

National Science Digital Library Pathways: One Library, Many Portals



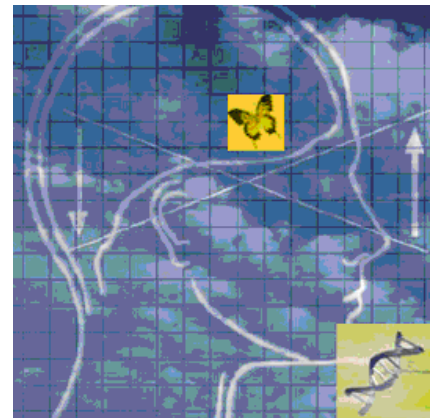
<http://nsdl.org>

The National Science Digital Library (NSDL) was established by the National Science Foundation to provide exemplary online resources for science, technology, engineering, and mathematics (STEM) education and research. NSDL provides an organized point of access to collections and services from resource contributors representing the best of public and private institutions including universities, museums, commercial publishers, government agencies, and professional societies. NSDL supports teaching and learning at all levels, from preschool to adult, with materials ranging from journal articles and lesson plans to interactive animations, and from real-time data and technology-based tools to blogging services.

NSDL features Pathways portals that address a range of audience needs

NSDL Pathways portals are...

- Educational level and discipline-specific views of NSDL
- Built by leading organizations trusted by their target audiences
- Provide resources, tools, services, and professional development
- A method for professional organizations to engage and serve their membership communities
- Serve as stewards of content and services for their specific audiences
- Demonstrate the value of NSDL in a variety of educational settings



NSDL Pathways represent the participation of over 90 national organizations, institutions, and societies

To learn more about NSDL Pathways visit: <http://nsdl.org/partners/?pager=pathways>



NSDL Pathways



ChemEdDL: Chemistry

High School to Graduate

Led by the American Chemical Society (ACS) and the Journal of Chemical Education (JCE) (<http://jchemed.chem.wisc.edu/>)



ComPADRE: Physics & Astronomy

High School to Graduate

Led by the American Association of Physics Teachers

<http://compadre.org>



NSDL Engineering Pathway

K-12 to Graduate

Led by UC Berkeley, University of Colorado
<http://engineeringpathway.org/ep>

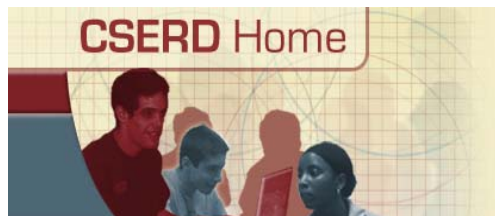


BiosciEdNet (BEN): Biological Science

High School to Graduate

Led by the American Association for the Advancement of Science

<http://www.bioscienet.org>



CSERD: Computational Science

K-12 to Graduate

Led by Shodor

<http://www.shodor.org/refdesk>



Science and Math Informal Learning Educators (SMILE) Pathway

Led by the University of California at Berkeley's Lawrence Hall of Science, with the Exploratorium, the New York Hall of Science, Science Museum of Minnesota, Children's Museum of Houston, and the Association of Science and Technology Centers. A new portal for SMILE is anticipated to be available in late fall 2008.

teachers'domain[®] Multimedia Resources for the Classroom and Professional Development



Teachers' Domain:

Life, Earth, Space, & Physical Science

K-12

Led by WGBH

<http://teachersdomain.org>



MatDL: Materials Science

Undergraduate to Graduate

Led by Kent State University

<http://matdl.org>



MathDL: Mathematics

Undergraduate

Led by the Mathematical Association of America

<http://mathdl.maa.org/>



AMSER: Applied Math & Science

Community Colleges

Led by Internet Scout Project, University of Wisconsin

<http://amser.org>

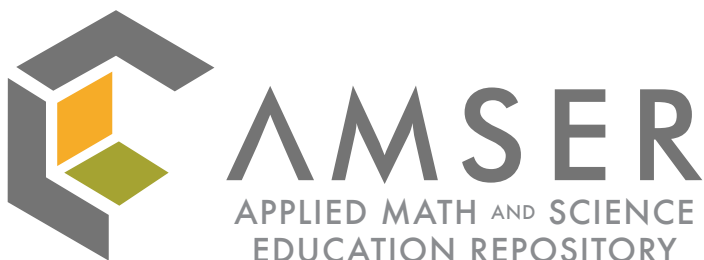


MSP Portal 2.0: Math & Science Pathways

Middle School

Led by the Digital Library Projects at Ohio State University

<http://msteacher.org>



2008 HIGHLIGHTS
<http://amser.org>

In 2008 AMSER expanded its user base through community building and outreach efforts, added resources from a diverse set of collections and projects, and expanded the project's scope of impact through collaborative partnerships and relationship building. In addition to ongoing collaborations with other members of the NSDL community, AMSER continued to focus on building and strengthening partnerships with community and technical college faculty, librarians, and staff, as well as affiliated projects and associations. Significant headway was made on the new **AMSER Key Concepts** vocabulary with feedback and assistance from community and technical college faculty having expertise in a wide range of fields of study. The new vocabulary is now being actively used in AMSER, and users can browse educational resources on the AMSER site by the key science and math concepts they illustrate.



In addition to the AMSER Key Concepts vocabulary, other new efforts in the past year included interface and feature changes and upgrades based on evaluation efforts and user feedback. As a result of user feedback a range of improvements were made to the AMSER portal interface and some of the key features and services. **Featured Folders** (shown above at right) are one of the new components introduced in 2008. These topical folders highlight an array of resources that address a specific area of applied math or science and can be used in a range of classroom and educational settings.

Another exciting new effort begun in the past year was the development of **ATE Central**. This project leverages off the work done by the AMSER team with the ATERC Network. ATERC was formed by eleven of the **Advanced Technological Education (ATE) Resource Centers** who recognized the advantages of coming together to increase their effectiveness and maximize their impact. The ATERC partners eventually decided that it would benefit ATE projects and centers to have a single online point of entry that would highlight the strengths of the ATE program and bring all electronic resources together in a searchable, browseable environment. A group decision was made to integrate this effort into AMSER in fall 2007. The result of this is ATE Central (<http://atecentral.net>), a project funded in 2008, which not only brings together valuable ATE resources but will help foster best practices between projects and centers and connect the ATE center and project participants and their deliverables to the NSDL.



Outreach continued as a major focus and many of these activities and venues afforded opportunities to gather feedback from a diverse range of community and technical college users and to recruit users to provide content expertise as well as strengthen and build partnerships with institutions and individuals. Staff conducted forums and presentations at a variety of conferences and meetings in 2008.

