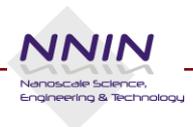




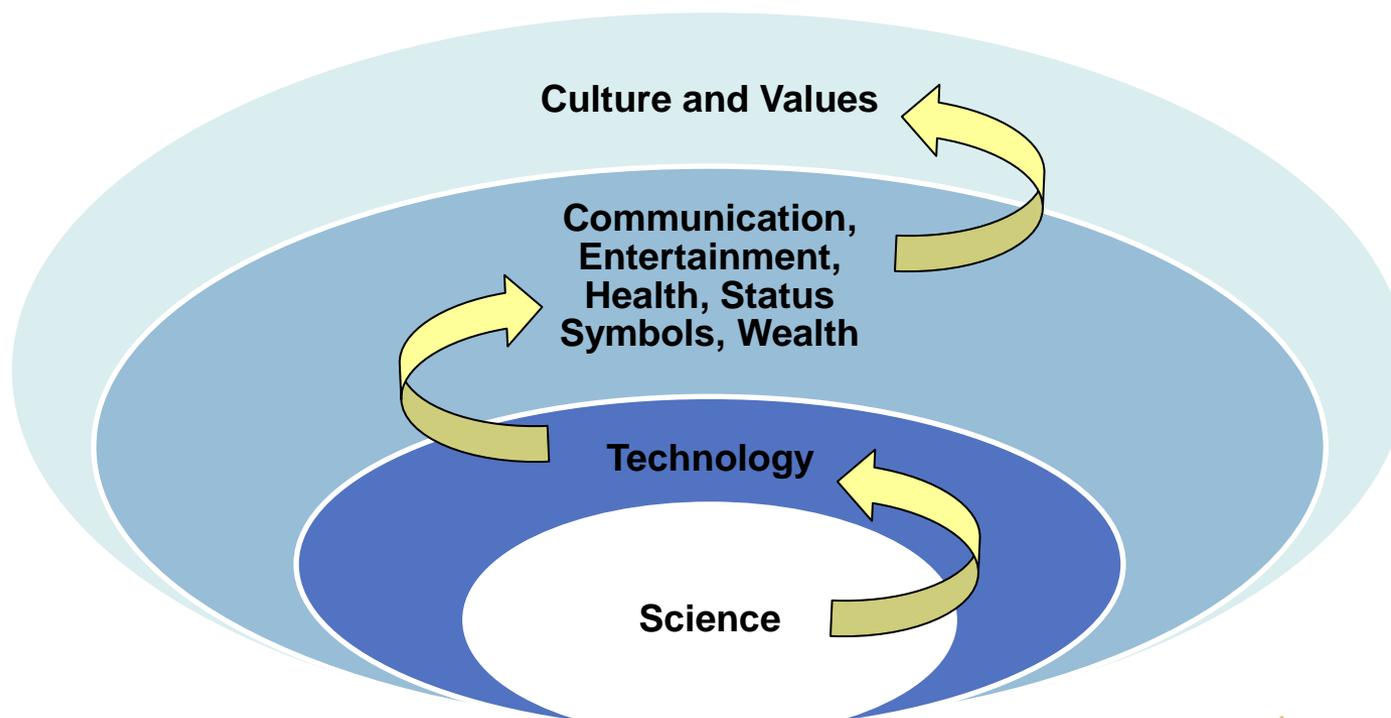
Societal and Ethical Implications of Nanotechnology



What is SEI?

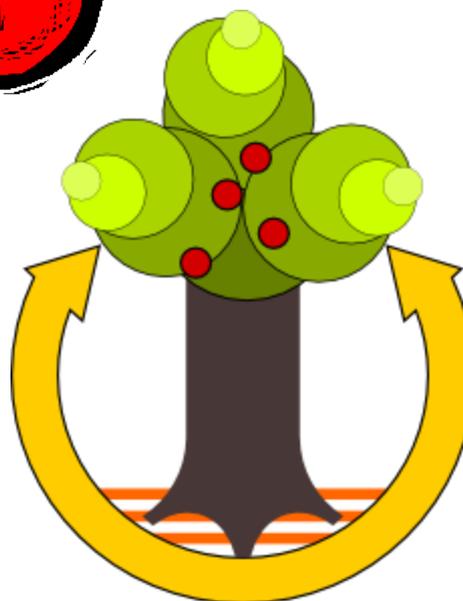
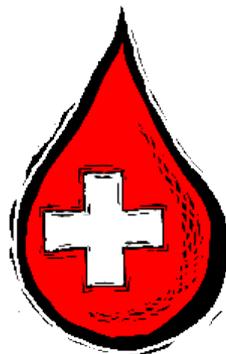
- Social and Ethical Implications

Science and technology are not separate from the rest of society.



