



Digital Library for Earth System Education

The Digital Library for Earth System Education:
Providing a High-Quality DLESE Experience

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July 7, 2004

Sponsored by the National Science Foundation

Providing a High Quality DLESE Experience

The DLESE is dedicated to the collection, enhancement, and distribution of materials that facilitate learning about the Earth system at all educational levels. It strives to be the premier source of high-quality resources and services to support its Earth system educational mission. In many areas, the DLESE is a leader among NSDL projects in building a community-driven library that addresses the needs of a broad audience, and many of its innovations have sparked change in other libraries. It has a dynamic and functioning user interface. The number of resources and collections is steadily increasing. The community continues to grow and more organizations are developing partnerships with DLESE. There is real progress to diversify the audiences served and participating actively in DLESE, and the Annual Meetings are energizing and provide a great opportunity for community feedback, to name a few successes. The DLESE community has achieved these results and many more by continually evaluating its position and setting goals to move the library forward. It has also achieved success through significant community contributions to its development.

We strongly advocate continuation of these activities, as well as other community-based projects that contribute to Earth system education in ways that enhance the overall DLESE goals. When conceived in 1999, DLESE and the National SMETE (Science, Mathematics, Engineering and Technology Education) Digital Library were a high-risk experiment. The nature of any complex experiment is that there will be both successes and failures. DLESE survived and thrived during this experimentation phase and is now enjoying a stage of adolescence in which all the key systems are working and the library community has a great deal of energy to move forward quickly. But, like an adolescent, DLESE needs to focus its energy to reach its full potential. Ensuring the quality of the resources and collections is the core of DLESE and must be its primary focus.

From the initial concept and plan for the DLESE, ensuring that the collections and services are of high quality has been paramount to the community (DLESE Community Plan, 2000). Initial threshold criteria for accessioning resources into the library were two-fold: “Is it relevant to Earth system education?” and “Does it function reasonably?” Additional criteria were proposed for the Reviewed Collection at the initial community workshop and later formalized and implemented in the Community Review System (crs.dlese.org). Although resources in the Reviewed Collection must all meet the same seven selection criteria, the actual review process and policies for determining whether a resource meets those criteria are not the same for every resource or sub-collection. For the Broad Collection, the person cataloging resources is asked to determine whether the resource meets the requirements of being relevant to Earth System education and functioning reasonably; DLESE Program Center staff also review the resource for these criteria when they check for metadata completeness. This uneven review process puts the burden of determining the quality of the review and the resource on the user, many of whom are not experts in Earth system education. In the sections below, we outline some suggested changes in how DLESE operates; one of our most important changes is implementing a standard framework of peer review that can be applied to all collections and by all developers.

In July 2003, a group of community leaders took a critical step in recommending new criteria and procedures for improving the quality of the DLESE Broad collection. The criteria (<http://www.dlese.org/Metadata/collections/resource-quality.htm>) were approved by the Steering Committee and steps are being taken by the Collections Committee to implement them. However, much work needs to be done to develop operational plans for implementing these guidelines and procedures. In May 2004 at the request of the DLESE Steering Committee, NSF funded this effort to assess the effectiveness of the current policies and procedures for assuring the high quality of all resources and services within the DLESE. This effort builds on all previous efforts and will result in a detailed plan for implementing a more comprehensive, integrated approach to achieving high quality resources and services across the library.

Key Steps in Providing a High-Quality DLESE Experience

This document outlines our current thinking about what the ideal DLESE might be and some of the key questions that need to be addressed to reach that ideal. It also includes a matrix detailing how to move from the state in which DLESE finds itself today to its ideal form. Many of these issues are not new to the community or unique to DLESE but a resolution on how to proceed on them has not been agreed upon by the community. This is the first step in the process and much community discussion and effort will be needed to develop the final plans.

You have several ways to participate in this process. You can share your thoughts on the DLESE Quality Library discussion group (www.dlese.org/MailingLists/) between now and September, send email to any of the authors, or share your ideas with the Steering Committee and us at several events during this year's Annual Meeting. After the Annual Meeting, we hope to engage the community in helping us fill in the critical details and refine the plan. The process will culminate in a workshop to be held September 19-21 in Santa Fe, New Mexico to formalize the plan and transmit its recommendations to the Steering Committee for consideration.

What Is Your Ideal DLESE Experience?

Below we present to you a preliminary description of the ideal DLESE which stems from the original Community plan and more recent community discussions. We ask that you consider the following description of the ideal DLESE and at the same time imagine going to the library for your own personal needs. What would you be looking for and how would you like to go about finding it? How would you hope the library is organized for your exploration, and how would you like the answers to queries to be presented? What kind of descriptive information would you like to see to help you select the most useful resources for your purposes? Is there a point of diminishing returns beyond which additional links just bog down your work? Would you value a tool that allows you to pull off a suite of resources and organize them into a personal collection? We would like for you to imagine your own ideal DLESE in very specific terms and share it with us.