Innovations 2008	March 2-5	Distance Learning	August 5-8
AACC	April 5-8	CCLI	August 13-15
NISOD	May 25-28	CIT / League	October 19-22
MathFest 2008	Jul 31 - Aug 2	ATE Annual	October 28-30



I. Objectives & Activities of the NSDL Biological Sciences Pathways - <http://biosciednet.org>

The BiosciEdNet (BEN) Collaborative is working with the NSDL Core Team and other Pathways to expand its stewardship role for biological sciences professional societies and coalitions that provide resources, tools, and professional development for educators in higher education institutions, including community colleges, and middle and high school STEM teachers.

BEN serves as a catalyst for professional societies or coalitions that seek to foster a change in biological sciences teaching in higher education institutions, including changes in pedagogy and assessment, and fostering multidisciplinary biological sciences teaching. The BEN Collaborative includes 26 biological sciences professional societies or organizations that receive services and resources as part of the NSDL BEN Pathways. The grant provides:

- Mentoring and professional development for organizations who want to build digital libraries or contribute resources to the digital library of another collaborator.
- Tools and technical assistance for digital library builders and catalogers.

Other activities supported by the BEN Pathways grant include:

- Maintenance of the BEN portal, including metadata management and review, search and browse functions, harvesting capabilities, and portal redesign.
- The BEN Scholars Program. The program is a 2 year professional development program for biological sciences faculty to help them better understand how to promote (a) the use of digital library resources and (b) student-centered teaching and learning methods in higher education, specifically in biological sciences lecture and laboratory courses, and in research training programs. Professional development includes face-to-face training and online assignments. Scholars are expected to conduct outreach activities on their campus with departments, locally throughout the region, and nationally through professional societies.

During Year 3 of the NSDL BEN Pathways grant:

- Twenty (20) new BEN Scholars were selected and the Scholars institute was held in July 2008. This brings the total number of BEN Scholars to 41 faculty members. For more information about the programs and bios of Scholars see <http://www.biosciednet.org/portal/about/benScholars.php?nav=main>
- Isovera, the BEN technical service provider:
 - Restructured the project documents page in the BEN portal to be more intuitive to the users and re-implemented to make it wiki driven in order to make it more dynamic. http://www.biosciednet.org/wiki/doku.php?id=ben_technical_faq
 - Released Isovera DL 2.1 which includes features such as support for checkboxes, multi-select dropdowns, author management, record cloning and released Dewey 2.0 with the Peer Review System.

II. Accomplishments of the NSDL Biological Sciences Pathway

A. BEN Portal Data

As of September 2008, the BEN portal included 11,326 peer-reviewed resources covering 77 biological sciences topics. Compared to the 3,676 records in April 2005, this represents an increase of 7,650 new peer-reviewed records. These resources are cataloged by the BEN Collaborators.

Google analytics data indicates that from February 12 to September 5, 2008 the BEN portal had 40,847 visits; 33,851 unique visitors; and 99,283 page views.

The number of registered users for BEN increased from 5,585 (October 2005) to 10,099 (September 2008) or by 4,514 new registered users. Over 92% of the registered users are educators and of this 58.3% are college and university educators and 22.4% are middle or high school educators.

B. Data from Nine BEN Collaborators

While we do not yet have data from the 26 BEN collaborators, data from nine of the collaborators indicate that the BEN teaching resources are being viewed by a large number of educators. Based on data provided by nine BEN collaborators, the estimated number of:

- Unique visitors to the BEN portal or to digital libraries of BEN collaborators is 4,476,168.
- Registered users for the nine BEN collaborators is 167,291.
- Page Views for the nine BEN collaborators is 34,687,661.

C. Follow up on 2006-07 BEN Scholars

Of the 21 2006-07 BEN Scholars, 16 or 76% developed and submitted a teaching resource to a digital library. Eleven (11) of the 16 or 68.8% of the submissions were accepted for online publishing. All Scholars conducted outreach activities in their departments or on campus and in regional and national meetings. In addition to the usual scientific society meetings, Scholars presented at:

- System wide meetings of Texas Community Colleges
- A Gordon Research Conference
- A PKAL meeting
- Carnegie Academy for the Scholarship of Teaching & Learning
- Higher Education & Learning Conference in Nebraska
- Library speaker series at Bradley, IL
- NC Academy of Sciences Annual Meeting.

D. Reports from nine BEN Collaborators indicate that they conducted 69 outreach events, including presentations, exhibits, and workshops. In addition the 2006-2007 BEN Scholars conducted at least 40 outreach activities.

E. *Science* and *Science's Signaling* (formerly STKE) Teaching and Evaluation Articles

Two related articles were published about how faculty use *Science's* Signaling resources in a graduate course on signaling transduction. The two related articles were published in *Science* magazine and on *Science's* Signaling site. The *Science* Signaling article describes the teaching resource. The abstract for this article is presented below.

The Teaching Resource describes how to use an online asynchronous discussion as a mechanism to introduce students to the peer-review process, as well as to assess student performance and understanding. This method was applied to a graduate course on signal transduction and the Teaching Resource includes a syllabus, detailed plan for incorporating the online discussion, sample journal club questions, and sample student responses to the discussion forum, faculty responses, and student revisions.

<http://stke.sciencemag.org/cgi/content/abstract/1/9/tr2>

The *Science* magazine article focused on the evaluation of the course. Excerpts from the article indicate the course helped graduate students develop critical thinking skills.

A valuable outcome of this integrative project was the ability to document and assess how students integrated breadth of knowledge with depth of reasoning. This was achieved by comparing the original and revised answers, as well as the references used in both answers. The commentaries on answers from their peers were also very useful in assessing the student's integrated learning capability. All of the faculty observed a difference between the classroom discussion, where students mostly did not challenge each others' comments, and the written Web postings where students were respectful but often quite critical of answers from their peers. Anonymity of the Web format and the time provided to think about the Web postings appear to contribute to this critical feedback between peers. We had a nearly even distribution of male and female students in a class of 25, but the female students on average made fewer unsolicited comments in class ($P = 0.03$; see graph, left).

We observed only a weak correlation between the number of unsolicited comments made by a student in classroom discussion and the student's grade on the assignment ($R^2 = 0.15$; see SOM). These data gathered over the four discussion forums support our original concern that some of the top students do not speak up in class. The gender divide in voluntary journal club participation in an advanced course is disconcerting and merits further study.

