NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

A Distributed U.S. Initiative, Improving Science, Technology and Mathematics Education for All Learners

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Presentation Outline

➡️ NSDL Program & Assumptions

- Core Integration Strategy

- Progress to Date

- Upcoming NSDL Challenges

- 3 Basic (Unanswered) Questions

NSDL Program (~$20M/yr)

Funding Agency: *National Science Foundation*

- *Education and Human Resources Directorate*

Scope: *Education, for all ages and all venues, in*

- *Science, technology, engineering and mathematics*

Status: *Since 2000, ~150 awards, along 3 tracks—*

- *Collections / Services / Directed research*

Construction: *Distributed holdings & services, provided & maintained by many organizations*

- *All joined by a "Core Integration" team, comprising*
  - University Corp for Atmospheric Research
  - Cornell University
  - Columbia University

Why a Digital Library for Science Education?

- *Excellent teaching materials have been developed... but they are not being used effectively.*

- The NSDL will provide organization and access for teachers and students

    - *Finding suitable materials (searching and browsing)*

    - *Saving materials for long term (preservation and reuse)*

    - *Sharing educational experience and expertise (reviews, recommendations, and other forms of discourse)*

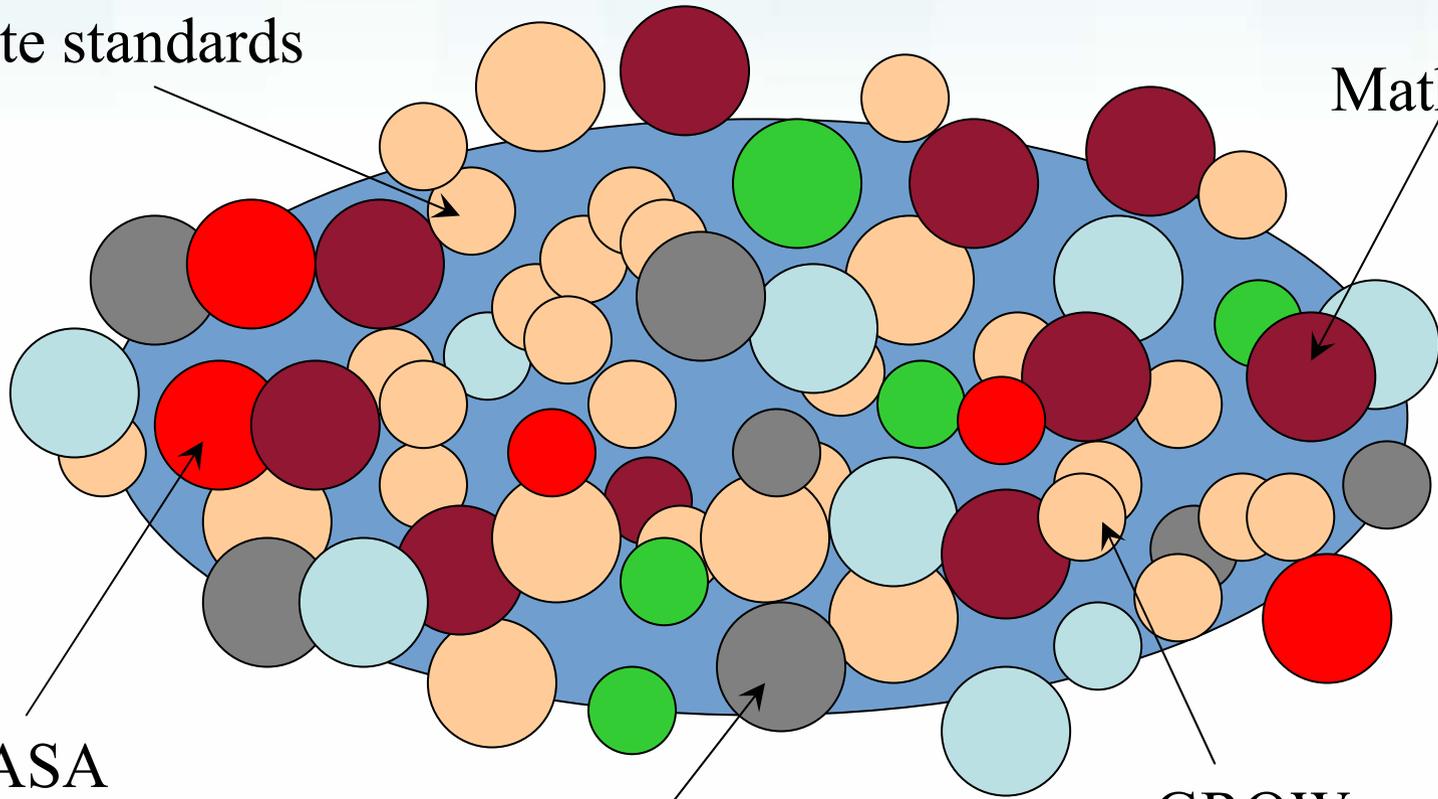# Teaching Materials Are Scattered Across the Internet

State standards

Math Forum

NASA

Scientific American

GROW

Sampled Characteristics of the NSDL Projects
from poster session at NSDL 2002 Annual Meeting

Discipline

Anatomy
Anthropology
Astronomy
Astrophysics
Biology
Chemistry
Computer Science
Earth System Science
Environmental Science
Engineering
Kinematics
Microeconomics
Mathematics
Oceanography
Physics
Technology

Data Type

Applet or Application
Article
Collection-building Tool
Course
Database
Graph
Handheld Software
Image or Animation
Learning Object
Movie or Video
Observed or Simulated Data
Ontology
Pedagogy Case Study
Review or Annotation
Strand Map
Surrogate (book, specimen...)

