

Higher Education Work Circle

Faculty Workshop for Learning & Teaching of Nanoscale Science & Engineering

T. O. Mason*, M. A. Hersam*, G. Light*, D. L. Drane*,
W. L. Fornes**, E. A. Hagedorn+, K. C. Chen++

*Northwestern University **Purdue University
+University of Texas-El Paso ++Cal Poly State University



Higher Education Activities

- ⊕ Research on undergraduate learning and teaching of nanoconcepts
- ⊕ Resources for higher education in nanoscience/nanotechnology, e.g., the NCLT Clearinghouse (courses, units, nanoconcepts, etc.)
- ⊕ Development of specialization, certificate and degree programs in nanoscience/nanotechnology
- ⊕ Annual Faculty Development Workshop for Learning & Teaching in Nanoscale Science & Engineering

Workshop Goals

- ✦ Establish a nationwide “community of practice” in nanoscale science & engineering education
- ✦ Identify key concepts in nanoscale science/engineering → “Nanoconcept Inventory”
- ✦ Carry out research on nanoscale concept learning & teaching at the undergraduate level
- ✦ Develop “best practices” for undergraduate nanoscale science/engineering education



2005 Workshop Content

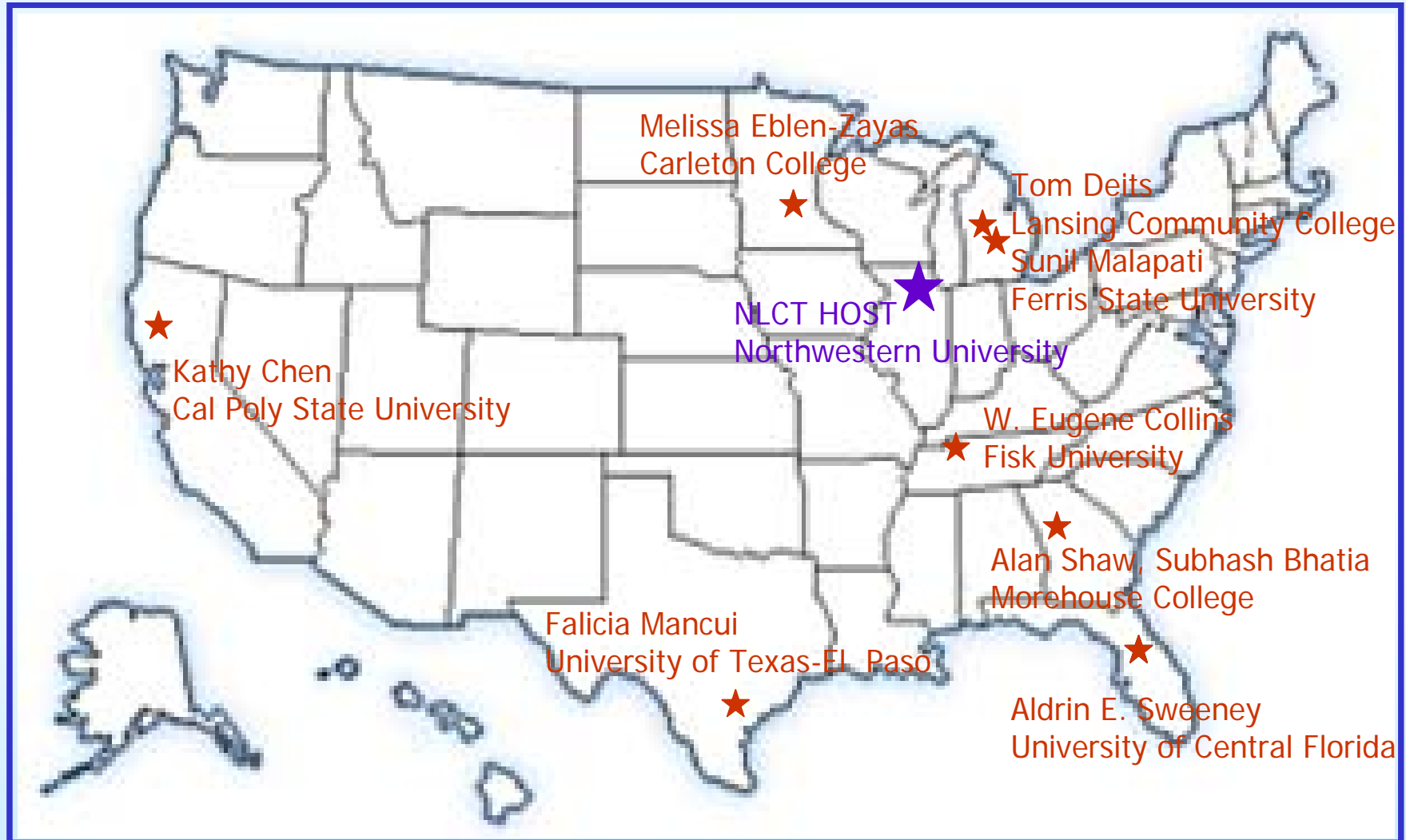
- ⊕ Introduction to nanoscale science & engineering
- ⊕ How to introduce nanoconcepts in the classroom
- ⊕ Teaching methods for nanoscale science/engineering
- ⊕ How to assess student learning outcomes in NSE
- ⊕ Research methods in NSE learning & teaching



