

**FY 2002 REPORT TEMPLATE FOR
NSF COMMITTEES OF VISITORS (COVs)**

Date of COV: April 3-4, 2002
Program/Cluster: National STEM Education Digital Library (NSDL) Program
Division: Undergraduate Education
Directorate: Education and Human Resources
Number of actions reviewed by COV: 35

Note: COV responses appear in a different and smaller font than the template text.

INTRODUCTION. COV PROCESS

The COV consisted of four members:

Susan Millar, University of Wisconsin-Madison, evaluation/anthropology and center director (chair)

Melvin George, University of Missouri, mathematics and past university president

Anne Craig, Illinois State Library, information science and library associate director

Nancy Allen, University of Denver, information science and library dean and director

Members of the EHR staff, including Norman Fortenberry (DUE Division Director), Jane Stutsman and John Hunt (senior staff to the EHR Assistant Director), and Lee Zia, the senior program officer for the NSDL program, welcomed us and gave us our charge. Lee Zia provided various additional NSDL documents and described the sample of jackets he selected for our review (see below). Importantly, he also devoted much of the first morning to providing a general orientation to the NSDL program, including the historical context and the vision and rationale. This orientation period provided the COV with a valuable opportunity to ask questions. The information Lee provided was especially valuable because the NSDL is new, its goals somewhat difficult to grasp, and its content not yet clearly defined or visible. Thanks to Lee's thoughtful and informative review, we were able to start our work with a shared understanding of the constraints and opportunities associated with a program that is still in an early stage of development. Indeed, the COV believes that, without his presentation, it is very likely that we would have spent our time in a less productive way.

Lee Zia and other NSF staff were very helpful during the course of the COV meetings. They quickly and effectively answered all questions and responded to all our requests. We met with some 8 to 10 NSF staff to discuss our early findings at the beginning and end of the second day.

Jacket sampling procedure: The principle Lee Zia used for selecting the sample was to select 2 jackets from the award list and 2 from the decline list for each of the 4 NSDL tracks for each of two years (2000 and 2001). To select the two jackets from a set consisting of all the awards or all the declines in a track, the jackets were ordered from highest to lowest by average score assigned by reviewers, the total number of jackets in the set was divided in half, and the first jacket in the first and second half was selected. This

should have resulted in a sample of 32 jackets. Because two jackets from each of these sets were not available in all cases, the resulting sample consisted of 28 jackets.

The COV noted and program staff agreed that this sampling procedure resulted in a set of jackets that was biased toward the high end of average scores. However, given the time available, we did not make a systematic effort to correct for this bias. Rather, we requested additional jackets as it seemed appropriate in the course of our review process. We also noted and corrected for the fact that, in one case, jackets selected for one track in the two different years fortuitously were from the same institution, and in another case, two of the jackets selected were for essentially the same proposal (submitted in 2000 to one track under one PI's name, and submitted the next year to another track under a different PI's name).

In the end, we thoroughly reviewed 35 jackets from the categories listed below, quickly reviewed a number of other jackets, and learned about the jackets in the "Other" category in discussions with program officers.

	NSDL Track	Awards	Declines	
Year = 2000				
	Core Integration	2	1	(there was only 1 decline in this set)
	Collections	3	2	(an additional award jacket was added at COV request)
	Services	3	2	(an additional award jacket was added at COV request)
	Targeted Research	1	2	(there was only 1 award in this set)
	subtotal	9	7	
Year = 2001				
	Core Integration	3	0	(all awards in the set were reviewed; there were no declines)
	Collections	4	2	(additional award jackets added at COV request)
	Services	3	3	(additional award and decline jacket added at COV request)
	Targeted Research	2	2	
	subtotal	12	7	
Totals		21	14	

PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

A.1 Quality and effectiveness of the program's use of merit review procedures.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, or DATA NOT AVAILABLE
<p>Is the review mechanism appropriate? (panels, ad hoc reviews, site visits)</p> <p>Comments: See section A.3.1</p>	Yes
<p>Is the review process efficient and effective?</p> <p>Comments: The process could be even more efficient and effective if a preproposal process were used, using Core Integration team members to advise about preproposal reviews. See A.1 Recommendations.</p>	Yes
<p>Is the time to decision appropriate?</p> <p>Comments: Essentially all jackets reviewed had time-to-decision of less than 6 months. Excellent attention was paid to timeliness of response.</p>	Yes
<p>Is the documentation for recommendations complete?</p> <p>Comments: We found consistently excellent documentation in the jackets reviewed.</p>	Yes

<p>Are reviews consistent with priorities and criteria stated in the program's solicitations, announcements, and guidelines?</p> <p>Comments: The COV noted that it was unusual, particularly in 2000, for NSDL panelists to consider how well each proposal was suited to the priorities and criteria stated in the program solicitation. Panelists predominantly focused their comments on each proposal in and of itself, rather than contextualizing each within the NSDL program. The COV notes that it may have been difficult for NSF staff to focus panelists' attention on the question of "fit with the program" because panelists' understanding of what the NDSL is still emerging. See A.1. Recommendations.</p>	<p>Yes</p>
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Issues identified by the COV concerning the quality and effectiveness of the program's use of merit review procedures:

Overall, we found that the quality and effectiveness of the NSDL merit review procedures is excellent. Superb NSF program officer attention to detail was apparent in many of the jackets. In some instances, NSF staff had returned to the applicants repeatedly to clarify, to negotiate, and/or to ensure that all questions were resolved, regardless of whether the questions came from an NSF staff member or a panelist. This persistence is especially commendable considering the complexity and number of partner applicants represented by each one of the proposals. Furthermore, the panelists' qualifications were outstanding, as were the majority of their analyses. The NSF staff succeeded in accurately synthesizing panelists' recommendations in their written correspondence with NSDL applicants. This program represents a departure from most NSF programs, as evidenced by the NSDL's diverse and nontraditional applicant pool. The COV commends the NSF as courageous and forward thinking in its support of the NSDL.

Recommendations:

1. To help NSDL 2002 panelists better understand the program, and thus be better able to assess how each proposal fits within the program, we suggest that the program staff:

- **Provide a detailed introductory briefing to panelists like the one Lee Zia provided us; including:**
 - **an orientation to the "Communications Portal" and its purpose(s) and**
 - **an orientation to the "Governance Structure" and its purpose;**
- **In order to guarantee the development of an infrastructure that is reliable and sustainable over time, we suggest using a combination of some "standing" panel members and some rotating panelists. We also suggest that you consider inviting key members of the Core Integration team to be the "standing" panel members. These individuals could help panelists understand how particular proposals might fill gaps in the emerging NSDL; how they might be redundant with existing projects; and/or how viable they would be within the emerging program, i.e., whether emerging technical specifications in the Core Integration framework are accommodated;**
- **Consider using the two-tiered review process we recommend directly below.**

2. Both to help panelists assess how well proposals fit within the emerging program and to increase the effectiveness and efficiency of the review process, we suggest using a substantive pre-proposal process (5 pages) and that members of the Core Integration group be asked to write a paragraph about each pre-proposal that would be shared with reviewers. We frequently discussed the theme of "growing the field," and note that efforts to produce a systematic body of knowledge about the formation, use, and value of the NSDL would be a tremendously valuable by-product of the NSDL's creation. We believe that a preproposal process is one step that would engender the growth of the field, by serving to inform both the members of the applicant

community, as well as NSF and Core Integration staff.

A. 2 Implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	% REVIEWS
What percentage of <i>reviews</i> address the <u>intellectual merit</u> criterion?	33% in '00 80% in '01
What percentage of <i>reviews</i> address the <u>broader impacts</u> criterion?	20% in '00 50% on '01
What percentage of <i>review analyses</i> (Form 7's) comment on aspects of the <u>intellectual merit</u> criterion?	70% in `00, 85% in `01
What percentage of <i>review analyses</i> (Form 7's) comment on aspects of the <u>broader impacts</u> criterion?	40% in `00 60% in `01

Discuss any concerns the COV has identified with respect to NSF's merit review system.

The proposal reviews in the jackets that we examined were inconsistent as to whether and if so how well they addressed either criterion. We noticed improvement in the 2001 reviews over the 2000 reviews, but found it less likely that criterion 2 was addressed either year. These statements hold for the review analyses (Form 7) as well, but to a lesser degree. We ourselves were puzzled, in many cases, about how to decide whether a reviewer had "addressed" either of these criteria, and in particular, criterion 2. This is a concern, given the importance that NSF places on both of these criteria.

Regarding the review analysis (Form 7), our assessment is that if only summaries were expected, these reviews were fine. However, if analysis of the proposal in terms of the two criteria was expected, this was usually provided only in situations where the program officer disagreed with the panel. If the program officers are expected to provide well-formed analysis of each proposal's intellectual merit and broader impacts, they must be given much more explicit guidance in how to do so. We questioned if program officers themselves understood their charge in preparing these analyses.

We therefore recommend that the program consider asking the panels to conduct a two-tiered review, with a first pass that focuses on the quality of the proposal itself, and a second that explicitly considers (a) "fit" with the NSDL program and (b) quality in terms of NSF's 2 merit review criteria. To support this two-tiered process, we recommend that you revise Form 7 so that it first requires the program officer to summarize reviewers' comments, and then requires them to provide analysis. To support

the analysis process, these forms should provide clear and explicit guidance for assessing both program fit and merit review criteria. We suggest that the form include rubrics that require, for example, a judgment as to whether the proposal addressed each criterion at a low, moderate, or high level of quality. (The IMLS program uses a format and process that may be useful to consider. IMLS provides each reviewer a poster containing evaluation rubrics for use while reading and assessing IMLS proposals.) In addition, program officers should be provided with examples of good and mediocre analysis to share with the panelists. In training the program officers to use Form 7 (the current or proposed redesigned form), we also suggest that you ask the program officers to read the COV template, so that they understand what the COVs are asked to look for when assessing Form 7 reviews.