We also examined the students' evaluations of the course, assessed using the school's standard survey instrument. We compared the overall course rating, exam format, and effectiveness of readings for this course to ratings for two other courses with similar formats except for the lack of asynchronous interactions. The cell signaling course ranked better in all three categories [table S1 (16)]. This integration project has appeared to work well both from the teachers' and students' perspectives and has struck a practical balance between student-teacher and student-student interactions. In the future, we feel a comparison between instructor critiques and peer critiques would be useful. <http://stke.sciencemag.org/cgi/content/full/sci:319/5867/1189>



ChemEd DL Pathway Report

Progress of the Chemical Education Digital Library has been excellent to date.

Major Research and Education Activities

Technical Developments. In year two we extended the services offered by ChemEd DL to include ChemEd Courses and ChemEd Collaborative. ChemEd Courses is an implementation of the Moodle (moodle.org) open-source learning management system. ChemEd Collaborative is an implementation of the MediaWiki wiki software. Both services have been augmented for use by chemists by adding support for Jmol (jmol.org) for molecular model viewing, math equations (MathML, MathType, TeX conversion), and QuickTime streaming video clips. Our entire video collection is on a QuickTime streaming server.

ChemEd DL Portal. A revised portal design for ChemEd DL was unveiled. The new design emphasizes three collections: What's This?, Periodic Table Live!, and Models 360. We are working on new features that include a news ticker with associated Chemistry In the News collection and ChemEd DL news.

Metadata Repository. We currently use the latest version of CWIS and are continuing to work on the ability to ingest large bodies of works into our existing CWIS metadata catalog, because we have about 50,000 journal articles, about 2500 videos, and more than 10,000 color images in the collection.

Textbook Tables of Contents (TToC) is our browsing system in which metadata link chapter and section headings from the tables of contents of standard textbooks with online resources in the ChemEd DL. Three textbooks have been added to TToC.

Chemistry Comes Alive! is our award-winning collection of more than 6000 multimedia Web pages, more than 2000 chemistry videos, and more than 10,000 color images. Keywords have been assigned to all videos and images. Based on a systematic analysis a data base has been created to house all CCA! metadata, and prototype tools and Web sites have been used to test the metadata. Sample videos are available at part of the NSDL iTunes U Beyond Campus collection and the *JCE* Web site: <http://www.jce.divched.org/JCESoft/CCA/pirelli/>.

Collections. We have added several new collections into ChemEd DL: *JCE* Web Software (<http://www.jce.divched.org/JCESoft/jcesoftSubscriber.html>); Chemical Education Resource Shelf, a listing of textbooks and media; Netorials, a series of online tutorials on general chemistry topics (<http://www.jce.divched.org/JCEWWW/Features/CERS/index.html>); Periodic Table Live! (which has been made available free of charge now that all of its videos are in streaming format); and Today's Science for Tomorrow's scientists, a series of Web sites that describe active research groups in terms understandable to middle school and high school students (<http://www.chemeddl.org/collections/TSTS/>). Several members of the Madison group are linking articles from the *JCE* and other digital assets to build larger learning objects in general chemistry and organic chemistry.

In year two, we continue to maintain and expand **current collections** of *JCE* Digital Library. A new section on inorganic chemistry, curated by John Berry, has been added to the *JCE* LrnCom collection. We have prepared these collections and they are now included in ChemEd DL: *JCE* ChemInfo; *JCE* DigiDemos; *JCE* Featured Molecules; *JCE* LivTexts; *JCE* LrnCom; *JCE* Qbank; *JCE* SymMath; and *JCE* WebWare (<http://www.jce.divched.org/JCEDLib/index.html>).

Major Findings Resulting from These Activities

In year two, we have proven the concepts for content and metadata developed in year one. We have implemented the ChemEd DL Web portal and set up a system to publicize it. We have discovered that the granularity of metadata we had developed earlier is not sufficiently fine to support the Textbook Table of Contents approach to browsing and we have initiated steps to deepen our metadata. We are also finding that metadata developed for one kind of resource needs to be expanded to include other types of resources.

Outreach, Collaborations, and Communities

Outreach/Publicity. The ChemEd DL project has developed many avenues for outreach and publicity, both for its own Web Portal and for the NSDL as a whole. We have presented ChemEd DL at workshops, exposition booths, and online courses and workshops. We have also trained others to present ChemEd DL and they have carried out separate workshops. To date there have been 12 face-to-face workshops or booths and four online outreach efforts. The total number of participants has been 1366, with about 500 face-to-face and about 860 online.

The ChemEd DL staff have also presented seminars describing the project and created publicity for publication in the *Journal of Chemical Education*. There have been 12 presentations at seminars and national meetings. There have been 12 publicity blurbs that have appeared in the *Journal of Chemical Education* since the ChemEd DL Portal became available on the Web. We have also made regular contributions to the NSDL Whiteboard Report.

Collaborations. We have collaborated with CI to provide videos in iTunes U, worked with the Metadata Working Group to develop restricted vocabularies in several areas, participated with Robert Payo on outreach through booths at meetings and NSTA Web Seminars, and helped develop a connection between CI and ChemEd DL with the Georgia Department of Education through its online GALILEO project.

We are collaborating with Robert Belford, who has just been funded by the NSF NSDL program to develop and incorporate into the ChemEd DL a WikiHyperGlossary (WHG). The WHG will allow glossaries to be created by ChemEd DL communities and turned into links that bring up the definition or other information. For example, by using the names of the chemical elements as glossary entries, the WHG will be able to automatically annotate a document so that each time an element is mentioned a link is provided to the information about that element in the Periodic Table Live!. We see the WHG as another tool on the same order of utility as our Textbook Table of Contents browsing tool.

Communities. Our plans to develop three new communities each year are proceeding nicely. We currently have initiated and are developing communities in these areas and they can communicate using the wiki and other tools in our ChemEd DL Online Services area.

High School Community. Developing high school chemistry clubs. More than 100 clubs to date.

Physical Chemistry Community. Has created a physical chemistry QBank collection with more than 800 questions to support the online textbook Quantum States of Atoms and Molecules.

A Testing and Assessment Community has been built around the ACS Division of Chemical Education (DivCHED) Examinations Institute.

General Chemistry Community now includes two general chemistry textbooks/courses and will soon include two more. We are building onto one of the books online learning modules for general chemistry. We have also translated a significant number of general chemistry resources into Spanish.

Dissemination Community. In collaboration with the ACS DivCHED Committee on Computers in Chemical Education we are archiving complete transcripts from online conferences held during the past decade. To publicize the ChemEd DL and NSDL we held an online conference in spring 2008.

Inorganic Chemistry Community. This group has support from NSF CCLI, has participated in the online conference described above, and participated in the NSDL/ChemEd DL workshop at the 20th Biennial Conference on Chemical Education, July 27, 2008.