Faculty Workshop Recruitment

- ✦ Targeted top-tier liberal arts colleges in US by sending flyers to physics and chemistry department chairs – 38 total
- ✦ Presented & distributed flyers at the Annual Chicago Symposium on Excellence in Teaching Mathematics and Science Research and Practice
- ✦ Potential interested collaborators received flyers

Faculty Workshop Attendees



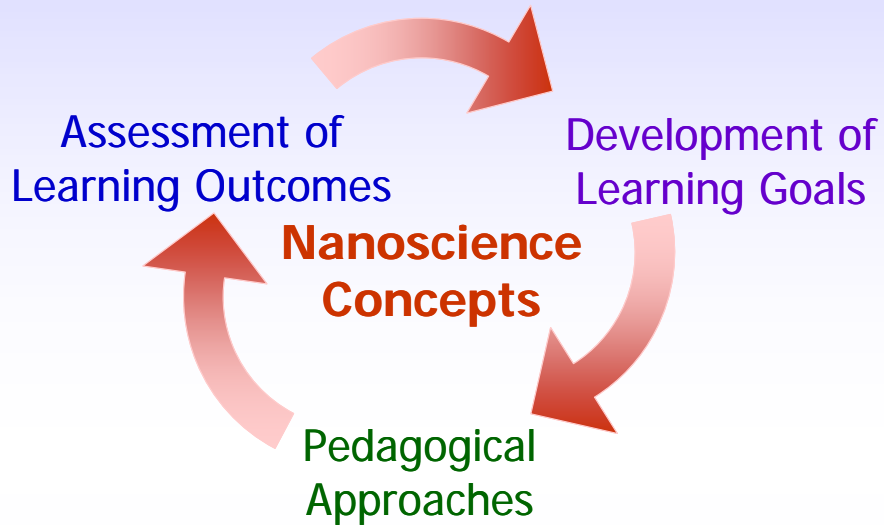
Introduction to Nanotechnology

- ✦ Two lectures by nanodomain expert, Prof. Mark Hersam (Northwestern)