Because the two merit criteria are of utmost importance in terms of evaluation of NSF efficacy, information about the criteria should be provided to all parties involved, and at multiple points, throughout the NSDL proposal development and review process: the applicant should address them according to RFP instruction, the panel and program officers should address them, and so forth.

A.3 Selection of reviewers.

<p>Selection of Reviewers</p>	<p>YES , NO Or DATA NOT AVAILABLE</p>
<p>Did the program make use of an adequate number of reviewers for a balanced review?</p> <p>Comments: We commend the use of 10-person panels for the Core Integration track. However, the COV noted that about a quarter of the jackets reviewed had 4-person panels, and considered them definitely too small. About a third of our jackets had 5-person panels, which is still not adequate. The balance of our jackets (excepting the CI track panels) had panels with 6 or 7 members, which appeared to work quite well. See the first recommendation, below.</p>	<p>Mixed</p>
<p>Did the program make use of reviewers having appropriate expertise and/or qualifications?</p> <p>Comments: Reviewer qualifications appear excellent.</p>	<p>Yes</p>
<p>Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups?</p> <p>Comments: Based on the limited information on panelists' characteristics provided in the jackets, we believe a good balance is achieved. See the second and third recommendations, below.</p>	<p>Yes</p>

<p>Did the program recognize and resolve conflicts of interest when appropriate?</p> <p>Comments: This matter was addressed properly.</p>	<p>Yes</p>
<p>Did the program provide adequate documentation to justify actions taken?</p> <p>Comments: When a program officer's decision was not aligned with the panelists' assessment of a proposal, we looked for good documentation to explain why. In all but one of the cases where a program officer took action that was not aligned with the panelists' judgment, the documentation was adequate.</p>	<p>Yes</p>

Discuss any concerns identified that are relevant to selection of reviewers in the space below.

In assessing alignment between the panel's and the project officer's judgment of a proposal, we were puzzled as to how much weight we should give to panelists' numeric scores, particularly when panelists' comments did not appear to be lined up with these scores. The scores seemed irrelevant in some cases, especially considering that some proposals were funded that actually had lower scores than those not funded.

Recommendations:

- 1. The NSDL proposals are very complex, cross-disciplinary, and new. A very broad base of shared panelist experience and knowledge is needed to review such proposals. With this in mind, we believe it is necessary to comprise panels of no fewer than 7 people, and that each member should be chosen to represent different relevant disciplines, and organizational roles (e.g., provosts, policy administrators, and other types of key potential NSDL "users"). In particular, we recommend that panelists with expertise in the organization of information, software, STEM content, human-computer interactions, and the learning sciences be included. We note that a shift toward including representatives of user groups is also likely to result in an increase in the ethnic diversity of the panels.**
- 2. Good information on panelist characteristics is not available in the jackets. On the second day of the COV review, we received a spreadsheet presenting much better information on these characteristics. We recommend that such information be provided from outset to future COVs. On the spreadsheet, we noticed that ethnicity was not listed for all panelists. We encourage the NSF to attempt to collect this information in a more uniform manner.**

A. 4. Resulting portfolio of awards under review.

<p>RESULTING PORTFOLIO OF AWARDS</p>	<p>APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE</p>
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<p>Overall quality of the research and/or education projects supported by the program.</p> <p>Comments: We noted that the scores, on average, assigned to both the declined and funded NSDL proposals are lower than expected. See our comments below on this matter.</p>	<p>Appropriate</p>
<p>Are awards appropriate in size and duration for the scope of the projects?</p> <p>Comments: Given the developing nature of this program, yes. For more on this matter, see our recommendations, below. The COV commends the program officers for advancing the NSDL by working flexibly with applicants whose proposals have excellent ideas but are not quite ready for funding. For example, a proposal was submitted in FY01 to explore how Native Americans' patterns of thought would influence their way of interacting with the NSDL. While the original proposal did not review well, the program officer felt the topic of accessibility for Native Americans was so important for the NSDL that he approved a \$75,000 planning grant to enable a series of workshops and meetings to take place under the auspices of the American Indian Higher Education Consortium to develop a research agenda that would inform the relevant questions of interest. As another example, we found upon reviewing <i>Collection And Dissemination of Geoscience Data And Knowledge For The National Science Digital Library</i> (DUE 0121390, Institution: Cornell-Endowed; PI: Seber) that the program officer negotiated a downsized budget by reducing the time line and scale of the project yet maintained the essential elements of the proposal. These examples indicate how the program officers are helping to "grow" this emerging interdisciplinary field. They also indicate that the program officers are working creatively to develop capacity in new (and underrepresented) principal investigators while also assuring that grant size and duration are aligned with the project quality.</p>	<p>Appropriate</p>
<p>Does the program portfolio have an appropriate balance of</p> <ul style="list-style-type: none"> ■ High Risk Proposals <p>Comments: The whole NSDL program is high risk. Even taking this into account, we believe that the program is doing a good job funding high risk proposals. We applaud this, as it is essential to pursuing the big dream that motivates the NSDL program. One type of risk we noted is that, while many of the PIs have very strong track records, they are working with new partners, using new collaborative techniques and developing new user communities—all of which create higher risk for projects. That is, PI track record counts less for projecting risk in this program than in more established areas. In other cases (such as the American Indian Higher Education Consortium project mentioned above), a commendable interest in involving a broad group of potential users led to an appropriate high risk funding decision. In addition, we noted that many of the funded projects are very</p>	<p>Appropriate</p>

