



MatDL

Interdisciplinary Virtual Labs for Undergraduate Education in the NSDL MatDL

NSDL Annual Meeting , Washington, DC
November 6-8 2007

Advancing NSDL Networks

**Donald S. Sadoway, Laura M. Bartolo, David Yaron, Jodi Davenport
MIT, Kent State University, Carnegie Mellon University**



Outline

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

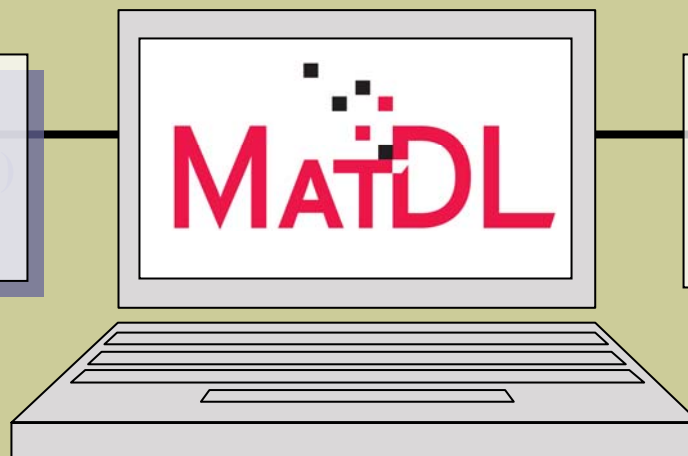
NSDL Materials Digital Library Pathway

<http://matdl.org/matdlwiki>

**NSF MS Initiatives
(NIRTs, MRSECs, IMIs)**
•Soft Matter Wiki

<http://matdl.org/virtuallabs>

Virtual Labs
•Intro to Solid State Chem
•Intro to Bio Physics
•Modern Chemistry



**Teaching Resource
Development**
•MS Teaching Archive

<http://teaching.matdl.org>

Stewardship
•MatDL Repository

<http://matdl.org>

Code Development
• Matforge
•NIST FiPy
•CMU
•DOE CMSN

<http://matdlforge.org>

- 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

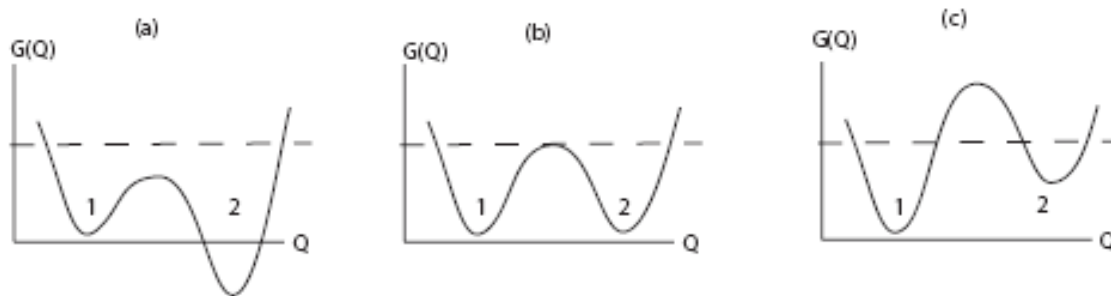
- Objectives - Engage students in:
 - authentic research related activity to provide memorable context for attaching knowledge.
 - forming mental models such as those experts employ to explain structure-property relationships

