"Big Ideas" and Learning Goals in NSE at the Undergraduate Level
Results of the 2006 Faculty Workshop in Learning & Teaching in NSE

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Faculty Workshop 2006

- Held August 6-9, 2006 at Cal Poly State University, San Luis Obispo
- 32 faculty participants from 17 schools (8 participants from community colleges, 24 from universities) across the country and Puerto Rico
- Emphasis on partnering with the NCLT for learning & teaching research in nanoscale science & engineering (NSE)

Workshop Goals

- To help identify key learning needs in NSE at the undergraduate level
- To develop individual action plans for incorporating nanoconcepts in undergraduate courses and programs
- To foster collaborations to study how undergraduates learn NSE
- To help build a national Clearinghouse of resources (programs, courses, lectures, etc.)

Workshop Activities

Big Ideas Workshop: What do our students need to know?

- How do the "big ideas" play out in higher ed?
- Break out into 4 disciplinary groups (~ 8 per group) to discuss
  - Chemistry
  - Physics
  - Engineering
  - Science Education
- Regroup and report back to entire group
- Results based on response from the 4 disciplinary groups

Learning Goals Workshop: Sketching out learning goals

- Introduction to learning goals/outcomes
- Each participant to write an "action plan" that includes learning goals
- Results based on 20 individual presentations by participants

Participating Institutions

Faculty Presentations on Teaching and Learning in NSE

Teaching and learning in nanoscale science & engineering: What do K-16 students need to know?

Aldrin Sweeney, University of Central Florida

Developing a course, unit, etc. in nanoscale science: Some pedagogical considerations

Greg Light, Northwestern University

Small steps towards incorporating nanoconcepts in the undergraduate physics curriculum

Melissa Eblen-Zayas, Carleton College

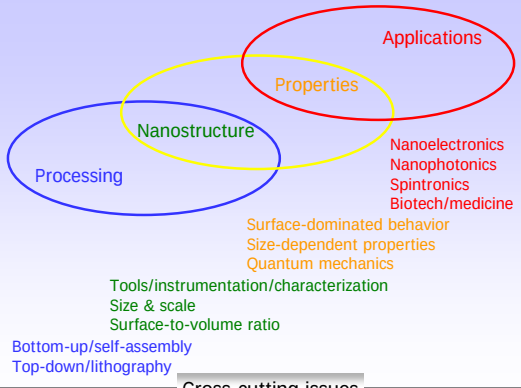
Team-based learning in a nanotechnology course: Enhancing critical thinking through course structure

Linda Vanasupa, Cal Poly State University

'Lesson learned' from creation and execution of a 2-year multi-disciplinary nanoscience program

Deb Newberry, Dakota County Technical College

Big Ideas and Learning Goals in NSE



Cross-cutting issues

Importance of biology/life sciences
Importance of models/simulations
Interdisciplinarity of nano
Societal impact/public education
Safety procedures/hands-on experience

Big Ideas	Topic	Learning Goals
2/4	Bottom-up/self assembly	2/20
1/4	Top-down/lithography	3/20
4/4	Tools/intrumentation/characterization	9/20
3/4	Size & Scale	3/20
2/4	Surface-to-volume ratio	0/20
3/4	Surface-dominated behavior	3/20
3/4	Size-dependent properties	10/20
3/4	Quantum mechanics	2/20
1/4	Nanoelectronics	4/20
0/4	Nanophotonics	1/20
0/4	Spintronics	1/20
0/4	Biotech/medicine	2/20
3/4	Importance of biology/life science	1/20
2/4	Importance of models/simulations	2/20
2/4	Interdisciplinarity of nano	3/20
2/4	Societal impact/public education	4/20
0/4	Safety procedures/hands-on experience	2/20

Major Observations

- Tools/instrumentation/characterization was frequently mentioned, both in big ideas and learning goals.
- Quantum mechanics was thought essential for teaching NSE at the undergraduate level.
- More attention was given to nanostructure vs. properties relationship than to processing and applications.
  More attention may need to be given to processing and applications.
- Societal impact was rarely mentioned in science courses.
- Biology and life sciences are essential to nanotechnology.
  Note: Many engineering schools do not require biology at the undergraduate level