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The material herein is developed under NSF-NUE (Nanotechnology Undergraduate Education) award #1242087, NUE: NanoTRA- Texas Regional Alliance to foster 'Nanotechnology Environment, Health, and Safety Awareness' in tomorrow's Engineering and Technology Leaders.
http://nsf.gov/awardsearch/showAward?AWD_ID=1242087

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The Continuing Shock of the New: Some Thoughts on Why Law, Regulation, and Codes are Not Enough to Guide Emerging Technologies

A Project of the University of Texas-Tyler and Texas State University

Presentation developed by Dr. Craig Hanks, craig.hanks@txstate.edu

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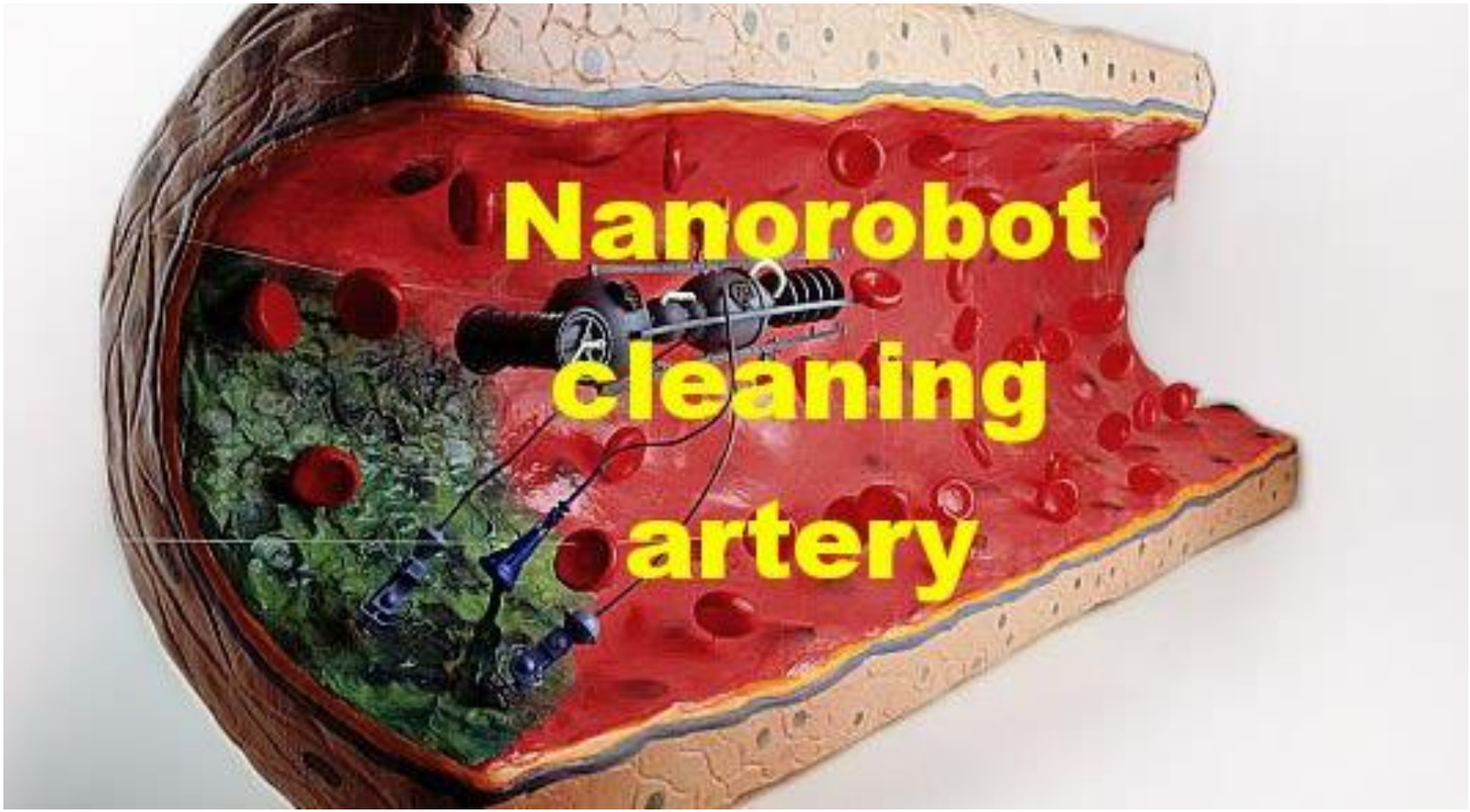
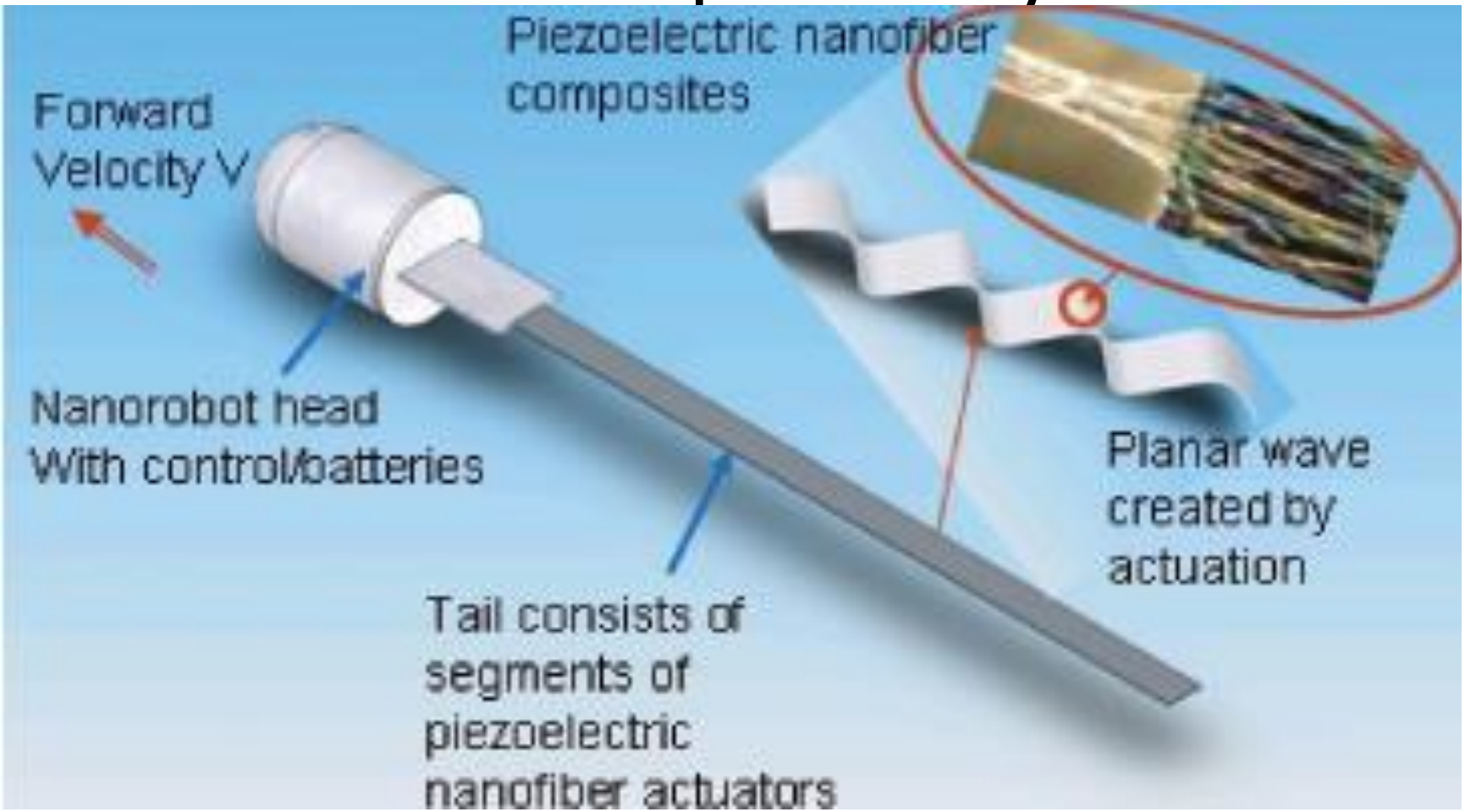
Science Fiction?



http://www.freegrab.net/nantech.htm

Or real possibility?