Learning Context

Informal
K-4
5-8
9-12
Undergraduate
Teacher Preparation
Course Development
Community of Practice
Cataloging

NSDL

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One Library, Many Portals

Different Groups of Users Need Different Views of NSDL

- *nsdl.org for general users*
- *comm.nsdl.org for library developers*
- *Middle School Portal**
- *new "Pathways" projects*
  - Other grade levels
  - Other audience delineations
  - All determined by the NSF grant-awarding process (peer reviewed proposals…)

*The middle school portal is being built by the Eisenhower National Clearinghouse at Ohio State University
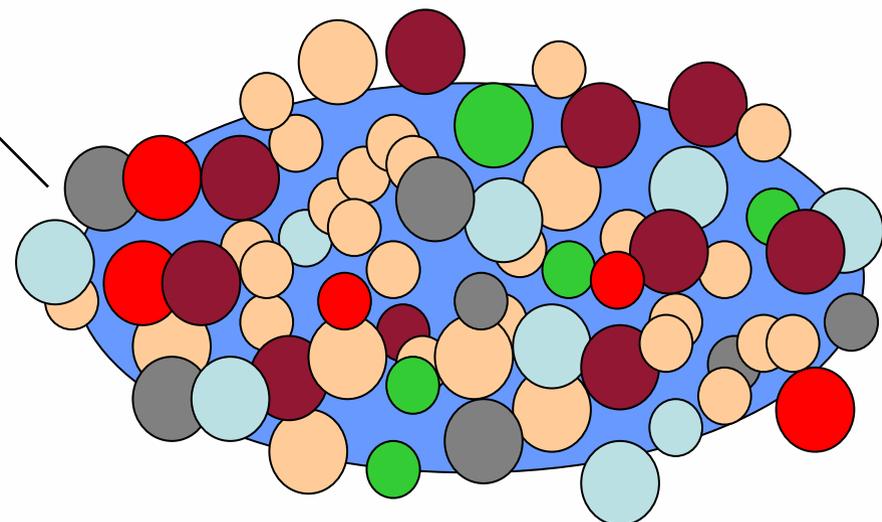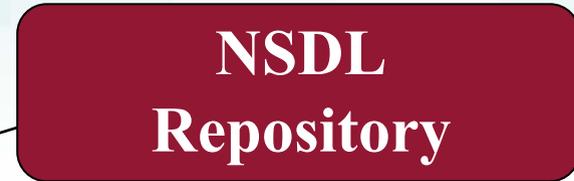
NSDL