<p>ambitious, a factor that increases the risk</p>	
<p style="text-align: center;">■ Multidisciplinary Proposals</p> <p>Comments: Multidisciplinarity is a hallmark of the NSDL program. While many proposals (particularly in Collections track) involved only one of the traditional STEM disciplines, experts in this STEM discipline almost always were working people from a broad spectrum of other disciplines (such as library scientists and sociologists) who generally are not included in NSF-funded projects.</p> <p>The COV commends the program for the initiative and creativity demonstrated in negotiating co-funding with other NSF directorates.</p>	<p style="text-align: center;">Appropriate</p>
<p style="text-align: center;">■ Innovative Proposals</p> <p>Comments: The COV found that the jackets reviewed demonstrated high levels of innovation. We anticipate that over time there will be a decline in technical innovation and anticipate an increase in innovative applications and user groups.</p>	<p style="text-align: center;">Appropriate</p>
<p>Of those awards reviewed by the committee, what percentage of projects address the integration of research and education?</p> <p>Comments: Many of the funded projects that we reviewed integrate research and education implicitly, rather than explicitly, suggesting that this characteristic also is endemic to the NSDL program. For example, <i>Developing an NSDL LibQUAL+Protocol</i> (DUE 0121769, Institution: Association of Research Libraries, PI: led by Webster), is "repurposing" the existing LibQUAL+ protocol (designed to support the library needs of researchers) in order to assess services provided to the NSDL user community. We commend the NSF for funding a program that simultaneously is devoted to pursuing "blue sky" ideas and to providing resources that meet very practical needs of STEM teachers and students.</p>	<p style="text-align: center;">Percentage: 75% - see comment</p>

Discuss any concerns identified that are relevant to the quality of the projects or the balance of the portfolio in the space below.

The COV speculated that the average scores of NSDL proposals have been relatively low because the field is emerging, reviewers may need a more in-depth understanding of the unique challenges of this program, and the program does not use a pre-proposal process. Accordingly, we reiterate our recommendation that the program consider using a pre-proposal process, which will focus more attention on the iterative shaping and improvement of the proposals. We believe that the extra staff effort this would require is justified, given amount of money distributed by this program. See related recommendations under A.1.

We noted that panelists for the Core Integration track presented largely the same concerns in 2000 as in 2001. In terms of the quality of projects, this raises a question as to whether the program is sufficiently monitoring the progress of funded proposals to ensure that reviewer comments are addressed over time.

PART B. RESULTS: OUTPUTS AND OUTCOMES OF NSF INVESTMENTS

Since the NSDL program is positioned as an element of the "tool" category within the overall Nsf/Ehr strategy of "People, Ideas, And Tools", the questions in Sections B.1 (People) And B.2 (Ideas) do not apply and require no consideration by the COV. Specifically, the NSDL is still in the developmental stage and thus does not yet contribute to performance under the People or Ideas goals or Emphasis Areas.

B.3.a COV Questions for TOOLS Goal

OUTCOME GOAL for TOOLS: Providing "broadly accessible, state-of-the-art and shared research and education tools."

<p style="text-align: center;">TOOLS INDICATORS</p>	<p style="text-align: center;">PROGRAM ACHIEVEMENT</p> <p style="text-align: center;">Select one:</p> <p style="text-align: center;">SIGNIFICANT,</p> <p style="text-align: center;">NOT SIGNIFICANT,</p> <p style="text-align: center;">DOES NOT APPLY or</p> <p style="text-align: center;">DATA NOT AVAILABLE</p>
<p>Provision of facilities, databases or other infrastructure that enable discoveries or enhance productivity by NSF research or education communities;</p> <p>Comments: Essentially all the funded projects we reviewed illustrate how the NSDL program is developing infrastructure that promises to enable STEM educators both to discover better ways to foster student learning, and to enhance the productivity of their and their students' education efforts. The infrastructure under development by the NSDL projects includes myriad databases, along with processes that are being designed and tested to enable educators to effectively use these databases. Projects that exemplify how the NSDL program is providing this electronic educational infrastructure include:</p> <ul style="list-style-type: none"> • <i>The NSDL Central System</i> (DUE-0085753, Institution: Cornell University – Endowed, PI: William Arms), a Core Integration Track project that is 	<p style="text-align: center;">Significant</p> <p style="text-align: center;">If Significant, provide award #s</p> <p style="text-align: center;">DUE-0085753</p> <p style="text-align: center;">DUE-0121669</p>

encouraging "new methods of learning, collaboration, and dissemination" through an electronic infrastructure that promises to transform STEM education.