Chemical Information Community. The Chemical Information Division of the ACS wants to create a permanent repository for an online collection of materials about chemical information using ChemEd DL.

Organic Laboratory Teaching and Learning Community. We have supported an NSF CCLI proposal by Brent Friesen and the OChemOnline Leadership Council to create a wiki-based Web site that will be hosted by the ChemEd DL. Even if their proposal is not funded we expect that this community will develop and grow under the ChemEd DL umbrella.



What's New in ComPADRE - 2008

The ComPADRE Pathway supports communities of instructors and students in physics and astronomy through organized content and web-based tools. The community-focused collections in the Pathway are designed and managed by editors and their advisors knowledgeable about the needs of the targeted users, whether these are needs for curricular resources, simulations, assessments, research results, or communication tools. Professional societies direct and promote the collections and resource authors collaborate in populating the resource catalog.

Launching New ComPADRE Collections:



The Open Source Physics collection (<http://www.compadre.org/osp/>) provides an online resource library for the NSF-Sponsored Open Source Physics Project. This collaboration is making available simulations, curriculum resources, modeling environments, and other computational physics tools.



The Physics Source (<http://www.physicssource.org>) supports instructors of introductory physics courses. The editors are working to connect related resources and to encourage the use of research-based content.



Advanced Labs (<http://advlabs.aapt.org>) is an online exchange for those responsible for the advanced laboratory experience for physics majors. Sharing of manuals, lab techniques, equipment, and software is the goal.

uCOMP uCOMP (<http://www.ucomp.org>) supports the incorporation of computational physics into the physics curriculum. Resources for both standard topics courses and computational methods classes are being collected and described.



The Physics Classroom (<http://www.physicsclassroom.org>) is a widely used web site of tutorials and media resources for high school physics. ComPADRE is hosting this material because, otherwise, it may become unavailable to most instructors and students. The author is collaborating to update and expand the existing materials.

Highlights from the Existing ComPADRE Collections:



Physical Sciences Resource Center (<http://psrc.aapt.org>), the ComPADRE comprehensive resource database, has a new interface with better browsing capabilities and more graphics to attract users.





Physics Front (<http://www.thephysicsfront.org/>), for high school and middle school teachers, has become the most-used ComPADRE community collection with both the number of direct access users and the number of users linking from educational databases growing larger than search engine traffic.



The Nucleus (<http://www.the-nucleus.org>) is employing undergraduate physics and astronomy majors to increase the content, extend the undergraduate research database, improve communications, and help expand the collection.



Physics-to-Go (<http://www.compadre.org/informal>) has become a bi-monthly online magazine of physics and astronomy for the public with topical features and interactive elements.



PER Central (<http://www.compadre.org/per>) has become a major community portal for physics education researchers, hosting reviews in PER and the annual Physics Education Research Conference.

Outreach:

ComPADRE editors and staff are spreading the word about the ComPADRE collections and promoting the use of these teaching and learning resources. The sponsoring professional societies play a key role in these efforts through communications with their members.

- GIREP 2008 – A keynote speech at this high-profile international physics education conference stressed the importance of coordinated online dissemination of educational resources. Digital libraries and reviews of multimedia resources were stressed in this talk.
- National Physics Meetings – Workshops, presentations, posters, and exhibits on ComPADRE are regular events at national physics teacher's meetings. These stress both the use of the library and the participation of resource authors.
- Local Physics Organizations – ComPADRE editors are often on the road presenting at local physics teachers meetings. This service promotes the library and helps those unable to attend national meetings learn of innovations in physics teaching.
- New Faculty Workshops – Information on ComPADRE is presented at the bi-annual New Faculty Workshops, NSF-sponsored events that reach a majority of new college and university faculty in physics and astronomy.
- NSDL Events – ComPADRE has joined with the NSDL for several outreach efforts, including NSTA and CCLI meetings, a workshop for Native American tribal librarians, and conference presentations in collaboration with other pathways projects.
- Newsletters and Lists – ComPADRE takes advantage of well-established physics and astronomy newsletters and email lists to spread the news about the collections, tools, and the NSDL.



CSERD - Computational Science Education Reference Desk
Shodor and our partners in CSERD are *transforming learning through computational thinking*. CSERD continues to enhance its technology infrastructure and expand its partnerships, recruit reviewers and editors as well as improve the user experience.

Awards and Accomplishments:

Shodor received a statewide partnership award. On April 19, 2008, The North Carolina Science, Math, and Technology Education Center (NCSMT) recognized Shodor as a statewide leader in innovative partnerships. Shodor's **Pathways to Cyberinfrastructure** program (CI-TEAM), brings computational science activities into existing afterschool programs at community centers such as the Emily K Center in Durham. The '**Partnership Award in Science, Mathematics, and Technology Education**' recognizes and honors North Carolina organizations that have an innovative partnership supporting science, mathematics, and technology education.

David Joiner was named the **Kenneth L. Estebrook Professor of Science, Technology, and Mathematics Education** at Kean University, for his work in promoting computational science on campus and for his work with CSERD.

One of Shodor's interns, Kelley Katzenmeyer, won the "**Voices of the South**" contest with her video about Shodor's internship program in which she learned the skills of being a next generation digital librarian. Kelley's video can be viewed at: <http://www.youtube.com/watch?v=NIoBG1Af2Vc>

Bob Panoff was honored by a computational science award given in his name at the **Education Program of Supercomputing 07**, an international conference for high performance computing held in Reno, Nevada. This was the first year for the **Dr. Robert M. Panoff Student Award for Explorations in Science Through Computation**, an honor to promote student exploration of science through computation.

Shodor and CSERD released a new set of tools to help teachers and students use a more dynamic approach to assess student achievement in math skills. The **Interactivate Assessment Toolkit** includes more than 50 Explorers, Games, and Quizzes that allow students to tailor their assessment activity by selecting a problem type, level of difficulty, and allowed time for solution. These assessment tools also keep score, so students will be able to track their progress as they improve their computation skills and basic understanding of math concepts.

Shodor's *Interactivate* was featured in **The Tech Savvy Educator**. The article highlighted the interactive applet *Pattern Generator* for Early Elementary educators. Because the patterns are virtual, and not paper and crayon or plastic blocks, it is much easier to quickly reset the board to start again or switch from one pattern type to another.

We are creating two new portals, **Computational Biology Portal** and **High Performance Computing University (HPCU) Portal**, as pilot projects to see whether providing custom search features, selected resources, and related information to specific audiences would help them make the best use of CSERD.