The NSDL Repository

NSDL Repository

OAI-PMH
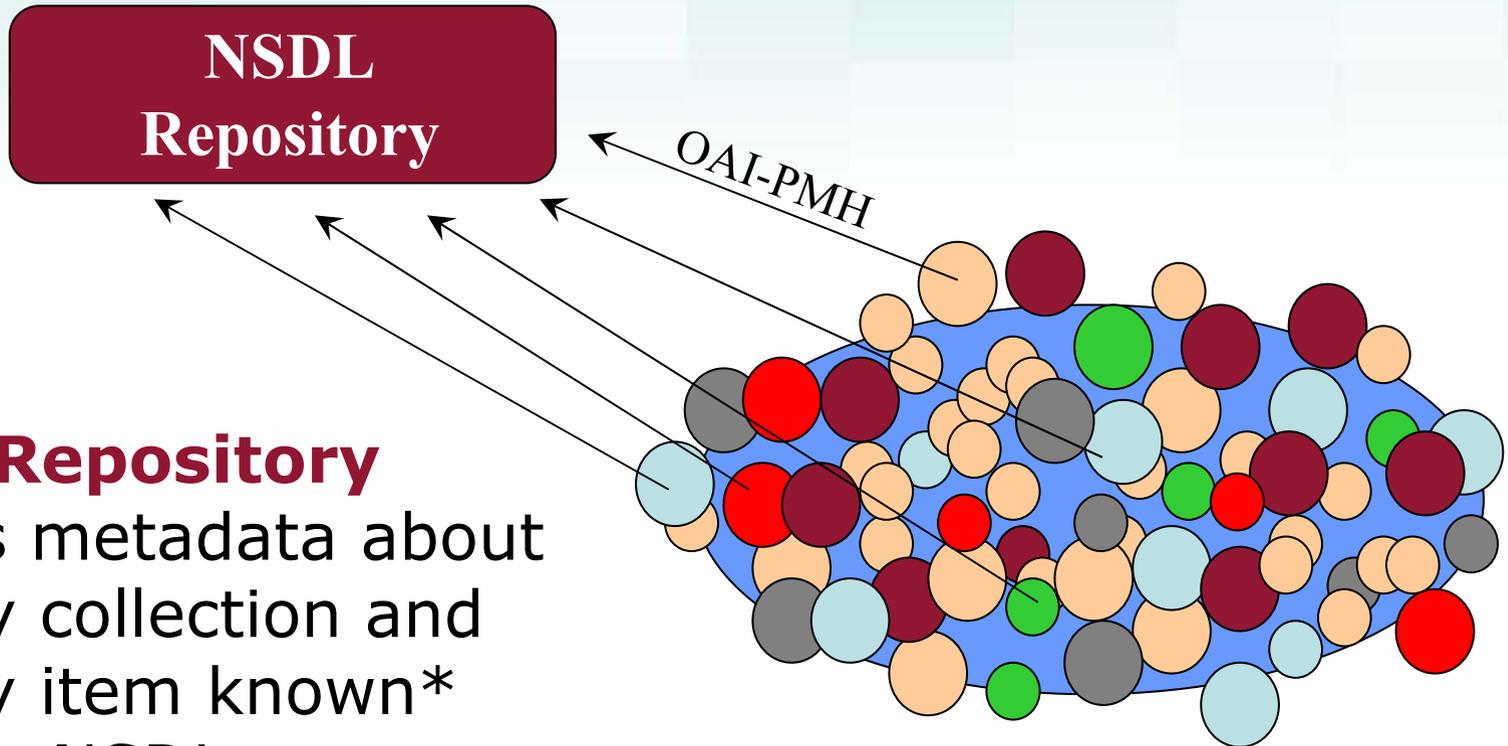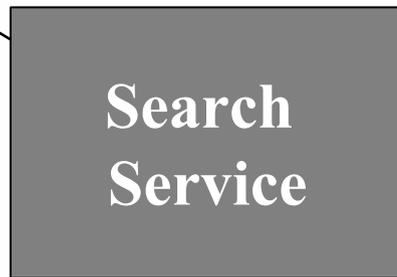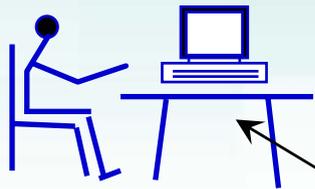
The Repository holds metadata about every collection and every item known* to the NSDL

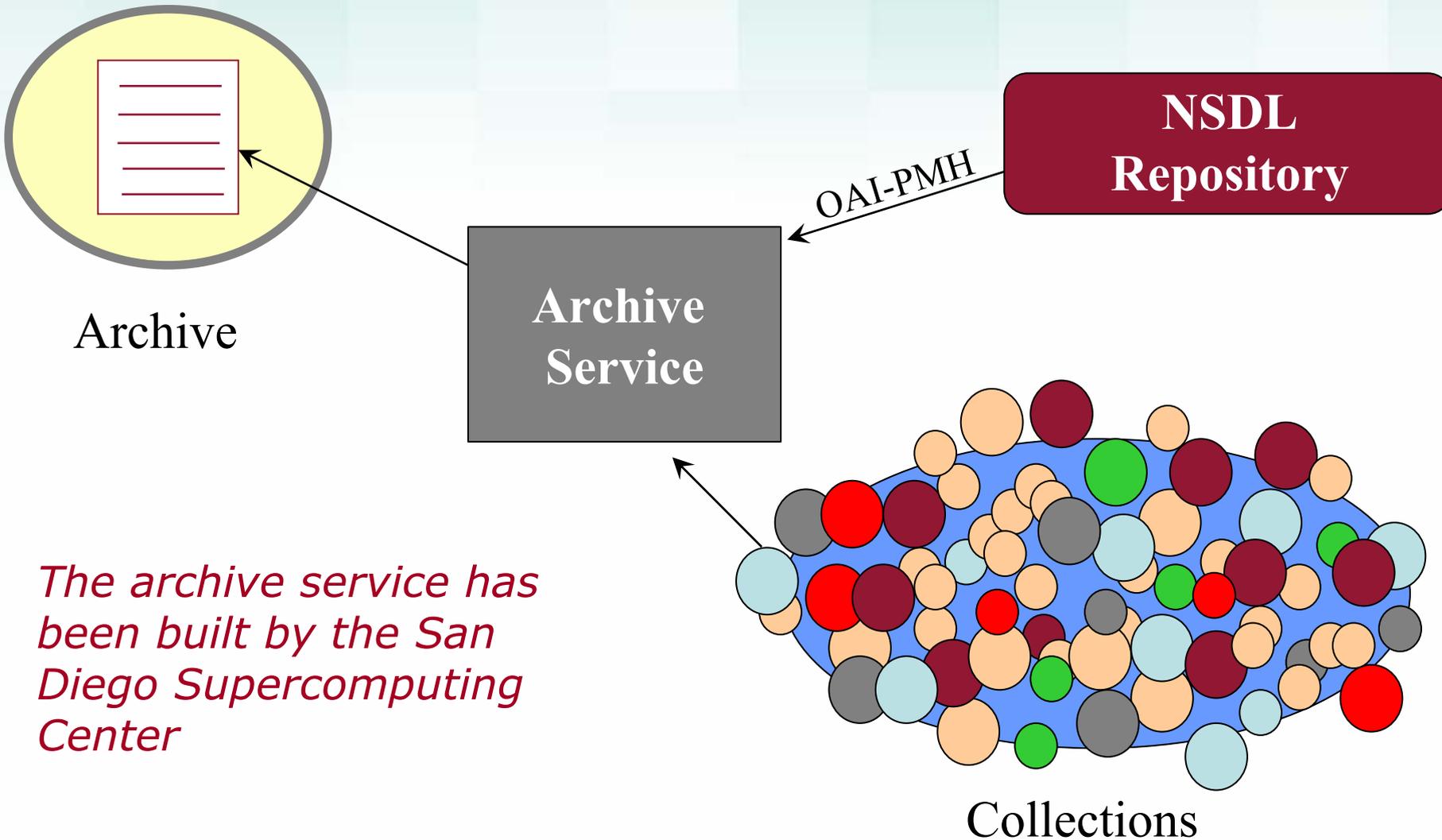*In some cases, all that is "known" to NSDL is the collection, not its items*

