nation's educational infrastructure.



The Future of Supporting NSDL Audiences: *Pathways Projects*

In the 2004 NSDL grant solicitation, the National Science Foundation introduced several new project tracks aimed at improving NSDL's service to particular audiences. Pathways Projects will be the largest in scope of the tracks and are expected to provide stewardship for the content and services needed by major communities of learners. NSDL holds a wide range of materials to support learning at all levels. For most users, however, NSDL will most effectively be used through portals and services tailored to their needs. Pathways partners will provide those portals and services, and act as library curators for their communities. These partnerships are important not only to enhance the educational character and value of NSDL by targeting specific audiences of users and contributors, but also to demonstrate the value of NSDL in a variety of educational settings. The previously existing services track was subdivided in the 2004 solicitation to include Selection Services, which will increase the amount of high-quality STEM content in NSDL, and Usage Development Workshops, which will provide opportunities to promote the use of NSDL and its resources by various communities of learners.

Exploring Sustainability Models

The National Science Digital Library is currently an NSF research program funded through FY2006. However, a key mission of NSDL is to provide resources for STEM education into the future. It will soon need to establish an operational business plan and an organizational structure that reflect its mission, while at the same time provide for long-term sustainability of NSDL. Several efforts across NSDL have been initiated to explore various business options.

The Sustainability Standing Committee sponsored a workshop, held at the National Science Foundation in November 2003, which began the process of examining several options to sustain NSDL from a business perspective. Forty representatives from government, higher education, libraries and museums, and open-access scholarly as well as for-profit publishing considered several business options in the context of whether they were feasible for NSDL. In the context of the digital education content and service delivery market, participants considered such questions as: Which business option is important to NSDL? Who is the market for the products or services? How will NSDL implement the option? The workshop web site contains results from those discussions. Some of the business options considered at the workshop are already being implemented by NSDL and other digital libraries.

Market Segments in Digital Education Content and Service Delivery

K–12 schools and districts, which consume digital resources and increasingly demand high-quality materials that are matched to evolving state standards

Institutions of higher education, which purchase or license digital resources primarily through library subscriptions and individual bookstore purchases

Commercial educational publishers and their new digital businesses

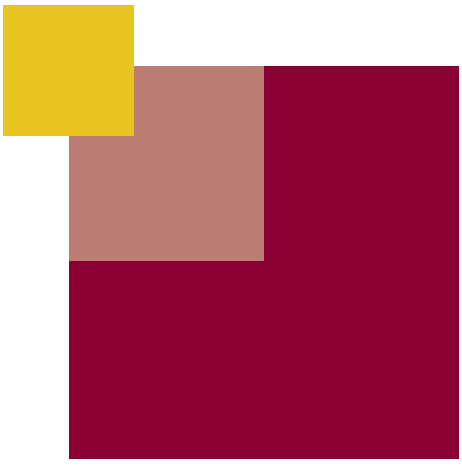
Smaller professional society and university publishers, under tough financial pressures

Open–access academic publishers, offering a new model that aims at cost minimization, often charging no user fees, and often putting control of property in the hands of authors

Academic and research libraries, under big budget crunches, often at war with publishers over the prices of e-journals, and looking hopefully to new publishers (some open–access, some not)

Institutional repositories, offering open-access, low-cost storage and management of digital scholarly communication and course resources, primarily in higher education

Course management vendors and other new providers of course materials, e-books, and knowledge-management services



Partnerships with Publishers

For NSDL to become a resource of choice for a broad range of teachers and students on a national scale, engaging the nonprofit and for-profit scientific textbook and software publishing communities is critical. These organizations control much of the high-quality educational science materials currently being produced for teachers and their students. Publishers' interest in NSDL as a potential market could result in their contributing materials or support. This would allow NSDL to provide a comprehensive range of content to STEM teachers and learners. NSDL publisher partnerships were considered during an NSDL Sustainability Standing Committee-sponsored workshop with educational publishers at Columbia University in October 2002. Partnerships are currently being actively pursued to add rich publisher content to NSDL.

Alliances with Professional Societies

ComPADRE (Communities for Physics and Astronomy Digital Resources in Education) has assumed a stewardship role for the educational resources used in physics and astronomy. As such, it is well positioned to support many communities through a distributed *and* centralized organizational structure, a potential model for NSDL. ComPADRE combines the creation of multiple community-focused collections to meet user needs while providing services through a central structure that supports economies of scale. Also relevant to NSDL is ComPADRE's practice of forming alliances with professional societies in physics and astronomy that provide links to researchers, instructors, and learners who use digital resources and who are accustomed to supporting societies through subscriptions or dues.

User Engagement at Institutional and Individual Levels

MERLOT (Multimedia Educational Resource for Learning and Online Teaching) provides resources and services for higher education faculty and students through multiple, diverse funding sources. It is supported through subscriptions from higher education institutions and through state and federal funding. At the same time, MERLOT relies on volunteers from its community to provide services and support for users. This potential model, combining support from individual users and from institutions, would allow NSDL to fulfill its mission of improving STEM education while continuing to serve as a center for research and innovation in digital libraries.

