Science and democracy

The future of nanotechnology depends on public acceptance, says **Chris Toumey**, so the nanotechnology community needs to listen to public opinion.

Nanotechnology comes to public attention at an interesting time. The question of the role of the lay public in science policy has recently matured into a series of arguments and approaches, and nanotechnology is often thought of as a test case for experiments in democratizing science today. There is nothing about atoms and molecules that makes nanotechnology more suitable for this than other technologies: this is a historical coincidence, not a scientific result.

Nevertheless, it is worthwhile for the nanoscience and nanotechnology community to know what people are doing to democratize nanotechnology. After all, every citizen is a potential stakeholder in nanotechnology in the sense that it will affect everybody's life, even if it is unclear how democratic societies will honour the status of the stakeholder.

Experiences of democratizing science vary quite a lot from one nation to another. Two are especially interesting, namely the British and US experiences. The former springs from a report, *The Public Understanding of Science*, which was published by the Royal Society in 1985. After noting that public understanding of science was desirable but needed improvement, this report offered a simplistic solution: scientists would learn how to communicate to non-scientists, who would then listen and learn[1]. This came to be known as the 'deficit model', meaning the problem was merely that the public did not know enough about science.

An exercise in the deficit model arose in 1986 when government scientists tried to protect consumers from sheep contaminated by caesium from the Chernobyl disaster. As they formulated regulations, they were terribly uninformed about local geography, agricultural economy and other important variables. This was a case study in how not to communicate scientific information to non-scientists. The UK government's handling of mad cow disease was equally clumsy.

Nanodemocracy in action, May 2006. Participants in the South Carolina Citizens' School of Nanotechnology engage in dialogue with nanoscientists regarding priorities and values in their research.

The deficit model seemed to be business as usual for government experts, but a group of academics centred at Lancaster University in the UK has challenged this approach. They argued for a programme that would both expose the internal contradictions of science and recognize that science is situated within a matrix of values and social forces[2].

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According to the deficit model, the public distrusts science because it is ignorant, but according to the Lancaster approach, the public distrusts science because it has good reason to.

Then nanotechnology arrived, and many people saw it as an opportunity for experimenting with 'upstream public engagement' or, in other words, getting laypersons involved in the crucial early stages of research[3]. In 2004 the Royal Society and the Royal Academy of Engineering produced a report that raised the question of the governance of nanotechnology and made a major virtue of upstream public engagement[4]. Another group organized a citizen jury on nanotechnology — a process of learning and deliberation that generated policy recommendations[5]. The Lancaster group is currently carrying out a large project that, among other things, allows laypersons to develop their knowledge and concerns about nanotechnology, and then share them with nanoscientists[6].

It will be interesting to see if the rest of the British public encounters nanotechnology through a deficit model, upstream public engagement, or a combination of the two.

American arguments start with John Dewey's philosophy of liberal democracy. If citizens know how to think scientifically, then democracy and science will be good for each other. But such a democracy needs an informed electorate. Unfortunately,

research carried out by Jon D. Miller has repeatedly found that levels of 'civic scientific literacy' are dreadfully low[7]. Dewey's ethos has failed to connect science with democracy.

Another approach was to assert the moral autonomy of science: scientists knew what they were doing, and the government ought to fund as much science as possible with as little interference as possible[8]. This was especially convincing during the Cold War, when technology was expected to protect the West from Soviet domination and nuclear war.

Subsequently, however, science as an institution was often discredited by the generic anti-authoritarianism of the 1960s; by the environmental movement, which challenged industrial-based science; by feminism, which argued that certain beliefs about biology were myths; and by certain cases of scientific misconduct, along with unfounded accusations of fraud.

From these anti-authoritarian stances, there emerged ways for non-experts to challenge the policy decisions of scientific authorities through legislation, lobbying, litigation, appropriations, regulations and referenda. These are known collectively as participatory democracy. Examples include laypersons serving on high-level advisory committees at the National Institutes of Health in the US, and consensus conferences in Denmark that allow citizens to investigate a specific scientific topic[9].

Participatory democracy in the US does not answer to any one theory or ideology. It is a collection of numerous independent case studies. Also, those who make science policy are not neatly divided into experts versus the illiterate. Any given episode is likely to have a broad spectrum of expertise, including scientists, engineers, technicians, would-be scientists, wouldn't-be scientists and so on.

In the midst of these conditions, nanotechnology arrived.

In addition to large-scale survey polls on public attitudes about nanotechnology[10–12], there are focus groups and consensus conferences to generate policy recommendations. In 2005, the National Science Foundation awarded $13 million for a Center for Nanotechnology in Society network, and $20 million for a Nanoscale Informal Science Education network. Researchers at Arizona State University are pursuing questions of 'real-time technology assessment'[13] that dovetail with the Lancaster group's upstream engagement project, and the two groups collaborate. There is a lot of serious interest in getting non-experts involved in decisions about nanotechnology.

British and US observers have repeatedly noted that many non-experts can acquire, comprehend and deploy technical knowledge when they need to. This is important because it shows that participatory democracy and upstream public engagement are feasible for non-experts who want a voice in science policy, even if general levels of civic scientific literacy are low.

One last observation is that there can be a conflict between two kinds of results, namely democratic decision-making and good science policy. For example, what could be more democratic than a referendum? There were hundreds of local referendums in the US on fluoridation policy in the 1950s and 1960s. The research that led to fluoridation was some of the best and most convincing epidemiology ever done, but the opponents of fluoridation won approximately 60% of referendums. Here we see a democratic process generating bad science policy. What should we do if participatory democracy or upstream public engagement generate results for nanotechnology like the fluoridation referendums?

As democracies should have democratic mechanisms for making science policy, and science policy should be grounded in good science, the trick is to find the intersection: neither bad science generated by foolish decision-makers, nor good science forced upon a population that resents it. Unfortunately, this formula describes two negative parameters: avoid this error, but also avoid the other error. The connection between democratic decision-making and good science remains problematic, and there is no easy formula by which democratic decision-making generates good science, but there are many cases in which the two dovetail.

Nanotechnology policy will have its successes, but there will also be mistakes caused by authoritarian attitudes, and maybe some bad science decisions as well, as it tries to satisfy both democracy and science.

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Richard Jones on biology and nanotechnology

Listening to the public. The South Carolina Citizens' School of Nanotechnology is one of a growing number of initiatives to get non-experts involved in decisions about nanotechnology.