- *An Active Mathematical Software Collection for Inquiry-based Computational Science and Engineering Education* (DUE-0121669, Institution: University of Tennessee Knoxville, PI: Dongarra), a Collections Track project that blends innovative content and new ways of accessing that content.

While the ultimate outcomes of these projects, in terms of enhanced student learning, are clearly not yet available, key intermediate outcomes already are apparent in the development of the "NSDL community." We are confident that the "process infrastructure" embodied in this emerging community will bear fruit, possibly of greater value than its designers anticipate.

Provision of broadly accessible facilities, databases or other infrastructure that are widely shared by NSF research or education communities;

Comments: In response to our question about how to interpret this indicator, EHR staff asked us to consider whether the NSDL "tool" is accessible to and widely used by NSF-funded PIs in their research and education efforts. In response, we note first of all that the program is too young to assess whether it has achieved this type of impact, but that there is every indication that it eventually will. Second, we note that the NSDL is designed to serve communities that are much broader than scholars funded by the NSF.

Data not yet available

If Significant, provide award #s

Partnerships, e.g., with other federal agencies, national laboratories, or other nations to support and enable development of large facilities and infrastructure projects;

Comments: The COV noted that many of the funded projects in our sample of jackets involved partnerships among institutions of education and other organizations, such as professional societies. These collaborations are underway at different levels. On the one hand, there are the awards classified formally as "collaborative awards." An excellent example is *Collaborative Project: Core Integration of the National SMETE* (DUE-0127298, 0127308, and 0127520, Institutions: University Corporation for Atmospheric Research (UCAR), Cornell University, and Columbia University, PIs: Fulker, Arms, and Wittenberg). Another example is *Collaborative Research: A Component Repository and Environment for Assembly of Teaching Environments (CREATE)* (DUE-0085862 and DUE-0085826, Institutions: Carnegie Mellon University and Brown University, PIs: David Yaron and Andries van Dam), which supports collaborative creation of a broad spectrum of learning objects and also provides teachers an "assembly environment" in which they can create curriculum materials that utilize the learning objects and suit their students' needs.

Significant

If Significant, provide award #s

DUE-0127298,
0127308, and 0127520

DUE-0085862 and
DUE-0085826

DUE-0085840

On the other hand, we commend projects that, while not formally "collaborative awards," are genuinely collaborative anyway. An example is *Bioscience Education Net* (DUE-0085840, Institution: AAAS, PI: Yolanda George) The objectives of this project are to develop a portal site to a collection of resources (tools and products) for the teaching and learning of biology by students at the undergraduate level with diverse interests and career aspirations (i.e. science majors, non-science majors, and prospective K-12 teachers). The materials are being collected and maintained by respected professional societies representing a broad spectrum of biological sciences from the molecular level to macroscopic population levels. The introduction of higher level collaboration across professional societies in the biosciences will benefit undergraduate learning in powerful new ways.

Co-funding within NSF was indicated in the summary spreadsheets provided. However, we noted that none of the jackets reviewed indicated co-funding with one obvious collaborator, the Institute for Museum and Library Services (IMLS), although such co-funding may actually have taken place. Future COVs would find it useful if the spreadsheet providing summary information about the proposals indicated when co-funding from other federal agencies, national laboratories, or other nations was sought.

Use of the Internet to make SMET information available to the NSF research or education communities;

Comments: As the intent of the whole program is to use the Internet to make STEM information available to the NSF education communities, all the awards could be provided as examples of this indicator.

Significant

If Significant, provide award #s

<p>Development, management, or utilization of very large data sets and information-bases;</p> <p>Comments: The development, management, and use of very large data sets and information-bases are endemic to the NSDL program. While all of the awards in the Collections track and those in the Services and Targeted Research tracks that we reviewed and that use very large data sets could be selected as examples, we feature the Core Integration (CI) awards here. In addition to developing individual datasets, the CI track is developing and piloting an organizational and technical infrastructure intended to optimally serve the needs of educators in our K-20 institutions and the informal sectors. To illustrate the strength of the NSDL program with regard to this indicator, we also point to a number of awards in the Collections track. For example, the 2001 awardees are developing and/or improving the "use infrastructure" for very large datasets used in computer science, molecular sciences, anthropology, geology, civil engineering, and ethno-mathematics, and for exploration of specific topics, including ceramic microstructures, technical literacy, earthquakes, environmental data, the life sciences and gender, and water resources management.</p>	<p style="text-align: center;">Significant</p> <p style="text-align: center;">If Significant, provide award #s</p>
<p>Development of information and policy analyses that contribute to the effective use of science and engineering resources.</p> <p>Comments:</p>	<p style="text-align: center;">Does not yet apply.</p> <p style="text-align: center;">See B.5</p>

Comment on steps that the program should take to improve performance in areas of the TOOLS goal.

Overall, the COV was impressed by the quality of the design of the NSDL program and by the progress to date represented by the grants underway. We believe that the program's performance could be improved by developing a more effective vehicle to enable current and potential PIs to build on previous NSDL-funded work, including the Digital Library Initiative and Knowledge and Distributed Intelligence programs, and the many NSDL-related Course, Curriculum, and Laboratory Improvement projects.