Tiny robots harness power and monitor health

http://4.bp.blogspot.com/-KOoHpXmRVrE/UKPoAsWSaBI/AAAAAAAAIc/eyGhLbd7XKY/s640/050812-F-2295B-947.jpg

http://2.bp.blogspot.com/_AbNytNzp2SY/TAKj5tUP7oI/AAAAAAAACfI/KvYCgUHWsNE/s400/Elbphilharmonie2.jpg

http://static5.depositphotos.com/1003595/455/i/450/dep_4556250-Green-energy-label.jpg

NANOTECHNOLOLGY WILL IMPACT (is impacting!)

http://trinitymtjoy.org/welcome/2012/10/clothing-give-away-coming-in-january-2/

http://iigcapital.com/may_2012.jpg

http://www.bestpharmguide.com/magazine/wp-content/uploads/2011/04/online-pharmacy-drugs.png

...and many other areas !!!!

Emerging Technologies Present Special Challenges for Engineering Education

- We argue that emerging technologies, such as nanotechnology, demand the skills of ethical analysis and judgment, coupled with ethical sensitivity, creativity, and wisdom, and that a focus on law, regulation, and codes is necessary but insufficient to guide responsible development and use of these new technologies.

Emerging Technologies Present Special Challenges for Engineering Education

1. Ethics and Emerging Technologies
2. Law, Regulations, and Codes as necessary to guide responsible practice
3. Why Law, Regulations, and Codes are insufficient to guide responsible practice
4. A description of our project to introduce students to Law, Regulations, and Codes, and to help them go further.

