Fostering Learning in the Networked World:

The Cyberlearning Opportunity and Challenge

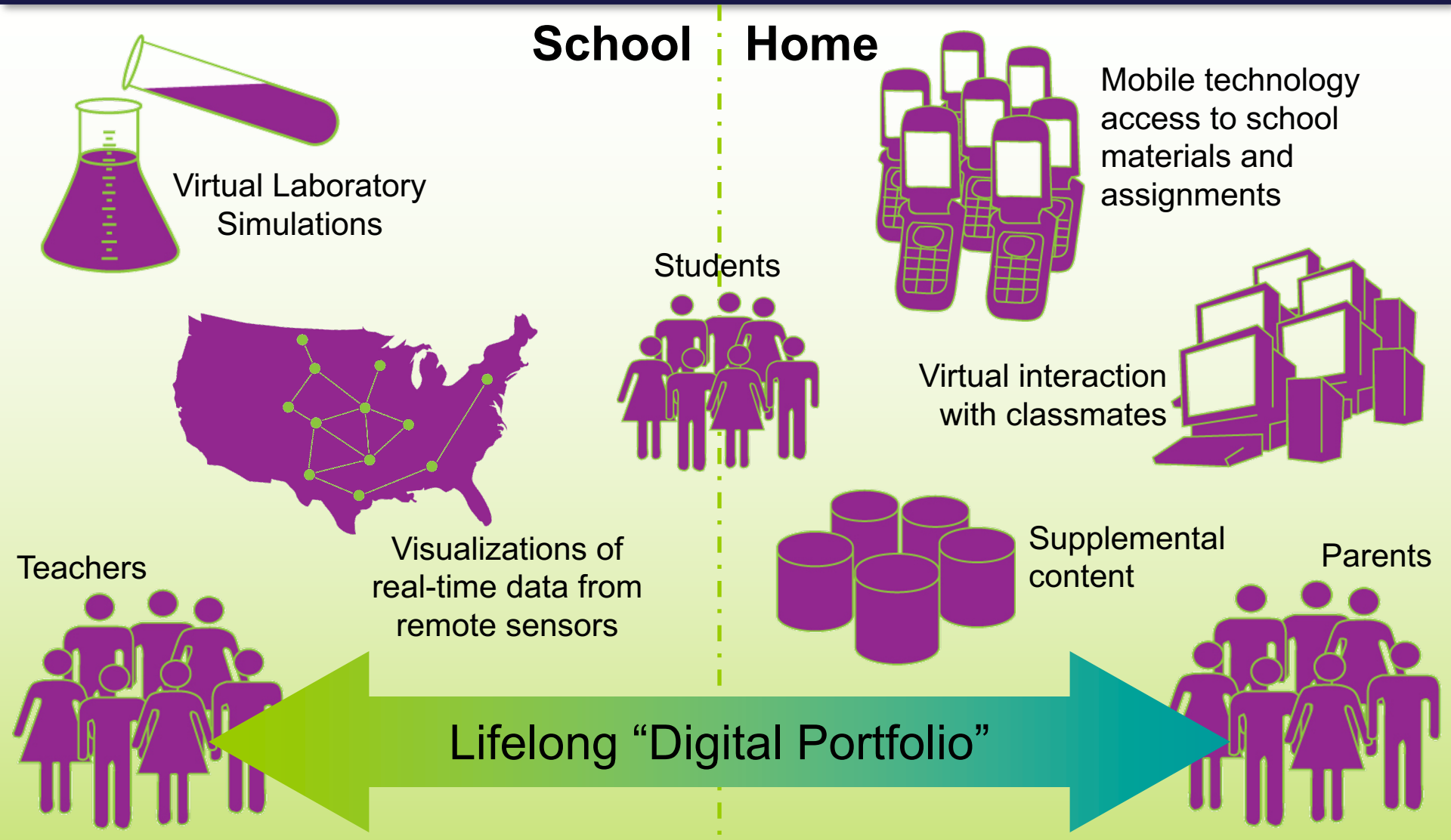
A 21st Century Agenda for the National Science Foundation

