Scientists share blame for public's ignorance of science

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industry-driven problems, says Hsu. "Instead, the government should focus more on taking discoveries and commercializing them."

Goodyear maintains that researchers "should be happy" and that their concerns are "not justified." He notes that across the government, funding for science and technology is higher than ever, and "for the first time in history, we have applied more money to the applied science part of the spectrum without any negative impact on the basic end. It is our goal to support the entire innovation–invention ecosystem." The problem, says Goodyear, is that "there are so many programs that even researchers don't know where to go. We will be looking at consolidating. We want to maintain funding levels and accessibility but not have so many programs."

Canada is shifting from a "peanut butter approach," in which resources are spread fairly evenly among researchers, to investing to achieve specific outcomes, says Pekka Sinervo, senior vice president of the Canadian Institute for Advanced Research, which funds international networks of researchers to study specific topics. "We have to pay attention when we tinker with the system," he says. "The jury is still out on whether we are going in the right direction."

Toni Feder

Scientists share blame for public's ignorance of science

Social scientists call for "smartening up" the process of disseminating scientific information to lay audiences.

Looking for a way to convey to the public the minuteness of the radioactivity reaching the US from the Fukushima nuclear disaster last year, presidential science adviser John Holdren settled on the banana standard. "Eating one banana commits you to a radiation dose of 8 microrem, or 8 millionths of a rem, because bananas have naturally occurring radioactive potassium-40 in them. We thought this was a great idea, because we can show that any radiation dose experienced by Americans as a result of releases at Fukushima would be small compared to eating a banana," Holdren recounted.

The anecdote illustrates a practical method of imparting scientific information to an American public that isn't known for a high degree of science literacy. According to speakers at a colloquium held in May at the National Academy of Sciences (NAS), the scientific community should not throw up its hands in the face of that ignorance. "It's easy for us to do a poor job of communicating and to hold the public responsible for our failure," said Baruch Fischhoff, professor of engineering and public policy at Carnegie Mellon University. "But people are capable of thinking when we give them a chance on things that really matter to them."

"There's a kind of frustration on the part of many scientists about not being able to get points across to the public," said NAS president Ralph Cicerone; as examples, he pointed to Earth's age, biological evolution, the teaching of evolution, and climate change. Arthur Lupia, a political science professor at the University of Michigan, said scientists must revise their approach to communication in order to compete for the attention of their audience. "Failure is common in attempts to communicate on science with the public. Attention is scarce, and working memory is very limited in capacity," he said. "We don't get a free pass because we are experts." His advice to educators is to appeal to the core values, fears, and aspirations of the listener, "not by dumbing things down, but by smartening up how we convey what we know." Doing that requires using concrete examples that the audience cares about, not abstractions.

But although some scientists are "amazing natural communicators or natural born TV and radio commentators, you can't expect every scientist to be expert in two fields: science and communication," noted David Pogue, *New York Times* columnist and author of a number of the For Dummies series of books. Most often, a communicator is needed to translate the scientific news to the public. Those scientists who have received some training in communicating with the public aren't always able to find a platform, he said.

Trust only goes so far

Scientists are among the top professions most trusted by the public (see figure),

even on topics as contentious as climate change. Jon Krosnick, a Stanford University social psychologist who since 1997 has been surveying US public knowledge and attitudes toward climate change, said that despite the 2009 hacking of email messages from the Climatic Research Unit at the University of East Anglia, the acknowledged errors in the Intergovernmental Panel on Climate Change's 2007 assessment of the world's climate, and the US government's inaction on the issue, a large majority of the public believes that global warming is under way (see PHYSICS TODAY, October 2011, page 48).

Americans continue to send "a pretty strong signal to lawmakers that they want something done on climate change," Krosnick said. His research results do not support the widespread perception among scientists that the media are perpetuating a false balance between the vast majority of scientists who say that climate change is occurring and the small minority of scientist skeptics. A survey of articles about climate change over the past 10 years shows that the media, with the exception of Fox News, have rarely quoted the skeptics. And even Fox included the dissenters in less than one-third of its climate change news reports, he added.

But Krosnick said his surveys also show that the public trust in scientists falls off steeply as soon as they stray into policy matters. "The public is very much on the side of the natural sciences on [climate change]," he said. "Natural scientists focusing on their bread and butter push points of view with the public very effectively," but it gets risky when scientists stray outside those boundaries, he said.