NSDL

NSDL Search Service

NSDL Repository

OAI-PMH

Search Service

The search service has been built by the University of Massachusetts, Amherst

Collections

NSDL Archive and Preservation Service

Archive

Archive Service

OAI-PMH

NSDL Repository

The archive service has been built by the San Diego Supercomputing Center

Collections

NSDL

Outreach & Communications Strategy

- Core message:
  - *NSDL … The National Science Foundation's online library, improving the way all Americans learn about science, technology, engineering, and mathematics*
- nsdl.org: a general-purpose window on the NSDL program
- Newsletters: *Whiteboard Report* and *Focus on Education*
- Promotional & relationship-building efforts
  - *Workshops for librarians, and teachers*
  - *Exhibit booth & presentations at educational conferences*
- NSDL developer community
  - *comm.nsdl.org: Web site to support communications*
  - *Workshops on evaluation, sustainability, engaging publishers…*
  - *Annual Meeting and Annual Report*

A Screenshot of nsdl.org

Monthly Newsletter: Focus on Education

- Supports effective use of NSDL in educational settings
- Fosters dialog with diverse audiences of NSDL users, e.g.
  - *teachers*
  - *librarians*
  - *media specialists*
  - *museum staff*

NSDL Focus on Education *highlights* NSDL *activities and opportunities of particular interest to educators in formal and informal settings. To receive subsequent issues of* NSDL *Focus on Education please subscribe at* whiteboard-focus_on_ed@comm.nsdl.org

Mar. 1, 2003 PREMIERE Issue 1

N E W S A N D A N N O U N C E M E N T S
Focus on Education *will provide updates on the full range of library activities and alerts of opportunities for community participation.*

NSDL Launches New Electronic Newsletter for Educators
Welcome to NSDL *Focus on Education*, the new electronic newsletter from the National Science Digital Library (NSDL). As the National Science Foundation's online library for science, technology, engineering, and mathematics education, NSDL offers access to collections of technology-enabled resources that support teaching and learning at all levels (preK-12, Higher Education, and Lifelong Learning) in formal and informal settings. *Focus on Education* has been established to support the effective use of NSDL in educational settings and to enhance dialogue with the diverse audiences that use NSDL including teachers, media specialists, faculty, museum staff, and others. NSDL encourages the readers of this inaugural issue, to provide suggestions and feedback that will help us grow *Focus on Education* into the most useful publication it can be. In addition, we invite readers to submit articles and announcements of interest to those using digital libraries in education to co-editors Carol Terrizzi (clt6@cornell.edu 607-255-2702), NSDL Communications Director, or Susan Van Gundy (vangundy@ucar.edu 303-497-2946).