Report of the NSF Task Force on Cyberlearning
July 2008

Christine L. Borgman, Task Force Chair
Coalition for Networked Information

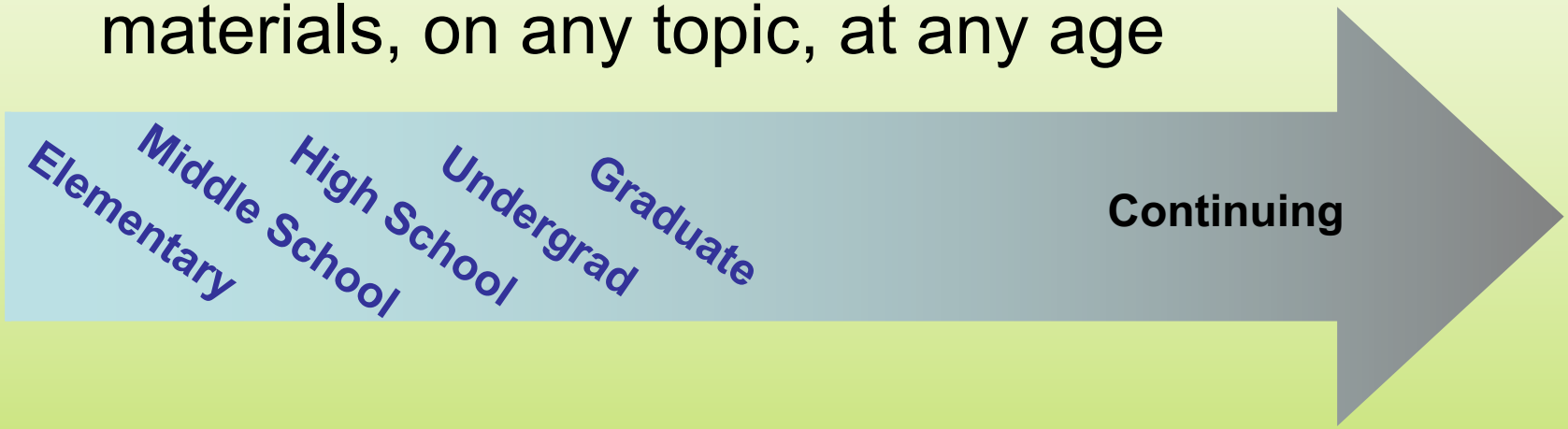
December 9, 2008

The Future of Cyberlearning:
A vision of the year 2015…

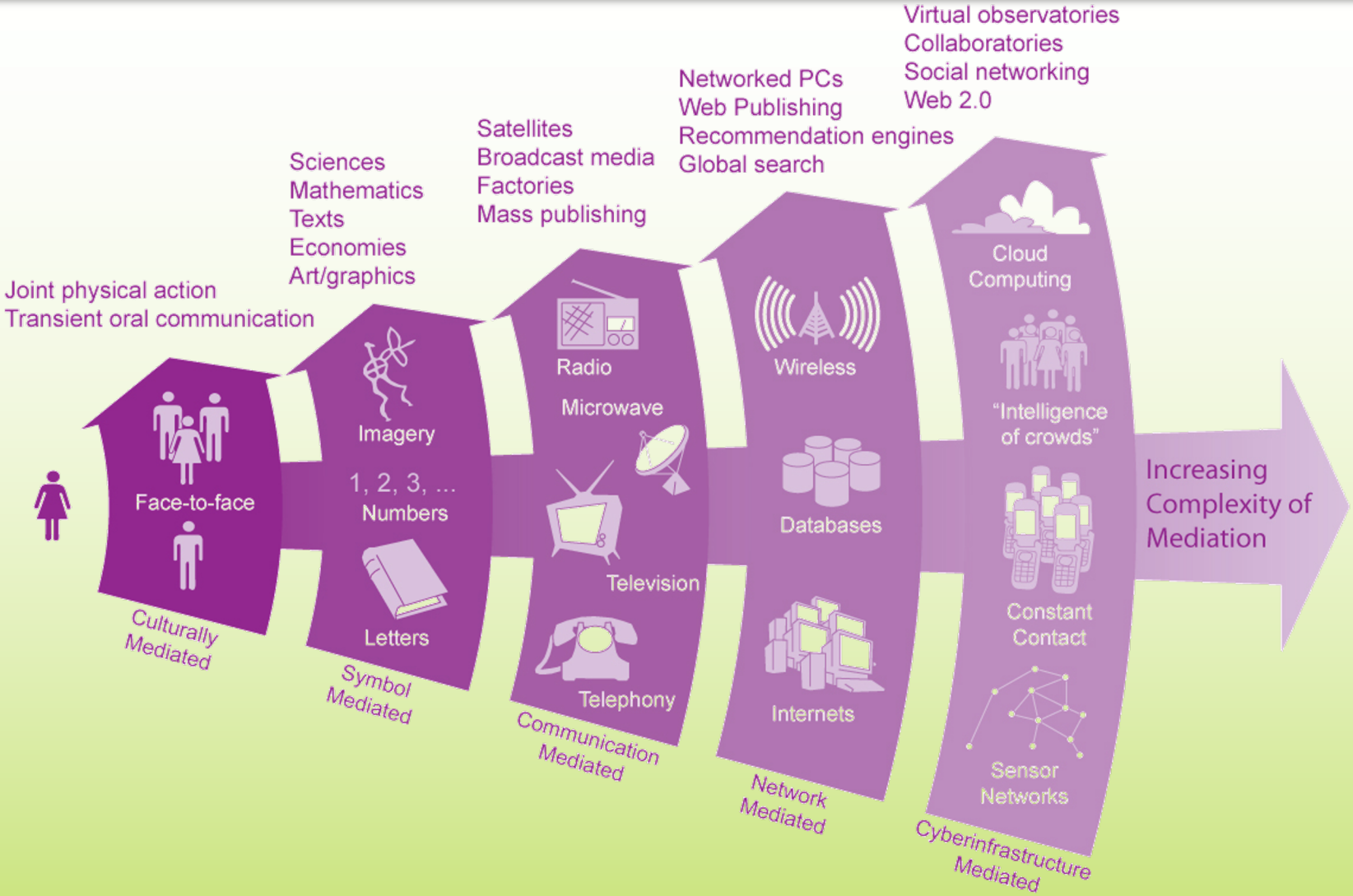


What Is Cyberlearning?

- The use of *networked* computing and communications technologies to support learning
- Interactions among communities of learners across space and time
- Customized interaction with diverse materials, on any topic, at any age



A Brief History of Technological Advances Making Cyberlearning Possible



Why Is Cyberlearning Important?