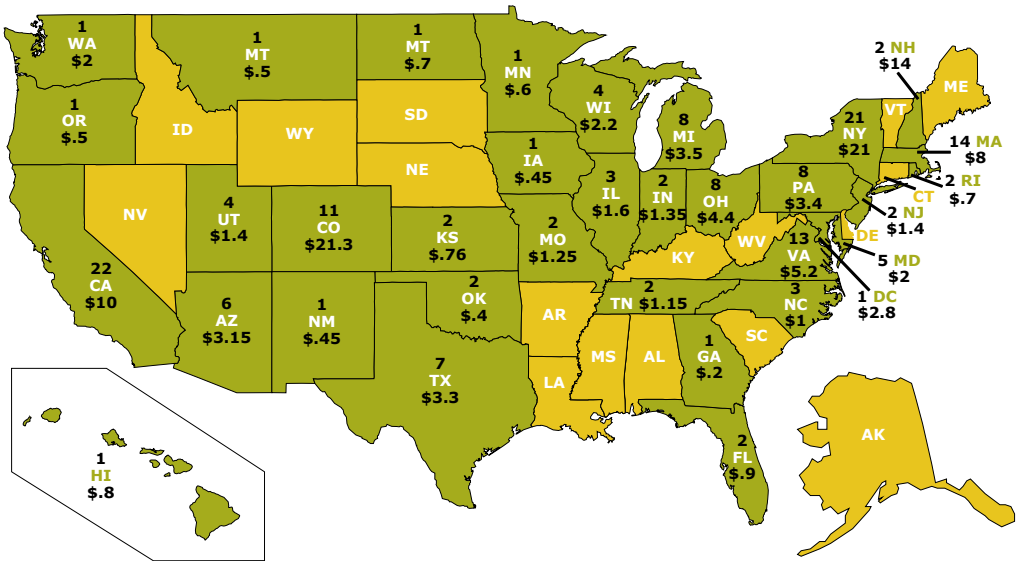
comPADRE
http://www.compadre.org

NSDL Projects 2000–2003

In the first four years of NSF funding, the NSDL program has received $88,348,169 in support of 167 awards. Core Integration activities support the management and coordination of the Library's distributed efforts. Collections projects gather subsets of the Library's content within a coherent theme or specialty. Services projects enhance NSDL's impact, efficiency, and value in support of Library users and developers. Targeted research projects conduct original investigations of new digital learning applications and technologies and evaluate the impact of NSDL.

Project Distribution and Funding by State

states with NSDL projects



NSDL grant solicitation
http://www.ehr.nsf.gov/her/due/programs/nsdl

NSDL Projects 2000–2003

State	Institution	Project Name	Investigator	Fiscal Year
AZ	**Center for Image Processing in Education**	SIMPLE Science: Image-based learning tools for K-12 education http://www.evisual.org/www/Funded/SIMPLE.html	Moore, Steven	2003
	University of Arizona	The Tree of Life Project: A Digital Library of Biodiversity Information http://tolweb.org/tree/	Maddison, David	2003
		Collaborative Project: The OCKHAM Library Network, Integrating the NSDL into Traditional Library Services http://ockham.library.emory.edu/	Frumkin, Jeremy	2003
		An Active Object-Based Digital Library for Microeconomics Education http://www.econport.org:8080/econport/request?page=web_home/	Cox, James	2003
		Intelligent Collection Services for and about Educators and Students: Logging, Spidering, Analysis and Visualization http://ai.bpa.arizona.edu/go/dl/getsmart.html	Chen, Hsinchun	2001
		Geotechnical, Rock and Water Resources Library (GRAWRL)—Towards a National Civil Engineering Education Resource Library http://www.grow.arizona.edu/	Budhu, Muniram	2001
CA	**California State University**	The NSDL Collaboration Finder: Connecting Projects for Effective and Efficient NSDL Development http://www.smete.org/nsdl/collabfinder/	Muramatsu, Brandon	2002
		Scaling the Peer Review Process for National Stem Education Digital Library Collections http://www.merlot.org/	Hanley, Gerard	2002
		Peer Review of Digital Learning Materials: Critical Service for Digital Libraries http://www.merlot.org/	Hanley, Gerard	2000
	Design Science, Inc.	Enhancing the Searching of Mathematics http://www.dessci.com/en/reference/searching/	Miner, Robert	2003
	Exploratorium	Exploratorium Online: Exhibit-Based Science Learning and Teaching Digital Library http://www.exploratorium.edu/index.html	Hsi, Sherry	2003
	Foothill College	Collaborative Project: To Enhance the Depth, Breadth, and Quality of the Collections of the Digital Library for Earth System Education (DLESE) http://www.dlese.org/	DiLeonardo, Christopher	2002
		Collaborative Project: To Gather, Document, Filter and Assess the Broad and Deep Collection of the Digital Library for Earth System Education http://www.dlese.org/	DiLeonardo, Christopher	2000
	New Media Studio	Marine Mammal Commission Digital Library of International Environmental and Ecosystem Policy Documents http://nsdl.tierit.com/	Berkman, Paul Arthur	2003
		Data Discovery Toolkit and Foundry http://www.newmediastudio.org/DataDiscovery/	Caron, Bruce	2001
	Stanford University	Collaborative Project: The Rosetta Project—ALL Language Archive http://www.rosettaproject.org/live/search/languagesearch/	Keller, Michael	2003
	The Long Now Foundation	Collaborative Project: The Rosetta Project—ALL Language Archive http://www.rosettaproject.org/live/search/languagesearch/	Mason, James	2003