Ultimately, we envision that changes to the current operations of DLESE based on community input to this process could result in an ideal Earth system education library

that serves the diverse needs of the entire community. Taking ideas and examples from numerous existing community documents and adding some new ideas of our own, we propose the vision below as a starting point for discussion of the ideal DLESE.

The ideal Earth system education library might be described as one that:

- Teaches instructors/scientists about the Earth as a system through a visual browse structure, and teaches about ways to improve teaching through the individual instructional resources for the classroom and/or through reference materials linked to those instructional resources;
- Recommends sequences of instruction, from small units to full curriculum, that support interdisciplinary approaches to teaching about the atmosphere, geosphere, hydrosphere, cryosphere, biosphere and solar/terrestrial relationships;
- Contains a reference collection of only the highest quality instructional resources and supporting materials covering the core Earth system science concepts and a separate supporting collection of high quality instructional and reference materials that supplement and expand upon the Earth system science content to include all of Earth system education;
- Links all resources to a teaching tip for use;
- Links all instructional resources to a pedagogical supporting reference;
- Is platform independent and browser independent;
- Uses clearly articulated and uniformly applied criteria for review of all resources;
- Includes only resources with attribution within them.

Some example criteria for the instructional and supporting materials in the core reference collection might include:

- Content is primarily about core concepts in understanding the Earth system and is scientifically valid;
- All instructional materials have a clearly articulated pedagogical framework that promotes inquiry, critical thinking, and problem solving and fosters mastery of significant understandings or skills;
- Instructional materials engage students in solving relevant problems with real data, demonstrate application of science to solving real world problems and/or convey connections such as general with specific, local to global, theory with evidence;
- Instructional materials are well-documented in both instructional guidance and supporting scientific literature for any data sets and scientific concepts (e.g., an investigation of global climate change based on ice core data will document the source of the data and provide references to supporting primary literature where this data was used and/or the topic of the lesson is addressed);
- The resources are well attributed and have robustness / sustainability as a digital resource.

Reaching the Ideal DLESE

In examining the integrated nature of DLESE resources and services, we concluded that assessing and assuring their high quality would impact nearly every component of the

library. In fact, resource and collections quality is at the heart of the DLESE and its mission of being the premier digital library to advance teaching and understanding of the Earth system.

Our work is guided by the overarching question:

What is required to implement an exemplary system of policies and procedures that ensure the high quality of all resources and services in DLESE?

This system must be transparent, efficient and consistent in application so that users can be assured of finding the high quality resources they need and developers have a clear set of guidelines for creating needed resources and collections of high quality. This is of fundamental importance to the growth of DLESE and the central goal of this effort.

The issues affecting the quality of resources, collections and services in the library and the assumptions behind them are presented in the following sections. The issues fall into three areas: assuring the quality of individual resources and collections; assuring a high quality cataloging and retrieval system to disseminate those resources; and assuring a high quality infrastructure to maintain the diversity and interest of the DLESE community that will create and use those resources to advance the teaching and understanding of the Earth system. The accompanying Quality matrix outlines the action plans needed to move from the current DLESE to the “ideal” DLESE.

Quality of Library Resources

From the above stated vision of an ideal DLESE library, we can extract three major elements that contribute to resource quality: scientifically valid content, appropriate depth and breadth of content within the library to allow broad implementation of Earth system content in educational settings, and effective pedagogical methods that support current understanding of how people learn. To ensure those elements of quality we must answer the following questions about the library.

What policies and procedures need to be implemented to ensure a high level of quality among all resources in the library?

The library will have as many as 8,000 resources by the end of summer 2004. No well articulated standard of quality currently exists that can be consistently applied across the library. Variable review criteria and among the resources and collections leads to confusion about what the review process means and can have the consequence of lowering user and developer confidence in the quality of all resources. From the Community Plan (p. 16) we can take this guidance:

“One of the highest priorities articulated by Earth science educators at all levels is the need for a system of quality assurance attached to instructional materials. The current state of the WWW is anarchistic in the sense that too much information is delivered indiscriminately, without benefit of organizing principles or standards. One of the central functions envisaged for DLESE is the development of a comprehensive system for reviewing and evaluating the diverse materials in its collections. This review system will provide a mechanism for recognizing high-quality work analogous to the peer review process traditionally used for journal articles. Once established, the review process should provide users with a high degree of confidence that they will be able to find the high-quality instructional materials that they need, and creators of new materials will benefit from incentives that will result in national recognition for their contributions.”