NSDL Partners with Eisenhower National Clearinghouse to Develop Middle School Portal
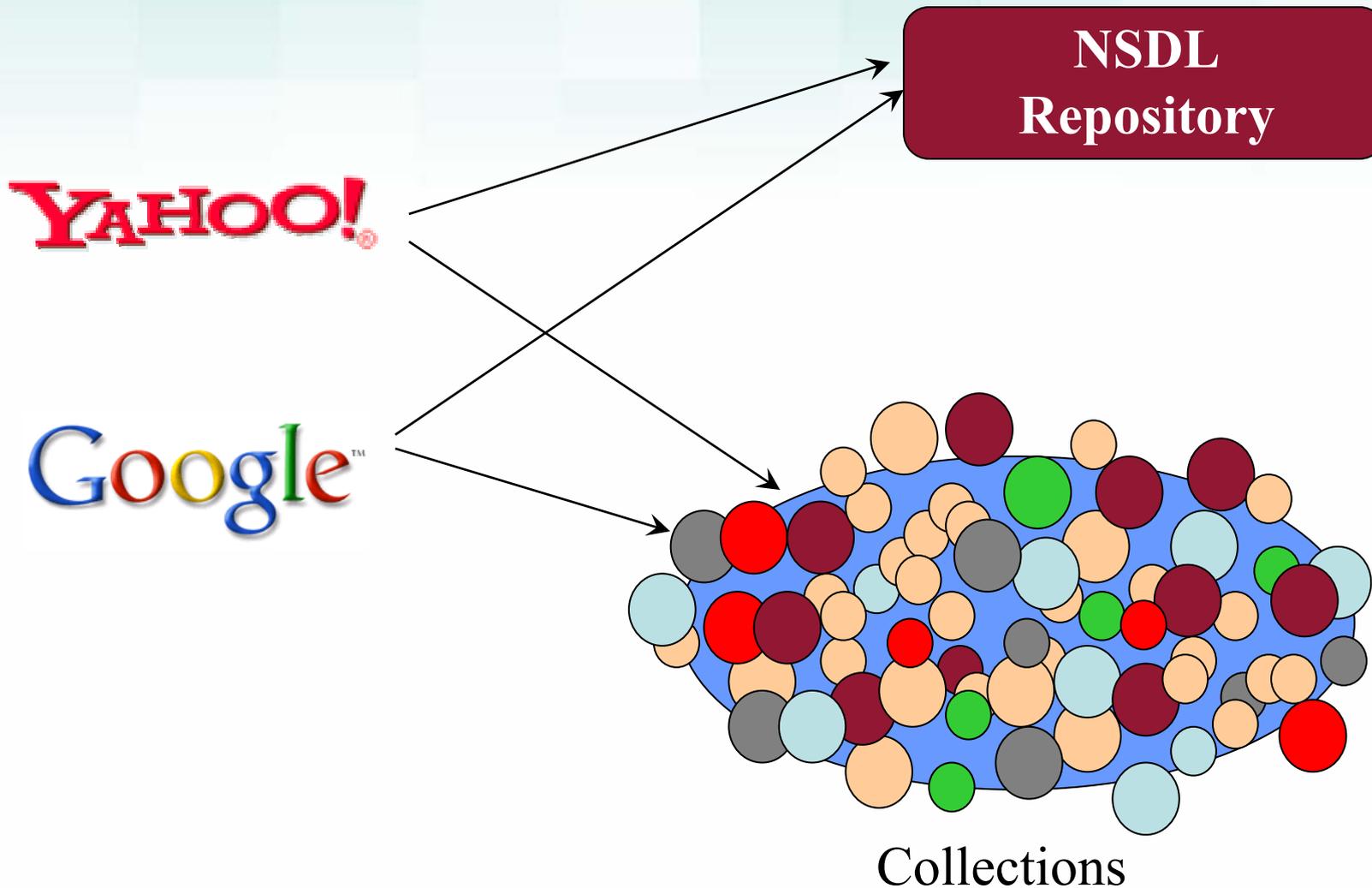NSDL Executive Director, Dave Fulker, has announced that the Eisenhower National Clearinghouse (ENC) at Ohio State University will be NSDL's lead partner in the development of an online portal to serve middle school science, technology, and mathematics educators. The middle school portal will be the first of many alternate points of access to NSDL resources and services designed for the specific needs of a more narrowly defined audience. This approach supports a "One Library, Many Portals" philosophy that draws on the strengths of different groups within the NSDL community to better serve the wide range of NSDL users via audience-specific options that complement general access available at NSDL.org.

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NSDL Collections, Graphed by Subject Area

Now approaching 200 collections

NSDL Visibility on the Web

NSDL Repository

YAHOO!

Google

Collections

Anecdote: How a Kindergarten Teacher in Philadelphia Got Involved with the NSDL

William Cullen Bryant Elementary School Philadelphia, Pennsylvania

Varnelle Moore

- Urban Systemic Initiative–Philadelphia
  - *Science Lead Teacher*
- Math Forum Summer Institute
  - *Math Forum Teacher Associate*

NSDL

How My Students Learn

- Concrete manipulatives
- Spatial experiences
- Story context
- Talking out ideas
- Virtual manipulatives
- Visual stimulus
- Writing on paper

"Building Shapes"

Kindergarten students working with concrete manipulative

"Activity Pattern Block Java Applet"

Kindergarten student working with virtual manipulative

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Some Generic Digital-Age Challenges

These problems are not unique to the NSDL, but some are exacerbated by its highly distributed nature…

- ## Scalability of bibliographic systems
  - *User expectations driven by search engines and the document-creation rates of the Web*

- ## Dynamic content and varied atomicity
  - *Documents boundaries are increasingly uncertain*

- ## Metadata universality vs. expressiveness
  - *Compatibility across many systems <u>or</u> powerful access to collections with special (disciplinary) metadata*