State	Institution	Project Name	Investigator	Fiscal Year
CA	**University of California, Berkeley**	DIGITAL CHEMISTRY LIBRARY http://socrates.berkeley.edu/~kubinec/index.shtml	Kubinec, Mark	2003
		Collaborative Project: Enhancing Interoperability of Collections and Services http://www.smete.org/	Agogino, Alice	2003
		Developing a Core Integration System for a National Science, Mathematics, Engineering, and Technology Education Digital Library at WWW.SMETE.ORG http://www.smete.org/	Agogino, Alice	2000
		Collaborative Research: Developing a Learner-Centered Metathesaurus for Science, Mathematics, Engineering and Technology Education	Agogino, Alice	2001
	University of California, Los Angeles	A Digital Library: Collection for Visually Exploring United States Demographic and Social Change http://www.socialexplorer.com	Halle, David	2002
		Collaborative Research: Health Education Assets Library http://www.healcentral.org/	Uijtdehaage, Sebastian	2002
	University of California, Santa Barbara	Textual-Geospatial Integration Services for the National SMETE Digital Library http://www.alexandria.ucsb.edu/	Frew, James	2001
	University of California, San Diego Scripps Institute of Oceanography	Mobilizing Enduring NSDL Resources in Plate Tectonics Research for Earth Science Education http://nsdl.sdsc.edu/	Miller, Stephen	2003
		Bridging the Gap Between Libraries and Data Archives http://nsdl.sdsc.edu/	Schottlaender, Brian	2001
	University of California, Office of the President, Oakland	Adding Value to the NSDL by Integrating it into Academic Libraries: A Business Proposition and a Service Enhancement http://www.cdlib.org/inside/projects/metasearch/nsdl/	Greenstein, Daniel	2003
	University of Southern California	Electronic Encyclopedia of Earthquakes http://www.scec.org/ecube/	Jordan, Thomas	2001
CO	**Colorado School of Mines**	Collaborative Research: TeachEngineering—Hands-On Engineering Resources for K-12 http://teachengineering.org/	Mooney, Michael	2003
	Colorado State University	Water in the Earth System (WES): An NSDL K-12 Collection Project http://www.csmate.colostate.edu/dwel/	Geary, Edward	2003
	University of Colorado	Collaborative Research: TeachEngineering—Hands-on Resources for K-12 http://teachengineering.org/	Sullivan, Jacquelyn	2002
		Strand Maps as an Interactive Interface to NSDL Resources http://swiki.dpc.ucar.edu/StrandMapService/	Sumner, Tamara	2002
		A Lightweight, Flexible, and Web-Based Approach to Supporting Workflow in Digital Libraries http://www-serl.cs.colorado.edu/metis/	Anderson, Kenneth	2001
	University Corporation For Atmospheric Research	Collaborative Research: THREDDS Second Generation http://www.unidata.ucar.edu/projects/THREDDS?Overview/Collaborations.htm	Domenico, Ben	2003
		Collaborative Project: Core Integration—Leading NSDL toward Long-Term Success	Fulker, David	2003