“DLESE will use the review process to encourage library users to become creators of new instructional materials. There is a wealth of high-quality educational materials that have been developed by educators for personal use in local classrooms. In the spirit of sharing ’best practices’ DLESE will establish mechanisms to translate new materials from the personal files of instructors into the DLESE collections for national dissemination. The DLESE review process will provide an essential service by providing critical feedback to the creators about the overall efficacy and utility of their materials.”

“The review process will also provide quality assurance by verifying that minimum standards, as articulated in the DLESE review criteria, are built in to the new materials. It is hoped that national recognition of new creative contributions will provide the incentive for educators to move their best materials into the public domain through DLESE.”

A formidable challenge confronting the implementation of accessioning policies and procedures that ensure consistent quality among resources and collections is how to apply them retroactively to a library that is now very large. It seems inescapable that a meaningful system to assure the high quality of resources and collections will require a formal peer review process. Additional desirable components may include, for example, options for ranking output from searches based on reviews, labeling or annotating resources with information on quality, or using the teaching tips as supplemental information for rankings.

How can DLESE best implement an Earth system education framework for building and evaluating the quality of the library's content and its comprehensiveness?

This assumes that the community can define, measure, and evaluate both quality and comprehensiveness in the library. Initial steps have been taken by different groups to define Earth system education and an Earth system education vocabulary for DLESE. A framework for determining if resources meet the Earth system education scope needs to be specific enough to apply with some surety but general enough not to exclude those things that should naturally fall within the supplementary resources in the supporting disciplines of Earth system education. The Earth system education vocabulary is critical for improving the search and browse structure of the library as the number and diversity of resources increase. Both the Earth system education framework and vocabulary need to be developed and implemented in the library within the next year to enable a true proof-of-concept test before funding for the Core Services ends in 2006.

How can we better measure the comprehensiveness of the library within refined definitions of Earth system education and within an environment where the size of the library can nearly double in one year?

The community needs new mechanisms to assess comprehensiveness of the library and identify new directions for collection building to serve community needs. Collections assessment efforts to date have focused on comparing the scope and balance of the library collection with the scope and balance of the requests coming into the Discovery System search and browse functions, according to key attributes recorded in the metadata: learning context, topic, and learning resource type. This approach has shown some power for identifying gaps and thin spots in the collection as represented by small or null-returns. However, this approach cannot assess attributes not included in the metadata (e.g. Earth system processes), is extremely labor intensive, and it does not capture nuances of individual users' needs. Moreover, the results of the collections assessment effort have not been widely disseminated and in general have had limited impact on the development or cataloging of new resources to fill gaps. Funding for this effort is ending, thus it is a good time to review the current techniques and explore additional mechanisms that support and align with the new Earth system education framework. A great deal of information about what is desired in the library is gathered each year at the annual meeting. Helping the community prioritize resource needs in this setting is valuable from a community-building standpoint and in recruiting developers of resources and collections to

address the highest priority needs. Using the quality review process to improve assessment of gaps, thin spots and areas of completeness is another approach, although there are likely others. A clear understanding of what should be in the library, what is in the library, and its quality will help the community identify and communicate future resource needs.

How can collection building guided by community needs and/or identified gaps in the collection be a more inclusive process encouraging individuals in the community to voluntarily create resources or collections in addition to those contributed by funded efforts?

DLESE should provide timely guidance to resource creators (and funding agencies) on library gaps and community needs, thereby promoting the acquisition — or creation — of new, needed resources. The collections should be developed, at least in part, in response to a coherent plan and priorities and mechanisms for collections building should be well known to the community.

How can DLESE most effectively incorporate a framework supporting cognitive science and pedagogic research literature and teaching resources to advance teaching and learning about the Earth system?

Advancing the community's knowledge and skills for effective teaching and learning is critical to advancing understanding of the Earth system. Ideally, DLESE resources will instruct on ways to improve teaching through the design of individual instructional resources and/or reference materials linked to those instructional resources. Several ongoing projects are beginning to address this component in the library (e.g. Starting Point and the DLESE/USGS/CA science teachers collaboration) but developing strategic approaches that all users can contribute to and benefit from is important. Further, developing appropriate metadata and vocabularies to improve search and browsing for these resources is essential.

How can communication and collaboration between DLESE and resource authors be strengthened and motivation increased for submitting new resources, data, tools, etc. to DLESE?

Participants in the 2003 Annual Meeting recommended the following steps to increase collections development and help collections builders: 1) promoting DLESE to potential collection builders; 2) increasing the benefits and recognition of collections builders, 3) creating and integrating tools and services for collection builders; 4) finalizing current criteria guidelines for collection builders; 5) creating a “cookbook” to educate developers; 6) developing and encouraging feedback to improve the collection; and 7) facilitating partnerships between current and future DLESE community members (Strand C1 at the 2003 Annual Meeting). Action has been taken on a number of these efforts already but more work is needed.