Shodor's web traffic for CSERD has grown to more than 105,000 pages viewed by more than 35,000 unique visitors per day in Spring 2008. Monthly totals consistently exceed 3 million page views and 100,000 visitors.

Outreach:

Shodor, with funding from the National Science Foundation, partnered with the Mountain Area Health Education Center (MAHEC) to offer training to 4th-8th grade math and science teachers in western North Carolina. The two-day workshop will be held at MAHEC in Asheville, NC on October 14-15, 2008. The goal of the workshop is to engage teachers in the power of computational science to explore the capabilities of web-based tools for problem-solving by becoming familiar with the many aspects of NSDL and the use of technology both in and outside the classroom.

CSERD outreach has engaged many educators (middle and high school teachers, and undergraduate faculty) locally and nationally. We have proactively sought to present CSERD and NSDL to a number of education and scientific audiences at most of the major meetings for NSF, including ITEST, CCLI, MSPs, ATE, and the HRD JAM.

A keynote address, "*Internet and Honesty. Found on the Web: But How Do You Know If It Is 'Right'?*" was given on Mar. 18, 2008 by Dr. Robert M. Panoff, founder and director of Shodor, as part of the UNIV 2008 Forum in Rome. The event focused on opening a new interdisciplinary debate on communication with nearly 4500 participating students from 200 universities.

Dr. Jeff Krause, a computational biologist and educator at Shodor, presented **Computational Biology for NSDL/NSTA Web Seminars**. Krause featured content and resources from CSERD and NSDL for teachers of grades 6-12. Participants learned about computational science and explored a variety of fun, interactive, and easy-to-use models through examples in math and science content.

Shodor hosted the Science Communicators of NC Meeting (SCONC) on January 17, 2008. During the meeting, Robert Panoff led the group through explorations in NSDL and Shodor's programs for local students. A world-class education requires world-class resources, and all science and math educators should be able to bring interactive modeling environments to their own teaching practice. Shodor provided a hands-on exploration of modeling tools from NSDL Pathway projects.

Shodor is working with the **SCO8 Education Program** to offer workshops. Participants will take part in hands-on activities to engage them in applying computational science, grid computing and high performance computing resources in education. The SCO8 Program will occur November 15-21, 2008 in Austin, Texas. Workshops are open to undergraduate faculty, undergraduate and graduate students, and high school teachers.

Bob Panoff presented NSDL Resources to Support Critical Thinking at the Critical Thinking Through Technology workshop at Elizabeth City State University (ECSU) on May 20, 2008. The workshop was part of the Minority Science and Education Improvement Program (MSEIP) sponsored by the U.S. Department of Education. During the workshop several NSDL Pathways were explored in a hands-on, day-long session that looked at physics, chemistry, and biology resources, along with the interactive models and tools from CSERD.

Shodor had **25 interns and 53 apprentices** during the summer of 2008, with some aspect of each student's work benefiting CSERD. This included performing the VV&A process on many applications, tools, applets, curriculum materials, etc.

Technical Developments

The goals of the CSERD project remain to provide access to the highest quality educational materials to

- extend the current collection in CSERD,
- increase the scope of the materials and the depth of the description of the materials,
- provide materials in a format compatible with the NSDL and other digital libraries while exploring innovative design of browsing and search environments,
- allow users to annotate and review materials and to include those annotations in the metadata record for the materials,
- archive materials where rights can be obtained,
- and to promote creation of educational materials and the metadata records for those materials by working with ongoing materials development efforts in CCLI, TeraGrid, and now the petascale computing arena.

During Year 4, we focused on the use of CSERD in the community and the improvement of its user interface and resources as well as its development tools. We also focused on the development of new portals, such as Computational Biology and High Performance Computing University (HPCU) for CSERD.

We have worked on CSERD's user interfaces - "the look and feel" of navigating its website. Resources on the Shodor site available through NSDL (CSERD, Interactivate, etc) are now presented with a standardized look-and-feel, to make users comfortable finding and navigating through materials they need. We continue to improve and update the CSERD website interface based on user feedback and experiences.

MASTER Tools and SUCCEED Curriculum are two major collections of CSERD resources that are currently receiving complete updates of content and interface. As part of this process, we are developing a standardized lesson plan outline and creation tool to accelerate the publication of future materials for CSERD.

CCCE and CBBE Sites, CSERD curriculum resources developed in conjunction with the National Computational Science Institute, are currently being brought up-to-date.

New Tools:

CSERD has also focused on the development of new tools over the 4 years for the support and availability of more CSERD resources. CSERD has required new data and content management tools when existing tools could not be found or when such tools were not compatible with CSERD's operational design. These tools enable staff to mentor teachers, high school apprentices, and college interns who can perform many of the data management tasks without requiring them to be programmers or content experts. We have developed tools for managing content, standards alignment, textbook alignment and reviews.

SNAP 2 - a content management system specializing in computational science-related content: it lets users integrate text, images, LaTeX code, and applets (exported AgentSheets, Netlogo, or custom Java).

Review Tool - In order to capture reviews of catalog items, we created a modular review tool that allows for the solicitation, submission, and publishing of Verification, Validation, and Accreditation reviews. The tool has been cloned for other projects requiring reviews, such as the DEAF STEM Technical Terms site, and has been reviewed for use by other NSDL existing and proposed pathways.

A review syndication service (*REST/XML*) now allows other websites to incorporate published review data from CSERD. In addition, Shodor staff and interns developed a PHP module called **PageRender**. This webpage generation tool merges content from databases, web services, a user's session, and other input sources, creating a custom page targeting a particular user. Using PageRender, resources reviewed and linked in CSERD and hosted on Shodor's servers are also presented with a standardized look-and-feel, making users comfortable finding and navigating through the materials they need. A key benefit of PageRender has been to enable easier, across-the-board improvements to the website interface based on user feedback.

Partnership Building:

Over the past year, CSERD has engaged key partners to leverage its computational science resources. Collaborations such as the SCXY Conference, HPC University, the Liberal Arts Computational Science Initiative, and the ECU Resources for Teaching allow CSERD to serve a wider community of educators and students.

CSERD has a **three-year partnership with SCXY and the National Computational Science Institute (NCSI)** to allow for the review, enhancement, and creation of objects in CSERD and NSDL occurring in summer workshops and the SCXY program from 2007-2009.

Through its Pathways to CyberInfrastructure (PTC), Shodor partners with local, statewide and national organizations, community and faith-based centers to teach computational science workshops in other-than-school time (OST) environments such as after-school and summer camp programs. The PTC workshop curricula leverage materials in computational science from CSERD such as Shodor's own Interactivate, and resources found in other Pathways or NSDL collections to allow students to use context-rich computational explorations in informal settings to improve math, science and technology skills.