Getting the message across

Some public communications campaigns haven't been evaluated for their effectiveness, said Wändi Bruine de Bruin, assistant professor of engineering and public policy at Carnegie Mellon. Lacking input from the general public, some messages use wording that people don't understand or omit relevant information. Reminders to wash hands, for example, don't often include instruction in the proper method of washing; the result is that bacteria are left on fingertips. Research has shown that much of the public would interpret "shelter in place" to mean that in the event of a terrorist dirty bomb attack, people should leave the buildings they are in to seek out the nearest bomb shelter—exactly the opposite of what the experts advise. "Possibly, this communication would be more effective if they used different wording, such as stay inside," she deadpanned.

Attempts at communications can backfire, as Neal Lane, a science adviser to President Bill Clinton, recalled. In 2000, responding to concerns that private companies like Celera Genomics could lock up the intellectual property resulting from the sequencing of the human genome, Clinton and then UK prime minister Tony Blair hurriedly issued a joint declaration that raw genome sequence data would not be allowed to receive intellectual property protections but that gene-related inventions would be patentable. The news caused the biotech-heavy NASDAQ to suffer its second worst decline ever, while the market value of Celera, which was in a race with the publicly financed Human Genome Initiative to complete the sequencing first, plunged by $2 billion.

When he's asked by scientific societies how to improve their public messages, Holdren said he advises them "to get better at telling stories that relate to what's happening in science and technology and what needs to happen to people's lives on the ground, where they live." Such stories are much more effective than generalities. "I can say more than 50% of American economic growth for the last 50 years has come from scientific knowledge and innovation, and people's eyes glaze over. If I say one NSF grant in 1994 to two Stanford graduate students, Larry Page and Sergey Brin, led to the formation of a company that now employs 20 000 people and has upwards of $60 billion a year in revenue, people get that," he said.

Separating fact from fiction

"People are essentially frightened by what they don't understand," said Pogue. When nonscientists don't understand something, particularly a subject with a heavy dose of jargon, their natural inclination is to "shut it out," he said. Topics that are least understood by the public, such as agricultural biotechnology, nanotechnology, and nuclear power, arouse the most suspicion and fear. "Biotech is pretty mysterious to the general public, and that creates an opportunity and challenge for us," admitted David Fischhoff, vice president for technology strategy and development at Monsanto. To further improve plants, he said, "we need freedom to operate, which comes from trust, which is based on communication."

Vicki Colvin, director of the Center for Biological and Environmental Nanotechnology at Rice University, said that most scientists advance their careers "by getting into the weeds" of their chosen field. "To come back out and deal with the broader [public's] questions is far different from what I have been trained for," she said. Colvin believes nanotechnology's challenge is to separate science fiction from fact; "flesh-eating nanobots" might be a problem in the next century, but not for now. Among the public, "there is hope of a new economy and a fear that Russia or China may have something that we don't," she said, noting NSF's estimate that nanotechnology will grow to a $1 trillion market by 2015.

For the nascent field of geoengineering, the trick will be to encourage a public debate on whether and under what circumstances the technologies should be deployed, while simultaneously proceeding with some small-scale experiments, said David Keith, a physics and public policy professor at Harvard University. That approach would enable scientists and engineers to reduce the degree of uncertainty with geoengineering methods and allow the public to see "how messy and imperfect" the technologies will be.

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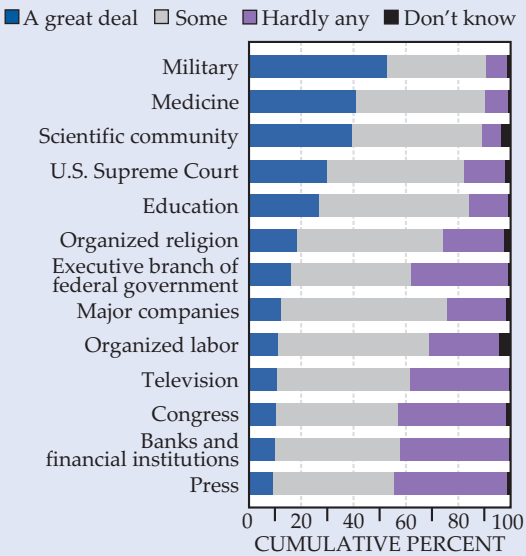

The scientific community scores high on the scale of professions that the US public trusts.

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