Specifically, meeting the goal of high quality will require increased professional recognition for resource developers and collection builders to participate in DLESE. In addition, it will require steps to foster a widespread perception that DLESE is the premier entity for disseminating high quality Earth system educational resources. A

set of criteria to encourage academic recognition for “publishing” reviewed resources in DLESE have been developed, but greater efforts to increase awareness within the scientific community of the significance of a DLESE publication may increase their value in promotion and tenure decisions, for example. In addition, improvements in the current Discovery system to clearly convey where the resources came from and highlight the community contributions to the library are an important step for recognition. Clearly indicating how and for what use a resource has been evaluated or reviewed will also improve the user experience and provide recognition to those developers and resource creators that put the extra effort into building high quality DLESE resources.

Additionally, improving communication between DLESE and both resource creators and collection builders will result in higher quality resources and collections. More specifically, collections builders are often not the creators of the individual resources and a gap exists in communication between the individual resource creators and DLESE. Developing new mechanisms and rewards that encourage individuals to submit their resources for "publication" in DLESE will result in a stronger community, increased opportunities to recognize individuals promoting high quality Earth system education, and a new opportunity to provide feedback directly to the resource creators on improving the resource.

Library Framework and Functionality

Accessioning of the resources is the first critical step in ensuring DLESE meets its goal of being the premier digital library for high quality resources and collections. Effective retrieval of those resources and services is equally critical to meeting this goal. Resource retrieval is affected by the quality of the cataloging and Discovery system and the abilities and needs of the users. Ensuring that users with diverse backgrounds are equally successful in searching and retrieving individual resources is critical for advancing the teaching and understanding of Earth system science. Achieving this component of the DLESE mission requires addressing the following questions.

How can DLESE most effectively and efficiently implement a true Earth system education search and browse structure while supporting the core disciplines contributing to our understanding of the Earth System?

Currently, DLESE resources and services are focused on the core disciplines in Earth Science (geoscience, atmospheric science, hydrology and ocean science, bioscience (related to human activities and the environment), space science, and cryoscience), due to early decisions made to get the library online quickly and the fact that fewer Earth system focused teaching resources exist compared to those in the core disciplines.

Changing this focus will not be easy but is essential if the goal of DLESE to be an Earth system education library is to be achieved. Developing and implementing an

Earth system controlled vocabulary to support searches and cataloging is a critical component of this effort. With any change, we must be mindful that K-16 educators are generally not trained or prepared to teach from an Earth system perspective and will need some help in designing their courses and curriculum with this approach. This is especially true for K-12 educators who must align their curriculum with state and national standards. There will be a need to provide models or conceptual frameworks that demonstrate a system/integrated approach. Several community-based projects of this type are already underway (e.g. Cutting Edge, Starting Points and the new pilot project between DLESE, the USGS and California science teachers). DLESE has also implemented mechanisms for K-12 teachers to search for resources based on the National Science Education Standards (NSES) and may expand that effort to include the AAAS Benchmarks. Developing linkages between the NSES, the Benchmarks, Earth system concepts, and relevant resources in the library will provide the framework for teachers to choose appropriate resources that meet their needs and support Earth system education.

How can DLESE improve the user experience to foster understanding of the Earth system and increase the user's understanding of the breadth of resources and services offered by DLESE?

The current user interface assumes one has an understanding of Earth Science and Earth system science and that users share a common technical vocabulary. Further, it assumes the user has an understanding of the breadth of resources that DLESE offers. Neither is true for many visitors. However, a user interface that teaches about the Earth system and the resources and services offered by DLESE would potentially increase use of the Earth system approach and understanding of the Earth system. The interface should quickly give users a feel for the scope of the library and help to frame the manner in which they use the search tools. This could be achieved by expanding the current Discovery system to include a browse structure that allows users to explore Earth system concepts and linkages visually and thereby begin to understand the scope and relevance of the Earth system approach and how to implement it. Additionally, it could be achieved by creating distinct portals in the library to familiarize and teach users about Earth system processes and interactions as well. To be effective, any new search and browse interfaces in the current Discovery system or in separate portals must accommodate the skills, knowledge and needs of the different user audiences (K-6, 6-12, college, informal educator). The user interface must also be intuitive and engaging enough to motivate users to investigate DLESE resources and services and learn about the Earth system.

How can DLESE automate more of its basic developmental, operational and maintenance activities to reduce costs, while increasing efficiency and flexibility to pursue new opportunities?

Automated services to assist resource and collection developers will increase the quality and diversity of resources in the library, helping to achieve a more comprehensive collection. Exploring mechanisms to automate metadata development, gap assessment, and other features would potentially free up resources that could be dedicated to innovation in other service areas. There are a number of existing tools

(both commercial and open source) and ongoing digital library projects that could provide assistance to DLESE. However to ensure high quality resources and metadata, care must be taken to ensure quality is maintained, thus human we cannot rely solely on automated metadata or indexing. Humans have to be part of the process to ensure that the resource descriptions, assigned subject and key words are relevant and accurate.