- Leverages learning through
  - Communication technologies
  - Students' technology skills
- Extends capacity of educational institutions into life-long learning opportunities
  - Increases public understanding of science
  - Prepares citizens for complex, evolving, global challenges

War

Recession

Global Warming

Epidemics

Poverty

Why Cyberlearning Now?

NSF funding for interdisciplinary programs in cyberlearning

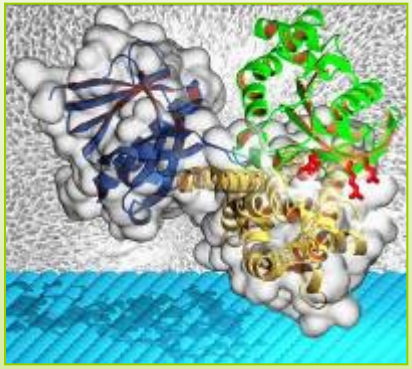
Powerful new technologies

Understanding of how people learn

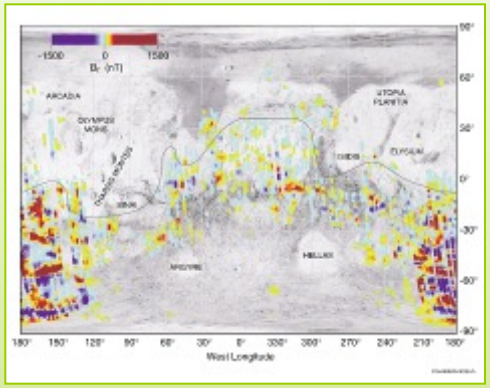
New, more responsive methods of development and testing