State	Institution	Project Name	Investigator	Fiscal Year
CO	**University Corporation For Atmospheric Research (continued)**	Core Integration Services for a Federated NSDL	Fulker, David	2000
		Thematic Real-time Environmental Data Distributed Services (THREDDS) http://my.unidata.ucar.edu/content/software/thredds/index.html	Domenico, Ben	2001
		Collaborative Project: Core Integration of the National SMETE Digital Library http://www.nsdl.org/	Fulker, David	2003
	United States Air Force Academy	JiTTDL : The Just-in-Time Teaching Digital Library	Patterson, Evelyn	2003
DC	**American Association for the Advancement of Science**	Biosci Ed Net (BEN)	George, Yolanda	2000
		BioSciEd Net (BEN) Collaborative: Cycle 2	George, Yolanda	2002
	Association of Research Libraries	Developing a National Science Digital Library (NSDL) LibQUAL+ Protocol	Webster, Duane	2001
	Mathematical Association of America	MATHDL: A Library of Online Learning Materials in Mathematics and Its Applications	Moore, Lawrence	2000
FL	**University of Florida**	Digital Library for Learning Life Sciences	Chen, Su-Shing	2003
		Enhancing Interoperability of NSDL Collections and Services http://dlbox.nudl.org/	Chen, Su-Shing	2003
GA	**Emory University**	Collaborative Project: The OCKHAM Library Network, Integrating the NSDL into Traditional Library Services http://ockham.library.emory.edu/	Halbert, Martin	2003
HI	**Pacific Resources for Education and Learning**	Ethnomathematics Digital Library http://www.ethnomath.org/	Lane, Nancy	2001
IA	**Eastern Iowa Community Colleges**	(NSDL) Advanced Technology Environmental Education Library (ATEEL) http://www.eerl.org/	Kabat Lensch, Ellen	2002
IL	**Argonne National Laboratory**	NSDL: Atmospheric Visualization Collection http://nsdl.arm.gov/	Klaus, Christopher	2000
	Northwestern University	Collaborative Research: THREDDS Second Generation http://www.unidata.ucar.edu/projects/THREDDS?Overview/Collaborations.htm	Edelson, Daniel	2003
	University of Illinois, Urbana-Champaign	Second Generation Digital Mathematics Resources with Innovative Content for Metadata Harvesting and Courseware Development http://mathworld.wolfram.com/	Mischo, William	2002
IN	**Indiana University**	Reciprocal Net–A Distributed Molecular Database http://www.recipnet.indiana.edu/	Huffman, John	2001
		Project ENABLE: Learning through Associations in a Grid based Bioinformatics Digital Library http://tara.slis.indiana.edu/enable/	Mostafa, Javed	2003
KS	**Kansas State University**	Collaborative Project: Physics Teaching Web Advisory (Pathway)–A Digital Video Library for Physics Teaching http://www.physicspathway.org/	Zollman, Dean	2002
	University of Kansas	Analytical Sciences Digital Library http://www.asdlib.org/	Kuwana, Theodore	2001
MA	**Education Development Center**	Gender and Science Digital Library http://www.edc.org/GDI/GSDL/	Hanson, Katherine	2001
		Effective Access: Using Digital Libraries to Enhance High School Teaching in STEM	Hanson, Katherine	2002

State	Institution	Project Name	Investigator	Fiscal Year
MA	**Education Development Center (continued)**	CaREN: Career Resources Education Network for STEM http://www2.edc.org/GDI/CaREN.htm	Hanson, Katherine	2003
	Marine Biological Laboratory	Collaborative Project: Digital Educational Resources in Microbial Ecology, Evolution and Diversity (DERMEED1)	Patterson, David	2003
	Harvard-Smithsonian Astrophysics Observatory	Harvard-Smithsonian Digital Video Library http://cfa-www.harvard.edu/cfa/sed/projects/dvl.html	Schneps, Matthew	2003
	TERC	Earth Exploration Toolbook: A Collection of Examples of Educational Uses of Earth System Science Tools, Datasets and Resources http://serc.carleton.edu/eet/	Ledley, Tamara	2002
	Tufts University	Collaborative Project: Managing Authority Lists for Customized Linking and Visualization http://nils.lib.tufts.edu/scale/scale_summary.shtml	Colati, Gregory	2002
	Tufts University/ Worcester Polytech Institute	Collaborative Research: TeachEngineering—Hands-on Engineering http://teachengineering.org/	Cyr, Martha	2002
	University of Massachusetts, Amherst	Question Triage for Experts and Documents: Expanding the Information Retrieval Function of the NSDL http://ciir.cs.umass.edu/research/triage.html	Croft, W. Bruce	2002
	WGBH	Teachers' Domain—Physical Science and Engineering http://www.teachersdomain.org/	Korf, Michele	2002
		Teachers Domain Collection: Life Sciences, K-12 http://www.teachersdomain.org/	Korf, Michele	2001
		Access NSDL http://accessnsdl.org/	Rothberg, Madeleine	2002
	Worcester Polytechnic Institute	Fire Science Multimedia Library	Woycheese, John	
		Collaborative Research: TeachEngineering—Hands-on Engineering http://teachengineering.com/	Cyr, Martha	
MD	**American Association of Physics Teachers**	ComPADRE: Communities for Physics and Astronomy Digital Resources in Education http://www.comPADRE.org/	Mason, Bruce	2002
	Johns Hopkins University	Collaborative Project: Managing Authority Lists for Customized Linking and Visualization http://nils.lib.tufts.edu/scale/scale_summary.shtml	Choudhury, Golam	2002
	University of Maryland	Collaborative Research: Developing a Learner-Centered Metathesaurus for Science, Mathematics, Engineering and Technology Education	Wood, William	2001
		Virtual Telescopes in Education (TIE) http://vtie.gsfc.nasa.gov/	Hoban, Susan	2001
	Universities Space Research Association	Implementing an Electronic Peer-Reviewed Journal of Earth System Science Education Resources (JESSE): A Pathfinder for SMETE Resource Peer Review http://www.jesse.usra.edu/	Johnson, Donald	2000
MI	**Eastern Michigan University**	TeacherLIB—Digital Community and Collections for Science and Mathematics Teacher Education http://www.teacherlib.org/	Hoffman, Ellen	2000
		Collaborative Project: The Rosetta Project—ALL Language Archive http://www.rosettaproject.org/live/search/languagesearch/	Aristar-Dry, Helen	2003