What are some areas of SEI in science and technology?

- Environment
- Health and Safety
- Economics
- Security and Privacy
- Education
- Politics
- Media
- Legal and Regulatory
- Culture
- Religion



What does this mean for researchers?

Science and technology researchers have influence and may be implicated in societal changes.

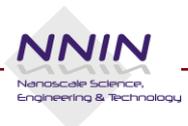
Rosalind Franklin unwittingly provided much of the foundation for James Watson and Francis Crick's "discovery" of the structure of DNA in 1953. Nine years later, Watson, Crick and Maurice Wilkins received the Nobel Prize in medicine for their joint findings.



Photographer: Vittorio Luzzati.; Institution: Retouching by: Winifred Kryda & Lynne Elkin

21st Century Nanotechnology Research & Development Act of 2003 (PL 108-153)

- Established a societal implications research program
- Requires nanoscale science and engineering centers to address societal implications of their research
- Provides for public input into nanotechnology research and development



Areas of Society Effected by Nanotechnology

Environment Health Economy

Possible Benefits

- Improved detection and removal of contaminants
- Development of benign industrial processes and materials
- Improved medicine
- Better products
- New jobs

Concerns

- High reactivity and toxicity
- Pervasive distribution in environment
- No nano-specific EPA regulation
- Ability to cross cell membranes and translocate in the body
- No FDA approval needed for cosmetics or supplements
- Redistribution of wealth
- Potential cost of cleanups and healthcare
- Accessibility to all income levels

Specific Societal and Ethical Issues in Nanotechnology

Lab safety

- consideration of the health and well-being of fellow researchers, reporting on unsafe practices

Environmental consequences of research

- minimization and safe disposal of hazardous substances, fate of “nanowaste,” fair notice to potentially affected parties

Academic conduct

- integrity of research results, equitable authorship recognition practices

Commercial fair dealing

- respect of confidentiality and trade secrets

Science education

- interdisciplinary studies, ethics education



More Societal and Ethical Issues in Nanotechnology

Environmental, health, and safety concerns

- ecological and toxicological effects of nanoparticles, workplace and consumer exposure

Economic effects

- rapid transformation and dislocation of industries, effects on wealth distribution, intellectual property issues

Medical technologies

- prospects for human enhancement and augmentation, improved genetic screening, advanced cures

Security and privacy implications

- novel weaponry and defense technologies, pervasive surveillance potential

Less Obvious Societal and Ethical Issues in Nanotechnology

National and international politics

- national research funding commitments and the “nanodivide,” technology transfer

Media and public perceptions

- polarized reactions to nanotechnology, involvement of lay public in decision making