Shodor is partnered with the Duke Talent Identification Program (TIP), to hold a two week Computational Science Institute. The Institute introduced students to the world of computational science and the application of computer programming, communication technologies, and mathematical analysis to the study of complex scientific problems.

During 2008, Shodor added a **Computational Chemistry expert**, Victoria Crockett, to its staff for CSERD. Crockett will assist in the development of Chemistry materials and resources for CSERD as well as perform verification, validation and accreditation reviews.

Significant work has proceeded to align CSERD to working group recommendations, interact with NSDL, contribute to regular conference calls and PI meetings, and participate in a number of regional and national education meetings in which NSDL and CSERD were showcased.

Engineering Pathway 2008 Highlights

Engineering Pathway (EP), the engineering education wing of the NSDL, is excited to introduce its redesign in support of a more public-friendly engineering education message. Incorporating findings and recommendations from the recent National Academy of Engineering study, *Changing the Conversation*, as well as user evaluation and feedback, EP made many changes and additions to the design and content of our website this year.

To better engage the next generation, we revised our look and feel. Our new logo connotes movement and adventure — paths that provide opportunities to learn, connect, create, dream, design and do. The tagline messages encourage the use of EP resources to “shape the future” and “turn ideas into reality.” New images, representing numerous library resources, picture diverse people engaged in myriad engineering activities. In addition, our new Premier Curriculum Award for K-12 Engineering (entries due October 15!) solicits outstanding pre-college engineering curriculum for national recognition.

New website features and content were added as well. In response to user feedback, a prominent, expanded quick search (shown right) allows users to immediately connect with our growing collection of resources. We also added a daily events feed on engineering innovations for every day of the year, with an associated “Today in History” blog that highlights our educational resources. Our new annotated textbooks provide browse links for both students and faculty.

Engineering Pathway
Turn Ideas Into Reality - Learn. Connect. Create.

Welcome to the Engineering Pathway!

Advanced Search »
Browse Resources
K-12 Community »
Higher Education Community »
Disciplinary Communities »
Broadening Participation »
Premier Award »
Submit Resources »
My Workspace
About Us »

First Time User? Questions?
[Get Help and Answers Here!](#)

Highlighted Resources
Editor's Choice
100 Most Popular
Premier Award Winners
100 Most Commented
Usage Statistics
[Today in History](#)

Welcome!
We invite you to *Learn, Connect, and Create* with high-quality teaching and learning resources in applied science and math, engineering, computer science/information technology, and engineering technology for use by K-12 and university educators and students.

Search for Educational Resources
Grade/Audience:
Keywords:
Resource Type: [Advanced Search »](#)

Today in History
September 11, 1841, [California metal tube is patented.](#)
See related resources on [manufacturing engineering and design.](#)

EP Weblog
[Engineering Education "Today in History" Blog: the Blanchard Lane](#)

In the Spotlight
Engineering Pathway celebrates [Hispanic Heritage Month](#), beginning September 15, by highlighting the [2008 HENAAAC Hall of Fame Inductee, Dan Arvizu, Ph. D.](#) Dr. Arvizu became the eighth Director of the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory (NREL) in 2005. As head of NREL, Dr. Arvizu oversees the U.S. government's research and development of renewable energy sources such

Environmental Engineering Education Community

News and Events
[Engineering Education History Blog: Crop dusting and pesticides](#)
August 31, 2008
[Annual Water Reuse Symposium of the Water Environment Federation](#)
September 7-10, 2008
Dallas, TX, USA

Associate Editor(s): [Andrew Ramsburg](#), Tufts University
[ABET Engineering Education Accreditation Criteria](#)

2009 Premier Curriculum Award for K-12 Engineering

Blow Us Away ...WITH YOUR ENTRY

EP now offers a wider range of communities in each ABET-accredited discipline in higher education computing and engineering, with browse features over courses, interdisciplinary topics, news, events, most popular or commented resources. Each is managed by associate editors who are innovative educators in their fields. We have also added new collections of resources, including PR2OVE-IT and Broadening Participation in Computing.

To provide improved access to curricular resources for pre-college teachers, our partner K-12 engineering collection, TeachEngineering, now integrates the ASN, CAT and SAT services, so that its hundreds of K-12 engineering lessons and activities are implicitly aligned to all 50 states' K-12 science, math and technology standards — a groundbreaking accomplishment representing a collaborative NSDL community effort.

Supporting learning for broad and diverse communities, with educator and learner audiences from elementary school through lifelong learners, K-Gray Engineering Pathway is a “one stop shopping” portal of comprehensive engineering education resources within the greater NSDL.

www.engineeringpathway.org

The Engineering Pathway is the engineering “wing” of the National Science Digital Library (NSDL).





Materials Digital Library Pathway

October 2008

About

The Materials Digital Library Pathway (MatDL) assumes stewardship of significant content and services to support materials education, research, and interactions between the two. Its target audience includes materials undergraduate and graduate students, educators, and researchers.

Services

- MatDL Repository (<http://matdl.org/repository>) offers authoritative materials research and teaching resources including images, exercises, preprints, and interactive applets.
- MatDL Wiki (<http://matdl.org/matdlwiki>) is a publicly accessible, expert-community-driven site for scientific communication and dissemination with emphasis on soft matter.
- MatForge (<http://matforge.org>) is a Subversion/TRAC workspace for open access, collaborative development of materials modeling and simulation codes.
- Virtual Labs (<http://matdl.org/virtuallabs>) lessons and applets currently available on MatDL reinforce understanding of the concepts of states, energy, degeneracy, entropy, and free energy.
- MatDL Teaching Archive (<http://matdl.org/repository/community/matdl:1>) was established beginning with the Transport Phenomenon collection. Educational code modules suitable for effective use with undergraduates are being developed based on research codes hosted on MatForge, starting with FiPy, to support the integration of research and education.

Outreach

- Laura Bartolo, PI of MatDL, participated in the August 2008 NSF Course, Curriculum, and Laboratory Improvement (CCLI) PI conference in the role of both NSDL Pathway PI and CCLI-PI, co-chairing a group discussion session on using the Web to help improve student learning.
- Laura Bartolo is a co-organizer of the September 2008 NSF Materials Education Workshop.
- MatDL gave presentations at conferences offered by STEM professional societies: American Association for the Advancement of Science (AAAS); the Minerals, Metals & Materials Society (TMS); Materials Science & Technology (MS&T) and the Materials Research Society (MRS). At TMS and MRS, multiple presentations were given by several MatDL Co-PIs.

