

Science and Technology Studies 201, Section 84405

## **Nanotechnology and Society**

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*Meets:* M, W, F (9:55 – 10:45) in Rm 234, Education Building, Spring '05

*Credits:* 3

*Instructor:* Charlie Tahan, Physics Department, Wisconsin-Madison

*Office:* 1202 Sterling Hall (Physics) or 6321 Social Sciences

*Office Hours:* 11-12pm MWF in 6321 Social Sciences

*Course Website:* <http://tahan.com/charlie/nanosociety/course201/>

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Syllabus: Course Overview, Course Outline, Major Assignments

### **Course Overview**

#### **Course description, objectives, and philosophy.**

This is a new course offered by the University on a new subject. I have no doubt that we will all – me included – learn new things as we go. Broadly, the objectives of this course can be summarized as follows:

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.

#### **Course requirements.**

*Required materials:* We will use one small text, available at the campus bookstore, in addition to supplemental reading materials, which will be available in a reader, which you can buy at the *Life Science Copy Shop* in the Agricultural Engineering Building (located around the back of the building – they only except cash or checks).

- S. Fritz, [\*Understanding Nanotechnology\*](#), from the editors of Scientific American, Warner Books (2002).
- A [course reader](#) available at the Life Sciences Copy Shop.

A decent notebook will serve you well in this course too.

*Class participation and homework (25%).* This is a discussion-based class and student involvement is vital to exploring the issues we will consider. I will be taking attendance sporadically via informal writing assignments (in-

class or homework). In-class writing (a few minutes at the beginning or end of class for example) will be checked for existence while homework writing will be graded on a check, check+ basis to differentiate and encourage quality. Assignments will be weighted by difficulty level. For example: an in-class writing assignment will get a single-check weighting while a two-page response essay for homework may get a three-check weighting.

*Exams (25%).* There will be one in-class midterm and a final exam each worth 12.5% of your grade. The midterm will be on Friday, March 4 and the final will be on Friday, May 13, during the exam period.

*Writing (20%).* This course is to a large extent about connecting disparate questions, concepts, facts, and ideas, and then producing our own. Writing is a vital skill in this endeavor in that it is the formal way of communication and contribution. There will be 4, 2-3 double-spaced paged response or op-ed type essays for each of the main topics we will cover. Each of the four graded essays will end up being 5% of your class grade. We'll talk more about this.

*Research Report and Presentation (30%).* There will be one personal research project with both a written (approximately 5 double-spaced pages with figures) and a class presentation (10-15 minutes) component. This will be on a particular topic of your choice (from my list of topics, barring duplicates) in nanoscience or nanotechnology and its implications. There will be four deadlines: 1) choice of your topic, 2) basic outline, 3) first draft, and 4) final version. More later.

### **Extra credit.**

I like jokes and corny poems and other interesting tidbits related to nano or quantum tech. There will be a contest for the five best nanojokes, nanopoesms, or nanofacts. Send them to the email list and I'll collate them on the web page. At the end of the semester we'll vote on them. The winners will get 4% extra credit and anyone who submits more than three entries will get 2%. These can be original or discovered, but if discovered the proper source and where you found it must be cited. As you would expect, novel finds or creations are better.

### **Other things.**

*Email list.* Listed above. It will be a good place to find any new articles or news concerning nanotech that we might find, but also any thoughts or ideas we might have as we go along. Of course, this is the place to send the aforementioned nanojokes, etc.

**Questions.** Part of being a good scientist or sociologist – or any –ist for that matter – is the talent of asking good questions. So that’s one of the skills I want to focus on in this course. I encourage you to write all the good questions you come up with in your notebook. As an in-class attendance check assignment I might ask you to write down your three latest questions. We’ll talk about this in class.

**On Academic Integrity.** And I quote: “You are expected to express your ideas and to sustain arguments in your own words. Failure to do so is plagiarism. It is unethical and often illegal. Plagiarism ranges from the blatant—purchasing a term paper or copying on an exam—to the subtle—failing to credit another author with the flow of ideas in an argument. Properly acknowledging the use of the words of others and avoiding excessive quotation of the work of others will eliminate most plagiarism problems. If you want to quote from a published work (including a web page), you must put the passage in quotation marks and provide a citation. Simply changing a few words from the writings of other authors does not alter the fact that you are essentially quoting from them. Paraphrasing of this sort, where you use the words of another almost verbatim without acknowledging your source, is the most common form of plagiarism among undergraduates. When you state another author's viewpoint, theory, or hypothesis—especially when it is original or not generally accepted—you must also include a reference to the published work. In general, citations are unnecessary when the information is considered common knowledge or a matter of widespread agreement. Common knowledge can often be identified by its appearance in several of the assigned readings for class.

“All papers prepared outside of class must have a bibliography at the end. This provides readers with a complete list of sources consulted, regardless of whether you quoted directly from them, and serves to acknowledge your intellectual debts to them. Another common and related problem may arise from working with another student in studying and carrying out assignments. Such collaboration is encouraged, but the work that you submit must be in your own words, and not jointly written or copied. If you are unclear about collaborating, paraphrasing, quoting, or the need to indicate sources, I will be glad to speak with you and can recommend additional materials for clarification. Failure to maintain academic integrity in any portion of the academic work for the course shall be grounds for awarding a grade of F for that assignment.”