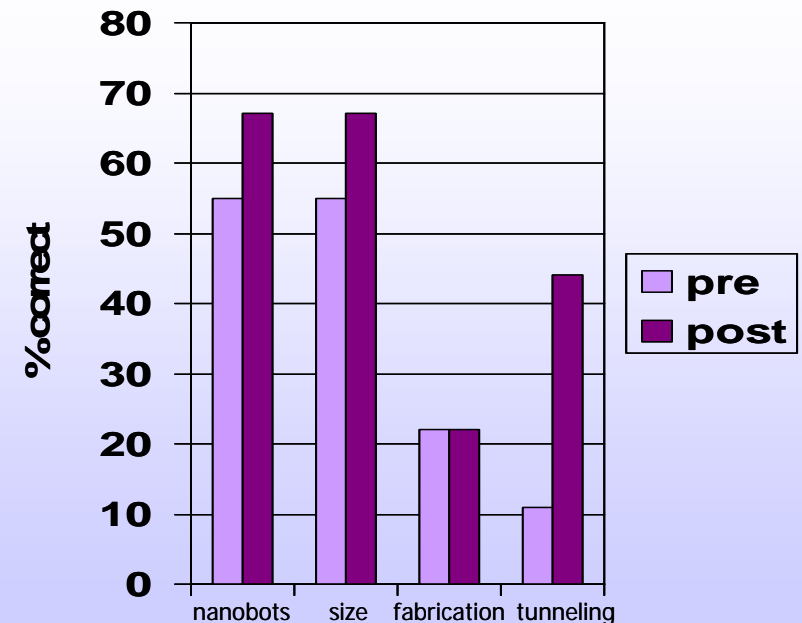
- ✦ What was emphasized:
 - ✦ Common misconceptions re: nanotechnology
 - ✦ How nanomaterials are made (processing)
 - ✦ How they are characterized (structure)
 - ✦ How they behave (properties/applications)

Workshop on Teaching and Learning



- ✦ Faculty participated in 3 interactive sessions on teaching and learning in nanoscience
- ✦ They developed learning goals, pedagogical approaches and assessment methods relevant to the nanoscience content of their own courses

- ✦ Participants completed a nanoscience concept inventory before and after the workshop
- ✦ Participants made gains on the concept inventory across all items.
- ✦ The most difficult items were related to misconceptions about nanotechnology e.g. existence of nanobots, size of a nanometer relative to cells and atoms, nanofabrication and tunneling.



Workshop Evaluation

Workshop Experience (n=9)	Strongly Agree	Agree	Disagree	Don't Know
I enhanced my knowledge of nanotechnology.	4	5	0	0
I developed ways to use my workshop experience to benefit my course.	5	4	0	0
The workshop helped me identify challenges in teaching nanoconcepts to undergraduates.	3	6	0	0
The workshop helped me develop strategies to overcome barriers to introducing nanoconcepts in my course.	1	7	0	1
The workshop provided a helpful framework for developing learning objectives related to nanoconcepts	6	2	0	1
The workshop provided a helpful framework for assessing students' understanding of nanoconcepts.	2	7	0	0

2005 Workshop Outcomes/Projects

- ✦ **Subhash Bhatia (Morehouse College)**, developing a module, “Nanostructures in Bio-systems” for general chemistry, biology, and bioengineering classes.
- ✦ **Melissa Eblen-Zayas (Carleton College)**, incorporating lessons on nanotechnology in her materials science course, plus a nano-module for her introductory physics course.
- ✦ **Tom Deits (Lansing Community College)**, awarded an NSF NIRT for curriculum development in nanotechnology. Plans to introduce nanotechnology modules into chemistry, math, and physical science courses.
- ✦ **Sunil Malapati (Ferris State University)**, integrating nanoconcepts into his junior/senior level biochemistry course. Plans to develop a nanotechnology module for the NCLT Clearinghouse.

The 2nd Annual Faculty Workshop for Learning & Teaching of Nanoscale Science & Engineering

- ✦ To be held August 6-9, 2006 at Cal Poly State University (San Luis Obispo)
Host: Prof. Kathy Chen
- ✦ Anticipate approximately 25 faculty participants from across the country
- ✦ Emphasis on partnering with the NCLT for learning & teaching research in nanoscale science/engineering



2006 Workshop Goals

- ✦ Identify key learning needs in nanoscience/nanotechnology at the undergraduate level
- ✦ Develop action plans for incorporating nanoconcepts in undergraduate courses and programs
- ✦ Foster collaborations to study how undergraduates learn nanoscience/nanotechnology
- ✦ Help develop a National Clearinghouse of Resources (course, lectures, demos, etc.) for nanoscience/nanotechnology educators