How can DLESE promote development of reusable learning resources that can be repurposed in part or wholly by collections builders for the library or by individuals for their own use?

Promoting the creation of reusable learning objects (e.g. <http://www.reusablelearning.org/nsdl>) for repurposing of high-quality resources or parts of those resources will improve DLESE's ability to provide comprehensive collections for all audiences. It could also reduce the overall number of unique resources needed in the library to meet the needs of the diverse audiences in the DLESE community.

Quality of Library Scope & Oversight

The final component of ensuring a digital library of high quality resources is community engagement. DLESE has invested a significant amount of effort to build a diverse and active community. Maintaining that community requires developing resources and services that meet their needs, and enacting a communication and governance structure that is open and responsive to the community.

How can we create structures within DLESE that support the needs of sub-audiences (K-6, middle school, high school, college, informal, professional societies, research facilities, special education teachers etc.) while effectively integrating their efforts and resources to strengthen the library overall?

Within the scientific and educational communities, digital libraries where quality measures have been well characterized and implemented are generally very focused. DLESE is serving a very broad constituency and each of the identified sub-audiences has different needs. Sub-audiences can be classified by grade level or subject taught, interests in pedagogical innovation, gender / ethnic equity, special needs students, field-based teaching etc. To meet the needs of these audiences, it will be necessary for DLESE to create new structures or encourage use of existing structures for the sub-audiences to organize themselves, identify their needs, set priorities and recommend mechanisms to address those needs. Creating smaller focus points in the library may help to build sub-communities that can address the critical needs of their own community. In addition, an Earth system education framework can help illustrate connections among sub-communities, aggregate them into a larger community, and build the expertise to enhance the library's quality and comprehensiveness.

How can we improve mechanisms for quickly identifying, reporting and resolving problems in DLESE resources and services?

To address the issues that arise concerning the content, character, operations and policies of the library and move DLESE toward its ideal state will require clearly articulated policies and procedures that result in quick response by authorized entities and flexibility in design of the library to accommodate growth and change. In the area of content, we can learn from bricks-and-mortar public libraries, some of which have put substantial effort into developing procedures for registering patron complaints about specific books and responding to such complaints in a way that balances the need to respect community values and yet refrain from heavy-handed censorship. It will also require nurturing a culture in which the community knows how to provide continual feedback and does so because they can see the results. This responsiveness will promote confidence in the integrity of the library and the value of being a community member.

This overview and the accompanying matrix below are presented as starting points of discussion within the community with the ultimate goal of a comprehensive plan for achieving the high quality library envisioned by the community. We hope to engage a

broad cross section of the community in a discussion of how to optimize the quality of the DLESE experience. The scope of this effort is broad and some may want to focus on only one aspect. Contributions in any area are welcome and encouraged. We hope that the community will join us in this discussion on the Library Quality discussion group at <http://www.dlese.org/MailingLists/>.

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Providing a High Quality DLESE Experience

<i>Quality of library resources</i>				
“Today’s DLESE”	Efforts to Build On	Assumptions	Action Items	“Ideal DLESE”
<p>Quality criteria are not as clear as they could be, nor consistently applied across the library. Variable review criteria and procedures among the resources and collections leads to:</p> <ul style="list-style-type: none"> • Confusion about what can and should be accessioned in the library; • Lower user and developer confidence in the quality of all resources. 	<ul style="list-style-type: none"> • Resource and Metadata Quality Guidelines and DLESE Reviewed Collection Best Practices adopted by the Steering Committee in April. • Community Review System (CRS) infrastructure. • Experience of the Collections Accessioning Taskforce in applying general quality measures and DLESE Review Criteria to existing collections. • Experience of the DPC and collections builders. • The Collection Builder’s Guide. • Collections Committee experience in deaccessioning issues. 	<ul style="list-style-type: none"> • Peer-review of both the science and the pedagogy is important in improving the overall quality of the collections. • Perception of high quality by users is based on confidence that <u>all</u> resources (unless noted otherwise) have been reviewed and passed specific quality criteria. • DLESE can develop rigorous criteria for evaluation that are easily interpreted and applied. • Mechanisms dealing with the non-static nature of resources will be in place to ensure a resource deemed of high quality for the library maintains its high quality. 	<ul style="list-style-type: none"> • Determine mechanisms for peer-review that reflect reasonable costs and effort for the level of quality desired. • Develop and apply consistent peer-review criteria and mechanisms for determining quality of all resources in the library. • Develop an Editorial Board or other review process and the associated policies and procedures for implementing a high quality, peer-review for the collections. • Develop means to enhance community involvement in the peer-review process. • Develop mechanisms for resource creators to improve “supporting collection” or Broad collection resources to meet “core collection” standards. • Identify whether multiple levels of quality can be supported effectively with appropriate labels or annotations. 	<ul style="list-style-type: none"> • Uses clearly articulated and uniformly applied review criteria for all resources. • Contains a core collection of only the highest quality instructional resources covering the core Earth systems concepts. • Contains a separate supporting collection of high quality instructional and reference materials that supplement and expand upon Earth system content. • Contains a broad collection of developmental and supplementary resources.

