

## **DEBATING SCIENCE: PRACTICAL REASONING AND NANOTECHNOLOGY**

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### **COURSE PURPOSE**

The huge public and private investments in nanotechnology over the last decade reflect enormous scientific enthusiasm over this emerging research area. Nanotechnology holds promise in fields as diverse as materials engineering, medicine, information technology, defense, environmental remediation, energy production, and agricultural technology. Alongside the promises hover a broad range of social and ethical concerns. These include questions of toxicity, privacy, economic injustice, copyright, terrorism, cyborgian post-humanism, and compromised environmental integrity.

To date there has been little formal coursework attempting to bridge the gap between the science of nanotechnology and the debates about the social and ethical implications of its innovations. But in the case of nanotechnology, the economic forces driving research are so strong, the public's lack of knowledge about the technology is so great, and the potential for the manipulation of public opinion is so high that scientists will find themselves forced to cross the gap between their research environment and the public discussions. Prospective nanotech researchers will need to become productive participants in the social and ethical deliberations.

This course is designed to give graduate students in the natural sciences and engineering the skills necessary to participate in deliberations about the promises and perils associated with nanotechnology.

### **SPECIFIC LEARNING OUTCOMES**

- 1) The first learning outcome of this course is for students to become better informed about the many ethical, social and political issues arising from the development of nanotechnology. The course considers a number of questions raised by nanotechnology that have social and ethical dimensions. For example, how does the current reality measure up to the promises being made by nanotechnology's most enthusiastic backers? What kind of social impacts will nanotechnology have? What will be nanotechnology's impact on the global economy? How will these benefits be shared among developed and developing countries? What types of nanotechnological development pose the greatest threats to environmental and biological health? What developments pose the greatest threat to political stability?
- 2) The second learning outcome is for students to become more adept at engaging in informed, deliberative dialogue on these important social issues. Reasonable and fair deliberation is a skill that needs to be learned and practiced in a group. Throughout the course, students will come to a better understanding of the process of deliberation.
- 3) The final learning outcome is for students to use their knowledge of the social and ethical issues together with their skills in deliberation to arrive at appropriate policy conclusions concerning the best way to move forward with nanotechnology.

## **COURSE STRUCTURE**

This course is structured around a particular model of practical reasoning/deliberative dialogue. Practical reasoning/deliberative dialogue is concerned with setting and prioritizing goals and selecting the appropriate means to achieve these goals. There are 5 tasks contained within this model:

- 1) Articulating, establishing, and prioritizing goals,
- 2) Identifying the available alternatives for achieving these goals,
- 3) Anticipating and evaluating unwanted side effects that might undermine the pursuit these goals,
- 4) Identifying and evaluating major obstacles that might prevent reaching these goals
- 5) Establishing the burden of proof, weighing the presumptive case for each of the alternatives, and coming to a conclusion about policy.

Students in this course will be learning how to deliberate together to settle on the goals to pursue, weighing the various option for achieving these goals, and arriving at a recommendation for an appropriate course of action

## **COURSE READING**

All of the reading can be found either in the reading packet at the bookstore or online (in the case of the publicly available documents).

## **SUGGESTED TOPICS LIST**

### **Week 1. NANO-HYPES AND NANO-PHOBIAS**

Laurent, L. & J-C Petit. 2006. "Nanosciences and their Convergence with Other Technologies: New Golden Age or Apocalypse?" In Nanotechnology Challenges: Implications for Philosophy, Ethics, and Society, eds. D.Baird & J.Schummer (New York: World Scientific Publishing, 2006): 249-286.

Berube, D. 2006. "Exaggeration, Hyperbole, and Hype-Steria." In Nanohype: The Truth Behind the Nanotechnology Buzz (New York: Prometheus, 2006): 29-47.

### **Week 2. INTRODUCTION TO THE SOCIAL/ETHICAL ISSUES**

Lewenstein, Bruce V. 2006. "What Counts as a Social and Ethical Issue in Nanotechnology?" In Nanotechnology Challenges: Implications for Philosophy, Ethics, and Society eds. D.Baird & J.Schummer (New York: World Scientific Publishing, 2006): 201-216.

Alhoff, Fritz and Patrick Lin. 2007. "Nanoscience and Nanoethics: Defining the Disciplines" by Fritz Alhoff and Patrick Lin. In Nanoethics: The Social and Ethical

Issues in Nanotechnology eds. F.Alhoff, P.Lin, J.Moore, J.Weckert (Wiley Interscience, 2007): 3-16.

**Week 3. INTRODUCTION TO THE SOCIAL/ETHICAL ISSUES (ctd.)**

Sandler, Ron. 2009. "Nanotechnology: The Social and Ethical Issues," (Project in Emerging Nanotechnologies Report 16). Available at:  
<http://www.nanotechproject.org/publications/archive/pen16>

**Week 4. RISK AND PRECAUTION**

Gardiner, Stephen M. 2006. "A Core Precautionary Principle," *Journal of Political Philosophy* 14.1 (March): 33-60.

Weckert, John and James Moore. 2006. "The Precautionary Principle in Nanotechnology," *International Journal of Applied Philosophy* 2.2: 191-204.