Legal and regulatory issues

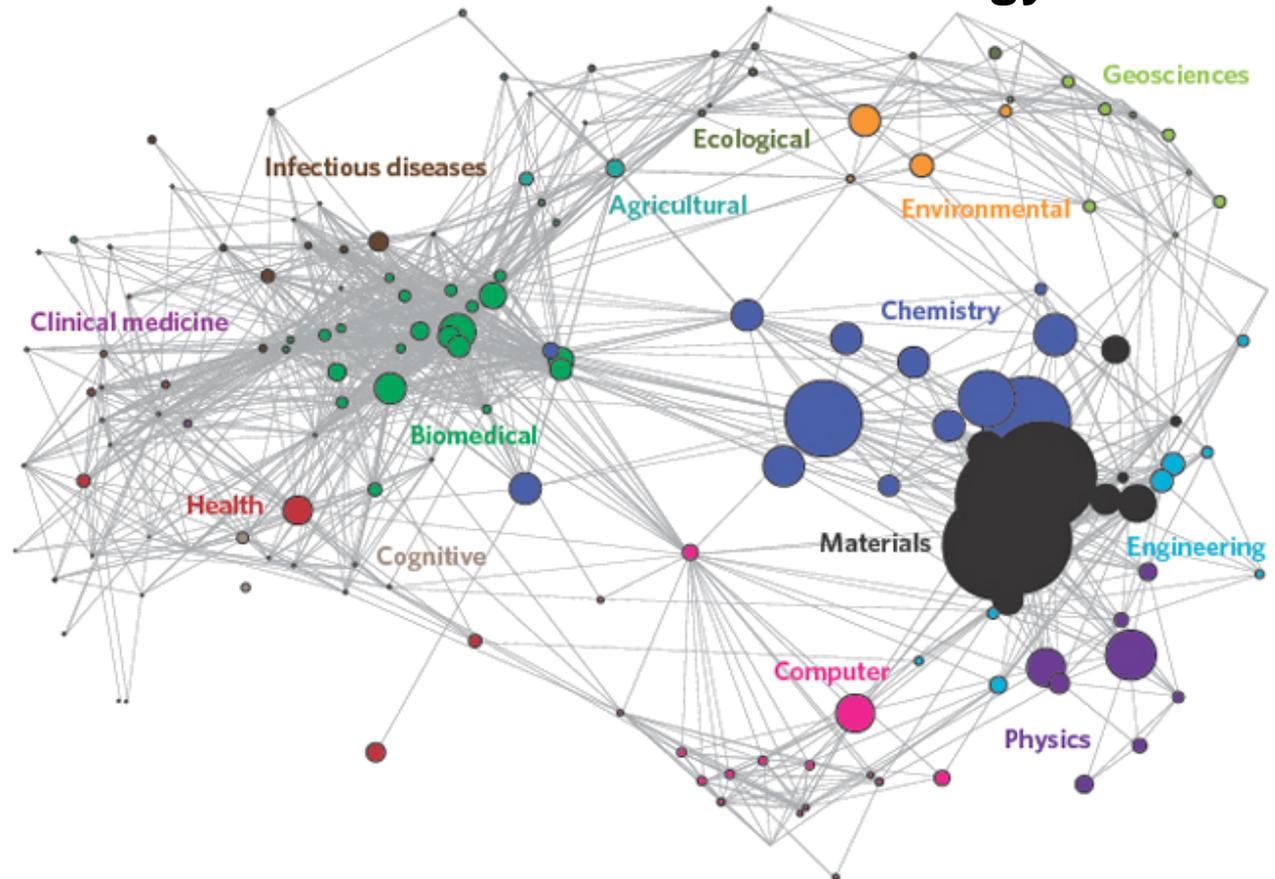
- proactive versus reactive regulation, international standard-setting

Cultural and religious repercussions

- new media and modes of representation, new challenges in defining life

Unique Social Characteristics of Nanotechnology

- Interdisciplinary
- Pervasive
- Global
- New



Program in Nanotechnology Research and Innovation Systems Assessment
Georgia Tech Technology Policy and Assessment Center
Center for Nanotechnology and Society, Arizona State University

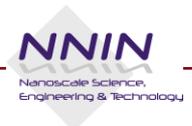
What we know about nanotechnology researchers and SEI

McGinn, R. *Ethics and Nanotechnology: Mapping the Views of the NNIN Community*

- Most NNIN researchers are interested in ethical issues surrounding nano (73.1%) and believe that these ethical responsibilities go beyond the laboratory (77%)

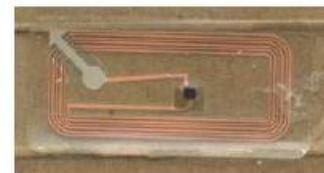
However...

- Nearly 80% did not feel that they were well informed about ethical issues relating to nanotechnology
- 64% of respondents had never taken a course in which ethical issues of science and technology were discussed



Nano is small... really small

- Privacy issues
- Implantation of devices in the body
- Penetration of tissues, cells, and organelles
- Translocation of particles



(Photo: © Liz McIntyre 2003)

Above: Magnified image of actual tag found in Gillette Mach3 razor blades.