## Course Outline

Knowledge is not linear, but our course has to be. So we’ll find ourselves repeating some material and foreshadowing future material often throughout the semester. The goal is to gain a state-of-the-art understanding of nanotechnology in the context of the issues surrounding it and the history preceding it.

### Introduction to Nanotechnology and Society

How do various people and groups define nanotechnology? How does it compare to previous technology? What’s so special about it? What path has got us here? Why should we care about the societal implications of nanotechnology?

### Nanoscience

Instead of doing this section in one big lump, we’ll tackle the topics below in individual classes spread out through the semester.

- Bigger is better? I don’t think so.
- Nanofabrication: Self-assembly vs. assemblers and good-old Lithography.
- Electronics at the Nanoscale.
- The Quantum World.
- Scanning Probe Microscopes.
- Quantum Dots aka Nanocrystals.
- The Many Forms of Carbon.
- Nanomedicine: Facts and Guestimates.
- Nanobiotech: Biosensing and More.
- Nanobots: Fact or Fiction?
- Quantum Information Technology.

### Nanotech in Culture

- **Nanoproducts.** What real nanoproducts are on the market now and what’s nanohyped?
- **Science Fiction.** What examples of nanotech in fiction can we find? What aspects of nano do authors focus on? How does science fiction bring science/technology to the public? What effect does it have?
- **In the News.** How has nano seeped into the media?

### Revolutions and the History of Science and Technology

What is technology? What is science? Is nanotech a new industrial revolution? Is it any kind of revolution? How does it compare to prior history (e.g. railroads, electricity)? How will it be different (from a U.S.A. perspective, from a global perspective)? Is the pace and number of revolutions quickening?

### **Technology and Society**

- **Progress.** What is progress? Do technological innovations necessarily contribute to progress? How does nanotech fit in?
- **Technology as Forms of Life.** How does technology affect the way we live? How might nanotech make a new form of life?
- **Social Choices.** How do the users shape the development of technology?
- **The Politics of Technological Change.** Is technology political? How might politics change technology?

### **How Government Drives Technology**

- **Nanotechnology Funding Initiatives.** How much money is being put into nano? From where? In the U.S.? Abroad? Why? To what disciplines?
- **Science Agencies.** What agencies handle nanotech funding? How does the process work?
- **The Military and Technology.** How does the military affect technological evolution now and in the past? To what extent is the technological world around us due to intervention by the military's needs? Are the results positive or negative?

### **Weighing the Risks**

- **Risk Analysis.** How does society decide what kinds of risks are acceptable given the possible consequences of pursuing a certain technology or science? How does industry (manufacturing companies, insurance companies, etc.)? How is nanotech being approached in this context?
- **Nanotoxicology.** Is nano explicitly more dangerous than micro? What may make nanotech more toxic? How does it differ from traditional toxic sources: chemical industry, air pollution, etc.? What research has already been done? How has it affected policy and public perception?
- **Accidents.** What is a *normal accident*? Is nano more or less prone to major accidents than any other technology?
- **Nanoethics.** Do scientists need to worry about ethics? What's wrong with the current arguments supporting nanotech?

### **Policy Reports and Reviews**

- **Nano-Critics.** What social groups care about nanotechnology? What reasons do they give for their concerns? What do they suggest?
- **Government Assessments.** What do governments think about all this?

**Thinking about the Future**

- **Prophets, Worriers, and Hacks.** What do the minds of today (or at least those who get media attention) think about nanotech?
- **More Science Fiction.** I just can't help myself.
- **Reflections.** What have we learned? Where do we see things going?

## **Major Assignments**

### **Essays**

There will be four response or op-ed type essays. should be no longer than three double-spaced pages.

### **Research Project**

The goal here is to compile a pamphlet of the present-day key nanotechnologies and their implications. One student will be responsible for one nanotechnology area.

I'll compile a list of specific nanotechnologies.

You will pick one and write a 5 double-spaced page summary report describing the technology, it's possible uses, and it's potential implications (with figures).

There will be four deadlines:

1. Your top three choices from my list.
2. A meeting with me with an outline of your proposed report.
3. Draft of your report.
4. Final report.

## **Mock Congressional Hearings** (If there is time.)

### *Goals:*

- Explore issues of nanotechnology and society from different perspectives.
- Build verbal and written communications skills

### *Hearings:*

- Government Investment in Nanotechnology Research: Should the government continue funding of nanotechnology? In what areas?
- Public Participation in the Evolution of Nanotechnology: Should the public be brought into the nanotechnology development process? How?

### *Format:*

- The class will be divided into two groups for each mock hearing: The speakers and the observers. Roles will be reversed the second time around.
- The speakers half of the class will be split further into four groups: Military brass, Scientists, Community Leaders, Business Interests. Each team will be responsible for producing a written statement to the congressional committee, which the group leader will deliver. In addition, the group as a whole will answer questions that arise. So preparations must be made *before* the hearing and the written testimony turned in that day. [Approximately 3 double spaced pages.]
- The observers will act as individuals representing either journalists or congressional aides. Their responsibility will be report on the proceedings. They will have one week to turn in these reports. [Approximately 3 double spaced pages.]