<i>Quality of library resources</i>				
“Today’s DLESE”	Efforts to Build On	Assumptions	Action Items	“Ideal DLESE”
<p>DLESE lacks an Earth systems framework for building the library's content. This impacts:</p> <ul style="list-style-type: none"> • Evaluation of quality and comprehensiveness in the library; and • Collection building. 	<ul style="list-style-type: none"> • NSDL’s exploration into faceted controlled vocabularies. • NSDL’s experience with hierarchical vocabularies. • Existing Earth science and Earth system vocabularies (e.g. NASA, USRA, AGI, and other NSF-funded projects). 	<p>We can define, measure, and evaluate both quality and comprehensiveness in the library.</p>	<ul style="list-style-type: none"> • Define the optimal scientific content of the library in terms of core concepts, supplementary concepts, and overall size of the collection. • Promptly revise current subject vocabulary, and develop new vocabularies, associated definitions and where relevant new thesauri capturing conceptual linkages between terms/concepts for Earth systems, teaching and learning, and other library content. • Re-catalog resources as necessary to ensure that older resources are adequately found with use of the new vocabularies. • Provide guidance on linkages among Earth system concepts and concepts in other disciplines, and the science education standards. • Provide a framework for evaluating comprehensiveness of the library, quality of resources, and development of collections. 	<p>Library users, resource developers and collection builders will be able to quickly determine the breadth and depth of resources in the library as well as the quality of different resources.</p> <p>Users will have an understanding that the library has adequate coverage of Earth system concepts although the collection may not be exhaustive.</p>

<i>Quality of library resources</i>				
“Today’s DLESE”	Efforts to Build On	Assumptions	Action Items	“Ideal DLESE”
Comprehensiveness of the library and the nature of “gaps” and thin spots in its contents are assessed but the methods are limited by the metadata structure and the time intensive analysis of the data. Further, the results are not widely disseminated nor acted upon.	<ul style="list-style-type: none"> • Monthly histograms of subject, resource type, and grade range vocabulary. • Term counts of any fields in the DLESE metadata including the resource description. • Results of De Felice collections assessment project. • Community input from annual meetings and workshops hosted by DLESE and affiliated programs and partners such as Cutting Edge, Starting Points and COSEE. 	<ul style="list-style-type: none"> • We can ascertain the bounds of Earth system education and thus describe, measure and evaluate whether we have achieved the appropriate breadth and depth of resources. • The development of an intended framework will allow the identification of gaps. 	<ul style="list-style-type: none"> • Automate existing collection assessment techniques and disseminate the results widely and prominently. • Develop new procedures to assess comprehensiveness of the library, identify community needs, and set priorities for gathering new resources through the quality review process, focus groups, user feedback on the null-return page of the Discovery System, annual workshops and Steering Committee (SC) deliberations. • Develop the mechanisms for filling identified gaps in a manner that meets the prioritized needs of the community in an open, competitive way. • Encourage establishment of funding opportunities to which individuals can submit proposals to develop materials that fill these gaps. 	The users, developers and collection builders will have up to date information on gaps in the library and mechanisms by which they can help fill those gaps in an ongoing fashion.
Collection building (developing metadata, assembling thematic collections, etc.) occurs without the guidance of a widely disseminated, clearly articulated plan that illustrates the gaps in the library. This affects DLESE quality by limiting the participation of new contributors to DLESE who are less familiar with its needs.	Same as above.	<ul style="list-style-type: none"> • The collections should be developed, at least in part, in response to needs identified by the community. • Priorities and mechanisms for collections building should be well known to the community. 	<ul style="list-style-type: none"> • Develop a process by which the current collection is refined and, where appropriate, expanded in response to the needs of DLESE users. This effort may involve monitoring website usage, hosting community workshops, and other such activities to determine what the community needs. 	Provides guidance to resource creators (and funding agencies) on library gaps, thereby promoting the acquisition -- or creation -- of new, needed resources.