Retrieved 7/19/06 from <http://www.boycottgillette.com/aboutrfid.html>

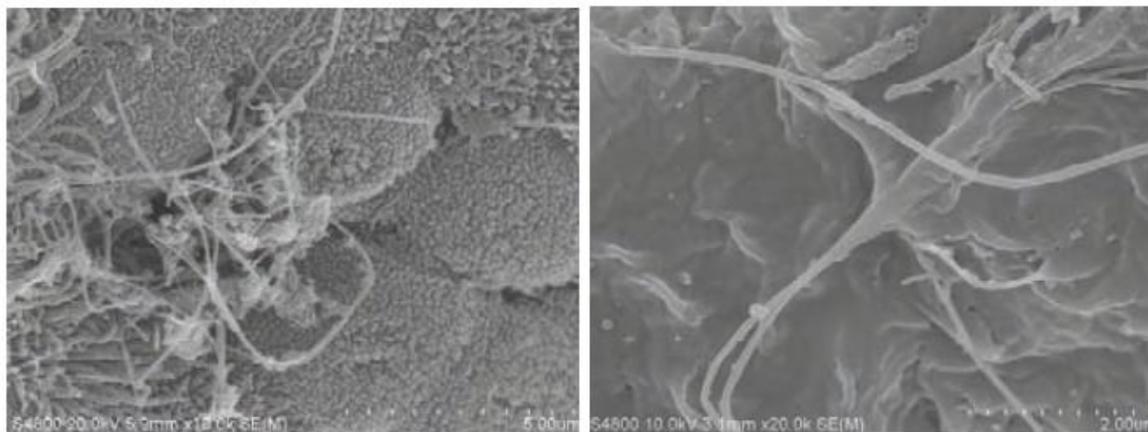


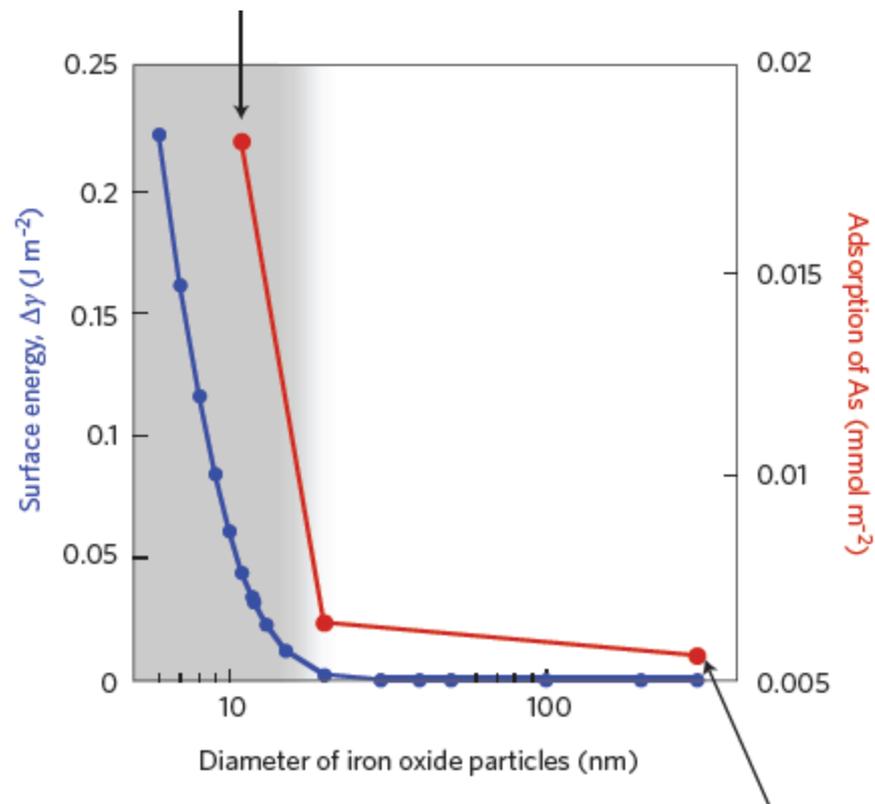
Figure 5–2. Deposition and clearance of MWCNTs from the conducting airways of mice following inhalation exposure

Approaches to Safe Nanotechnology

Managing the Health and Safety Concerns Associated with Engineered Nanomaterials. OSHA.