- ## Mixed modes of metadata creation
  - *Joining multiple libraries and collections yields a huge mixture of metadata approaches*
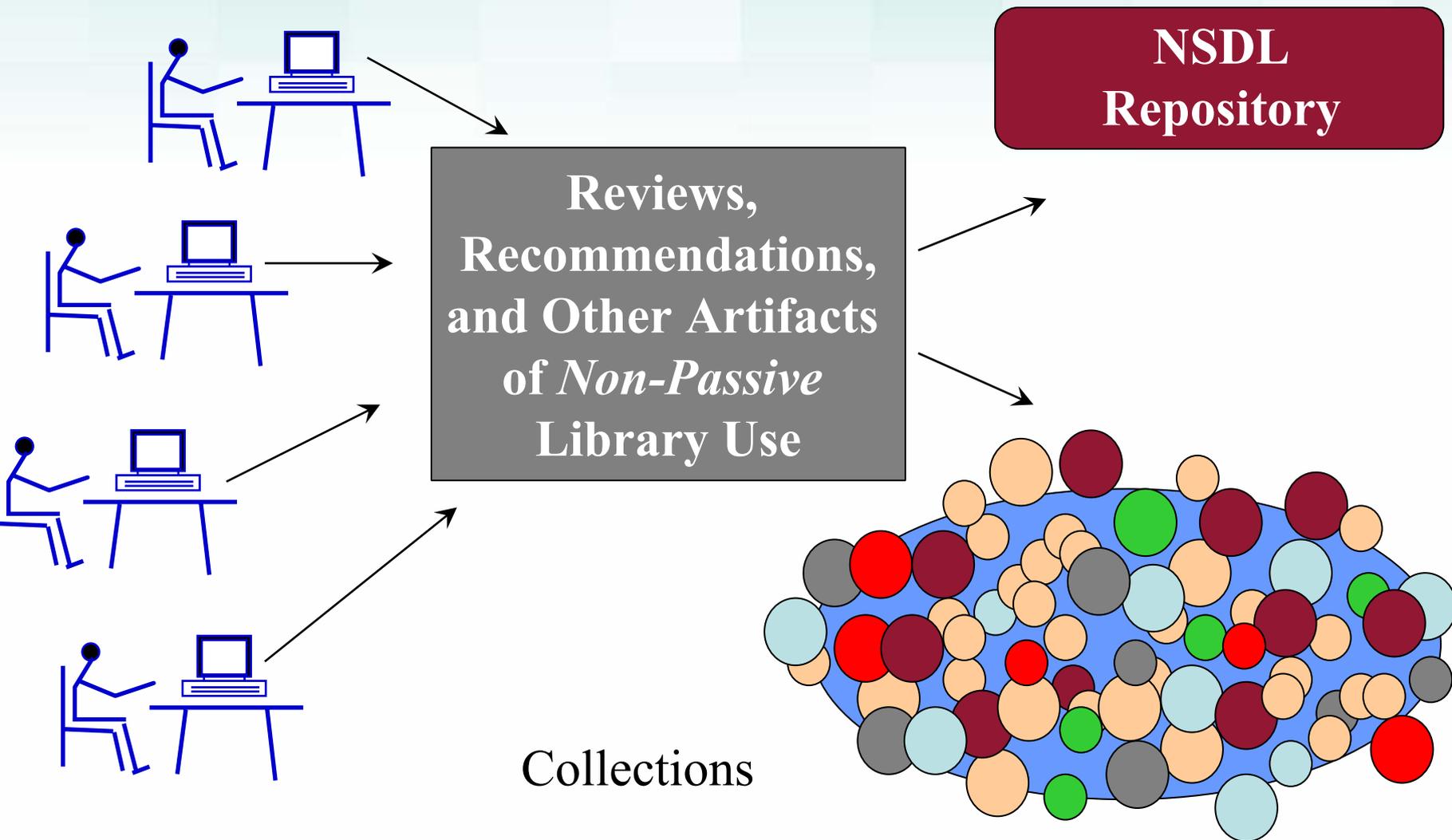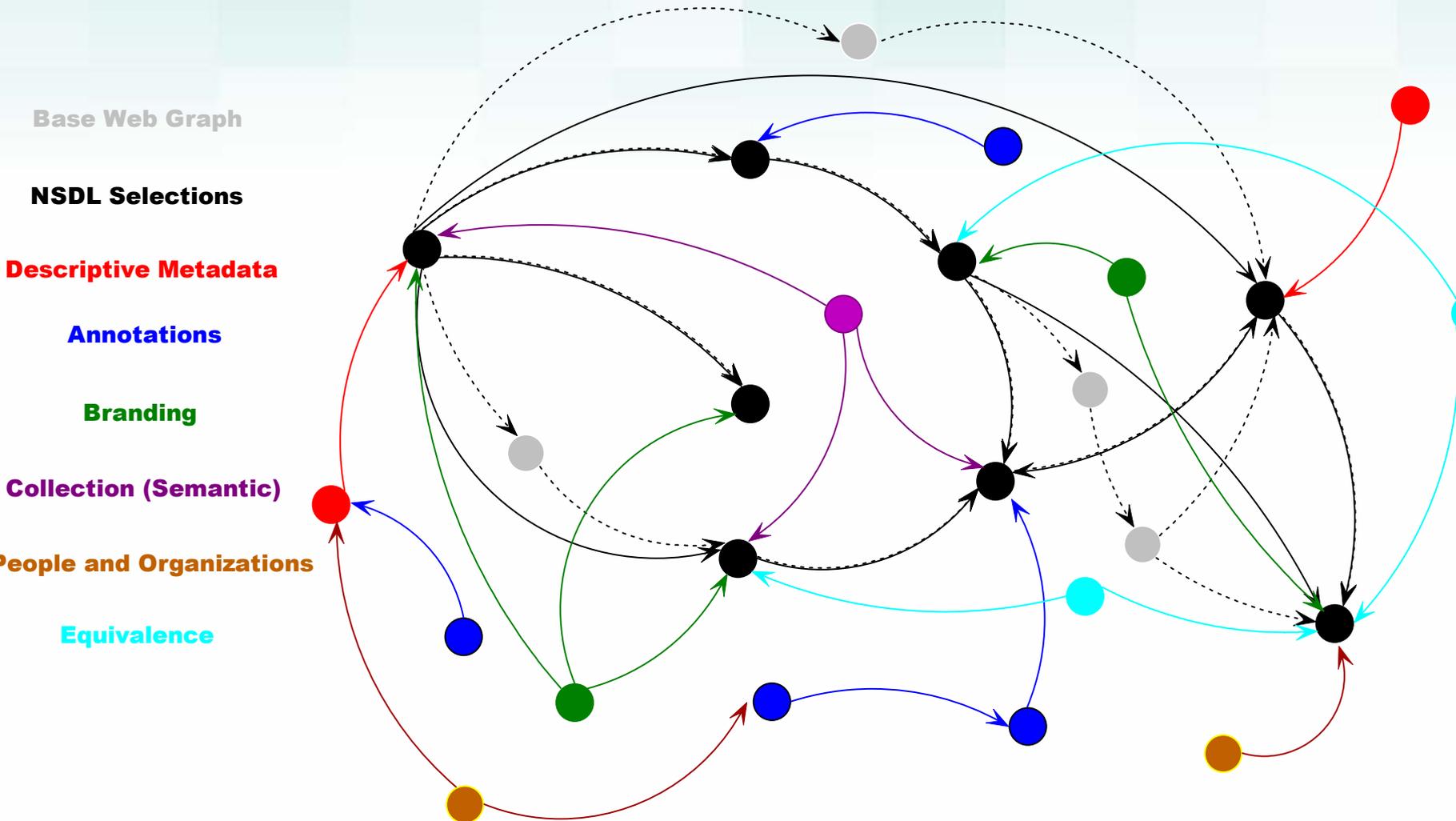
Becoming Indispensable

