Nanoscale Science and Engineering Education Programs at the National Science Foundation

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Nanoscale Science & Engineering Education

- Centers for Learning and Teaching in Nanoscale Science and Engineering (NCLT)
- Informal Science Education in Nanoscale Science and Engineering (NISE)
- Instructional Materials Development in Nanoscale Science and Engineering (NIMD)
- Nanotechnology Undergraduate Education (NUE)
Centers for Learning and Teaching in Nanoscale Science and Engineering (NCLT)

- Develop a cadre of STEM education leaders focused on nanoscale science and engineering.
- Provide professional development to teachers in Grades 7-12 and undergraduate faculty.
- Conduct research on issues related to integrating advances in nanoscale science and engineering into middle school through undergraduate curriculum.
NCLT: Develop Nanoscale Science & Engineering Education Leaders

Northwestern University, Chang (0426328)
http://www.nclt.us/

Instructional Modules based on the themes: (1) Manipulation of Light in the Nanoworld; (2) Information Storage and Processing; (3) Mechanical Properties of Nanomaterials; (4) Tools for Probing the Nanoworld; (5) Design and Fabrication of Nanomaterials; and (6) Nanomaterials for Energy, Environment, and Pharmaceuticals.

The teacher professional development activities will be built around the implementation of these instructional materials.
Informal Science Education in Nanoscale S&E

Too Small To See (Cornell University, Anna Waldron, 0426378)

A 3,500 square foot traveling exhibition that explores two concepts:
• How do we see things too small to see?
• How do we make things too small to see?
The intended audience is children of ages 8-13 and adults

Earth & Sky Nanoscale Science and Engineering Radio Shows (Earth Talk, Inc., Britton, 0426417)

A series of 72 radio shows on nanotechnology. Shows will also be available on the project’s website
Instructional Materials Development (K-12)


• Development team of Scientists, Science Education Professionals, Teachers, and Assessment Experts

• Pilot and Field tested and revised after each test

• Published and Marketed by Commercial Publishers
Issues in K-12 STEM Education

• Working Conditions in the Schools
• Teachers Teaching out of Field
• Social Issues/Safety
• Accountability Issues (Testing)
Instructional Modules

Example 1

Probing the Nanoworld (Mid-Continent Research for Education and Learning, Ristvey, 0426401)

- Modules on nanoscale science and engineering
- Replacement Units for existing curricula
- Collaboration with Stanford Nanofabrication Facility
Instructional Modules, Example 2

_NanoSense: The Basic Sense Behind Nanoscience_ (SRI International, Schank, 0426319)

Units for high school science. Central Concepts:
- Properties at the Nanoscale (electromagnetic, optical, mechanical, surface effects, surface area vs. volume)
- Self Assembly (bionanotechnology, crystal structure)
- Quantum Principles & Probability
- Scale (size, number, forces, properties, time)
- Energy (role of interparticle interactions, scale of energy)
- Nanostructures (nanotubes, colloids, thin films, dots)
- Fabrication (tools, processes, metrology)
NanoSense: The Basic Sense Behind Nanoscience
(Schank, SRI International, 0426319)
Learning Goals:
• Distinguish common objects (atom, cell, human hair) in terms of size)
• Predict whether certain sizes of aggregations of matter will exhibit bulk or nanoscale properties
• Describe two or more applications of nanoscale science and their possible effects on society

http://www.nanosense.org/index.html
What We Learned from Pilot Tests

Students in two AP Chemistry courses:
• Were engaged and on task with the activities;
• Had taken physics and understood why different forces dominate at different scales;
• Seemed to grasp the concepts;
• Had difficulty using their existing knowledge to explain the novel effects at the nanoscale.

The teacher is 2-3 standard deviations beyond the typical teacher and yet:
• Struggled with the fundamental concepts
• Had trouble fielding some of the questions
• Had an incomplete picture of how things work at the nanoscale and reverted to her knowledge of the macroscale.