Increased Reactivity

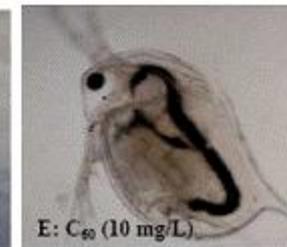
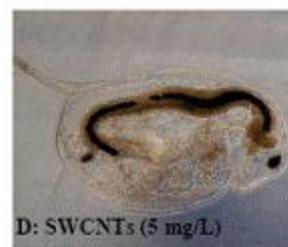
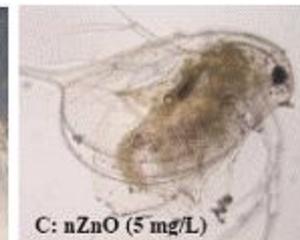
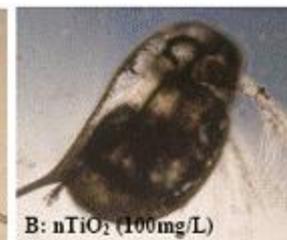
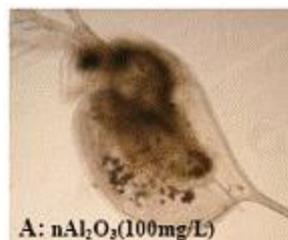
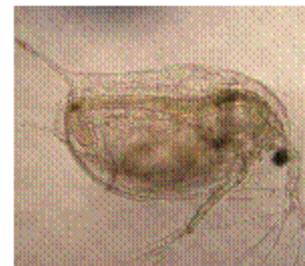
- Some material properties change
- Increased surface area
- Unusually high reactivity
 - Fire
 - Combustion
 - Catalytic reactions



Towards a definition of inorganic nanoparticles from an environmental, health and safety perspective. Mélanie Auffan, Jérôme Rose, Jean-Yves Bottero, Gregory V. Lowry, Jean-Pierre Jolivet and Mark R. Wiesner.

Increased Toxicity

- Penetrate cell walls
- Increased toxic effects
- Translocate in body and environment
- Bioaccumulation



Towards a definition of inorganic nanoparticles from an environmental, health and safety perspective. Mélanie Auffan, Jérôme Rose, Jean-Yves Bottero, Gregory V. Lowry, Jean-Pierre Jolivet and Mark R. Wiesner.

Case Study: Bionic Lenses

University of Washington <http://depts.washington.edu/ntethics/>

- Contact lenses that display virtual images
 - Monitor bodily status via tears
 - Access websites
 - Display images or information
 - Gaming
- Will they become part of communication systems?
 - Email
 - Advertising spam
 - Can people hack into your lenses and get information about your health?
- Will ideas of what is acceptable social behavior change?
 - Answering your phone during a lecture is considered rude, how about reading images off your lenses?
- If we start using them will we be able to live without them?
 - Reliance on new communication infrastructure
 - Reliance on real-time bodily health monitoring

What Can We Do?

- Our first responsibility should be to notice this larger picture
- Our second responsibility should be to think critically about our role in it
- Our third responsibility should be to integrate social and ethical considerations into our research planning, not as an afterthought or as something left for other decision makers, but as a central purpose of our actions
- And our final responsibility should be to engage with others concerning these issues, within the lab, within the larger scientific community, and within the society that ultimately will both influence, and be influenced by, our efforts

How to Think About SEI in your Research

- For whom and what purposes are you developing your product?
- What problem is your "product" trying to solve?
- Who will benefit from it? And, conversely, who won't?
- Who will have access to it? Who will be excluded?
- Who will own it? And, how can you assure access to it?
- How will it affect and reconfigure social, economical and political relationships?
- Are there dangers involved with its development? (e.g. safety, health, pollution)? How can you minimize them?



**Please complete the ethics training quiz at
<http://www.surveymonkey.com/s/nrfethics>.**