State	Institution	Project Name	Investigator	Fiscal Year
MI	**Eastern Michigan University (continued)**	Infusing NSDL in Middle Schools: Obstacles and Strategies http://www.terc.edu/TEMPLATE/projects/item.cfm?ProjectID=142	Hoffman, Ellen	2003
	Merit Network	Viewing the Future: Aligning Internet2 Video to K-12 Curriculum http://mtn.merit.edu/	Mardis, Marcia	2002
	Michigan State University	An Intelligent Digital Environment for Groundwater Education and Research	Li, Shu-Guang	2003
	University of Michigan, Ann Arbor	A Digital IdeaKeeper For K-12: NSDL Scaffolded Portal Services for Information Analysis and Synthesis http://hice.org/ideakeeper/introduction.html	Quintana, Christopher	2002
		Web Lecture Archiving System for Professional Society Meetings	Neal, Homer	2003
	Wayne State University	Unleashing Supply: Services for Collaborative Content Development http://www.opencourse.org/	Stephenson, Robert	2002
MN	**Carleton College**	Linking Pedagogy, Resources and Community Interaction to Support Entry-Level Undergraduate Geoscience Courses http://serc.carleton.edu/introgeo/index.html	Manduca, Cathryn	2002
MO	**University of Missouri/ University of Florida**	Enhancing Interoperability of NSDL Collections and Services http://dlbox.nudl.org/	Chen, Su-Shing	2003
		National Biology Digital Library	Chen, Su-Shing	2003
MT	**Montana State University**	Collaborative Project: Digital Educational Resources in Microbial Ecology, Evolution and Diversity (DERMEED-1)	Mogk, David	2003
NC	**North Carolina State University**	PER-CENTRAL: A Digital Library Supporting Physics Education Research	Beichner, Robert	2003
	University of North Carolina at Wilmington	Integrating Digital Libraries and Traditional Libraries: A Model for Sustaining NSDL Collections http://people.incw.edu/vetterr/NSDL_101203_Brief_Report.ppt/	Ward, Charles	2003
	Winston-Salem State University	NSDL: Towards Reusable and Shareable Courseware: Topic Maps-Based Digital Libraries http://gorams.wssu.edu/faculty/dichevad/iis/NSDL-home.htm	Dicheva, Darina	2003
ND	**North Dakota State University, Fargo**	The Digital Archive Network for Anthropology (DANA) http://atl.ndsu.edu/archive/index.htm	Clark, Jeffrey	2001
NH	**Dartmouth College**	Collaborative Project: To Enhance the Depth, Breadth, and Quality of the Collections of the Digital Library for Earth System Education (DLESE) http://www.dlese.org/	DeFelice, Barbara	2002
		Collaborative Project: To Gather, Document, Filter and Assess the Broad and Deep Collection of the Digital Library for Earth System Education http://www.dlese.org/	DeFelice, Barbara	2000
NJ	**New Jersey Institute of Technology**	Digital Library Service Integration http://is.njit.edu/dlsi/	Bieber, Michael	2003
	Rutgers University	The Moving Image Gateway http://gondolin.rutgers.edu/MIC	Agnew, Grace	2003
NM	**Integre Technical Publishing Company, Inc.**	Techexplorer and MathDL: Robust Support for Dynamic Web-Based Mathematics http://www.integretechpub.com/techexplorer/	DeLand, Donald	2003

