# Nanotechnology and Society

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Background

- **Societal Implications of Nanotechnology**
- **Proposal for Nano & Society teaching at UW**
- **Undergraduate Course (Spring '05)** *"Nanotechnology and Society"*
  - Sci. and Tech. Studies 201, 2 sections, 3 credits
  - 2 Graduate students: Ricky Leung (Sociology) and CT (Physics)

"The National Nanotechnology Initiative sets aside $80 million out of $774 million for education and societal implications ($30m), and environmental studies ($50m) in 2003."
                                    - M. C. Roco, NSF
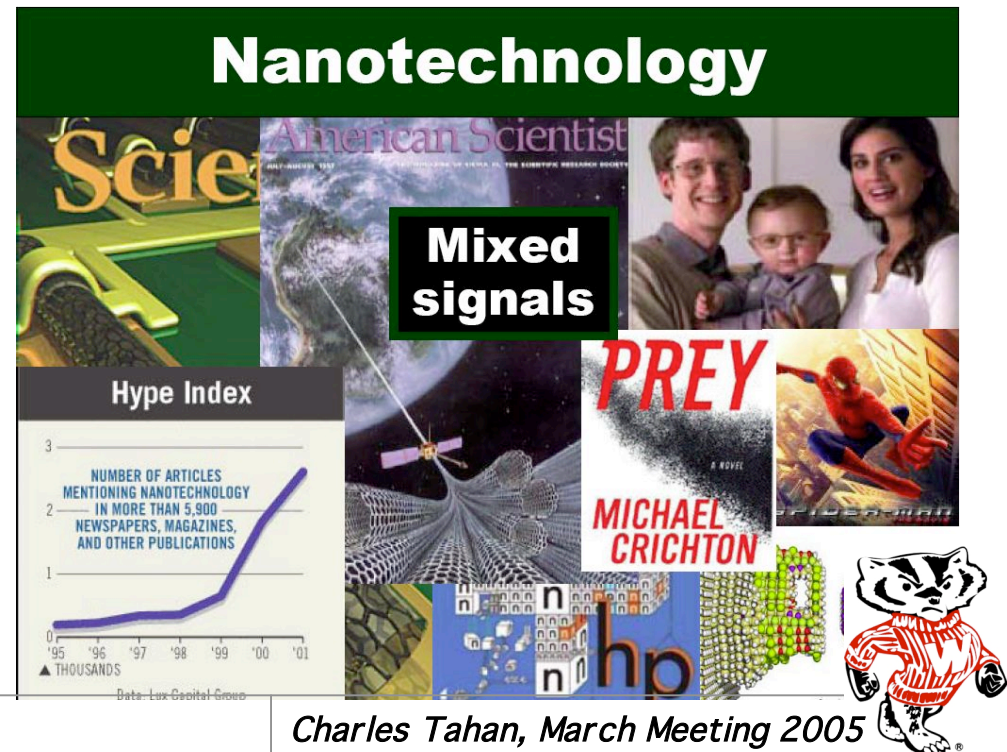
Preparation for Class This Spring

- **Graduate Seminar last fall**

- **Introduction to materials - sociological texts/ nanotech readings**

- **"Clash of civilizations"**

- **Led by graduate students**

- **Chance to test active learning/discussion techniques**

Examples:
- **Think-Pair-Share**
- **Jigsaw**
- **Town-meeting format**
- **Group discussion**
- **Black-board exercises**
- **...**

(Organized by G. Zenner, W.Crone, C. Miller, K. Ellison)

My class

STS **201**: Nanotechnology and Society, and Freshman (and Sophomores, and Juniors, and …).

Freshman (4)

Sophomores (11)

Juniors (4)

Seniors (4)

Mixed class.

Atmospheric & Oceanic Sciences

Biology

Undecided

Biochemistry (**4**)

Botany

Business/Marketing (**2**)

Chemical Engineering

Communicative Dissorders

Computer Science/Eng. (**5**)

Legal Studies

Mathematics

Nuclear Engineering (**2**)

Pharmacy

Zoology

Pre-assessment

PRE ASSESSMENT
STS 201: **Nanotechnology and Society**
Section 84405

Please rate your comfort level with the following topics.	Very Comfortable	Comfortable	Slightly Comfortable	Not Comfortable
1. The science of nanotechnology.	☐ 0%	☐ 17%	☐ 48%	☐ 35%
2. Any science or engineering field.	☐ 36%	☐ 36%	☐ 28%	☐ 0%
3. Science and society issues.	☐ 21%	☐ 42%	☐ 33%	☐ 1%
4. Nanotechnology and society.	☐ 0%	☐ 22%	☐ 43%	☐ 35%

Pre-assessment

Where did you first hear the term nanotechnology?