New Collaborative Efforts

- MatDL is partnering with the Minerals, Metals & Materials Society (TMS) a major, international, materials professional society. At the February 2009 TMS Annual Meeting, MatDL & TMS are: co-organizing the *Progress in Computational Materials Science and Engineering Symposium* and; holding roundtables focusing on two open source computational materials research code projects hosted on MatDL's MatForge, *FiPy* and *OpenThermo*. Participants will include the core developers, potential developers, and users as well MatDL, TMS, and Shodor.



- A recently awarded CCLI Phase 2 grant, with ChemCollective, will support development of additional virtual labs addressing recurring patterns in molecular science.
- MatDL worked with Education Directors, researchers, graduate students, and REU students at Princeton and Northwestern Materials Research Science & Engineering Centers (MRSECs) to train and support interested REU students in the use of the MatDL Wiki to support their research activities as well as communicate their research results.
- MatDL in partnership with the Journal of Materials Education (JME) has made available at <http://matdl.org/jme/> full text of some articles to appear in the print Special Issue.



Mathematical Sciences Digital Library: MathDL
The Mathematical Association of America's Pathway to NSDL

On July 14, 2008 the Mathematical Association of America (MAA) inaugurated a new Mathematical Sciences Digital Library (MathDL), which combines the old MathDL and Math Gateway sites and now serves as the MAA's pathway to mathematical resources within the National Science Digital Library (NSDL) at <http://mathdl.maa.org/mathDL>

The new site continues most of the old Math Gateway functions including daily *Math in the News* articles, *on this day* (in mathematics), and the My Library features for registered users. A search over resources held by MathDL partners (formerly Math Gateway partners) remains an important feature of the new site. In addition, with help from JSTOR, we are completing presentation within MathDL of pdf copies of award-winning articles from the three print publications of the MAA: *The American Mathematical Monthly*, *The College Mathematics Journal*, and *Mathematics Magazine*.

We have consolidated three online publications from the old MathDL, *The Journal of Online Mathematics and its Applications (JOMA)*, *Digital Classroom Resources (DCR)*, and *Convergence*, into a single new online publication, *Loci*. While this publication provides access to materials presented in the three earlier publications, *Loci* will have a single editor and a single editorial board.

MAA Reviews and *Classroom Capsules and Notes*, the two components of the old MathDL that were available only to MAA members or by subscription, are no longer formally part of MathDL. While they are still supported by the MathDL content management system, from a user's perspective they are part of the general MAA website, MAA Online. Metadata from resources in these two sites is no longer included in those held by MathDL, and the search over partner resources does not include these resources. Now all MAA materials referenced by MathDL are free to everyone.

We are seeking new partners for MathDL. Indeed, as part of their work in redesigning and implementing the content management system for the new MathDL, Math Resources Inc. of Halifax has become a MathDL partner, contributing entries from their mathematical dictionary, *The Mathematical Resource*. Other partners will be added in the next months.

We are actively pursuing both formative evaluation and outreach. A major component of the new evaluation effort will be a User Panel that will give us feedback on the design and content of the new MathDL. Our outreach effort will center on a plan to organize a cadre of supporters for MathDL, who will conduct MAA Section workshops, speak on their own and other campuses, and, in general, promote the project. This outreach effort will kick off with a workshop at the MAA's Carriage House Conference Center on October 17-19.

The new MathDL has the capability for creating a special collection within MathDL by selecting specific partner resources and supplementing the existing metadata. Work on the special collection will begin later this year.

Lang Moore
Executive Editor of MathDL
8/26/08

Middle School Portal 2.0: Math & Science Pathways

<http://msteacher.org>

The Ohio State University College of Education, the National Middle School Association, and Education Development Center, Inc. have assumed a stewardship role for middle level educators of mathematics and science, by expanding the *NSDL Middle School Portal* to support middle school educators and youth by creating the Middle School Portal 2.0. While continuing to create and offer contextualized, high-quality resources, MSP2.0 will capitalize on Web 2.0 tools to promote interactivity, collaboration, and knowledge sharing among its users and transform a passive, text-based web site into a dynamic, collaborative experience. In addition, MSP2.0 will expand its scope of influence through a new section designed for middle school aged youth and new resources related to career development, 21st century skills, and STEM and information literacy. Project partners will integrate resources, tools, and services across projects, and support multiple methods of resource discovery to meets the needs of this audience. Collaboration with these and other organizations will provide sustainability and stewardship of MSP2.0 after formal funding has ended.

MSP2.0 provides opportunities for its users to:

- Develop increased content knowledge in the areas of science, mathematics, technology, and developmentally appropriate pedagogy
- Participate in individual and collaborative professional development
- Share knowledge with a community of practitioners
- Easily locate and identify exemplary, standards-based resources
- Increase your understanding of Web 2.0 tools
- More effectively integrate technology into your existing teaching practice
- Explore math and science standards-based topics in depth
- Connect to "just-in-time" teaching ideas
- Search or browse by subject lists based on the national math and science education standards

NSDL Middle School Portal (MSP) Highlights from September 1, 2007- August 15, 2008

- 636,124 page views
- 232,965 visitors
- 12,669 site searches
- Two project blogs: [Connecting News with the National Science Standards](#) (launched September 5, 2007) and [Exemplary Resources for Middle School Math and Science](#) (launched February 28, 2008) received over 35,775 page views
- Augmented 2,419 resource records
- 18 [math](#) and 28 [science](#) Explore In Depth publications
- Built a [TappedIn](#) MSP room and have a monthly chat
- Started a NING-based [Middle School Portal social network](#)
- Started a Curriki group called [Middle School Math and Science](#)
- School districts and education organizations such as Miami Dade County Schools, FL; Kyrene School District, AZ; Trinity County, CA; MiddleWeb; Math Counts; Scholastic; Louisiana State Teachers Association; and Learn North Carolina link to *NSDL Middle School Portal* and provide significant referrals
- Much of the *NSDL Middle School Portal* content has a Google Top 5 or Top 10 page ranking
- Held a workshop and wrote and launched a MSP tutorial with National Middle School Association



SMILE PATHWAY UPDATE

October 2008

Accomplishments of the Science and Math Informal Learning Educators (SMILE) Pathway during the past year include:

KICK-OFF MEETING / PLANNING FOR THE FIRST ADVISORY MEETING

SMILE participants and collaborators met in February 2008 to discuss project goals and methods. In attendance were project staff and advisors from the Exploratorium, Lawrence Hall of Science, New York Hall of Science, Children's Museum of Houston, Science Museum of Minnesota, ASTC, and CAISE. Non-staff collaborators included two local homeschooling families (to give us insight into that subcategory of end-users), three web interface design specialists (from KQED, IDEO, Inc., and from a local independent design firm), and evaluation consultant Douglas Spencer, who facilitated the meeting. Plans have been finalized to hold the first Advisory meeting at Lawrence Hall of Science on December 5, 2008. Project advisors and key staff will be in attendance.