State	Institution	Project Name	Investigator	Fiscal Year
NY	**Columbia University**	Collaborative Project: To Gather, Document, Filter and Assess the Broad and Deep Collection of the Digital Library for Earth Systems Education http://www.dlese.org/	Kastens, Kim	2000
		Columbia Pubscape: A Core Integration System for a National Science Digital Library Publishing Center	Wittenberg, Kate	2000
		Collaborative Project: Core Integration—Leading NSDL toward Long-Term Success http://nsdl.org/	Wittenberg, Kate	2003
		Collaborative Project: Core Integration of the National SMETE Digital Library http://www.nsdl.org/	Wittenberg, Kate	2001
		Collaborative Project: To Enhance the Depth, Breadth, and Quality of the Collections of the Digital Library for Earth Systems Education (DLESE) http://www.dlese.org/	Kastens, Kim	2002
	Cornell University	Digital Mathematics Library	Thomas, Sarah	2002
		Collaborative Project: Core Integration of the National SMETE Digital Library http://www.nsdl.org/	Arms, William	2003
		Collection and Distribution of Geoscience (Solid Earth) Data Sets for the National Science Digital Library http://atlas.geo.cornell.edu/	Seber, Dogan	2000
		The NSDL Central System	Arms, William	2000
		Collection and Dissemination of Geoscience Data and Knowledge for the National SMETE Digital Library http://atlas.geo.cornell.edu/	Seber, Dogan	2001
		Kinematic Models for Design Digital Library (K-MODDL) http://kmoddl.library.cornell.edu/	Saylor, John	2002
	Cornell University–Endowed	Collaborative Project: Core Integration—Leading NSDL Toward Long-Term Success http://nsdl.org/	Arms, William	2003
		Enabling Large-Scale Coherency Among Mathematical Texts in the NSDL	Constable, Robert	2003
	Cornell University–State	A Digital Rich Media Library of Animal Behavior http://birds.cornell.edu/LNS/archive/archive_search_index.html	Bradbury, Jack	2003
	Solutions	Breaking the Metadata Generation Bottleneck	Paik, Woojin	2000
	Syracuse University	Breaking the Metadata Generation Bottleneck http://www.cnlp.org/research/project.asp?recid=6	Liddy, Elizabeth	2000
		Students Using NSDL (SUN): Science Information Literacy and the NSDL http://www.nsdlsun.com/	Silverstein, Joanne	2003
		Developing Virtual Reference Desk Capabilities for the NSDL http://www.vrd.org/	Lankes, Richard	2003
		MetaTest: Evaluating the Quality and Utility of Metadata	Liddy, Elizabeth	2002
		Collaborative Project: StandardConnection—Mapping NSDL Educational Objects to Content Standards http://www.ischool.washington.edu/sasutton/NSDL/StandardConnection/	Liddy, Elizabeth	2001

State	Institution	Project Name	Investigator	Fiscal Year
OH	**Kent State University**	Green's Functions Research and Education Enhancement Network (GREEN) http://appling.kent.edu/nsdlgreen/	Shreve, Gregory	2001
		Materials Digital Library: MatDL.org http://matdl.org/	Bartolo, Laura	2003
		Quality Analysis of Metadata Records in the NSDL Metadata Repository	Zeng, Marcia	2003
	The Ohio State University	National Digital Library for Undergraduate Mathematics, Science, and Technology Teacher Preparation and Professional Development http://thelearningmatrix.enc.org/	Lightle, Kimberly	2000
		Marine Mammal Commission Digital Library of International Environmental and Ecosystem Policy Documents http://nsdl.tierit.com	Berkman, Paul Arthur	2002
		Collection Building and Capacity Development for K-12 Federally-Produced Mathematics and Science Education Digital Resources http://www.enc.org/	Lightle, Kimberly	2002
	Ohio State University Research Foundation	CAUSEweb: A Digital Library of Undergraduate Statistics Education http://www.causeweb.org/	Pearl, Dennis	2003
	University of Dayton	A Digital Library of Ceramic Microstructures http://www.udri.udayton.edu/udri_extranet/DLCM/home.asp/	Wills, Roger	2001
OK	**University of Oklahoma Health Sciences Center**	Collaborative Research: Health Education Assets Library http://www.healcentral.org/	Summers-Ables, Joy	2002
	University of Oklahoma/ Colorado School of Mines	Collaborative Research: TeachEngineering–Hands-On Engineering Resources for K-12 http://teachengineering.org/	Mooney, Michael	2003
OR	**Eduworks Corporation**	Fostering Reuse and Interoperability for the NSDL http://www.reusablelearning.org/index.asp?id=7	Robson, Robert	2003
	Oregon State University	Collaborative Project: The OCKHAM Library Network, Integrating the NSDL into Traditional Library Services http://ockham.library.emory.edu/	Frumkin, Jeremy	2003
PA	**Carnegie Mellon University**	Threading Information Pathways Through NSDL Video http://www.informedia.cs.cmu.edu/	Wactlar, Howard	2000
		Collaborative Project: A Component Repository and Environment for Assembly of Teaching Environments (CREATE) http://ir.chem.cmu.edu/create/	Yaron, David	2000
		Collaborative Project: Physics Teaching Web Advisory (Pathway)—A Digital Video Library for Physics Teaching http://www.physicspathway.org/	Stevens, Scott	2002
		Using Digital Libraries to Build Educational Communities	Yaron, David	2003
	Drexel University	Collaboration Services for the Math Forum Digital Library http://www.cis.drexel.edu/faculty/gerry/publications/proposals/nsdl2003/index.html	Stahl, Gerry	2003
		Improving Knowledge Transfer: Prioritizing Content Creation in Digital Libraries Using Competitive Intelligence Systems	Atwood, Michael	2000
		The NSDL Math Tools Project http://www.mathforum.org/mathtools/	Klotz, Eugene	2002