1. News/Internet/TV
2. This class
3. Science fiction
4. Pop-sci

5. Sister's boyfriend
   Bill Clinton
   Feynman
   A video game

Define nanotechnology.

- Study/tech of small particles/minute/very, very small tech (6)
- Study/design/manufacturing of products/objects at nanoscale (5)
- "…to make our lives easier/better/improve society" (4)
- Technology involving microscopic particles
- "minute scale"
- Technology on nanometer scale
- Modification and altering of nanoparticles or atoms (1)
- Larger than a single atom and smaller than a living cell (1)
- 10^{-9} meters (1)

Pre-assessment

Give three examples of nanotechnology applications.

Really, Really Fast Computers/chips (7)
Carbon nanotube particles
Water resistant fabrics
Stain free pants (3)
Fiber Optics
Biotech (2)
Quantum Dots (2)
CPU lithography
Microchips
LCD screens

Stained glass (8)
Medicine/Medical things (4)
Surgery
Robotics
Synthetic diamonds
Nanobots (2)
Sensors and data acquisition
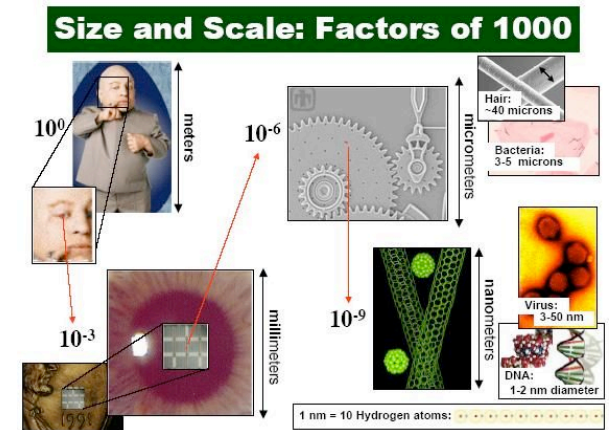Agriculture (2)
Military
Sensors

Curriculum

Size and Scale: Factors of 1000

TEXTS:
- **Hand-made course reader** (sociological, science and technology studies, history of science, science policy, nanotechnology reviews)
- **Understanding Nanotechnology** (SciAm Press)

Syllabus

1. Introduction to Nanotechnology and Society
2. Topics in Nanoscience
3. Nanotech in Culture
4. Revolutions and the History of Science and Technology
5. Technology and Society
6. *How Government Drives Technology*
7. Weighing the Risks
8. Policy Reports and Reviews
9. Thinking about the Future

Congressional Mock Hearings/Town Hall Meetings

1. Nanotech Funding: Should the government continue funding of nanotechnology research?
2. Public Participation: Should the public have an active role in the evolution of nanotechnology? How?

Research Project and Presentations

1. Summary report on a key nanotechnology, it's applications, and it's implications.
2. 25 students, 25 technologies.
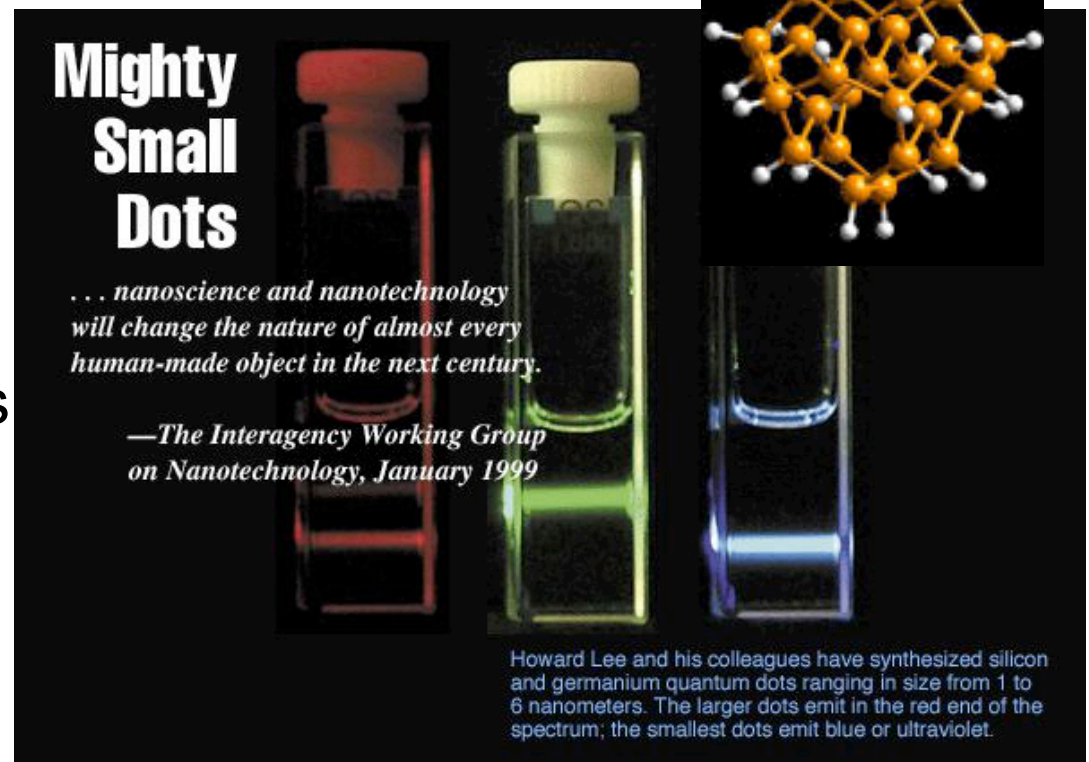3. Result: Pamphlet on Nanotechnologies for the lay person.