The COV applauds the quite remarkable efforts underway to generate synergy across the NSDL projects. This said, we believe that both the program officers and the emerging "NSDL community" should focus even more of their energy and creativity on improving cross-project synergy.

B.3.b TOOLS Areas of Emphasis

<p style="text-align: center;">TOOLS Areas of INVESTMENTS *</p>	<p style="text-align: center;">Demonstrates likelihood of strong performance in future?</p> <p style="text-align: center;">Select one:</p> <p style="text-align: center;">Yes, No,</p> <p style="text-align: center;">Does Not Apply or Data Not Available</p>
<p>Scientific databases and tools for using them</p> <p>Comments: An especially resourceful feature of essentially all NSDL projects is their work in "repurposing" existing scientific databases and tools to make them useful to STEM educators. Because this approach is endemic to the NSDL program, we do not cite specific awards to exemplify achievement of this indicator.</p>	<p style="text-align: center;">YES</p> <p style="text-align: center;">Awards = all</p> <p style="text-align: center;">If Yes, provide award #s</p>
<p>National STEM Education Digital Library</p> <p>Comments: See all comments above and below.</p>	<p style="text-align: center;">YES</p> <p style="text-align: center;">Awards = all</p> <p style="text-align: center;">If Yes, provide award #s</p>

*** Only two of the tools areas of investment are relevant to the NSDL program.**

B. 4. Please comment on any program areas in need of improvement.

To avoid redundancy in this report, the various specific recommendations provided in the sections above are not reiterated here. We present instead one overall concern and make a recommendation for addressing that concern.

Many endeavors that are as ambitious, risky and innovative as the NSDL program could be characterized by the phrase "make the road by walking." To make new trails, pioneers must communicate constantly and work together as they move along. The NSDL program is less akin to a road than to a vast network of thin trails on which pioneers who speak quite different (disciplinary and "agency") languages are found. It is a great challenge for the multitude of pioneers spun out across this loosely coupled network to establish and maintain effective communication processes. It is also not clear how a "field of 1000 pathways" can be transformed from a maze into a "user-friendly" yet comprehensive network.

In light of these challenges, the COV believes that, as the vision of NSDL becomes clearer and more detailed, there will be increasing need for closer NSF oversight/management of the program projects, particularly the Core Integration team. If the NSDL "tool" is to be useful and used over a long period of

time, more consistency and coherence will have to be developed. As the "big picture" evolves, information essential for preparation of successful proposals must be easily available to all members of the community (and especially to new proposers and members of underrepresented groups), and the context in which proposals are to be reviewed must be understood by an even broader set of reviewers. To achieve this end, we recommend that the NSDL Communications Portal (<http://comm.nsdlib.org/>) be considered the primary source of information for prospective NSDL PIs, and that the NSF control the information appearing on the portal. We also recommend that NSF hire a portal manager-communicator.

In addition, the entire STEM community must feel welcome to participate in and able to benefit from the NSDL. We provide two examples to illustrate our point here. 1) A mathematics professor must be able easily to ask about research supporting the efficacy of inquiry-based learning and find John Wright's work in chemistry; 2) A dean/provost must consider parts of NSDL as providing fully peer-reviewed vehicles for scholarly work in science education that are credible enough to be rewarded and must find the NSDL easy to use for this purpose. To this end, the Core Integration team must not, even inadvertently, foster a sense of "us" vs. "them." Finally, an NSDL that adequately serves the nation will have to be comprehensive in both type of collections and kinds of potential users.

All of these strongly suggest that in order to maintain a good balance between openness and coherence, and an appropriate accountability, a more "managed" approach by NSF to the Core Integration team will be needed as time goes on.

B.5 Provide comments as appropriate on the program's performance in meeting program-specific goals and objectives, which are not covered by the above questions.

We begin this section by making note of the following strengths of the NSDL, as they became apparent during our review:

- We consider the NSDL program to be more than a standard NSF program – it also is an NSF leadership initiative.
- Overall, the NSDL program is doing an excellent job of communicating with PIs during the proposal process. In particular, the program officers have demonstrated the capacity to listen and make excellent decisions. Among these excellent decisions is their choice to share leadership with the field through Core Integration process. We consider this activity to be an example of how NSF is "growing the field."
- We are impressed that the Core Integration group, in turn, is developing community and good communication processes among the project PIs by sharing leadership with them. We consider the emerging NSDL community a key intermediate outcome of the program.
- We commend the program for organizing a series of planning workshops (1996-99), special community development workshops, and meetings for all NSDL projects. In particular, we note the workshop for NSDL PIs with projects that have a K-12 focus. These meetings are an excellent strategy for building a productive community among the PIs. We encourage the program officers to continue organizing these activities, and to take other creative community building efforts of this type.
- The NSDL is a "stand out" among NSF programs in a variety of ways:
 - Projects are unusually innovative and very interdisciplinary.
 - The four program tracks are well-designed and the program officers are appropriately adjusting the tracks in response to changes in the field.
 - The program officers are willing to take risks in their project choices, a characteristic all the more notable because the program is high risk to begin with.

