Cyberinfrastructure: Facilitating Transformative Materials Science Research & Education

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NSF Cyberinfrastructure in Materials Science Science Workshop, 08/04/06
Outline

- **Background:**
  - NSDL program
  - NSDL MatDL Pathway

- **Government funded Materials Initiatives**

- **Contributing to:**
  - Transformative Research
  - Transformative Education
NSF, Cyberinfrastructure & Digital Libraries

NSF NSDL Program
2000

DLs & UG Earth Systems Education initiated FY99, continuing

DLI 2 Special Emphasis in UG Education FY 98-99

DLI 2 - NSF, et al., initiated in FY98, continuing

Digital Libraries Initiative (DLI 1) - NSF/NASA/ARPA, FY 94-97

NSDL Launch
Fall 2002
National Science Digital Library
NSDL

Includes a diverse set of:

- **Users** (e.g. students, scientists, professional organizations, teachers, universities, research laboratories, publishers, government agencies)
- **Digital resources** (e.g., learning objects, publications, data sets)

Offers Coordinated Access & Broad Dissemination
NSDL Pathways

- domain specific and user community views of NSDL
- Built by leading organizations trusted by target audience
- Provide resources, tools, and services
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<tr>
<th><strong>Math Gateway</strong></th>
<th>Undergraduate</th>
<th>Mathematics</th>
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<td>Mathematical Assoc of America</td>
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<td><strong>CSERD</strong></td>
<td>Undergraduate &amp; HS</td>
<td>Computational Science</td>
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<td><strong>AMSER</strong></td>
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<td>Applied Mathematics &amp; Science</td>
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<td>Life, Earth, Space, &amp; Physical Sciences</td>
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<td><strong>Materials Digital Library</strong></td>
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<td>Materials Science</td>
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<td>KSU, NIST, MIT, U-M, Purdue, ISU</td>
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<td><strong>Engineering Pathway</strong></td>
<td>Undergraduate &amp; K-12</td>
<td>Engineering</td>
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<td>UC Berkeley</td>
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NSDL MatDL Pathway:

• Provide stewardship of significant materials research output & education resources
• Facilitate connections between materials research & education
• Support broad dissemination of materials education & research
• Multiply impact of NSF initiatives
Materials Digital Library Pathway

NSF MS Initiatives
• Nanoscale Interdisciplinary Research Teams
• Materials Research Science & Engineering Centers
• International Materials Institutes

Teaching Resource Development
• MS Teaching Archive

Collaborative Code Development
• NIST FiPy
• UM

Virtual Labs
• Intro to Solid State Chemistry

NSF NSDL MatDL Pathway
Goal: Facilitate interactions between research & education
Audience: Undergraduate and above
Site available: September 2006

Supporting...
Government Funded MS Initiatives

Facilitating collaboration & dissemination

- NIRTs
  - Simulate behavior of surfactants on nanostructured surfaces

- MRSECs
  - Cornell CCMR

- IMIs
  - CoSMIC
Contributing to
Transformative Research

Facilitating
• Collaboration
• Shared instrumentation
• Dissemination

Possibilities for implementing
• Fedora (information infrastructure)
• Shibboleth (authorization & single sign on)
Contributing to Materials Research now

Example: MatForge & MSEL/NIST

- Computational modeling of materials
- Workspace on MatDL for collaborative code development
  - FiPy
- Educational opportunities

Using FiPy to model superconformal electrodeposition (superfill)
What if …
Distributed Virtual Notebooks

- common ground built upon standards (e.g. metadata) for communication and collaboration
- rapid, easy, and rich transfer of data, including annotations and comments,
  - among research groups for exchange
  - among teaching groups for classroom use
- “repository-ready” data supporting open access, reuse, and preservation of scientific information
Contributing to Transformative Education

Connecting recent research with education

- Virtual labs
- Collaborative teaching resource development
Virtual Labs

- Services and content for virtual labs in large undergraduate introductory science courses
- Alternative to traditional labs
- Beginning with MIT *Intro to Solid State Chemistry*
Collaborative Development of Teaching Resources

- Online space for collaborative development of educational materials
- Need for high-quality, relevant teaching resources using recent research.
- Problems, Resources, Readings, Pedagogy and Courseware

Encapsulated liposomes for long-term drug delivery
A Partner in Cyberinfrastructure

- NSDL
  - Information infrastructure and social network of services & tools for STEM research and education

- NSDL Pathways
  - Domain and user community specific views of NSDL

- NSDL MatDL Pathway
  - Focus on materials education & research at undergraduate level and above