Demand for solutions to educational problems

Cyberlearning



Credit: John Sondek, University of North Carolina, Chapel Hill



Using data to teach geoscience thinking
Credit: Tracy Gregg
State University of New York Buffalo

Task Force Charge

Advisory Committees

- Directorate for Education and Human Resources
- Office of Cyberinfrastructure

Task Force

- Opportunities
- Research questions
- Partners
- Strategies
- Existing resources

NSF's US-based Charter

STEM

- Science
- Technology
- Engineering
- Mathematics

SBE

- Social Science
- Behavioral Science
- Economics

- Arts
- Humanities

Task Force Members

- **Christine L. Borgman *(Chair)*:** Professor of Information Studies, UCLA
- **Hal Abelson:** Professor of Computer Science and Engineering, MIT
- **Lee Dirks:** Director of Scholarly Communication, Microsoft
- **Roberta Johnson:** Director of Education and Outreach, UCAR
- **Kenneth R. Koedinger:** Professor of Human Computer Interaction / Psychology, Carnegie Mellon University
- **Marcia C. Linn:** Professor of Development and Cognition, UC Berkeley
- **Clifford A. Lynch:** Executive Director, Coalition for Networked Information
- **Diana G. Oblinger:** President, EDUCAUSE
- **Roy D. Pea:** Professor of Education and the Learning Sciences, Stanford University
- **Katie Salen:** Executive Director, Institute of Play
- **Marshall S. Smith:** Director of Education, Hewlett Foundation
- **Alex Szalay:** Professor of Astronomy, Johns Hopkins University

Key Strategies and Opportunities for NSF

- **Strategies:** To promote the growth of a cyberlearning infrastructure
- **Opportunities for Action:** Greatest short-term payoff and long-term promise
- **Themes**
  - Develop and advance technologies
  - Enable students to use data
  - Harness learning data
  - Support broader audiences
  - Sustain cyberlearning materials

Develop and Advance Technologies

- **Strategy:** Promoting new talent and new technology
- **Opportunity:** Using technologies to
  - Coordinate learning across contexts
  - Connect students with remote and virtual laboratories
  - Access interactive virtual or "mixed reality" environments

Ann Myers Medical Clinic in Second Life
Image credit: Scienceroll blog

World of Warcraft
http://www.worldofwarcraft.com/burningcrusade/imageviewer.html?/burningcrusade/,images/screenshots/,116,241,http://www.worldofwarcraft.com/burningcrusade/screenshots.html?14@27

Enable Students to Use Data

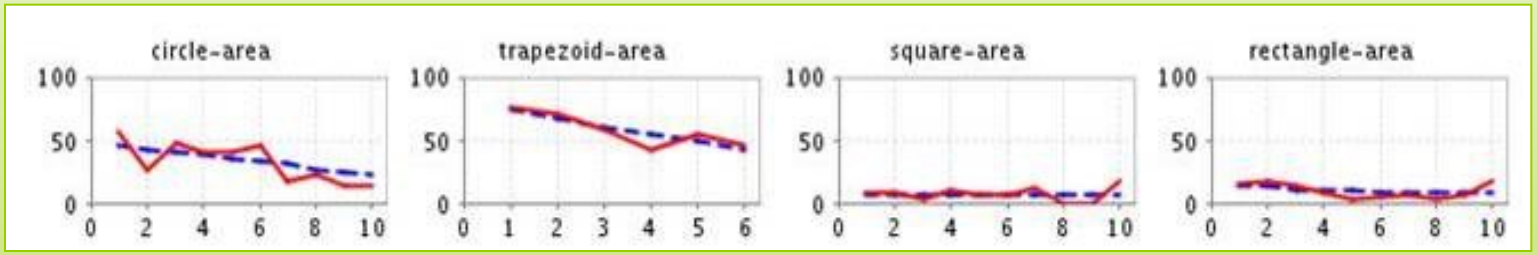
- **Strategy:** Transforming STEM disciplines and K–12 education
  - New ways of looking at and understanding content
  - Preparing students for “computational thinking”
- **Opportunity:** Teaching students and teachers how to harness large amounts of data
  - Scientific research
  - Responsible use of data