We commend the program officers and Core Integration project leaders for managing creatively in a large organization with many new features.

1. How well is the NSDL program progressing towards the enhancement of the K-20 curricular, laboratory, or instructional infrastructure?

We believe that the NSDL program, by funding numerous projects that allow for educators to dynamically create and design their own tools, is enhancing tremendously the instructional infrastructure of the K-20 environment.

This said, it is useful to consider the situation in terms of two audiences: K-12 and higher education.

- **K-12:** We noted that during the first 2 years of the program, 29 projects are focused on developing materials and processes to help the Digital Library improve K-12 education. (It was the PIs of these are the programs that the NSDL program brought together for special meeting.)
- **Higher education:** Actually creating pedagogical change among faculty, and encouraging use of new NSDL resources in teaching is crucial to reforming the STEM education system. While the Core Integration group already is making good effort to connect with existing efforts of this type, more needs to be done. For example, there appears to be no link between the NSDL and the National Institute for Science Education's College Level One's on-line STEM faculty professional development resources; how would a faculty member using the NSDL locate resources such as these? How might the NSDL involve more of the higher education teaching and learning community in the development and use of this wonderful new tool? An area of particularly high priority should be finding ways to help new STEM instructors. We also believe progress in this area could be made by pilot testing NSDL services and collections with reform-ready faculty. (For more on this topic, see question 5, below.)

We note that the NSDL has struck a good balance between a tightly coupled and loosely coupled system, where the tight structure supports standards and interoperability, and the loose structure enables creativity in terms of new proposals, and new ways to draw in and interact with an ever broader community of producer-users. We urge the program to continue monitoring this balance.

While it is clear that the NSDL understands the importance of bringing participants currently on the periphery into the mainstream of NSDL projects, we believe both NSF and Core Integration leaders could do even more to "grow the community." For example, they might organize workshops on "What a Good Proposal Looks Like." If done well, preproposal workshops are an excellent way to ensure the pool of applicants remains diverse (re gender, ethnicity and other factors) and open.

We believe that all NSF directorates should either continue to, or begin to, contribute to NSDL. In this regard, we note that once the NSDL gets to the point where K-20 educators and learners consider it indispensable, technical capacity will become a problem. Possibly grid computing activity underway in the CISE Directorate might represent a set of solutions.

2. How well is the NSDL program enabling professional development opportunities to be delivered for the STEM instructional workforce?

(In responding to this question, we are assuming that the STEM instructional workforce comprises individuals who teach the STEM disciplines, and that the focus of the question is teacher training.)

We found relatively little evidence that the NSDL program is systematically working on the matter of professional development, and are aware that it may be premature to expect this.

This said, it is of utmost importance that in the future STEM educators (K-20) become aware of and learn how to use the NSDL. We encourage the NSF and IMLS to think proactively about how to proceed with this training, bearing in mind ideas such as the following.

- **The NSDL should explore new models for working with teachers. Simply delivering new tools will not ensure their use; rather, iterative, partnership-based, and practice-tested methods of integrating new tools into practice are needed. At some point in the near future, it might be useful to develop RFPs designed to identify new models for professional development that advance how practitioners, teachers, researchers, and other user communities (including the general public) use the new tools.**
- **We noted that many NSDL projects enable teachers to craft their own tools. How can we help teachers understand that the NSDL is not just about delivering information, but also presents a new paradigm for teaching and learning? How can teachers learn that they will have to change their methods in order to take full advantage of the NSDL resources? How can teachers use the NSDL to find innovative ways to meet state standards for K-12 education and curricular requirements in higher education?**
- **There are other efforts underway that are related to the development of digital, networked research, learning and problem-solving resources. One example is the Association of Research Libraries initiative SPARC, which is testing alternatives to the traditional high-cost scholarly journal as the basis of scholarly communication. As new models for dissemination and scholarly advance are developed, NSF and the NSDL investigators will want to explore integrative strategies with this and many other digital and networking developments.**

3. How well is the NSDL program fostering partnerships that enable the flow of ideas among the academic, public, and/or private sectors?

We commend the program for the excellent work it is doing attempting to keep the NSDL community open. We encourage the program to continue in this way, paying special attention to, and resisting, the tendency for a program to become more exclusive as it evolves.

4. What additional data might we collect from projects in order to better assess the extent to which the program as a whole is successfully progressing towards its intended goals and outcomes?

High quality evaluation and assessment processes are critical in order for the NSDL program to both demonstrate its value and to improve its processes and products. This said, we note that evaluation and assessment are difficult and expensive to do well, and that most of the NSDL PIs do not have the necessary skills and time themselves, or the necessary local resources and budget. We therefore recommend that the NSDL consider supporting the projects by contracting a set of evaluation and assessment experts who would be available to assist all NSDL PIs. These consultants could design formative evaluation processes that, for example, provide information about the level and type of community "buy in." They could work systematically with the PIs on the thorny problems of defining desired outcomes prior to developing assessments. They also could be asked to help the program design a longitudinal assessment program. In this regard, we believe that it is not too soon to begin collecting baseline data. We note that the NSDL also might wish to adopt the IMLS's process of requiring all PIs to attend an outcome-based assessment training program. In short, we believe that any support the NSDL program can provide in order to help the PIs obtain good evaluation and assessment information will broaden the experience and perspectives of the PIs.