Emerging Technologies Present Special Challenges for Engineering Education

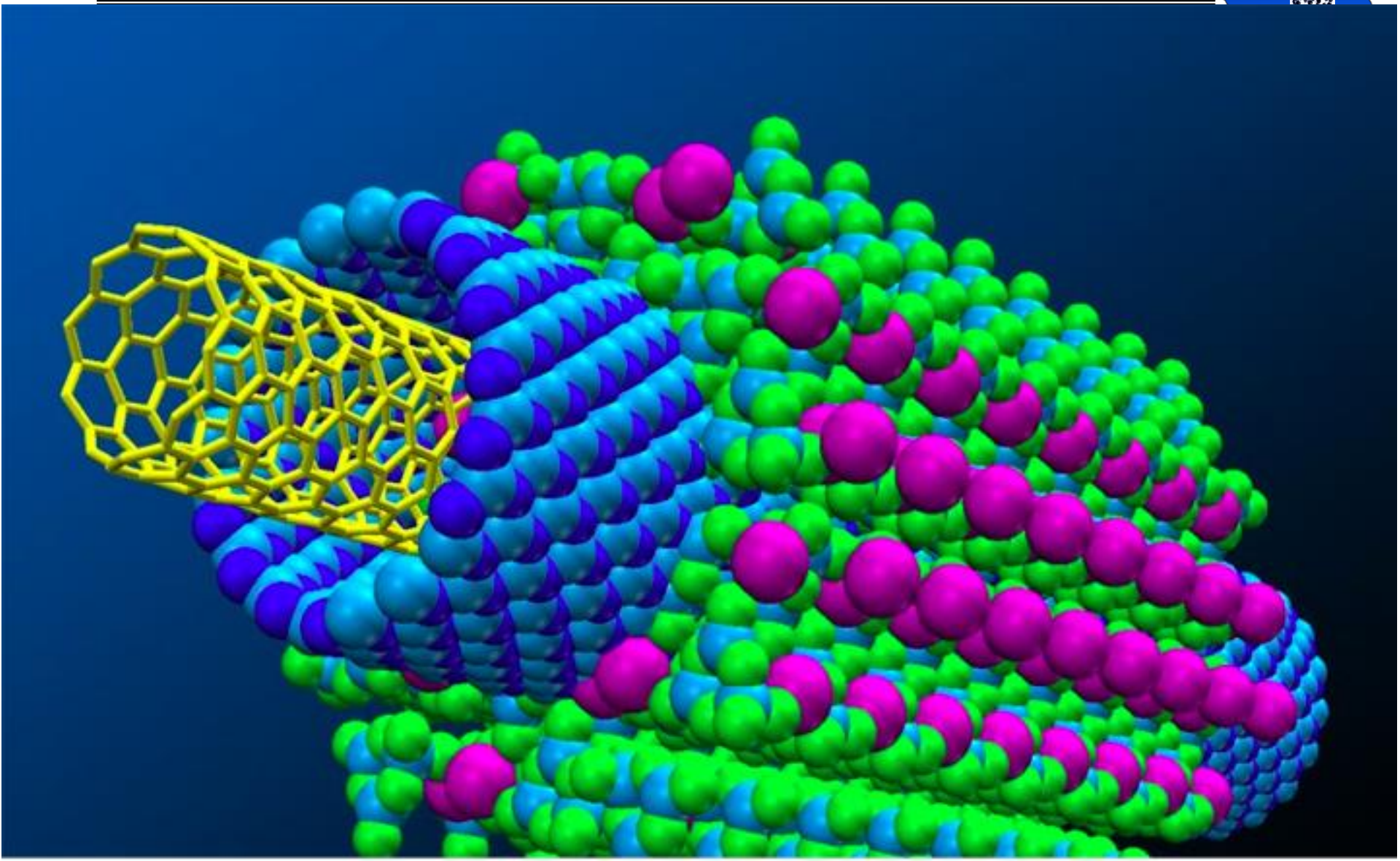
1. Ethics and Emerging Technologies

Science, Technology, and Change

- Eric Drexler: author of:

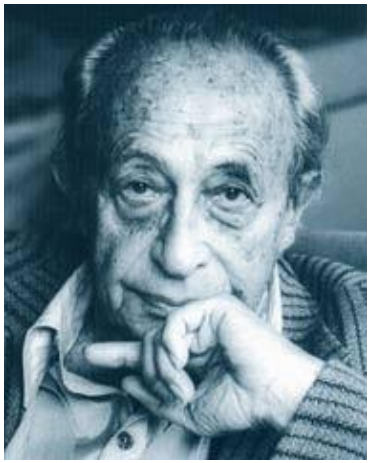
  - ***Radical Abundance: How a Revolution in Nanotechnology Will Change Civilization***
  - ***Engines of Creation: The Coming Era of Nanotechnology***
  - ***Nanosystems: Molecular Machinery, Manufacturing, and Computation***

  – A founder of nanotechnology, a concept he introduced in a foundational 1981 paper in the *Proceedings of the National Academy of Sciences*

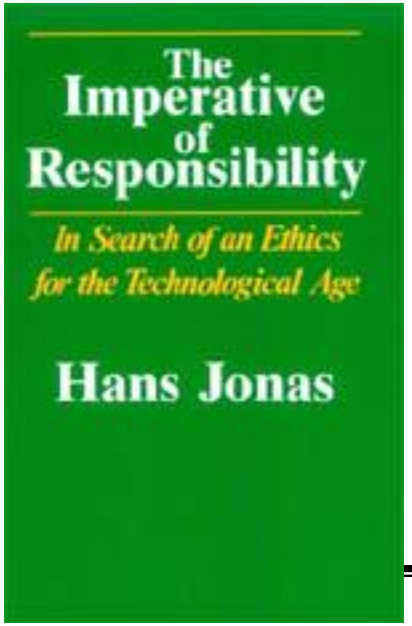


Science, Technology, and Change

- Technological change tends not toward equilibrium, but toward further change.
- Innovation spreads quickly because of a) communications technologies, and b) competition.