<i>Quality of library resources</i>				
“Today’s DLESE”	Efforts to Build On	Assumptions	Action Items	“Ideal DLESE”
<p>The DLESE frameworks are designed to catalog objects generically; however the DLESE controlled vocabularies do not fully support resources focused on teaching and learning science. This affects quality by not effectively cataloging pedagogic and learning science resources to advance teaching and learning about the Earth system.</p>	<ul style="list-style-type: none"> Existing pedagogic fields in the DLESE metadata. Existing collections that catalog such materials. Strategies implemented to address Earth systems vocabulary. 	<p>Advancing the community’s knowledge and skills for effective teaching and learning is critical to advancing understanding of the Earth system.</p>	<ul style="list-style-type: none"> Encourage continued development and cataloging of cognitive science and pedagogical resources to support Earth system teaching. Investigate options for sub-collections serving diverse needs and audiences such as gender equity, special education, exam and study questions development, and pedagogical content knowledge, among other topics. 	<p>Instructs on ways to improve teaching through the design of individual instructional resources and/or reference materials linked to those instructional resources. Each resource within the library contains or is linked to appropriate pedagogical models for use in the classroom.</p>
<p>Communication between DLESE and the community about the rewards of contributing and current needs for new resources, data, tools etc. is not widely disseminated. This affects quality by:</p> <ul style="list-style-type: none"> Limiting the number of potential contributors and the potential recognition they could receive for contributing. 	<ul style="list-style-type: none"> Annual meeting reports. Academic Recognition Task Force survey and recommendations. 	<ul style="list-style-type: none"> Perception of DLESE as the premier entity for disseminating high quality Earth system educational resources will motivate academic and other institutions to provide professional reward (promotions) to collection or resource creators. Sufficient incentives can be offered to encourage development of high quality collections that adhere to a well-defined and achievable set of review criteria. Sufficient structures can be implemented to guide developers of collections in their work and to provide consistent, constructive reviews to improve the quality of the library and its resources. 	<ul style="list-style-type: none"> Promote development of resources that have the essential characteristics needed to meet DLESE’s highest quality criteria and that earn recognition equivalent to a “traditional” publication. Promote the concept of DLESE “publications” to the academic community to ensure acceptance. Identify issues that resource developers and DLESE Core Services currently perceive as obstacles for growing a high quality library and develop strategies to address them. Evaluate current incentives for developers and reviewers to increase quality of collections. 	<ul style="list-style-type: none"> Acceptance of a resource into DLESE’s reference collection brings prestige to the resource creator. Brokers partnerships among resource creators, evaluators, and end-users to create and evaluate resources.

<i>Quality of library framework & functionality</i>				
“Today’s DLESE”	Efforts to Build On	Assumptions	Action Items	“Ideal DLESE”
<p>DLESE lacks an Earth system framework for building the library's functionality. This results in:</p> <ul style="list-style-type: none"> • Search and browse structures that are presently subject specific not concept-, process-, or interdisciplinary-oriented. 	<ul style="list-style-type: none"> • Ongoing DLESE, NSDL, industry and NSF-funded efforts in user-centered human interface design. • Strand map and Standards visual interfaces. 	<p>There should be a method within DLESE for users who want to know more about the Earth system and how to teach about it to learn more. For example, a visual browse structure could provide a means for users to learn about the Earth system while searching for resources, while those who know what they want and understand the nature of Earth system education can go directly to the search engine.</p>	<ul style="list-style-type: none"> • Develop visual search and browse structures (built upon the new Earth system vocabulary and thesaurus) that facilitate learning about the Earth system and support complex searches for interdisciplinary resources. • Create a conceptual framework that will facilitate development of recommended sequences of instruction (e.g. pre-college educators). • Plan for growth and refinement of the browse structure and Earth system framework as DLESE and the community’s needs evolve. 	<ul style="list-style-type: none"> • Teaches about the Earth as a system through interactivity and browse structure linkages. • Recommends sequences of instruction that support interdisciplinary approaches to teaching about the Earth system.
<p>The user interface to DLESE does not convey effectively the breadth or depth of resources in the library available to a user. This results in:</p> <ul style="list-style-type: none"> • Poor understanding of the potential usefulness of the library and increased difficulty in constructing appropriate searches. 	<ul style="list-style-type: none"> • Same as above. 	<p>The user interface should quickly give the user a feel for the scope of the library and help to frame the manner in which they use the search tools.</p>	<p>Design an expanded browse interface in conjunction with the new Earth system metadata structures that conveys the scope of the library resources in a simple but effective manner, and encourages further exploration of the library.</p>	<p>A user can see the range of content, resources, and services provided by the library and will be motivated to explore them. The interface supports diverse user audiences.</p>
<p>Services and functions vary for different browsers and platforms. This results in:</p> <ul style="list-style-type: none"> • User frustration and decreased confidence in the quality of the library. 	<ul style="list-style-type: none"> • Industry standards for field-testing and user-centered design. 	<p>Platform and browser independent web services and functions can be achieved with existing tools and knowledge.</p>	<ul style="list-style-type: none"> • Ensure uniform library functionality among a wider array of platforms and browsers. • Needs to be modem-friendly (28.8 or 56.6 kb/s). • W3C testing should be routine. 	<p>Functionality is consistent across a broad range of platforms and browsers.</p>

