CS-480—Senior Seminar
Study questions for *Gray Goo*
Spring '04

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Primary Papers

Peterson, Christine "Taking technology to the molecular level." *Computer*, Vol. 33, No. 1, pp. 46–53, Jan., 2000.

Joy, Bill "Why the future doesn't need us." Wired, (date unknown) `<http://www.wired.com/wired/archive/8.04/joy_pr.html>`, accessed 19/Jan, 2004. Also in *Wired*, Vol. 8, No. 4, (Page numbers missing), Apr, 2000.

Baum, Rudy (with Eric Drexler and Richard Smalley) "Point-counterpoint: Nanotechnology" ACS, (date unknown) `<http://pubs.acs.org/cen/coverstory/8148/8148counterpoint.html>`, accessed 20/Jan, 2004. Also in *Chemical and Engineering News*, Vol. 81, No. 8, pp. 37–42, 1/Dec, 2003.

Dyson, Freeman J. "The future needs us! (Review of *Prey* by Michael Crichton.)" *New York Review of Books*, Vol. 50, No. 2, pp. 11–13, 13/Feb,2003.

Additional Papers

Drexler, K. Eric "Machine-Phase Nanotechnology." *Scientific American*, Vol. 285, No. 3, pp. 74–75, Sept,2001.

Smalley, Richard E. "Of Chemistry, Love and Nanobots." *Scientific American*, Vol. 285, No. 3, pp. 76–77, Sept,2001.

Peterson

1. According to Peterson, what is the most significant physical factor limiting the performance of nanomachines? How do designers compensate for that phenomenon? How does this distinguish engineered nanomachines from biological machinery? What role does this phenomenon play in biological machinery.

2. What is the role of Computer Science in nanotechnology?

3. What does *ab initio* mean?
4. What is MEMS? How is it distinct from nanotechnology?
5. Why does Merkle believe self-replication is essential to nanotechnology?
6. How does Peterson intend to limit the risks of self-replication?
7. What engineering issues stand in the way of large scale (even MEMS scale) systems based on nanotechnology?
8. Visit the Foresight Institute (www.foresight.org) and Institute for Molecular Machinery (www.imm.org) webs. How much has changed over last four years? What personnel do they have in common?

Joy

1. What is gray goo?
2. On what sources does Joy base his projections for the future that include the possibility of the development of gray goo? On what do those sources base their projections?
3. What political, scientific and sociological events of the past does Joy cite as examples of how we have failed to confront the challenges that nanotechnology may present?

Smalley and Drexler (Baum, C&EN)

1. What goals do Smalley and Drexler have in common? What is the issue they disagree on?
2. What are the "fat fingers" and "sticky fingers" problems (see the supplementary articles from Scientific American)?
3. In the figure on Page 2, Drexler suggests a mechanism for overcoming the sticky fingers problem. Does the figure suggest anything about the fat fingers problem? (Why is the resolution of the rendering of the molecular tool and reagents different than that of the substrate?)
4. Why is Smalley not willing to allow this controversy to be resolved in the laboratory—by success or failure of attempts to build molecular assemblers?
5. How essential are molecular assemblers to the gray goo scenario?

Dyson

1. Dyson brings up a couple of more Physical arguments about nanotechnology. Are they evidence against either the gray goo scenario or the feasibility of molecular assemblers?

2. How is Dyson's disagreement with Joy similar to Smalley's disagreement with Drexler, how different?

3. What is Dyson's take on Drexler's assembler? Is his argument against Joy based in Physics?

4. Dyson also cites scientific, political and sociological history to support his position. What role did "alarmists" like Joy play in that historical sequence? What role did safeguards like those suggested by Joy play? Has the history of those safeguards been as reassuring to you as it is to Dyson?

5. How well does Dyson's analogy with Milton's defense of liberty of publication stand for you? In what ways are Milton and Dyson arguing for the same thing? How are they different?