Hans Jonas



- Technological Means create new ends, new tools open new possibilities for action and new possible goals.
- Progress - "the juggernaut moves on relentlessly, spawning its always mutated progeny by coping with the challenges and lures of the now"

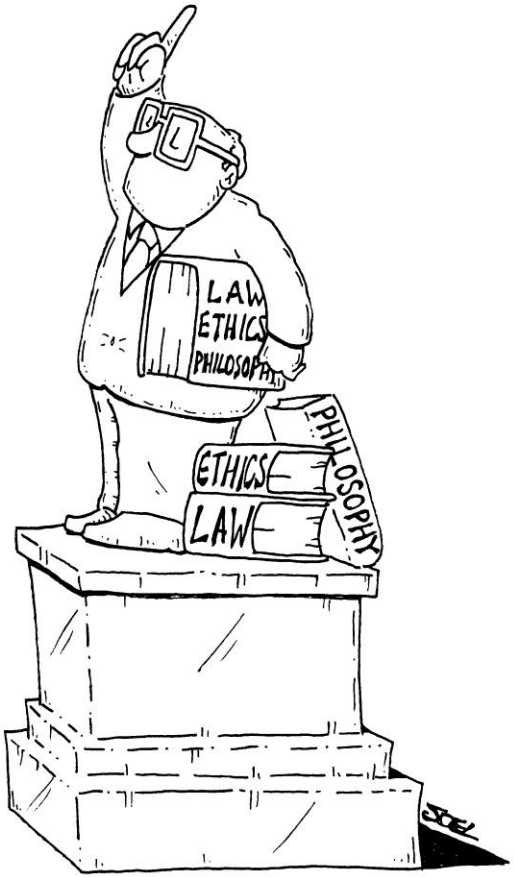
Science, Technology, and Change

- This is different from earlier eras of human existence.
- This means ever new products and techniques, changing individual lives, communities, nations, the international community, and nature itself.
- This also means that change comes to be accepted as the natural state of human existence, as a taken-for-granted background condition.

- Restlessness is thus one of the characteristics of contemporary technological society and of our individual lives and expectations. We now expect change and we wonder what will change next, and in what ways, and this brings hopes and joy as well as fears and threats.

CHALLENGES!

- All new technologies present novel ethical issues that must be explored.
- This issue can be exacerbated by not always *knowing* what the implications of the new technologies will be.
- All emergent technology, exists beyond current understandings and consensus.



Emerging Technologies Present Special Challenges for Engineering Education

2. Law, Regulations, and Codes as necessary to guide responsible practice

Characteristics of Law, Regulation, and Codes

- Promoting minimal standards of conduct with the aim of ensuring safety
- A grounding in ethical principles and values (sometimes quite explicitly as in Principlism in Bioethics), but do not evaluate or contextualize those principles or values
- Providing lists of allowable and prohibited actions, with considerably more of the second. Thus they provide guidance about what not to do, emphasizing what ethicists call our "negative duties" (what we should avoid doing).
- Provide Sanctioning and punishment for failure to meet the standards required.

Functions of Law, Regulation, and Codes

- Defining and promoting the profession's image – internally and to the public
- Providing support for practitioners
- Serving as inspiration and guidance
- Regulating behavior
- Standardizing professional practice and communicating expectations to professionals, clients, citizens, and government.

Law, Regulation, and Codes: An Important Success Story

- BIOSCIENCE, BIOMEDICINE, AND BIOTECHNOLOGY
  - Law, Regulation, and Codes developed in response to history of abuses
  - These were developed with explicit consideration of ethical theories and principles, including beneficence and autonomy
  - The existence of these motivates many researchers and practitioners to be more responsible in practice

Emerging Technologies Present Special Challenges for Engineering Education

3. Why Law, Regulations, and Codes are insufficient to guide responsible practice

Limitations of Law, Regulation, and Codes: General Considerations

- Compliance Approach
- Ethic of Technical Compliance
- Undesirable Impacts of Adopting a Compliance Approach