**Week 5. RISK AND PRECAUTION (ctd.)**

Allhoff, Fritz. 2009. "Risk, Precaution, and Emerging Technologies", *Studies in Ethics, Law, and Technology*, Vol. 3, Issue 2, Article 2 (Electronic Journal). Available at:  
<http://www.bepress.com/selt/vol3/iss2/art2>

Sunstein, Cass R. 2003. "Beyond the Precautionary Principle", *Pennsylvania Law Review* 151: 1003-1058

**Week 6. GOALS SELECTION DISCUSSION WEEK**

Students will come to class to discuss selection of an overall goal for nanotechnology regulatory policy.

**Week 7. LESSONS FROM BIOTECH**

Busch, L. & J.Lloyd, "What Can Nanotechnology Learn from Biotechnology?" *What Can Nanotechnology Learn from Biotechnology* (London: Elsevier, 2008): 261-276.

**Week 8. ALTERNATIVES SELECTION DISCUSSION WEEK**

Students will discuss together in class a number of alternative ways to meet the regulatory goal decided upon in week 6.

**Week 9. US REGULATORY REALITIES**

Davies, Clarence J. 2009. "Oversight of the Next Generation of Nanotechnology" (Project in Emerging Nanotechnologies Report 18) Available at: <http://www.nanotechproject.org/publications/archive/pen18/>

### **Week 10. SIDE EFFECTS AND PRACTICAL OBSTACLES DISCUSSION WEEK**

Students will identify obstacles and side effects that attend each of the alternatives discussed in week 8.

### **Week 11. BALANCING RISKS AND BENEFITS**

Sunstein, Cass. 2005. "Cost Benefit- Analysis and the Environment." *Ethics* 115: 351-385.

### **Week 12. POLICY DIRECTIONS AND OUTCOMES**

Students will settle on a policy recommendation in the light of the strengths and weaknesses of each of the alternatives they have been considering.

## **ASSIGNMENTS AND GRADING (Traditional Letter Grade Option)**

**Course Attendance Participation (20%):** Students are expected to attend every class and to stay for the duration of the class.

**Course Readings and Thought Papers (20%):** There will be approximately 20-30 pages of course readings per week for the first 7 weeks of the course. Readings will consist of scholarly articles, book chapters and popular essays written by scientists, activists, philosophers, and public policy experts. Additional material will be drawn from various websites that address nanotechnology. There will be three, 4-5 page (double-spaced) papers assigned in these first 7 weeks. The papers will assess the first learning objective of the course. They will be designed to assess the student's grip of the course readings and will probe how well informed students are about the major ethical, social and political issues in the debates surrounding nanotechnology.

**On-line Deliberation Document (60%):** A major portion of this course will be a group project. It consists of collaborating on a policy document about nanotech regulation issuing from our semester of deliberation. ODC pages will articulate a goal for nanotechnology regulation, several alternatives for reaching that goal, considerations of the obstacles and side-effects that attend each alternative, and a policy conclusion in the light of the above. Contributions to pages on the ODC will form a large portion of the term grade. These contributions are tied to both the second and the third learning outcomes of the course. Students are required to demonstrate on the ODC that they have developed the relevant skills of practical reasoning in order to make appropriate policy decisions concerning nanotechnology and its regulation. Dissenting opinions will be allowed as appendices to the document but the document as a whole must be written with clear enough conclusions to make it usable by policy makers.

## **GRADING**

The +/- grading system will be used as follows: 93-100 = A; 90-92 = A-; 87-89 = B+; 83-86 = B; 80-82 = B-; 77 - 79 = C+; 73 - 76 = C; 70 - 72 = C-; 67 - 69 = D+; 63 - 66 = D; 60 - 62 = D-; Below 60 = F.

## **HELPFUL SUPPLEMENTARY READING**

Nanotechnology Challenges: Implications for Philosophy, Ethics, and Society. Edited by Joachim Schummer & Davis Baird (World Scientific, 2006).

Nanoethics: The Ethical and Social Implications of Nanotechnology. Edited by Fritz Alhoff, Patrick Lin, James Moore, and James Weckert (Wiley Interscience, 2007).

What Can Nanotechnology Learn From Biotechnology? Social and Ethical Lessons for Nanoscience from the Debate over Agrifood Biotechnology and GMO's. Edited by Kenneth David & Paul B. Thompson (Elsevier, 2008).

Nanotechnology: Ethics and Society. Deb Bennet-Woods (CRC, 2008).

Nanotechnology and Society: Current and Emerging Ethical Issues. Edited by Fritz Alhoff and Patrick Lin (Springer, 2009)

Nanotalk: Conversations With Scientists And Engineers About Ethics, Meaning, And Belief in the Development of Nanotechnology. Rosalyn Berne (Lawrence Erlbaum Associates, 2005).

Nanotechnology, Risk, and Communication. Alison Anderson, Alan Peterson, Clare Wilkinson, and Stuart Allan (Palgrave MacMillan, 2009).

Managing Nano-Bio-Info-Cogno Innovations: Converging Technologies in Society. Edited by Williams Sims Bainbridge and Mihail Roco (Springer, 2006).

Nanohype: The Truth Behind the Nanotechnology Buzz. David Berube (Prometheus, 2006).

“Societal and Ethical Interactions with Nanotechnology: An Introduction” by Davis Baird & Tom Vogt, *Nanotechnology, Law, and Business Journal*, vol 1 (4)(2004)