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

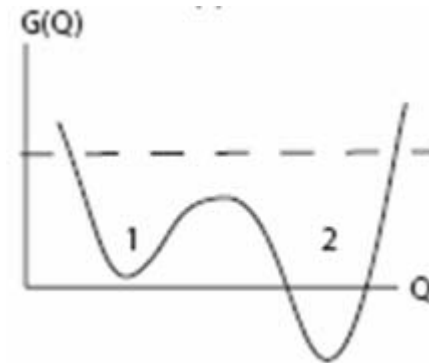
- Reaction paths and energy landscapes



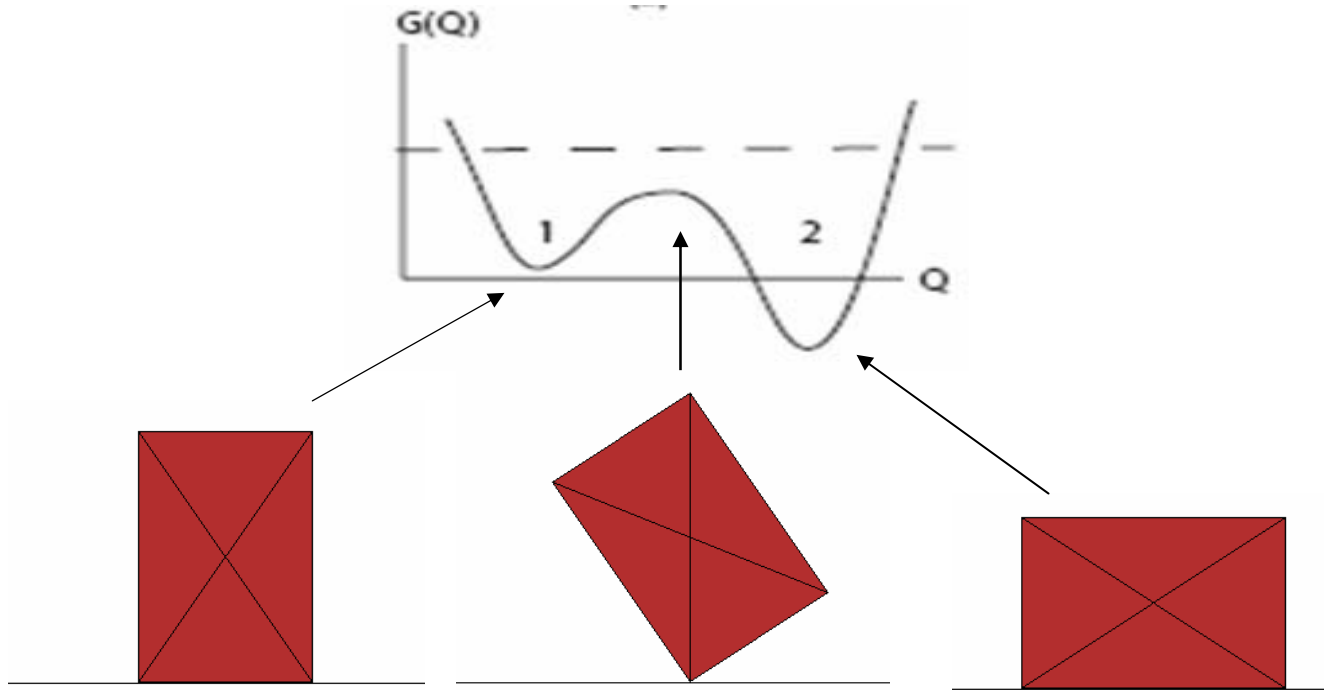
- Used to describe, for example,
 - Organic chemistry reactions
 - Diffusion on surfaces
 - Protein folding/unfolding