Limitations of Law, Regulation, and Codes: Emerging Technologies

- Newness and Uncertainty
- Burdens and Constraints
- The “Owl of Minerva”

Characteristics of Ethics

- Promoting more than minimal standards of conduct with the aim of encouraging considerations of what is good and most desirable. Ethics thus is aspirational and includes also Positive Duties.
- A reflexive and inquisitive relation to ethical principles and values, with the goal of better understanding, refining, and justifying underlying concepts, ethical principles, and ethical values.
- In some cases providing good grounds for judging some law or regulation or section of code to be unethical or unjust, providing grounds for discussion and possible change.
- The sanctions of ethical failure or success are praise and blame within a profession or community and by one's conscience.

Emerging Technologies Present Special Challenges for Engineering Education

4. A description of our project to introduce students to Law, Regulations, and Codes, and to help them go further.

OUR GOALS

- **Goal:** The goal for this project is to help prepare students to be responsible developers, users, marketers, critics, workers, administrators, and leaders in nanotechnology.
- **More Generally:** We hope to help students be better **citizens** in an advanced technological society.
- **Professionally:** Our project will help meet standards for engineering education (ABET), and will help students be ready to address problems and questions in the workplace.
- **Our Plan:** Develop modular courses (more later!)
- **Diversity:** Design and implement course modules to better support members of under-represented groups.

ABET PROGRAM OUTCOMES

Relationship to ABET Program Outcomes:

- (c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical constraints as well as considerations of public health and safety, manufacturability, and sustainability.
- (f) An understanding of professional and ethical responsibility.
- (g) An ability to communicate effectively.
- (h) The broad education necessary to understand the impact of engineering solutions in a global economic, environmental, and societal context.
- (i) A recognition for the need for and an ability to engage in lifelong learning.
- (j) A knowledge of contemporary issues.

NUE: NanoTRA- Texas Regional Alliance to foster 'Nanotechnology Environment, Health, and Safety Awareness' in tomorrow's Engineering and Technology Leaders.

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- **Co-PI:** Dr. Craig Hanks (Philosophy, Texas State)
- **Co-PI:** Mr. Satyajit Dutta (Engineering, Texas State)
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- **Senior Personnel:** Dr. Robert McLean (Biology, Texas State)
- **Senior Personnel:** Dr. Fritz Allhoff (Philosophy, Western Michigan)

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- Graduate:
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  - Mr. Seth Barton
  - Mr. Zach Russell
- Undergraduate:
  - Mr. Sergio Espinoza
  - Ms. Luna Wilson
  - Mr. Adam Mokhtari

External Reviewer:

- Dr. Rita Caso (Sam Houston State Univ.)

Nanotech Advisory Council

Pedagogical Considerations: Resistance to Conceptual Change

- Many studies demonstrate that students' existing conceptions are very resistant to change.
- This is even true in instances when the students score very highly on formal and technical assessments.

Pedagogical Considerations: Nurturing Student Engagement

- Integrating a new idea into one's existing conceptual scheme is highly dependent on the social context in which the examination of the ideas takes place.
- ***Student engagement, interaction, and enthusiasm, as well as perceived instructor enthusiasm and expertise, are important markers of a productive context.***