FRONT END SURVEYS & EVALUATION

SMILE will be the first NSDL Pathway to collect and create learning activities, tools, and services specifically for educators serving a diversity of youth in out-of-school settings. Because the design of SMILE must reflect the needs of that specific audience, we executed two front-end studies. The first was a set of 13 phone interviews to inform the design of a longer survey, as well as to serve as an initial needs assessment from key leaders and project directors at informal science institutions, afterschool programs, university-based science outreach, and scientific research institutions with educational outreach departments. The second, more in-depth study was sent to 500 ISIs to find out how they might contribute learning and teaching activities to a new digital library for informal educators, as well as to gather information from potential contributors and end users. We anticipate the results of the survey to be completed in time for the advisory board meeting at the start of Year 2.

METADATA FIELDS

The Editorial team finalized a first set of metadata fields appropriate to the audience of the SMILE pathway. The Exploratorium conferred with fellow editors across the country by email and in conference calls, consulted experts in digital archiving and database construction and management, and solicited advice from PIs of other NSDL projects. All fields will be reviewed in combination with survey results at the 1st Advisory Meeting.



TECHNOLOGY & INFRASTRUCTURE

The technology team at the Lawrence Hall of Science and Exploratorium had several key meetings to plan the architecture of SMILE. Dean Krafft and other members of the NSDL Core Integration team provided knowledge about the Fedora-based NCore platform available to SMILE. Project staff have already set up a local instance of the NSDL collection system (NCS) for preliminary testing of the new SMILE metadata schema. All core project partners except the Exploratorium plan to use the NSDL Fedora-based tools to enter metadata and aggregate collections. The Exploratorium is presently modifying its existing proprietary digital library software using MySQL middleware so that the library assets, with newly updated SMILE metadata, will be interoperable with the NSDL Data Repository (NDR). A finalized SMILE-specific NCS and a completed middleware solution at the Exploratorium are expected in Year 2.

PROJECT WEBSITE & INTERNAL PROJECT MANAGEMENT SITE

Project participants and collaborators all have access to Basecamp, a web-based project management space set up at the start of the project that allows us to archive documents and communicate internally. In addition, an informational project website is being developed and is expected to launch in Fall 2008 as www.howtosmile.org. Concurrent with web site development was the creation of a SMILE logo for all branding activities of the project.

OUTREACH

The Outreach team, composed of Science Museum of Minnesota and ASTC staff, created a work plan, decided on roles and responsibilities within the team, and identified the team's primary tasks. The primary tasks are identified as:

1. Communicating what SMILE is (to the broader SMILE group, to participating ISEs, and to potential users and contributors)
2. Creating passionate users (utilizing everything from effective web design to face-to-face workshops teaching people about SMILE)

The team has generated a host of dissemination ideas, including the creation of some quick informational videos to show at meetings and to post online (i.e., on YouTube, Instructables.com, or social networking sites), as well as exploring the use of "Web 2.0 and 3.0" tools and approaches with the aim of "seeding" the internet and creating buzz for what SMILE will soon offer.





Teachers' Domain: Pathways to Digital Media for Education
September 2008 Update

Activities and Accomplishments of the Past Year

- **Version 4 Launch:** This new infrastructure, which launched on August 29, is built in Python/Django and allows for a dynamic site run with content managed through a CMS. Multiple partners can now enter and update content and have custom hierarchies, and the site can be "skinned" for multiple editions. Current editions include K-12, College Edition, and VITAL NY for New York State educators.
- **College Edition:** Developed with the advice of other Pathways and CI and with higher ed reviewers recommended by them, this edition offers a subset of TD resources deemed appropriate for higher ed, organized by post-secondary subjects and topics and by common courses.
- **Expanded K-12 Edition:** We've continued to build out new content, through grants from Hewlett Foundation, NSF Geosciences, NSF IPY, NSF Informal Ed, and other funders. Public TV partners have also added new STEM content, including, for the first time, elementary math. WGBH and partners, through other funding, are also adding non-STEM content (English language arts, social studies, fine and performing arts), which will add to uptake of service by K-12 schools and PTV organizations, which have expressed desire for a more comprehensive service.
- **New Standards API:** We published the Standards correlation API developed under an earlier supplementary grant, and are now using that API to access ASN standards records as part of the K-12 service. We've now developed a Math lexicon and are planning to add additional state math standards over the coming year.
- **Growth in Usage:** As of early September 2008, 261,000 registered users in 58% of US K-12 schools (up from 180,000 and 46% a year ago).
- **Marketing:** We led interactive workshops for middle and high school teachers throughout the US, including events for the Bureau of Indian Education, the Presidential Awards for Excellence in Mathematics and Science Teaching, and Woods Hole Oceanographic Institute. With the addition of a new marketing coordinator in the spring, we have accelerated our marketing campaigns through regular e-newsletters, blogposts, PR Wire announcements, and outreach to media outlets.
- **Training:** TD/NSDL Workshop held in September 2008 for state and regional education service agency staff.

Plans for Coming Year:

- **New STEM content:** Funded projects to add Advanced Technology Education resources, additional open educational resources, cutting-edge science; awaiting funding responses on climate change, biotechnology, virology.
- **Adapted Professional Development Courses:** Working with BSCS to adapt existing courses, including blended (face-to-face/online) formats and less intensive survey courses for in-service teachers with less time to devote.
- **Social Media:** Research and pilot implementation of social media tools and activities, such as tagging, expanded user profile functionality, depositories for media mashups.
- **Accessibility:** Integrate metadata, user preferences, and fully accessible resource examples from current access pilot.
- **Marketing:** Expand training opportunities to include live seminars via the Internet, and utilize Web 2.0 strategies through blogs and social networks. Broaden public relations efforts through press releases, story pitching, and targeting prospective online and print publications.
- **Workshops:** Begin development of face-to-face and online TD/NSDL workshop protocols for use by PTV and other partners.
- **Archiving:** Begin work to archive video and interactive master material in a digital asset management system in formats for preservation and future-proofing.
- **Expand Partnerships:** Continue working with public media partners, including PBS and state departments of education, exploring ways to discover and add new media resources, expand user base, and provide content through metadata exchange with alternative portals where already in place.