Astronomer Caroline Zunckel uses the galaxyzoo.org website to classify a spiral galaxy.
Credit: www.galaxyzoo.org

GALAXY ZOO.org

Harness Learning Data

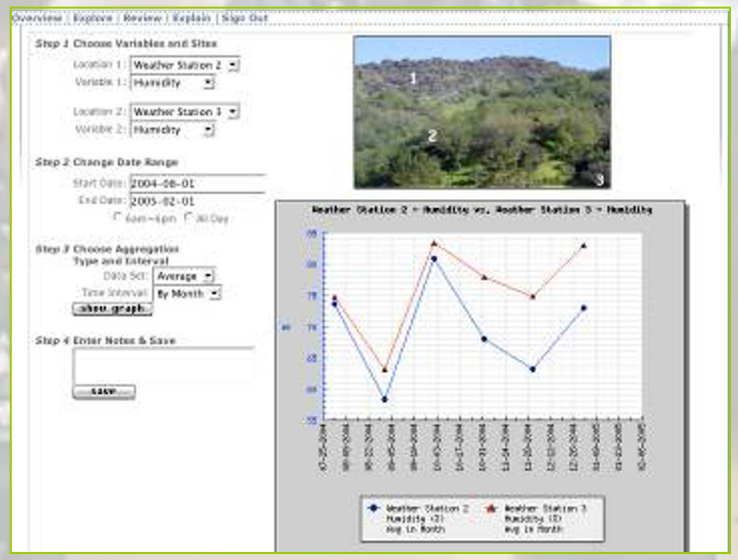
- **Strategy:** Leveraging the data produced by cyberlearning systems
  - Teachers interacting with students and their school assignments
  - Students' educational histories
- **Opportunity:** Encouraging shared systems that allow large-scale deployment, feedback, and improvement



Pittsburgh Science of Learning Center's DataShop: learnlab.web.cmu.edu/datashop

Support Broader Audiences

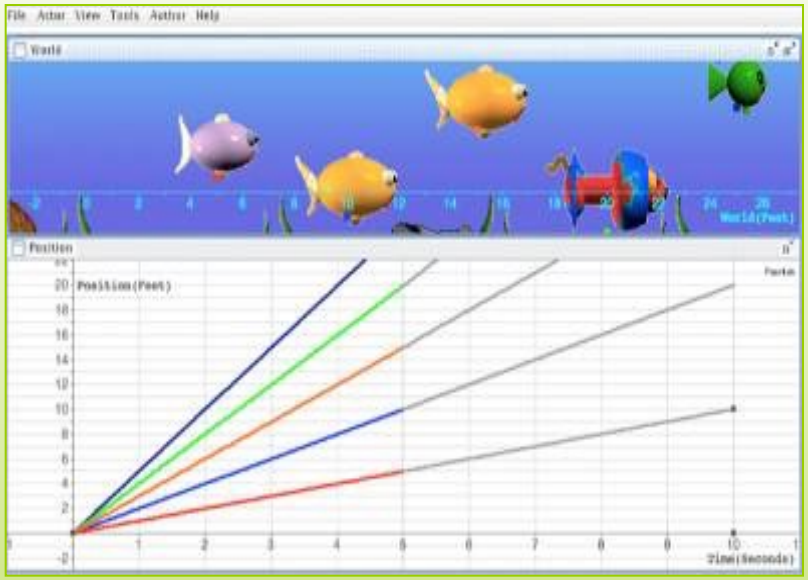
- **Strategy:** Addressing problems and opportunities with
  - Reapplication of tools and resources
  - Scaling of technology for larger communities
- **Opportunity:** Funding development of resources usable for both research and education



Students learning about photosynthesis in classroom & online activities
Images courtesy of Bill Sandoval, CENSEI

Sustain Cyberlearning Materials

- **Strategy:** Sustaining cyberlearning innovations beyond their initial funding
- **Opportunity:** Guaranteeing future availability of Open Education Resources



SimCalc Project
http://www.kaputcenter.umassd.edu/downloads/products/technical_reports/tr1_1.pdf

