Cyberinfrastructure: Facilitating Transformative Materials Science Research & Education

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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

→ **NSDL Launch**
Fall 2002

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

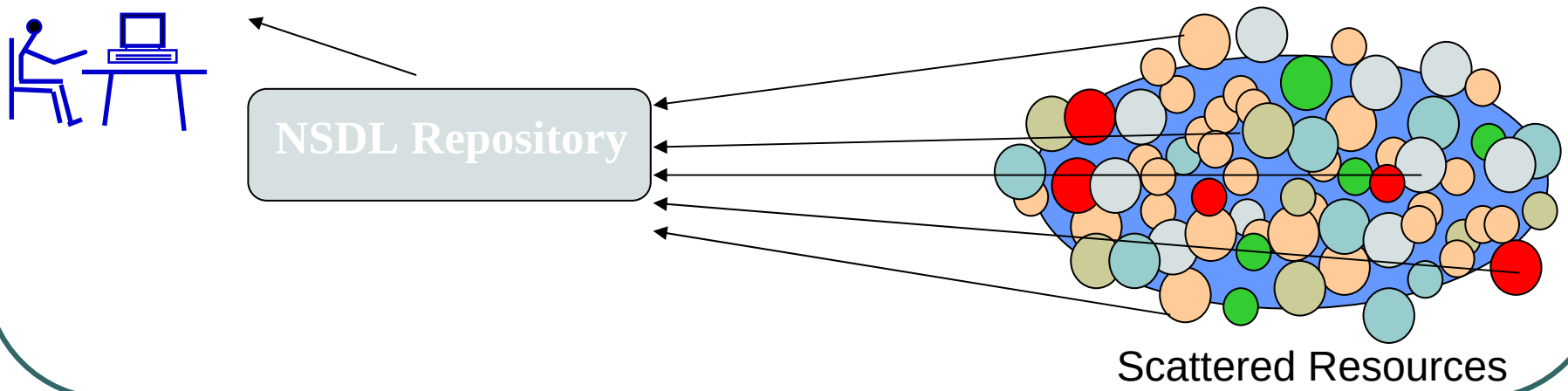
Digital Libraries Initiative (DLI 1) - NSF/NASA/ARPA, FY 94-97

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

Math Gateway Mathematical Assoc of America	Undergraduate	Mathematics
CSERD Shodor Education Foundation	Undergraduate & HS	Computational Science
AMSER Univ of Wisc, Madison	Community Colleges	Applied Mathematics & Science
Teachers' Domain WGBH Public Television	K-12	Life, Earth, Space, & Physical Sciences
Middle School Portal Eisenhower Nat'l Center	Middle Grades	Science, Mathematics, & Technology
ComPADRE AAPT, APS, AIP/SPS & AAS	Undergraduate & HS	Physics & Astronomy
BioSciEdNet (BEN) AAAS	Undergraduate & HS	Biology
Materials Digital Library KSU, NIST, MIT,U-M, Purdue, ISU	Undergraduate & Above	Materials Science
Engineering Pathway UC Berkeley	Undergraduate & K-12	Engineering

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

NSF NSDL MatDL Pathway

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

Supporting…

Virtual Labs
- Intro to Solid State Chemistry

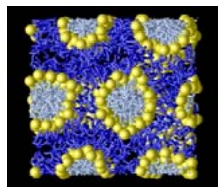
Collaborative Code Development
- NIST FiPy
- UM

NIST National Institute of Standards and Technology · KENT STATE UNIVERSITY · MIT Massachusetts Institute of Technology · UNIVERSITY OF MICHIGAN · PURDUE UNIVERSITY · IOWA STATE UNIVERSITY

Government Funded MS Initiatives

Facilitating collaboration & dissemination

- NIRTs
  - Simulate behavior of surfactants on nanostructured surfaces



- MRSECs
  - Cornell CCMR

- IMIs
  - CoSMIC

NSF-IMI COSMIC International Materials Institute

Contributing to Transformative Research

Facilitating

- Collaboration
- Shared instrumentation
- Dissemination

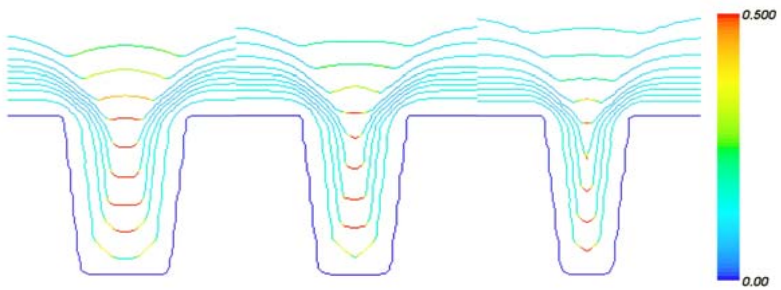
Possibilities for implementing

- 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

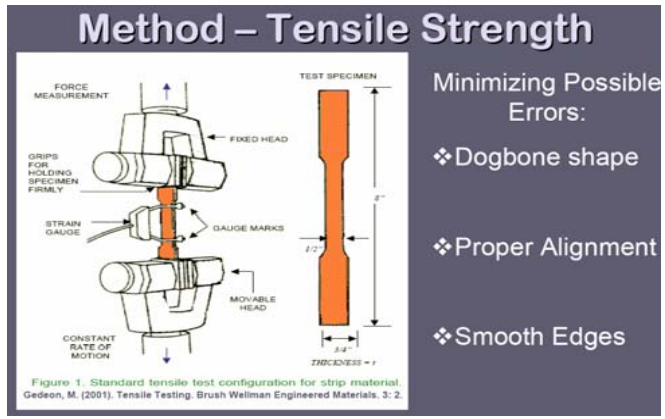
Contributing to Transformative Education

Connecting recent research with education

- Virtual labs
- Collaborative teaching resource development

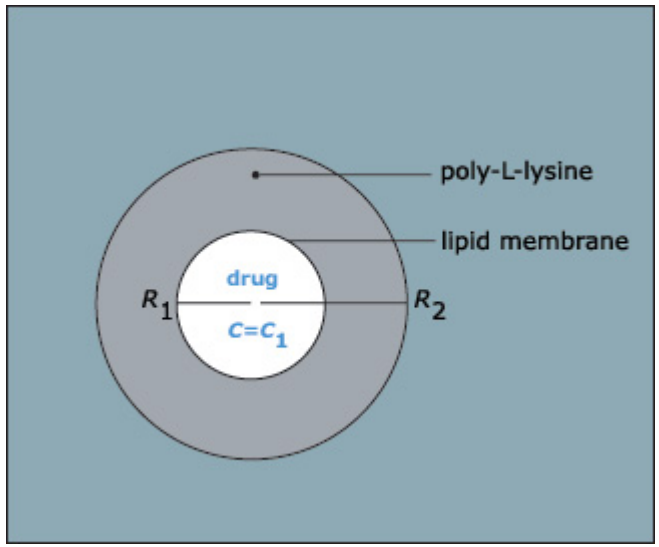
Virtual Labs

- 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