5. What additional evaluation activities might be pursued in order to better document impact? What information or policy analyses could be developed to better understand how the NSDL is enabling effective use of STEM education resources?

Regarding evaluation activities, please see the points made in response to question 4. We discussed only one area pertaining to policy analyses that might be undertaken in order to further improve the NSDL: state-wide policies pertaining to mandatory testing place pressures on K-12 teachers to raise scores and on school districts to develop lessons/curricula that meet state standards. We reasoned that these policies force teacher development programs to allocate much of their resources and their teachers' professional

development time to programs designed to improve test scores. We recommend that the NSDL program bear in mind this policy environment when designing teacher development programs intended to improve the integration of NSDL resources into K-12 classroom activity. As another practical approach to improved integration of NSDL resources at the K-12 level, we recommend focusing on school media specialists who, in turn, work regularly with teachers in providing support and access to information resources.

6. How might the overall outreach strategy of the NSDL projects be refined to better allow NSDL to reach its many target audiences?

As noted elsewhere, we commend the NSDL program for carefully monitoring of its progress, developing the Communications Portal, and developing an NSDL governance structure. are all factors that indicate that this program is successfully evolving. To strengthen the NSDL program's overall outreach strategy, we recommend that these and other features of program evolution be made visible in future RFPs, in order to offer new potential participants a level playing.

We also recommend that future RFPs provide more explicit information about how to address Criteria 1 and 2 (see related recommendations under A.2.), very clearly define overall goals and strategies for interacting effectively with a broad set of users, and require PIs to include a section on how their proposed work would fit with these stated overall NSDL outreach goals and strategies.

At a more specific level, we also suggest:

- Provide increasingly sophisticated linkages to user communities that extend far beyond those targeted by NSDL-funded projects.
- Be aware that the "outreach" is itself problematic, in that it does not convey the interactive nature of the relationships the NSDL seeks to maintain with its user communities. We suggest that NSDL consider using terms that better convey its interest in interactive feedback/linkages.
- Who will control the flow of NSDL information that the NSF presently does not control? There is a place for unidirectional information from NSF to the research and development community. This information should be provided in a very visible, easily accessed manner, that ensures a level playing field for new applicants. New people won't be able to join the community unless NSF makes clear the requirements for inclusion.
- The program should develop a process by which it can scan the environment and decide what gaps exist (in terms of collections, services, and so forth), and request proposals in those areas, rather than just relying on the field to fill the gaps.

7. In the area of sustainability of the digital library what additional prospects and strategies might the program pursue?

We realize that questions about sustainability are inherently difficult to address because of the emerging and dynamic nature of the NSDL, and applaud the innovative thinking already underway among NSF staff to address the need for long term access to and support of the digital resources created for education.

This said, we suggest the following strategies that may help efforts to ensure sustainability:

- Encourage institutional sponsorship, like that obtained for the Why Files (<http://whyfiles.org>), which originally was funded by the NSF, and then was taken over by an institution on behalf of the nation.
- Require match on proposals in order to encourage more institutional collaboration and a stronger commitment to sustainability.
- Seek more co-funding across the NSF, particularly with the Biological Sciences Directorate.
- Include in future RFPs requests that PIs specifically address sustainability by, for example, discussing

the degree of institutional commitment to sustaining a project, addressing adherence to standards involved in sustainability of the digital objects created and the metadata used to describe digital resources, as well as long-term preservation efforts to be undertaken to support ongoing access to digital resources. If relevant, each new proposal could also be asked to address sustainability in terms of how the proposed project fits with other elements of the NSDL.

- Consider models for ensuring sustainability such as membership or use fees, and NSF support comparable to that provided for research facilities.

B.6 NSF would appreciate your comments for improvement of the COV review process, format and report template.

1. We found that the time we had to review a program of this complexity was very limited, particularly given the need to address the GPRA requests.

2. In Section A of the template, allow the COV choices other than "Yes" or "No." Frequently, the more accurate answer would be conveyed by a choice such as "Generally."

3. There is need for alignment of COV with Form 7. For example, if the COV is to assess "analysis" (whatever that means) with regard to reviewer mention of "broader impacts," Form 7 itself should explicitly lead the program officer to provide this type of analysis.

4. We appreciated receiving a lot of good information in advance. It would be good to ensure that future COV members get information about reviewers' characteristics in advance as well.

5. We were unclear about the meaning of the phrase "integration of research and education."

6. We appreciated the ability to review jackets other than those presented to us as the evaluation sample. In two instances, we had jackets that were in some way duplicative of other jackets in the sample. We recommend continuing the practice of allowing the reviewers to reject and replace jackets reviewed.