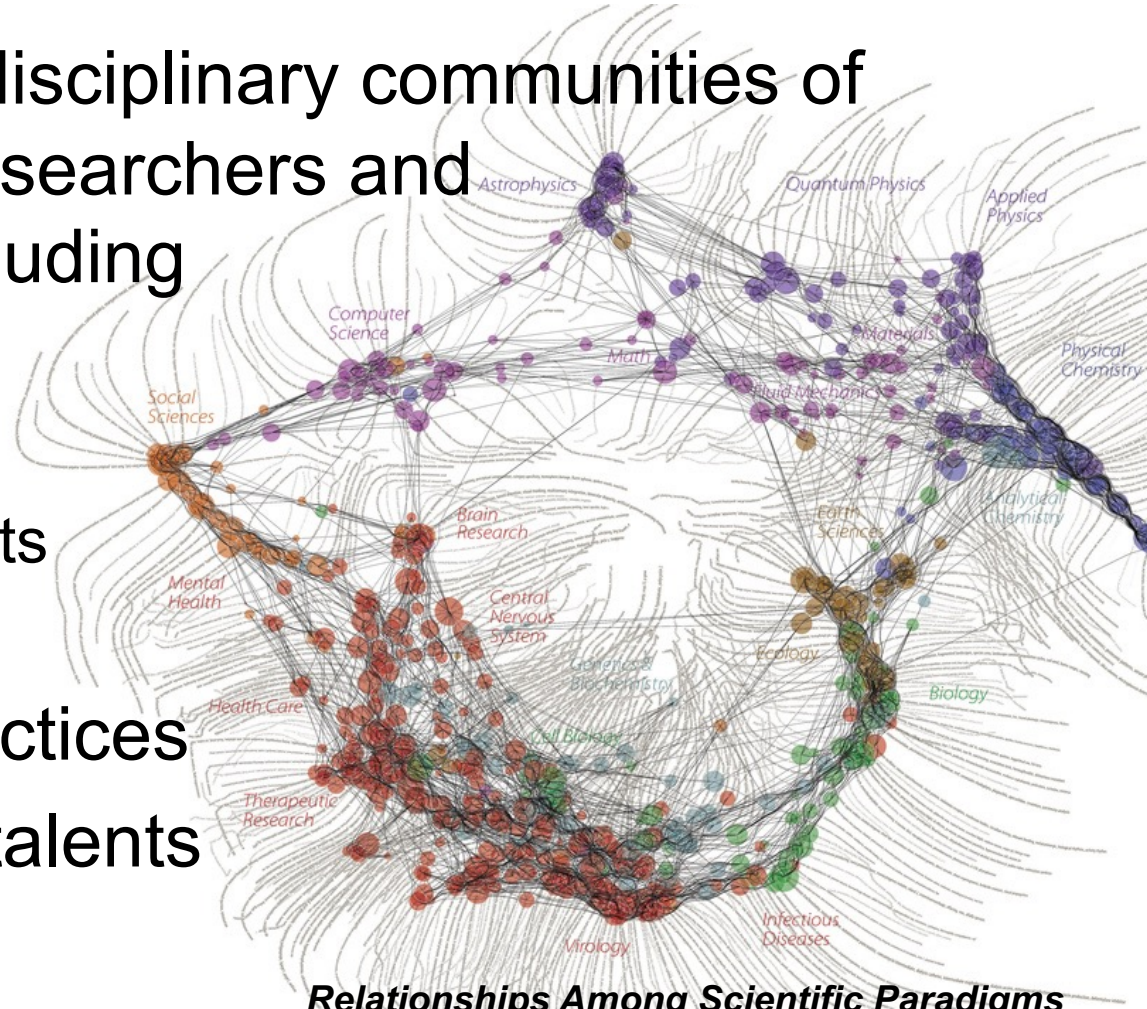
iLab Inverted Pendulum:
Mark Schulz, iLab

Task Force Recommendations

1. Build a vibrant cyberlearning field
2. Instill a “platform perspective”
3. Emphasize the transformative power of technology
4. Promote open educational resources
5. Sustain NSF-sponsored projects

1. Build a vibrant cyberlearning field

- Promote cross-disciplinary communities of cyberlearning researchers and practitioners including
  - Technologists
  - Educators
  - Domain scientists
  - Social scientists
- Publish best practices
- Recruit diverse talents