Module [# sessions]	Topics and Subtopics
1A [2 Sessions]	What is nanotechnology and nanoethics? And, Societal dimensions of nanotechnology
2A [2 sessions]	Ethics of Science and Technology; Science and technology as agents of social change; Moral agents: Developing Ethical Frameworks
3A [2 sessions]	Societal Impacts; Defining ethical and societal implications; Precautionary principle in nanotechnology; Developing Ethical Frameworks; Engineering as Social Experiment Impact of nanotechnology on developing countries
4A [2 sessions]	Ethical Methods and Processes; Human subject research; Global Dimensions, Ethical framework for technology assessment; Risk and Uncertainty; Model for ethical analysis
5A [2 sessions]	Nanomaterials and Manufacturing; Processes used (e.g. etching & laser ablation); Framing ethical questions: principles of respect for communities, common good, and social justice; Assessing options for action
6A [2 sessions]	Environmental Sustainability; Environmentalism and sustainability; Environment risks and nanotechnology; Potential benefits of nanotechnology for sustainable development; Framing ethical questions; Assessing options for action
7A [2 sessions]	Nanotechnology in Health and Medicine; What are the issues? Context described: pharmaceuticals and therapeutics; diagnostics and imaging; nanoscale surgery; implants and tissue engineering; multifunctional nanodevices and nanomaterials; personalized medicine; broader health care system – Framing ethical questions – Assessing options for action
8A [2 sessions]	Military and National Security Implications; Nanotechnology and art of war; Nanotechnology and national security; Framing ethical questions; Assessing options for action
9A [2 sessions]	Nanotechnology Issues in the Distant Future; Challenges and pitfalls of exponential manufacturing; Nanotechnology and life extension; Who will control this technology? Global implications

First Course

Topics Outline: Advanced Course

MODULE	TITLE
1B	Overview of Occupational Health & Safety
2B	Applications of Nanotechnology
3B	Assessing Nanotechnology Health
4B	Sustainable Nanotechnology Development
5B	Environmental Risks Assessment
6B	Ethical and Legal Aspects of Nanotechnology
7B	Developing a Risk Management Program
8B	Presentations of Case Studies or Research Project Possible Guests: Academic/Scholar, Industry Representative, Safety Officer
9B Hands On	Composites and Plastics Lab, Texas State
10B Plant	Local Nanotechnology Industry:

Location	Course # and Title [Instructor]	Course/ module	Background of students taking particular course
UT at Tyler	TECH 2303/4350: Introduction to Nanotechnology Safety **[Fazarro]**	Full course/On-Line	Basic Chemistry and Basic Physics
UT at Tyler	TECH 3303: Principles of Risk Management for Nanoscale Materials **[Fazarro]**	Full course/On-Line	Basic Chemistry, Basic Physics, Statistics
Texas State	US 1100: Seminar **[Ms. Romanella]** **Fall 2013, Fall 2014**	2A	High School level Chemistry and Physics
Texas State	PHIL 1320: Society and Ethics **[Hanks] Fall 2013, Spring 2014, Fall 2014**	1A, 2A, 3A, 4A, 6A, 7A, 8A	High School level Chemistry and Physics
Texas State	TECH 4380: Industrial Safety **[Dr. Juan Gomez] Fall 2013, Fall 2014**	**1A, 3B, 4B, 6B, 7B**	Basic Chemistry, Basic Physics, Statistics
Texas State	ENGR/EE 2300: Materials Engineering **[Drs. Londa and Lawrence] Fall 2013, Spring 2014, Fall 2014**	1A, 3A	Chemistry I
Texas State	MFGE 2332: Material Selection and Mfg Processes; **[Dr. You] Fall 2013**	6A, 8A	Chemistry I, Materials Engineering
Texas State	IE 3330: Quality Engineering **[Dr. Walters] Spring 14**	7B	Chemistry I, Physics I, Engineering Statistics
Texas State	EE 2400Circuits and Devices **[Dr. Casey] Spring 14**	1A, 2B	High School level Chemistry and Physics
Texas State	MFGE/EE/TECH 4392: Microelectronics Manufacturing **[Dutta & Other] Spring 14**	9A, 3B, 4B	Chemistry I
Texas State	IE 4380: Industrial Safety **[Dutta] Fall 2013, Fall 2014**	**1A, 3B, 4B, 6B, 7B**	Basic Chemistry, Basic Physics, Statistics
Texas State	MFGE 4367: Polymer Prop. and Proc. **[Tate] Spring 2014**	7A, 8A, Guest	Chemistry I, Physics I, Materials engineering, Statistics
Texas State	MFGE 4399: Polymer Nanocomposites **[Tate] Fall 2014**	2B, 4B, 5B, 9B, Guest	Chemistry I, Physics I, Materials engineering, Statistics

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