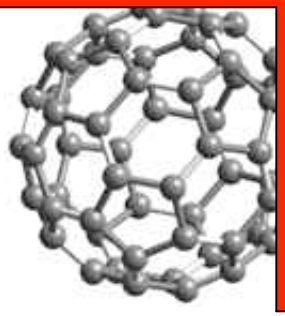
The Ambassadors of Nano



Charles Tahan
Physics Department
December 16, 2004
University of Wisconsin, Madison

The People

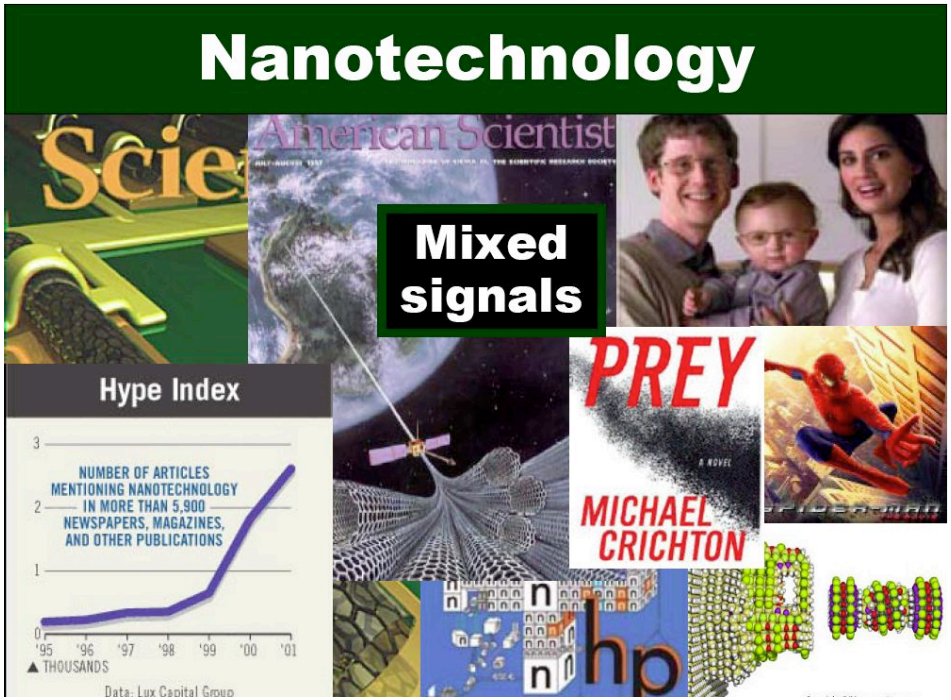
NUE: ***An Integrated Approach to Teaching Nanotechnology and Society***

Background

- **Societal Implications of Nanotechnology**
- **Preempt what happened in GM foods**
- **Proposal for Nano & Society teaching at UW**

"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



Components

***NUE:** An Integrated Approach to Teaching Nanotechnology and*

- **Graduate Seminar (Fall)**
  - 1 hour/week
  - Sci./Eng. and Humanites grad. students
- **Guest Lectures**
  - Introduction To Engineering 160
  - Med. Hist. & Bioethics 559: Body Modification
- **Undergraduate Course (Spring '05)**
  - 3 hours/week
  - Sci. and Tech. Studies 201, 2 sections

Graduate Seminar

- **Introduction to material**
- **Preparation for Spring course**
- **Led by graduate students**
- **Chance to test active learning/discussion techniques**

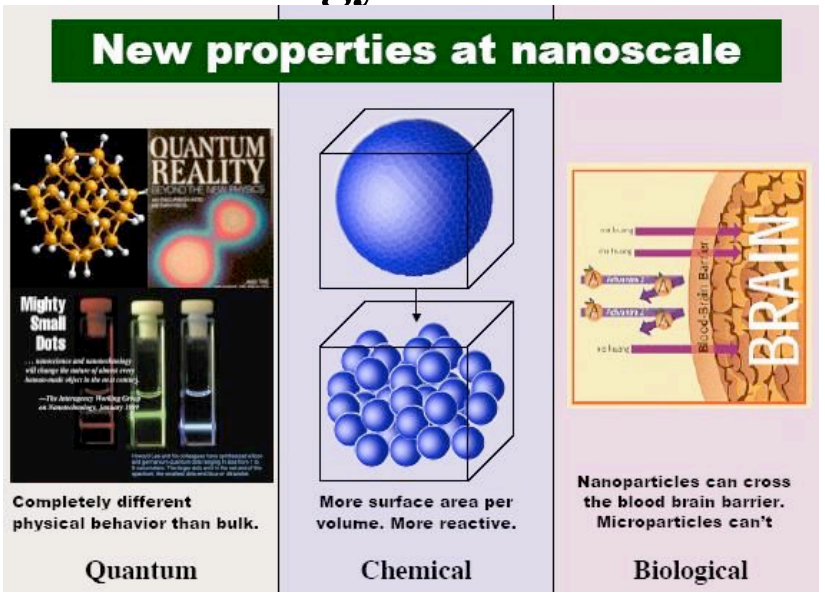
Examples:
- **Think-Pair-Share**
- **Jigsaw**
- **Town-meeting format**
- **Group discussion and reporting**
- **Black-board exercises**
- **…**