Relationships Among Scientific Paradigms

(Credit: Research & Node Layout: Kevin Boyack and Dick Klavans (mapofscience.com); Data: Thompson ISI; Graphics & Typography: W. Bradford Paley (didi.com/brad); Commissioned Katy Börner (scimaps.org))

2. Instill a “platform perspective”

- Platform = shared, interoperable designs of hardware, software, and services
- Incorporate and support
  - New technological innovations
  - Fully tested modules for classroom use
- Widely usable now and in the future
- Guidance from expert panel

Current NSF “platforms” to review

- National Science Digital Library (NSDL)
- Innovative Technology Experiences for Students and Teachers (ITEST)

NSDL
THE NATIONAL SCIENCE DIGITAL LIBRARY

ITest
Learning Resource Center

http://www2.edc.org/ITESTLRC/Materials/ITESTSnapshot_2008v2.pdf

3. Emphasize the transformative power of technology

- Potential for learning, from “K to grey”
- Information and communication technologies that
  - Allow interaction with data, visualizations, remote and virtual laboratories, and experts
  - Bridge multiple learning environments and technologies
- Support teachers’ professional development through
  - Training programs
  - Professional societies
  - Collaborating to create new teaching materials

Intel Classmate PC
Photo credit: Getty Images

Wikipedia

Intel Classmate PC
http://flickr.com/photos/stuardo/1753064186/

4. Promote open educational resources

- Make materials available on the web with permission for unrestricted reuse and recombination
- New proposals should plan to make their materials available and sustainable