State	Institution	Project Name	Investigator	Fiscal Year
PA	**Swarthmore College**	A Digital Library Collection for Computer Vision Education http://cved.org/	Maxwell, Bruce	2002
RI	**Brown University**	Collaborative Project: A Component Repository and Environment for Assembly of Teaching Environments (CREATE) http://www.cs.brown.edu/exploratory/	van Dam, Andries	2000
		ReMarkable Texts: A Digital Notepad for the NSDL	van Dam, Andries	2002
TN	**University of Tennessee, Knoxville**	An Active Mathematical Software Collection for Inquiry-Based Computational Science and Engineering Education http://icl.cs.utk.edu/active-netlib/	Dongarra, Jack	2001
		Increasing Effective Student Use of the Scientific Journal Literature	Tenopir, Carol	2003
TX	**Rice University**	Advanced Placement Digital Library for Biology, Physics and Chemistry http://apdl.rice.edu/DesktopDefault.aspx/	Kumari, Datla Siva	2002
	Texas A&M	Using Spatial Hypertext as a Workspace for Digital Library Providers and Patrons http://www.csdl.tamu.edu/VKB/	Shipman, Frank	2002
		Metadocuments as Communicative Artifact to Enable Use of a Research Digital Library in Undergraduate SMET Education http://www.csdl.tamu.edu/walden/	Furuta, Richard	2000
		Integrating Digital Library Resources into Online Courses	Reaves, William	2002
		Design and Evaluation of Maintenance Tools for Distributed Digital Libraries http://www.csdl.tamu.edu/walden/	Shipman, Frank	2001
	University of Texas, Austin	www.eSkeletons.org: An Interactive Digital Library of Human and Primate Anatomy http://www.eskeletons.org/	Kappelman, John	2002
	University of Texas, Galveston	Ceph School: A Pedagogic Portal for Teaching Biological Principles with Cephalopod Molluscs	Lee, Phillip	2002
UT	**University of Utah**	A Digital Multimedia Library for Health Sciences Education http://www.healcentral.org/	Dennis, Sharon	2000
		Collaborative Research: Health Education Assets Library http://www.healcentral.org/	Dennis, Sharon	2002
	Utah State University	The Instructional Architect: A System for Discovering, Recommending, and Combining Learning Objects http://ia.usu.edu/	Recker, Mimi	2000
		Integrating and Extending the Instructional Architect: An Instructional Service for NSDL http://raymondyee.net/wiki/InstructionalArchitectProject/	Recker, Mimi	2003
VA	**American Geological Institute**	Collaborative Research: To Enhance the Depth, Breadth, and Quality of the Collections of the Digital Library of Earth System Education (DLESE) http://www.dlese.org/	Tahirkheli, Sharon	2002
		Collaborative Research: To Gather, Document, Filter and Assess the Broad and Deep Collection of the Digital Library for Earth System Education http://www.dlese.org/	Tahirkheli, Sharon	2000
	American Indian Higher Education Council	Digital Library Services for American Indians http://www.aihec.org/	Billy, Carrie	2001

State	Institution	Project Name	Investigator	Fiscal Year
VA	**International Technology Education Association**	National Digital Library for Technological Literacy http://icontechlit.enc.org/	Sterry, Len	2001
	National Association of Biology Teachers	Biology Education Online —An Interactive Electronic Journal http://www.accessexcellence.org/LC/BEOn/	Carley, Wayne	2000
	Old Dominion University	An OAI-Compliant Federated Physics Digital Library http://archon.cs.odu.edu/	Maly, Kurt	2001
	Old Dominion University Research Foundation	A Self-Sustainable Digital Library for Evolving Communities http://www.cs.odu.edu/~zubair/	Zubair, Mohammad	2003
	University of Virginia	Decentralized Image Retrieval for Education (DIRECT) http://viva.ee.virginia.edu/projects_direct.htm	Acton, Scott	2001
	Virginia Polytechnic Institute and State University	Collaborative Project: The OCKHAM Library Network, Integrating the NSDL into Traditional Library Services http://ockham.library.emory.edu/	Fox, Edward	2003
		A Digital Library Network for Engineering and Technology http://www.dlnet.vt.edu/	Rahman, Saifur	2000
		Computing and Information Technology Interactive Digital Educational Library (CITIDEL) http://www.citidel.org/	Fox, Edward	2001
	Washington & Lee University	The Alsos Digital Library http://alsos.wlu.edu/	Settle, Frank	2000
		The Development and Use of Digital Collections to Support Interdisciplinary Education http://home.wlu.edu/~blackmere/planning/electronicmaterialsguide.htm/	Settle, Frank	2002
WA	**University of Washington**	Collaborative Project: StandardConnection—Mapping NSDL Educational Objects to Content Standards http://www.ischool.washington.edu/sasutton/NSDL/StandardConnection/	Sutton, Stuart	2001
WI	**University of Wisconsin, Madison**	The Internet Scout Project's Personalized Content Delivery System http://scout.cs.wisc.edu/nsdl-reports/	Strikwerda, John	2001
		The Journal of Chemical Education Digital Library http://jchemed.chem.wisc.edu/	Moore, John	2002
		Optimizing Workflow and Integration in NSDL Collections http://scout.cs.wisc.edu/Projects/CWIS/	Strikwerda, John	2002
		The Internet Scout Project's Targeted Information Provision Service http://scout.wisc.edu/index.php/	Strikwerda, John	2003