Nanotech Example

Quantum dot nanocrystals

- Bulk-"Nano" transition

- Optical properties: bandgap, photons

- Atom-like properties

- Bands become energy levels

- "Cool or Hot, Quantum or Not"

Silicon nanocrystal

Mighty Small Dots

. . . nanoscience and nanotechnology will change the nature of almost every human-made object in the next century.

—The Interagency Working Group on Nanotechnology, January 1999

Howard Lee and his colleagues have synthesized silicon and germanium quantum dots ranging in size from 1 to 6 nanometers. The larger dots emit in the red end of the spectrum; the smallest dots emit blue or ultraviolet.

Nano+Society Example

6. How Government Drives Technology: **Military and Tech**

Reading:

(Policy) **M. C. Roco**, *The US National Nanotechnology Initiative After 3 Years*, **Journal of Nanoparticle Research, 6: 1-10, (2001-2003)**

(Society/STS) **David Noble**, *Command Performance: A Perspective on Military Enterprise and Technological Change*, **in Military Enterprise and Technological Change (Cambridge: MIT Press 1987).**
  • **Performance, Command, Modern Methods**

(News) **D. Talbot**, *Super Soldiers*, **in MIT Tech Review Oct 2002, 105(8): 44-50.**

(Science) **Video: Institute for Soldier Nanotechnologies**

Working through it:

Debates, Town Hall Meeting, Discussion, Essay

Rumsfeld vs. Langdon Winner

Research Projects

"Centers of Knowledge"

Professional article for a lay audience: science/societal implications.

(Matt) **(Racheal)** Nanofab/Manufacturing

Nanofab: Inkjets/Dip Pen/AFM

Nanoscopes (STM/AFM)

NEMS **(Adam)** **(Mike)**

(Sweeney) **(Justin)** Nanoparticles and Drug Delivery

Cancer and Nanotechnology

Nanotech at UW Hospital (?)

Diagnostics/Lab on a chip **(Nicole)** **(Kaizan)**

(Lynn) **(Adam)** Many Faces of Carbon

Carbon Fullerenes (Buckyballs)

Carbon Nanotubes (mechanical properties) **(Lianne)**

(Mark) **(Brent)** Nuclear Nanobatteries

Solar Energy and Nano

Nanomaterials (QDs in substrates)

Nanoelectronics **(Mike)** **(Aaron)**

(Troy) **(Adam)** Nanocrystals as QDs/Medical Imaging

QDs on the Body

Nanobiotechnology **(Dong)**

Nanoparticles and nanocrystals: Synthesis and Toxicity

Nanofiltration/ Sorting/ Water Desalinization

Nanotech and Agriculture

Nanocrystals as Catalysts

Output

- Research Reports
  1. **Summary report on a key nanotechnology, it's applications, and it's implications.**
  2. **25 students, 25 technologies.**
  3. **Result: Pamphlet on Nanotechnologies for the lay person.**

- Curriculum materials / Course portfolio

- Did it work? (assessment)

  - T - 1 month to go

  - Write something up.

Wisconsin Initiative on Nanotechnology and Society
http://www.lafollette.wisc.edu/research/Nano/

http://tahan.com/charlie/