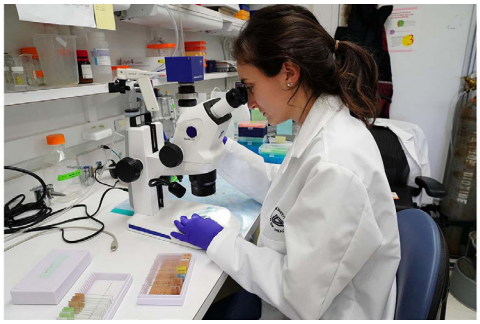
Science and society

Societies have changed over time, and consequently, so has science. For example, during the first half of the 20th century, when the world was enmeshed in war, governments made funds available for scientists to pursue research with wartime applications — and so science progressed in that direction, unlocking the mysteries of nuclear energy. At other times, market forces have led to scientific advances. For example, modern corporations looking for income through medical treatment, drug production, and agriculture, have increasingly devoted resources to biotechnology research, yielding breakthroughs in genomic sequencing and genetic engineering. And on the flipside, modern foundations funded by the financial success of individuals may invest their money in ventures that they deem to be socially responsible, encouraging research on topics like renewable energy technologies. Science is not static; it changes over time, reflecting shifts in the larger societies in which it is embedded.

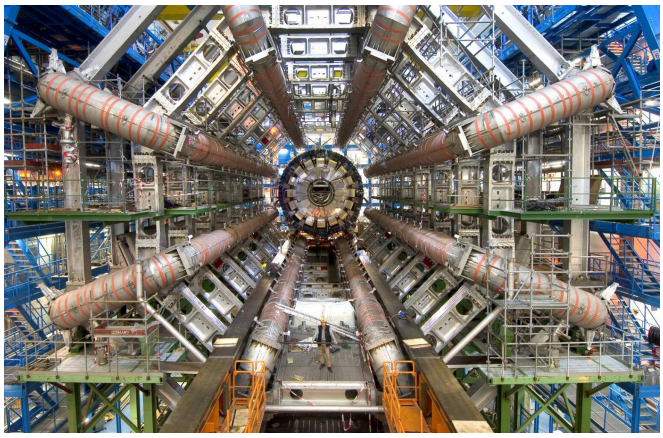

Agricultural, medical, and energy-related research, as shown here, reflect the concerns of society. Photo credits: Flickr user U.S. Department of Agriculture, Flickr user NIH Image Gallery, and Flickr user Sandia Labs.

Here, we'll briefly examine a few of the many ways in which the larger society influences science. You can investigate:

- *Supporting science*
- *Meeting society's needs*
- *Shaping scientists*

Or just click flip to the next page to dive right in!

Supporting science



This is just a small part of the Large Hadron Collider, a scientific instrument near Geneva, Switzerland. It is the result of a collaboration between more than 8000 physicists and hundreds of organizations from all over the world. It didn't come cheap. Photo credit: CERN.

Some science can be done without much money at all. You can make careful observations of the sparrows in your backyard and do real scientific research on a shoestring, but many research topics in science are not so cheaply addressed. For example, scientists are eagerly awaiting the answers to key questions in particle physics, which they hope will come from a multi-billion dollar particle accelerator scheduled to be operational in 2009. Of course, most scientific research doesn't cost billions of dollars — but neither is it free.

Science can be expensive. There are salaries to be bankrolled, lab equipment to be bought, workspace to be paid for, and field research to be financed. Without funding, science as a whole simply can't progress, and that funding ultimately comes from the societies that will reap its benefits. Hence, those societies help determine how their money is spent. For example, a society that largely approves of stem cell research will encourage government support, stimulating advances in the field. However, a society that largely disapproves of stem cell research is unlikely to support politicians who provide funding for that research. In the latter situation, less research on stem cells will be done, and that society is unlikely to become a leader in the field.