Development process

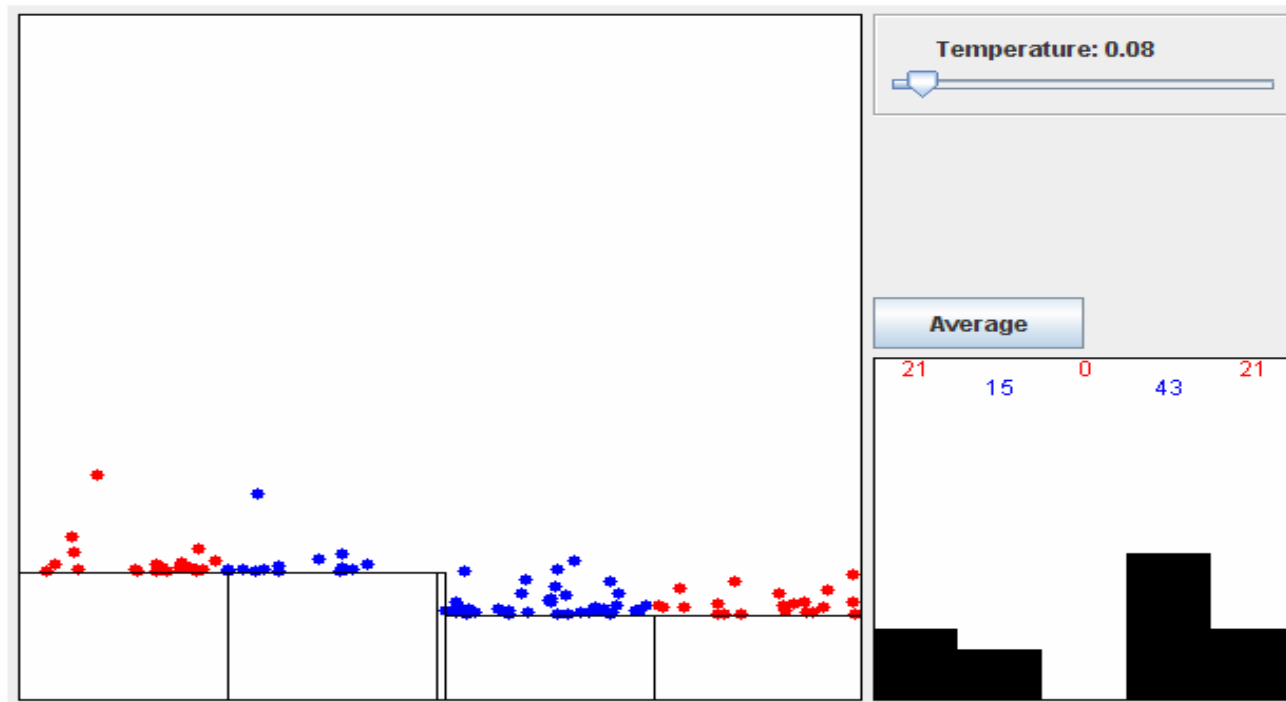
- Analyze content with experts, novices and psychologists
- Sequential focus on aspects of the diagram
 - What is Q ?
 - What is temperature?
 - Energy vs. free energy



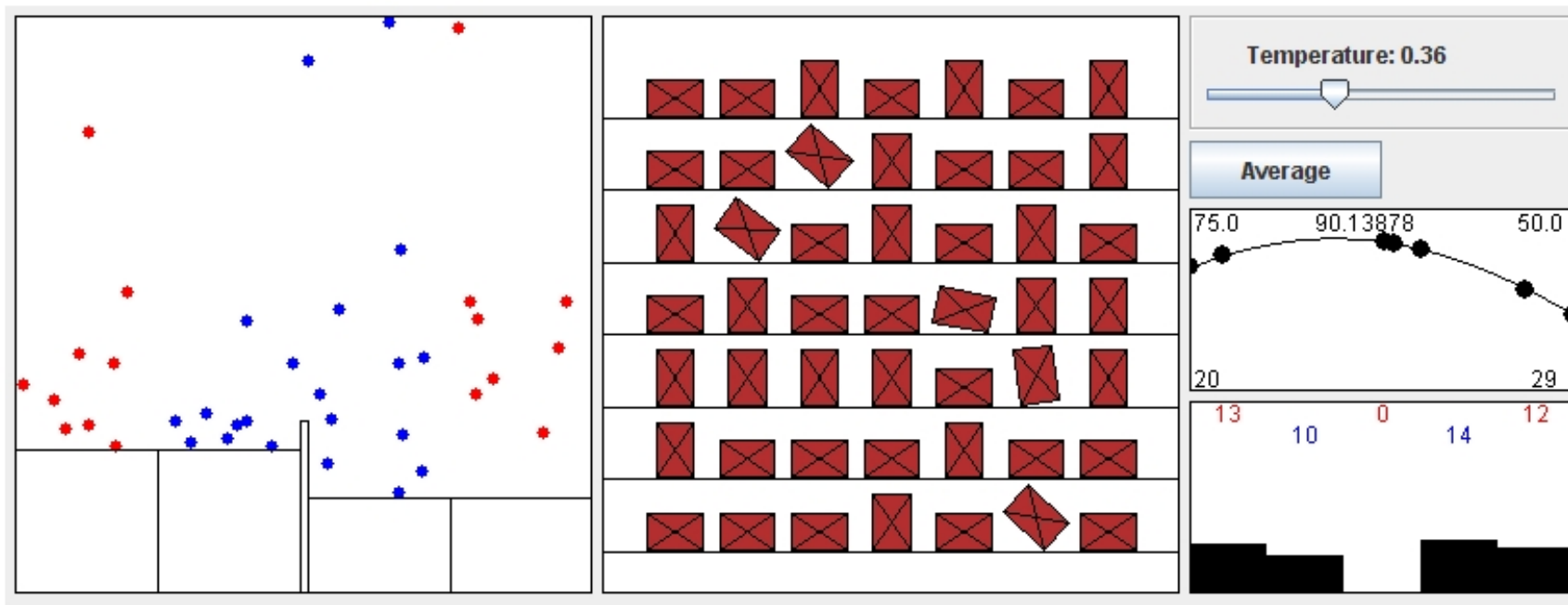
What is the reaction coordinate Q ?



