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Letter

Goals for the National Nanotechnology Initiative (NNI)

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Dear Editor,

The overall goals for the National Nanotechnology Initiative (NNI) are

1. To advance world-class nanotechnology research and development. (http://www.nano.gov/goaloneobjectives)

2. To foster the transfer of new technologies into products for commercial and public benefit. (http://www.nano.gov/goaltwoobjectives)

3. To develop and sustain educational resources, a skilled workforce and the supporting infrastructure and tools to advance nanotechnology. (http://www.nano.gov/goalthreeobjectives)

To support the responsible development of nanotechnology.

Goals 2-4 include societal dimensions: two uses the term public benefit, three mentions a skilled workforce and four emphasizes responsible development.The NSF has funded two Centers for Nanotechnology in Society at ASU and UCSB whose evaluations I managed while a Program Director in the STS Program at the NSF; they do impressive work.

I was also involved in developing the 2011 NNI Strategic plan that emphasizes collaborations among consumers, engineers, ethicists, manufacturers, nongovernmental organizations, regulators, and scientists (including social and behavioral scientists) to accomplish responsible development (NNI sub-goal 4.3.2). These collaborations can "enable prompt consideration of the potential risks and benefits of research breakthroughs and to provide perspectives on new research directions" (http://www.nano.gov/sites/default/files/pub_resource/2011_strategic_plan.pdf).

My work is in methods for creating and sustaining these collaborations, particularly the ones involving social scientists, ethicists, scientists and engineers. My colleague Erik Fisher at the CNS ASU developed methods for embedding social scientists or humanists in nanotechnology laboratories as participants in the research process, not just observers (Fisher from tzvol). Embedding succeeds when the participants in this social science/science collaboration form a trading zone (Gorman, 2010), in which each disciplinary culture adds value to the others' work. The main value of the social scientist is to help the laboratory reflect on its culture and practices; in turn, the laboratory members help the social scientist understand how they work. Participants begin by developing shared meanings for specific terms; if the engagement broadens into a collaboration like those in the Centers for Nanotechnology in Society, the end result might be a kind of 'nano creole', or simplified common language, that could be adopted by others wanting to collaborate across the science, engineering and socio-ethical aspects of nanotechnology, which are always intertwined--especially when discoveries become applications. If embeddedness does not lead to collaboration, it can at least lead to mutual respect and understanding.

Nanotechnology also creates an opportunity for interdisciplinary education in science and technology. My work in this area has been to develop a 3rd year University course in societal dimensions of nanotechnology for engineering students, focused especially on nanotechnology policy (Gorman et al 2013) [1,2]. I think that we need more scientists and engineers who are capable of active participation in policy debates and even becoming members of Congress. My course is centered around a role-playing simulation of the NNIN that allows students to create their own short and long-term goals for nanotechnology research and then try to reach them by working their way up a technology tree that the instructors design with them. Students are put in groups representing roles like funding agencies, laboratories, Congress, a newspaper and an NGO skeptical of nanotechnology; the actual roles depend on the number of students in the class and their goals. Readings and guest speakers add knowledge and depth to the role-playing exercise. I am trying to recruit students from social sciences and humanities to join the engineering students who make up the bulk of the class, so that students will learn how to form interdisciplinary trading zones to pursue nanotechnology opportunities [3].

We are now in the Anthropocene, a new geological epoch where the major factor shaping the Earth's climate and ecosystems is human activity (Allenby 2012). In this epoch, the most important challenge is figuring out how to work together to achieve common goals like sustainable development and improved quality of life for human beings across the globe. Nanotechnology could

potentially facilitate accomplishment of such goals, especially when coupled with breakthroughs in biology, computer science, cognitive science and social psychology.

Sincerely

Michael E. Gorman

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