Interdisciplinary Virtual Labs for Undergraduate Education in the NSDL MatDL

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Advancing NSDL Networks

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Outline

- MatDL Pathway & Virtual Labs (Laura Bartolo)
  - Background
  - Partners
- Learning with virtual labs (Dave Yaron)
- Virtual Labs in a digital repository (Laura Bartolo)
Multidisciplinary, multi-institutional team

- MIT – Materials Science & Engineering
  - Fall’07 Introduction to Solid State Chemistry, 3.091
  - Don Sadoway, W. Craig Carter, Colin Ashe

- CMU – Chemistry & NSF Center on Science of Learning
  - Spr’08 Modern Chemistry
  - David Yaron, Jodi Davenport, Michael Karabinos

- KSU – BioPhysics & MatDL
  - Fall’07 Introduction to BioPhysics
  - Laura Bartolo, John Portman, Aaron Slodov
Virtual Labs @ MatDL

- Goal
  - provide alternative/complement to physical labs

- Objectives - Engage students in:
  - authentic research related activity to provide memorable context for attaching knowledge.
  - forming mental models such as those experts employ to explain structure-property relationships
Design Process

- Experts from multiple domains met to identify concepts/frameworks that are
  - Central to their domain
  - Have strong leverage
  - Are difficult to teach/learn
- Find intersections/overlaps
- Will cross-disciplinary design lead to more reusable learning objects?
Outcome of the Design Process

- Reaction paths and energy landscapes

- Used to describe, for example,
  - Organic chemistry reactions
  - Diffusion on surfaces
  - Protein folding/unfolding
Development process

- Analyze content with experts, novices and psychologists
- Sequential focus on aspects of the diagram
  - What is $Q$?
  - What is temperature?
  - Energy vs. free energy

![Graph: $G(Q)$ vs. $Q$ with points 1 and 2]
What is the reaction coordinate $Q$?
Motion connected to a heat bath
Coordination
Entropy: Energy vs. free energy
Formative assessment

- Psychologists examine for coherence
- Trial in computer cluster
  - 15 students, 3 faculty, 2 developers, 1 psychologist
  - Filmed the activity and a group discussion
- Post survey
  - Meaning of representations
  - Self-perceptions of learning
  - Open-ended conceptual questions

http://matdl.org/virtuallabs
Virtual Labs on MatDL: Current & Next Steps

- Virtual Labs wiki (http://matdl.org/virtuallabs)  
  - Support multidisciplinary development & use of VLs
- Virtual Labs code development (http://matforge.org/virtuallabs)  
  - Support collaborative enhancement of existing & new VLs
- MatDL Repository (http://matdl.org/repository)  
  - Support reuse of source code & teaching resources for Virtual Labs
Virtual Labs in Digital Repositories

- Metadata & Dissemination:
  - In MatDL Repository & NSDL NDR
- Learning in context:
  - In Virtual Labs Wiki - labs & teaching resources
- Reuse:
  - In MatDL – modifying context of digital objects
  - In MatForge – modifying source code
  - Key concepts across science domains, audiences
VLs & Community Development

- Have potential to accelerate development
- Contributes toward sophisticated, stable networks
- Need to build appropriate research data into VLs
- Integrating research into undergrad+ coursework helps attract & better prepares next generation of US scientists.
Thank you & Questions?

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