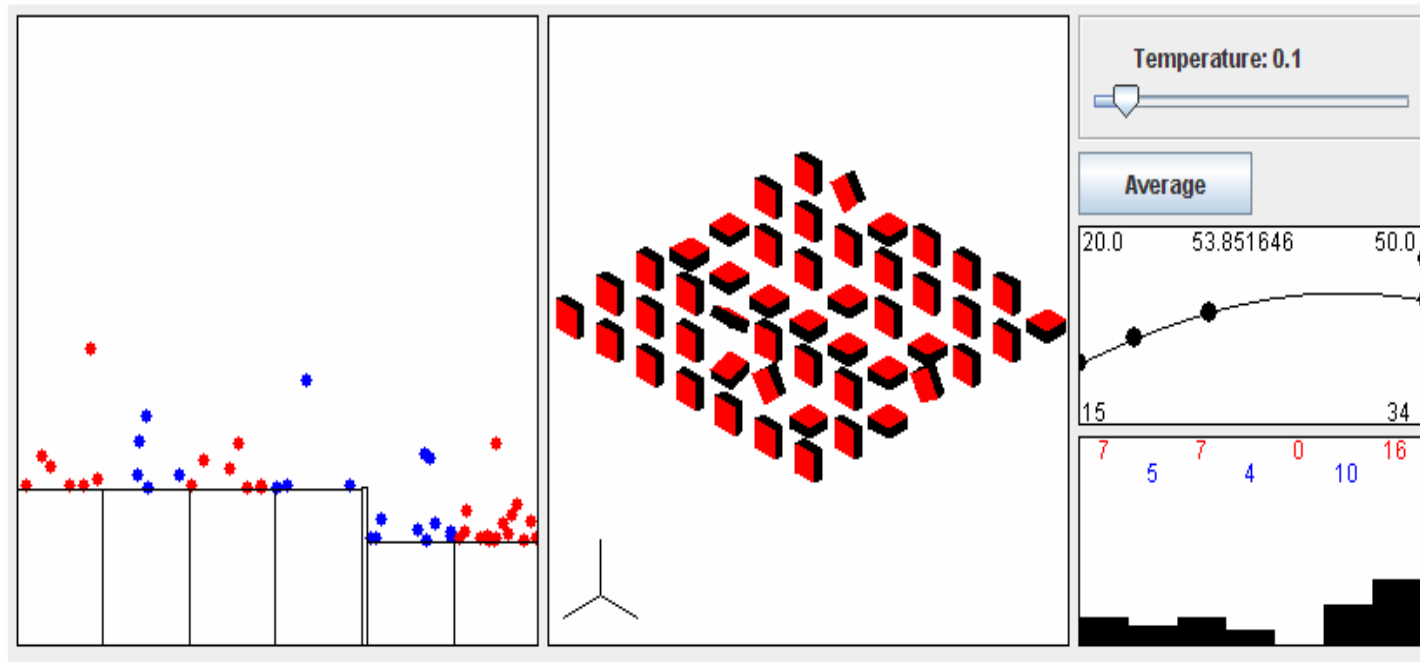
Motion connected to a heat bath



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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