COURSE OUTLINE
Week 1: Course Introduction
Week 2: What is Nanotechnology? Why Do We Care about Its Societal Dimensions?
Week 3: What is Progress?
Week 4: Technologies as Forms of Life
Week 5: Social Choices and Technological Change
Week 6: The Politics of Technological Change
Week 7: The Military and New Technologies
Week 8: Technological Accidents
Week 9: Technology, Risk, and Society
Week 10: Nanotechnology Risks – Environment and Health Impacts
Week 11: Nano-Critics
Week 12: Government Assessments
Week 13: Science Fiction
Week 14: Technology and the Future

Guest Lectures

- **Introduction to Engineering 160:**
  - **Freshman design course**
- **Goals:**
  - **Introduce basics of nano**
    - **Size and Scale, Definition?, Possible Applications**
    - **Interdisciplinarity, Generate Interest as Career Path**
  - **Consider societal implications of technology**
    - **Environmental, Sociological**
  - **Assessment**

In one 50 minute class in a big lecture hall.

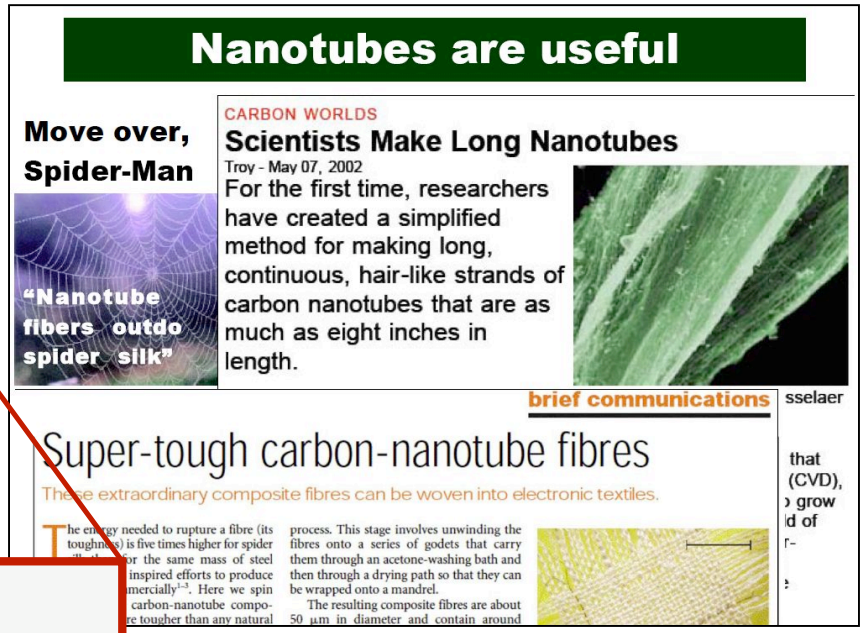


Intro. to Eng. Guest Lecture

- Course format:
  - Introduction to Nano (12 min.)
  - Group Discussions and Reports
    - **Activity**: Brainstorm ways in which new ultra-strong materials based on carbon nanotubes could be used in different sectors of

What they came up with:

- Shark-proof life jacket.
- Elevator cable to bottom of ocean.
- Conductive electricity net in earth's atmosphere.
- Unbreakable fishing net.
- Better bullet-proof vest.



Guest Lecture Assessment

1) The size of a material can determine its properties (i.e. macro vs. nanoscale).

93% answered True

True False (Circle One)

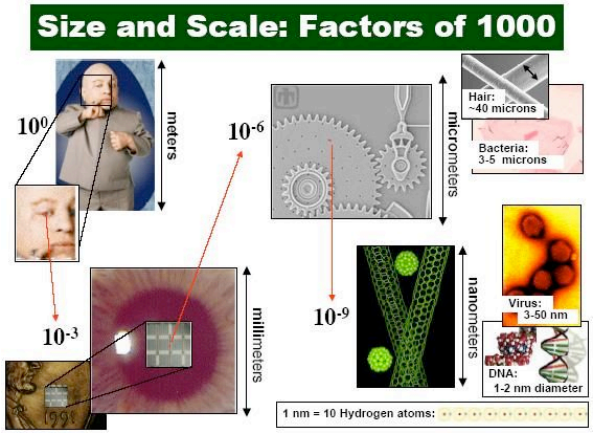
2) Rank the following 4 items from largest to smallest:

92% knew that a hydrogen atom is the smallest and hydrogen atom < 10 nm

MiniMe
bacteria
hydrogen atom
10 nanometers

MiniMe _____ bacteria _____ 10 nm _____ Hydrogen _____

LARGEST → → → smallest



What action do you believe should be taken concerning research and regulation of nanotechnology? (Choose One)

- ☐ Use existing regulation protocols.
- ☐ Develop a new legal category specific to nanosized substances
- ☐ Wait to impose regulation after research has been done to investigate the environmental impact of nanotechnology.
- ☐ Impose a moratorium (ban) on nanotechnology research.

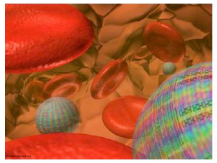
Why? (Support your choice with a brief explanation.)

Guest Lecture for MHB 559

- **Medical History and Bioethics 559: Body Modification**
  - **Upper undergraduates**
  - **The application of technology (mostly biotech) to the modification of the human body and its implications**
- **Goals:**
  - **Introduce basics of nano**
    - **Size and Scale, Definition?, Possible Applications**
  - **Overview medical applications of nano today and in near future**
    - **That are realistic!**
  - **Introduce more fantastic possibilites in far future**
    - **Nanomedicine's future.**
    - **Relevant to body modification.**

Applications to medicine

- Labeling/Contrast Imaging
- Cancer treatment or drug delivery
- Testing/detection
- Visualizing the nanoscale: the AFM
- Nanotoxicology & Environmental Impact



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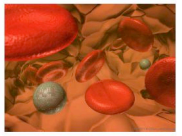
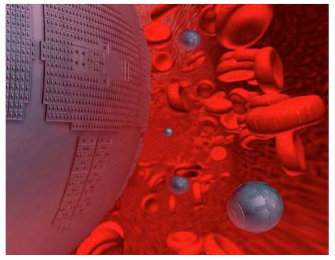


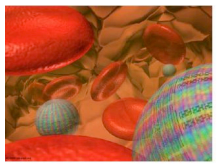


Guest Lecture for MHB 559

- **Course format: 75 min.**
  - Introduction to Nano & Medical applications today (30 min.)
  - Nanomedicine's future (20 mn.)
  - Discussion (25 min.)
- In-situ assessment:
  - Students raised issues and concerns present in the literature, unprompted.

Applications to medicine

- Labeling/Contrast Imaging
- Cancer treatment or drug delivery
- Testing/detection
- Visualizing the nanoscale: the AFM
- Nanotoxicology & Environmental Impact



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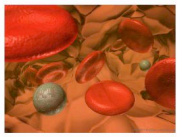
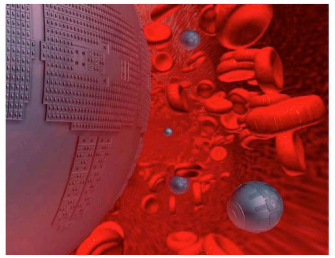




Undergraduate Course

- **STS 201: Nanotechnology and Society**
- **3 hours/week 200 level course**
- **2 Sections: One lead by Ricky Leung, one by Me, 25 students each**
- **Discussion format class**

Course objectives (from my syllabus):

1. To introduce you to the broad and ill-defined field of nanotechnology and the science and technology behind it;
2. To consider the societal implications of nanotech in the context of social, scientific, historical, political, environmental, philosophical, ethical, and cultural ideas applied from other fields and prior work;
3. To develop your questioning, thinking, idea producing, and communication skills, both written and verbal.

Undergraduate Course

- **STS 201: Nanotechnology and Society**
- **Course portfolio**

My class:

Syllabus

1. Introduction to Nanotechnology and Society
2. 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

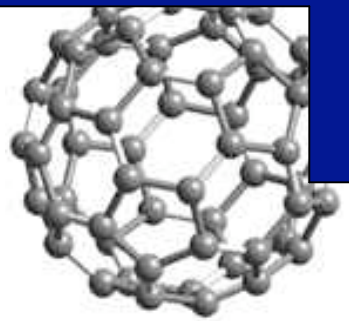
Congressional Mock Hearings

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.

Nanotechnology and Society



A course being offered next spring: **Science and Technology Studies 201**

What is nanotechnology and why are scientists, businesses, and governments around the world so excited about it?
What happens when nanotechnology leaves the laboratory and enters society?
How will nanotechnologies change our future?
Take our class and find out.

STS 201: Nanotechnology and Society, 2 sections being offered:

#84375	T, R	9:30-10:45 am	by Ricky Leung
#84405	M, W, F	9:55-10:45 am	by Charlie Tahan