THE ENERGY RESEARCH ROLLERCOASTER

Scientists researching alternative energy sources (e.g., wind, solar, and geothermal energy, as opposed to fossil fuels) are used to seeing their fortunes rise and fall with the societal, political, and economic climates. Funding available for alternative energy research often rises in step with the cost of fossil fuels and with society's interest in curbing pollution and conserving our natural resources. The energy crisis of the 1970s, for example, triggered a sharp increase in funds available to investigate alternatives to oil. Will current concerns over fossil fuels spark a similar increase? As of early 2007, society's concerns had yet to pay off significantly in terms of research funds — but such wheels turn slowly, and alternative energy research may yet get its much-needed injection of research funds.

A wind farm in Southern California. Photo credit: Wikimedia.

Funding influences the path of science by encouraging research on some topics and pointing away from others. That influence may be indirect, such as when political priorities shape the funding programs of government funding agencies (like the National Institutes of Health or the National Science Foundation). Or that influence may be more direct, such as when individuals or private foundations provide donations to support research on particular topics, like breast cancer — or when an individual or institution offers a monetary prize for solving a particular scientific problem, such as the 25-million-dollar prize offered in 2007 for the invention of a viable technique for removing carbon dioxide from the atmosphere. As that example demonstrates, funding can shape the course of science by prodding it in particular directions — but ultimately, funding cannot change the scientific conclusions reached by that research.

Meeting society's needs

Science responds to the needs and interests of the societies in which it takes place. A topic that meets a societal need or promises to garner the attention of society is often more likely to be picked up as a research topic than an obscure question with little prospect for a larger impact. For example, over the last 15 years, science has responded to the HIV/AIDS epidemic with a massive research effort. This research has addressed HIV in particular, but has also increased our understanding of viral infections in general. Society's desire to slow the spread of HIV and develop effective vaccines and treatments has focused scientific research, which improves our understandings of the immune system and how it interacts with viruses, drugs, and secondary infections. Science is done by people, and those people are often sensitive to the needs and interests of the world around them, whether the desired impact is more altruistic, more economic, or a combination of the two, as demonstrated in the example below.

Photo of HIV researcher by CDC/ Hsi Liu, Ph.D., MBA, James Gathany; photo of vaccine by Jim Gathany; photo of avian flu virus by CDC/ Courtesy of Cynthia Goldsmith, Jacqueline Katz, and Sherif R. Zaki; photo of tuberculosis by Janice Carr.

THE COLOR MAUVE

In 1856, while trying to make a synthetic version of the anti-malarial drug quinine, the young chemist William Perkin spied a glint of purple. He had stumbled upon a dye which produced a new color: mauve. The color was an instant hit, adorning women across Europe and enriching its inventor. This attention attracted other chemists hoping to make a similar impact (and a buck) — and the field of organic chemistry took off, buoyed by a fashion craze. The whims of society may sometimes seem frivolous; yet, even such trivial changes may end up changing the course of science.

Shaping scientists

We are all influenced by the cultures in which we grew up and the societies in which we live. Those cultures shape our expectations, values, beliefs, and goals. Scientists, too, are shaped by their cultures and societies, which in turn, influence their work. For example, a scientist may refuse to participate in certain sorts of research because it conflicts with his or her beliefs or values, as in the case of Joseph Rotblat, a Polish-born physicist, whose personal convictions profoundly influenced the research he undertook.

Joseph Rotblat in 1944, while working on the atomic bomb project. Photo credit: Wikimedia.

In 1939, Joseph Rotblat became one of the first scientists to grasp the implications of splitting atoms — that the energy they release could be used to start a chain reaction, culminating in a massive release of energy — in other words, an atomic bomb. However, instead of being excited by the possibility, Rotblat worried about the enormous cost to human life such weapons would have and avoided following up on the idea. Then, in the same year, Rotblat narrowly made it out of Poland before the Nazi invasion and eventually lost his wife to the German occupation there. He was now fearful that Germany would develop their own atomic bomb.

Reasoning that a competing power with a similar weapon could deter Hitler from using such a bomb, Rotblat began working on the idea in earnest and came to the United States to help the Manhattan Project develop an atomic bomb. But then came another turning point. In 1944, Rotblat learned that German scientists had abandoned their research into atomic weapons. It no longer seemed likely that the bomb which Rotblat was helping to develop would be used merely for deterrent purposes. In 1944, Rotblat became the only scientist to resign from the Manhattan Project — because he found its probable application unethical. After World War II, Rotblat channeled his physics towards medical applications and in 1995 won the Nobel Peace Prize for his efforts towards nuclear nonproliferation.