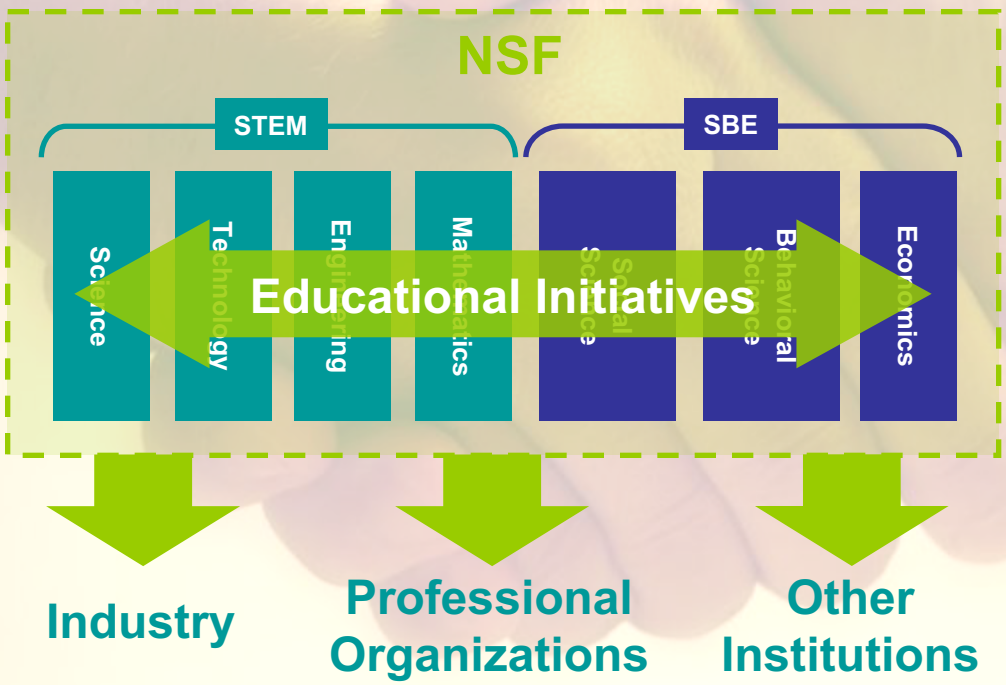
Open Educational Resources

science commons

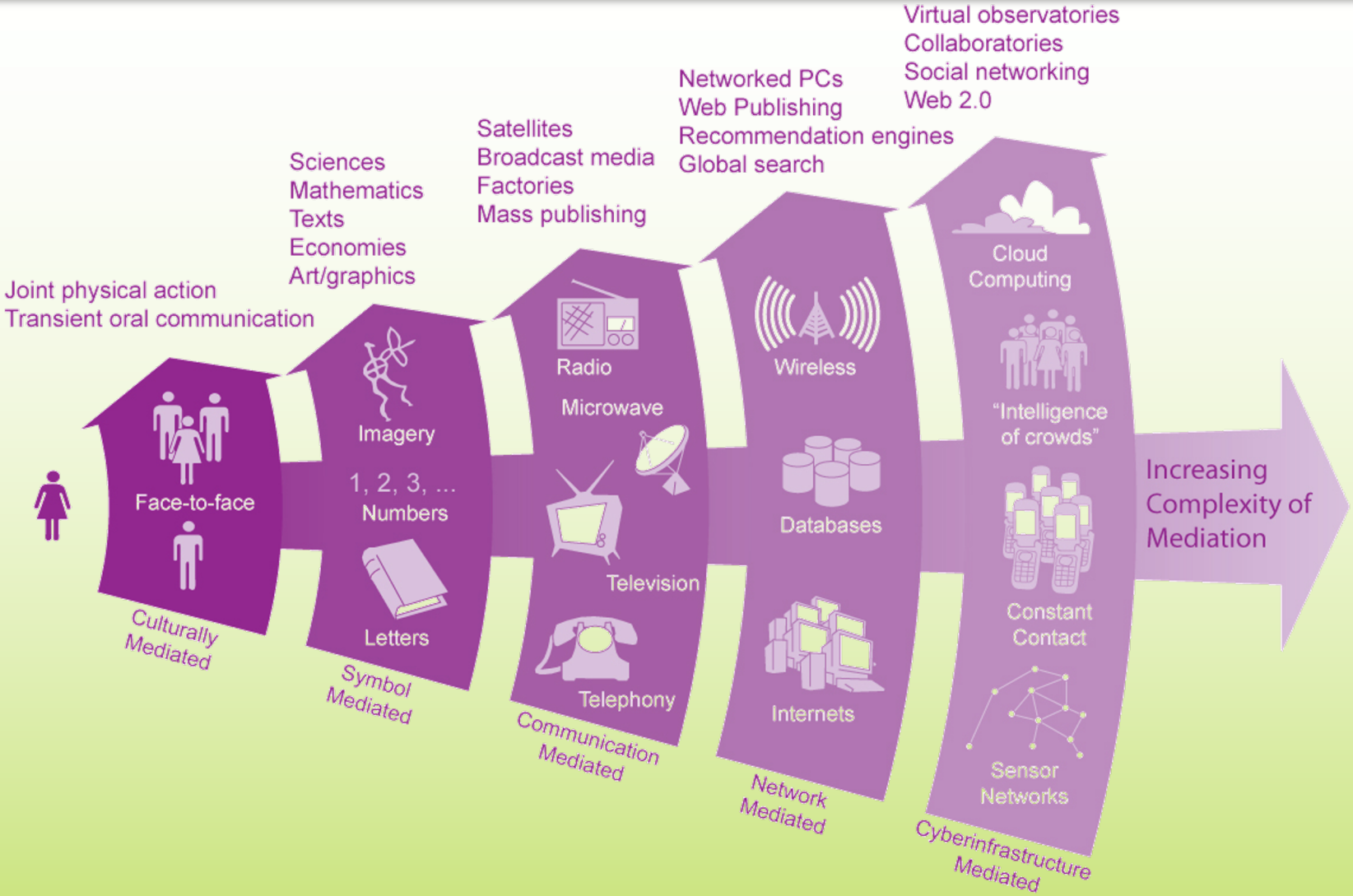
Learn

5. Sustain NSF-sponsored projects

- Maintain cyberlearning innovations beyond the funding of a grant
- Extend initiatives across NSF divisions and create external partnerships



The Cyberlearning Challenge: Transition from Network to Cyberinfrastructure



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Report and followup

Report online:
http://www.nsf.gov/pubs/2008/nsf0804

(link is in your CNI program)

Further questions / followup:

Cyberlearning@nsf.gov
(James Colby)