Leadership

Principal Investigators

Kaye Howe (Director)
University Corporation for Atmospheric Research

William Arms
Cornell University

Kate Wittenberg
Columbia University

National Visiting Committee

Diana Oblinger (Chair)
Vice President, Educause

Martin Blume
Editor-in-Chief,
American Physical Society

Wade Ellis
Mathematics Department,
West Valley College

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

Sandra Glass
Independent Philanthropy Advisor, Vice President Emerita, Keck Foundation

William E. Kirwan
Chancellor, Maryland University System

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

Alfred Moye
Former Director of University Relations, Hewlett-Packard

Thomas Reeves
Professor, Instructional Technology, University of Georgia

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

Bernard Rous
Deputy Director/Electronic Publishing, Association of Computing Machinery

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

Gerry Wheeler
Executive Director, National Science Teachers Association

Policy Committee

Howard Burrows (Chair)
Autonomous Undersea Systems Institute

Katherine Hanson (Vice-Chair)
Education Development Center, Inc.

Rachael Bower
University of Wisconsin

Lillian A. Cassel
Villanova University

Edward A. Fox
Virginia Polytechnic Institute

Yolanda George
American Association for the Advancement of Science

Gerard L. Hanley
MERLOT

Ellen Hoffman
Eastern Michigan University

Flora McMartin
MERLOT

William H. Mischo
University of Illinois at Urbana-Champaign

Jeanne L. Narum
PKAL

Len Simutis
Eisenhower National Clearinghouse

Vivian Lee Ward
National Health Museum

Stephen A. Weimar
The Math Forum at Drexel University

Standing Committees

Community Services

Marcia Mardis (Chair)
Eastern Michigan University

Amy Chang (Co-Chair)
American Society for Microbiology

Content

Kimberly Lightle (Chair)
Eisenhower National Clearinghouse

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

Educational Impact and Evaluation

Anita Coleman (Chair)
University of Arizona

Laura Bartolo (Co-Chair)
Kent State University

Sustainability

Paul Berkman (Chair)
University of California at Santa Barbara

John Moore (Co-Chair)
University of Wisconsin

Technology

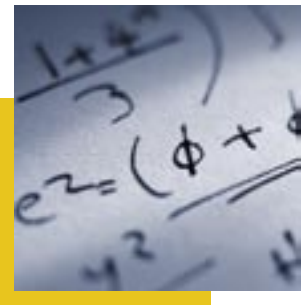
Timothy W. Cole (Chair)
University of Illinois at Urbana-Champaign

Mike Wright (Co-Chair)
University Corporation for Atmospheric Research

NSDL Funding FY2000–FY2003

	Core Integration	Subcontracts	Collections	Services	Research	Total
FY2000						
Number of Awards	6	0	13	9	1	29
Percentage of Funding	32%	0%	42%	24%	2%	100%
Dollar Amount	4,398,381	0	5,780,925	3,222,401	249,945	13,651,652
FY2001						
Number of Awards	3	4	18	14	4	39
Percentage of Funding	18%	1%	57%	21%	3%	100%
Dollar Amount	4,626,700	285,279	14,291,772	5,204,161	722,766	25,130,678
FY2002						
Number of Awards	3	5	35	11	6	55
Percentage of Funding	3%	5%	68%	15%	9%	100%
Dollar Amount	945,789	1,226,114	18,080,901	4,159,299	2,351,705	26,763,808
FY2003						
Number of Awards	3	5	22	11	8	44
Percentage of Funding	20%	5%	47%	16%	12%	100%
Dollar Amount	4,488,183	1,197,183	10,843,363	3,578,130	2,695,172	22,802,031

Note: Subcontract figures are a part of the Core Integration budget but are separated here to discern between CI and community tasks.



Acknowledgments

NSDL Contributors
Educational Impact and
Evaluation Committee:
- Anita Coleman, Chair
- Laura Bartolo, Co-chair
- Sarah Giersch
- Members of the Committee

Core Integration Team:
- Kaye Howe
- Susan Jesuroga
- Casey Jones
- Carol Minton Morris (Terrizzi)
- Susan Van Gundy

Cornell University Communication and Marketing Services
Sally Dutko, project manager
Clive Howard, designer
Elizabeth Bauman, editor

Vermilion Graphic and Web Communications

Sources

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2. Market Segments in Digital Education Content and Service Delivery, page 12, McArthur, D. (2003). NSDL Report: A Review of Business Options for the National Science Digital Library. Online: [http://nsdlbizmodel.comm.nsdl.org/docs/] visited 19 July 2004.

3. NSDL Projects 2000-2003, pages 15–23, NSDL Fastlane Awards Database.

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NSDL Central Office
P.O. Box 3000
Boulder, CO 80307-3000
(303) 497-2940
http://NSDL.org