Rotblat (back row, furthest to the right) attended and helped organize the first Pugwash Conference in 1957. It was a meeting of scholars and prominent figures with the goal of reducing the danger of armed conflict and seeking cooperative solutions for global problems. Photo credit: American Institute of Physics.

Rotblat *avoided* a particular research area because of his ethical views; other scientists have *chosen* research topics based on their values or political commitments. For example, Harvard scientist Richard Levins was an ardent supporter of socialism. After a stint as a farmer and labor organizer in Puerto Rico, Levins returned to the U.S. to study zoology, but not to focus on a small-scale concern, like the behavior of an individual organism or species. Instead, Levins invested himself in population biology and community-level interactions — areas with implications for issues he cares

about: economic development, agriculture, and public health. Levins' political views don't change the outcomes of his scientific studies, but they do profoundly influence what topics he chooses to study in the first place.

And of course, the societal biases that individual scientists may have influence the course of science in many ways — as demonstrated by the example below…

FINDING INSPIRATION IN THE DETAILS

In the early 1900s, American society did not expect women to have careers, let alone run scientific studies. Hence, women who chose to pursue science were frequently relegated to more tedious and rote tasks. Such was the case when Henrietta Leavitt went to work at Harvard College Observatory for Edward Pickering. She was assigned the task of painstakingly cataloguing and comparing photos of thousands of stars — mere specks of light. (In fact, at the time, women were preferred for such tasks because of their supposedly patient temperaments.) However, even within this drudgery, Leavitt found inspiration — and a startling pattern in her stars. For stars whose brightness varies — called variable stars — the length of time between their brightest and dimmest points is related to their overall brightness: slower cycling stars are more luminous. Her discovery had far-reaching implications and would soon allow astronomers to measure the size of our galaxy and to show that the universe is expanding. But Pickering did not allow Leavitt to follow up on this discovery. Instead, she was sent back to her measurements, as was deemed appropriate for a woman at that time, and the study of variable stars was left for other scientists to pick up. Had society's views of women been more open-minded, this chapter in astronomy's history might have played out quite differently!

Henrietta Leavitt. Photo credit: Wikimedia.

Women at work at the Harvard College Observatory in 1891. Edward Pickering is standing in the corner to the left. Photo credit: Harvard University, call #: HUV 1210 (9-4).

Summing up science and society

In this section, we've seen that society shapes the path of science in many different ways. Society helps determine how its resources are deployed to fund scientific work, encouraging some sorts of research and discouraging others. Similarly, scientists are directly influenced by the interests and needs of society and often direct their research towards topics that will serve society. And at the most basic level, society shapes scientists' expectations, values, beliefs, and goals — all of which factor into the questions they choose to pursue and how they investigate those questions.

Sawing through an ice core to obtain samples to study climate change. Photo credit: Flickr user NOAA Photo Library.

GET INVOLVED

Even if you don't spend your days sequencing DNA, conducting particle accelerator experiments, or analyzing the composition of rocks, you can still influence the path of science with your actions every day. How? Here are some suggestions for getting more involved with scientific research:

- **Change how funding agencies distribute research funds.** For example, if you wanted to encourage research into alternative energy sources, you could write your congressperson to let him or her know what research you'd like to see government agencies fund.
- **Support research.** For example, if you wanted science to find a cure for juvenile diabetes, you could support a foundation that promotes research on the disease.
- **Help with data collection and analysis.** Some scientific research projects are actively seeking your help as a volunteer. For example, during your home computer's downtime, you could offer up its computing power to chemists at Stanford to help perform calculations about protein shapes. Or you could help astronomers by making backyard observations of variable stars. For more information about getting involved with scientific research through volunteering, check out National Geographic's list of citizen science projects or DistributedComputing.info for projects looking to use spare computing power.

Here, we've seen how society influences science. But what about the reverse? How does science influence society? To find out, read on…