- **To states:** implementing *our* standards & other policies

- **To communities:** developing *our* citizens & *our* economy; reflecting *our* values re education & equity

- **To schools/districts:** developing/supporting *our* curriculum; selecting textbooks; implementing reform; gaining stature

- **To teachers:** improving *my* teaching; meeting standards; being prepared; finding/giving counsel among colleagues; being recognized

- **To parents:** knowing *my* children's challenges & progress; sharing responsibility for their learning; contributing to *my* community

- **To students:** constructing *my* knowledge via interesting paths (complementing textbooks); navigating through complex knowledge; learning how to learn; satisfying *my* curiosity (deductively & critically)

Community Input

Reviews, Recommendations, and Other Artifacts of *Non-Passive* Library Use
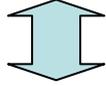
NSDL Repository

Collections

Strategy (Carl Lagoze) for Extending the Metadata Repository:
A Data Warehouse, Specialized for Relationships

Base Web Graph

NSDL Selections

Descriptive Metadata

Annotations

Branding

Collection (Semantic)

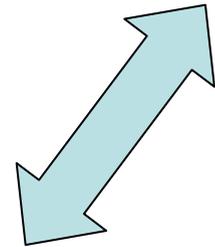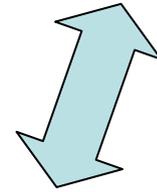People and Organizations

Equivalence

Diverse Network of Partner Libraries and Services (retail)

Specialized Mining

Annotations/Relations
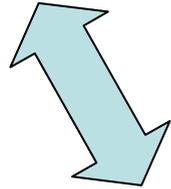
NSDL Data Warehouse: Entities and their Relationships (wholesale)

Harvesting, Gathering, Normalization

Digital Sources
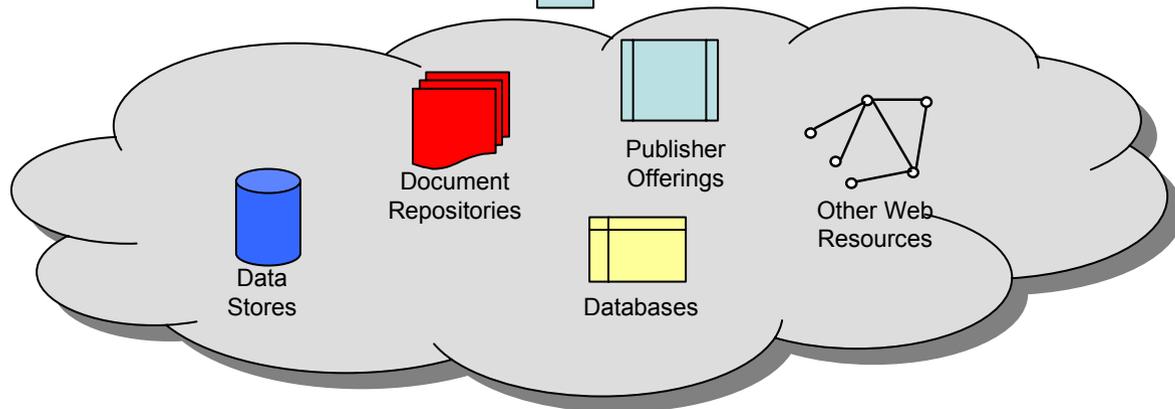
Data Stores

Document Repositories

Databases

Publisher Offerings

Other Web Resources

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➔ 3 Basic (Unanswered) Questions

