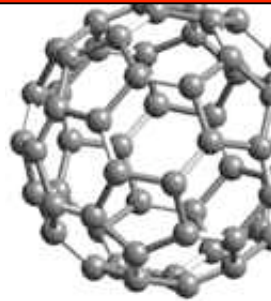


The Ambassadors of Nano



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

The People

NUE: An Integrated Approach to Teaching Nanotechnology and Society

Ricky Leung
Sociology

Wendy Crone
Eng. Phys.

Karin Ellison
Hist. Science

Clark Miller
Sci. & Tech. Studies

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MRSEC



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 Humanities 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

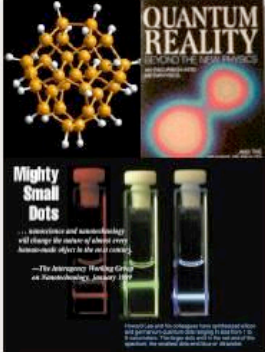
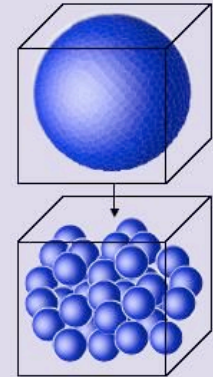
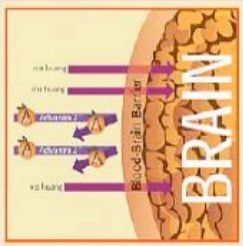
Week 14: Technology and the Future



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.

New properties at nanoscale		
 <p>Completely different physical behavior than bulk.</p> <p>Quantum</p>	 <p>More surface area per volume. More reactive.</p> <p>Chemical</p>	 <p>Nanoparticles can cross the blood brain barrier. Microparticles can't</p> <p>Biological</p>

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.

Nanotubes are useful

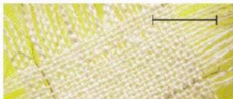
Move over, Spider-Man
"Nanotube fibers outdo spider silk"

CARBON WORLDS
Scientists Make Long Nanotubes
Troy - May 07, 2002
For the first time, researchers have created a simplified method for making long, continuous, hair-like strands of carbon nanotubes that are as much as eight inches in length.



Super-tough carbon-nanotube fibres
These extraordinary composite fibres can be woven into electronic textiles.

The energy needed to rupture a fibre (its toughness) is five times higher for spider silk than for the same mass of steel. Inspired efforts to produce carbon-nanotube composites commercially. Here we spin carbon-nanotube composite fibres tougher than any natural process. This stage involves unwinding the fibres onto a series of godets that carry them through an acetone-washing bath and then through a drying path so that they can be wrapped onto a mandrel. The resulting composite fibres are about 50 µm in diameter and contain around



that (CVD), grow id of

Community Reports

Shing Village
Las Vegas
airy Town
st Belt Town

Traveling Circus
Space Station
Retirement Community
State Prison
Deserted Island

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

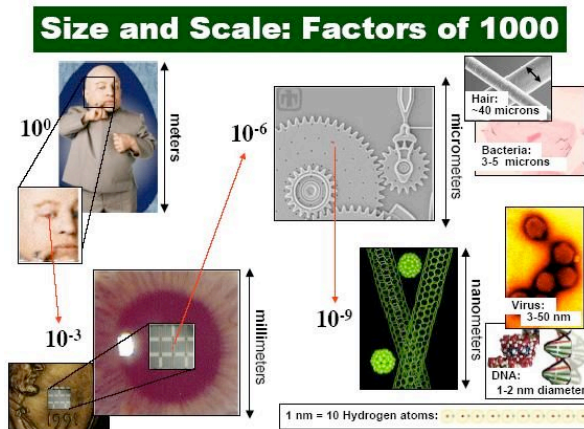
LARGEST

→

→

→

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.

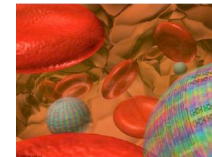
Why? (Support your choice with a brief explanation.)

Guest Lecture for MHB 559

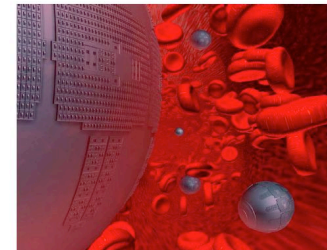
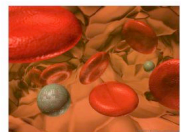
- **Medical History and Bioethics 559: Body Modification**
 - Upper undergraduates
 - The application of technology (mostly biotech) to the modification of the human body and its implications
- **Goals:**
 - Introduce basics of nano
 - Size and Scale, Definition?, Possible Applications
 - Overview medical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



Respirocyte

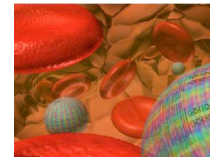


Guest Lecture for MHB 559

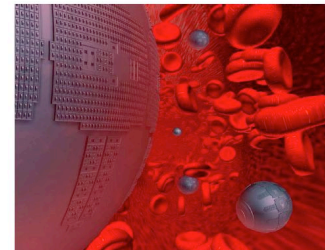
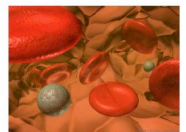
- **Course format: 75 min.**
 - Introduction to Nano & Medical applications today (30 min.)
 - Nanomedicine's future (20 mn.)
 - Discussion (25 min.)
- **In-situ assessment:**
 - Students raised issues and concerns present in the literature, unprompted.

Applications to medicine

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



Respirocyte



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?

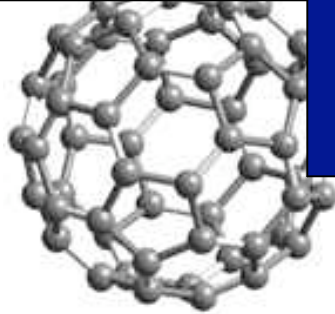
Research Project and Presentations

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