<i>Quality of library framework & functionality</i>				
“Today’s DLESE”	Efforts to Build On	Assumptions	Action Items	“Ideal DLESE”
<p>Developmental, operational and maintenance activities require human intervention at many levels. This results in:</p> <ul style="list-style-type: none"> Limiting feedback, and slowing response to problems with content, operations, policies and procedures. 	<ul style="list-style-type: none"> NSF-funded ‘automated’ metadata creation projects (Liz Liddy et. al.) as well as commercial and open source tools. Current DPC automated checks (link checking and other maintenance tasks). 	<p>As digital libraries evolve, more of the routine activities can and should be automated to free up technical personnel for more creative endeavors that keep the library on the cutting edge. However, computer generated information is not at a level of precision and accuracy that can ensure high quality, therefore human verification of automated metadata is required. Creating metadata and evaluating the collections for gaps/comprehensiveness are two areas that could benefit from increased automation. If reviews are put in place for all resources, new tools to facilitate that will be essential.</p>	<ul style="list-style-type: none"> Develop tools and services that further automate development and maintenance of resources and collections, metadata and evaluation and other services. 	<p>Interactions with the infrastructure of the library are seamless, intuitive and efficient for developers, and operations and maintenance activities are streamlined.</p>
<p>Promoting development of reusable resources is limited and results in:</p> <ul style="list-style-type: none"> Development of new resources that are more difficult to repurpose and the need for multiple resources of similar nature. 	<ul style="list-style-type: none"> Web services (e.g. DPC collaboration with FCOSEE) Reusable learning resources e.g. http://www.reusablelearning.org/nsdl 	<p>Reusability or repurposing of quality resources or parts of resources will improve DLESE’s ability to provide comprehensive collections for all audiences.</p>	<ul style="list-style-type: none"> Develop guidelines for reusability following the NSDL example and encourage their use by resource and collections developers. 	<p>Collections developers and individuals interested in creating customized resources for different audiences and needs will be able to repurpose information easily.</p>

<i>Quality of library scope & oversight</i>				
“Today’s DLESE”	Efforts to Build On	Assumptions	Action Items	“Ideal DLESE”
<p>Target audience is very broad. This impacts quality because:</p> <ul style="list-style-type: none"> • The needs of sub-audiences are not well understood or characterized; • The expertise to meet the needs of all audiences is not readily available; • The number and variety of resources required to meet the needs of all sub-audiences increases with the breadth of the audience. • Priorities for addressing needs are not well stipulated. 	<ul style="list-style-type: none"> • Ongoing community outreach efforts. • List serves and other existing virtual learning and communication environments. • DLESE Annual Meeting and other community workshops. 	<ul style="list-style-type: none"> • Digital libraries where quality measures have been well characterized and implemented are generally very focused. • Creating smaller focus points in the library helps to build sub-communities that can aggregate into a larger community. • Sub-audience groups will actively identify needs and set priorities for those needs. • An Earth system education framework can help illustrate connections among sub-communities and build the expertise to enhance the library’s quality and comprehensiveness. 	<ul style="list-style-type: none"> • Identify needs of and incentives for different sub-audiences to develop, submit and review resources and collections that meet their needs. • Provide leadership and support structures for sub-audiences to create and maintain collections for their needs. • Evaluate to what degree different audiences may need information presented to them differently. 	<p>Meets the needs of broad community by nurturing sub-audiences, accession resources and collections for those sub-audiences, and providing coherent links among distinct sub-audiences. In doing so, DLESE as a whole is greater than the sum of its parts.</p>
<p>Mechanisms for quickly identifying, reporting and resolving problems in DLESE resources are not clear to the community. This impacts quality by:</p> <ul style="list-style-type: none"> • Limiting feedback, and slowing response to problems. 	<ul style="list-style-type: none"> • Current exploration on a feedback mechanism by the Management Council. • <u>Support@DLESE.org</u> and <u>catalog@dlese.org</u> are often used to report problems, request help by users and collection builders 	<p>Clearly articulated policies and procedures that result in quick response by authorized entities will promote confidence in the integrity of the library and the value of being a community member.</p>	<ul style="list-style-type: none"> • Formalize decision-making mechanisms and lines of authority for efficient operation of Core Services and committees and make them transparent to the community. • Formalize mechanisms to effectively partner with and respond to the needs of other DLESE and NSDL-funded projects. • Communicate priorities of the Steering Committee and Core Services in ways that allow the community to participate more fully. • Establish mechanisms for gathering, considering and acting upon community input. 	<p>Has a high degree of responsiveness in light of changing demands and opportunities.</p>