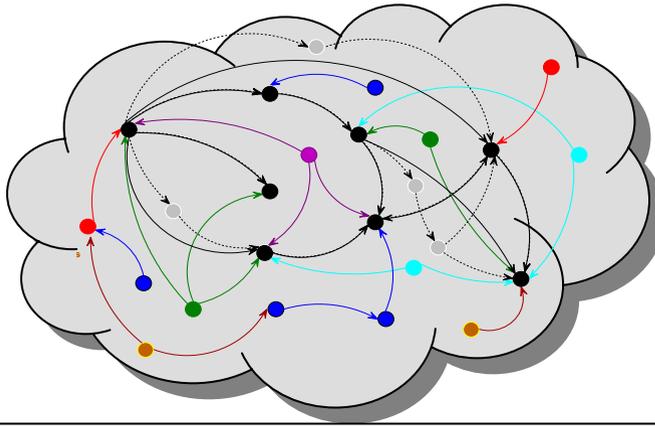# Three Basic Questions
These are largely unanswered in my view;
in other words, NSDL is an experiment…

- What are the correct <u>balances</u> regarding services, centralization, and funding sources?
- Can NSDL be usefully <u>distinct</u> in the Internet world?
- What are the appropriate <u>core</u> services/standards?

Questions of Balance

- Library development/operation vs. client services?
  - For students or for teachers and other intermediaries?
  - How much human mediation?
  - *NSF "Pathway" grants (new in 2004) are increasing emphasis on long-term stewardship & reaching end-users*
- Centralized vs. distributed responsibilities?
  - *NSDL is about 25%/75% now, but the ratio is increasing*
  - *Most collections are open-access now, but this may change*
- National (NSF) vs. other sources of funding?
  - *Increasingly clear that NSF has a long-term commitment, but the non-NSF fraction (now near zero) is very uncertain*
  - *This is complicated by the highly distributed funding and control of U.S. education*

Questions about Distinctness

- Can NSDL complement (and not compete with) Google, Yahoo, and other advancing services?
  - *NSDL Core is building relationships with these firms*
- Will excellent access to excellent content yield the NSDL goal (improved science education)?
  - Research on learning (per NRC reports, e.g.) indicates:
    - Learning occurs best in teams and in settings aligned with community or institutional *values $\Rightarrow$ need for NSDL localization*
    - Learners do not absorb knowledge, rather they *construct* their own knowledge $\Rightarrow$ *need for active, <u>not passive</u>, library usage*

  Note 1: good librarians (implicitly) understand these factors

  Note 2: Some NSDL projects offer interactions beyond access to content, but these are not yet integrated across the whole

Questions re Core Services/Standards

- **What services are need to make NSDL coherent?**
  - *NSDL Core now offering (a sub-critical set?):*
    - Web site at nsdl.org, as one of many (audience-specific) NSDL portals
    - Union catalog (with normalized DC and native metadata)
    - OAI-based harvesting (both client-side and server-side)
    - Programmatic interface to a search service (Lucene)
    - Archival/retrieval service (for crawlable content)
    - Authentication services (Shibboleth-based)
    - Volunteer-based reference-desk service (askNSDL)
    - Publicity/collection-building/community-building/evaluation activities
- **What factoring of services will foster innovation?**
  - *Considering new search methodology and a single crawl (now separate for search and archive)*
  - *NSDL Core planning to adopt FEDORA*

Why Fedora?

- Data model
  - *Abstraction for heterogeneous resources & many "content models"*
  - *Locally stored content aggregated with by-reference content*
  - *No bifurcation of metadata and content*
- Distributed repositories (i.e. federation) & Web services
  - *Common data model, with open APIs for access/management*
  - *Fedora is exposed via web services & can interact with others*
  - *Fedora uses WSDL and XML*
- Content repurposing
  - *Multiple views, with dynamic transformations of content/metadata*
  - *Additional views/transformations over time*
- Object Lifecycle and preservation
  - *Content versioning & event history*
  - *Does not assume any particular workflow or end-user application*

Fedora Server Design: 3 Layers

1. Interface	▪ Web Service for Access/Search ▪ Web Service for Management ▪ OAI Provider
2. Application Logic	Implements all functionality in terms of the Fedora digital object model.
3. Storage	▪ RDBMS 　▪ *Object "cache" for performance* 　▪ *Digital object registry* ▪ XML object serializations 　▪ *Authoritative object with versioning* 　▪ *All management operations on XML*

Conclusion & Summary

- **NSDL Program & Assumptions**
  - *NSF has acted boldly, with a highly distributed model*
- **Core Integration Strategy**
  - *UCAR, Cornell & Columbia devised a basic framework*
- **Progress to Date**
  - *NSDL is operational and gaining educational use*
- **Upcoming NSDL Challenges**
  - *Specific/generic problems include heterogeneity, e.g.*
- **Basic Questions (NSDL as an Experiment)**
  - *Balances re service, centralization & funding*
  - *Educational utility & distinctness in the Internet*
  - *Core services/standards for flexibility, innovation…*

NSDL