Science costs money – research is guided by who funds it and why

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NSF is one federal agency that funds a wide range of basic science research.

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Scientists have always needed someone to help foot the bill for their work.

In the 19th century, for example, Charles Darwin made an expensive voyage to the southernmost tip of the Americas, visiting many other places en route, including his famous trek through the Galapagos Islands. The fossil evidence Darwin collected over his five-year journey eventually helped him to think about an infinite variety of species, both past and present.

The HMS Beagle and its crew traversed these places while testing clocks and drawing maps for the Royal Navy, and the voyage was funded by the British government. Darwin's position as a naturalist aboard the ship was unpaid, but, fortunately, his family's private assets were enough to cover his living expenses while he focused on his scientific work.

Today, government and private funding both remain important for scientific discoveries and translating knowledge into practical applications.

As a professor of science education, one of my goals while preparing future teachers is to introduce them to the characteristics of scientific knowledge and how it is developed. For decades, there has been a strong consensus in my field that educated citizens also need to know about the nature of the scientific enterprise. This includes understanding who pays for science, which can differ depending on the type of research, and why it matters.

Funding for science is more than just the amount of money. To a large extent, the organizations that fund research set the agenda, and different funders have different priorities. It can also be hard to see the downstream benefits of scientific research, but they typically outweigh the upfront costs.

Basic research leads to new knowledge

Basic research, also called fundamental research, involves systematic study aimed at acquiring new knowledge. Scientists often pursue research that falls into this category without specific applications or commercial objectives in mind.

Of course, it costs money to follow where curiosity leads; scientists need funding to pursue questions about the natural and material world.

About 40% of basic research in the U.S. has been federally funded in recent years. The government makes this investment because basic research is the foundation of long-term innovation, economic growth and societal well-being.

Funding for basic research is distributed by the federal government through several agencies and institutes. For more than a century, the U.S. National Institutes of Health have sponsored a breadth of scientific and health research and education programs. Since 1950, the National Science Foundation has advanced basic research and education programs, including the training of the next generation of scientists.

Other federal agencies have complementary missions, such as the Defense Advanced Research Projects Agency, created in response to the Soviet Union's launch of Sputnik in 1957. DARPA focuses on technological innovations for national security, many of which have become fixtures of civilian life.

Through a competitive review process at these agencies, subject experts vet research proposals and make funding recommendations. The amount of funding available from the NIH, NSF and DARPA varies annually, depending on congressional appropriations. Most of the awarded funds go to universities, research institutions and other health and science organizations that conduct research. The sum of research dollars awarded differs among states.

Applying research

Scientists undertake basic research to generate new knowledge with no specific end goal in mind. Applied research is different in that it aims to find solutions to real-world problems.

Research that investigates specific, practical objectives or improvements with commercial potential is more likely to attract private investors. Companies directly invest in research and development to gain a competitive edge and turn a profit. Private industry is more likely to sink dollars into applied rather than basic research because the potential payoff in the form of a new product or advance is more visible.

From discovery to real-world implementation

As applied research addresses problems, promising findings are moved toward clinical application or mainstream use. This research and development process can lead to tangible benefits for individuals and society.

Federal agencies such as the NIH make substantial investments in the basic and applied science underlying new drugs. Pharmaceutical and biotechnology companies heavily invest in the development of drug candidates. Recent reports have shown that industry has been responsible for 50% or more of the dollars invested in health and biomedical research in recent years. This expenditure includes significant spending to advance clinical trials – the studies that test new medical treatments before they get approved for use.

The NIH funded basic research that contributed to every single drug approved by the U.S. Food and Drug Administration between 2010 and 2016. This includes key work that led to COVID-19 vaccines. The COVID-19 vaccination campaign likely saved the U.S. more than $1 trillion in health care expenses that would have otherwise been incurred and also saved lives.

Initial NSF investments in research was instrumental in capturing images of black holes and exploring deep oceans. Basic research funded by NSF paved the way for everyday conveniences such as smartphones, the Google search engine and artificial intelligence. Other funded projects led to quality of life improvements such as American Sign Language and kidney matching for transplants. Educational programming, such as “Bill Nye the Science Guy” and “The Magic School Bus,” were NSF-backed projects, too.

It matters who pays: Funding shapes science

Funders and financial systems shape the trajectory of research across fields. Institutions advertise funding opportunities based on their current priorities. Changes in the amount of funding available ultimately direct the attention of researchers. Any interruptions to basic research, such as changes to financial supports or institutions, may threaten future discoveries and potential payoffs for years to come.

According to numbers reported by a coalition of research institutions, every dollar that NIH spends on research leads to $2.56 of new economic activity. For the 2024 fiscal year, this means, of the $47.35 billion Congress appropriated for NIH, the $36.94 billion awarded to U.S. researchers fueled $94 billion in activity through employment and the purchase of research-related goods and services.

Economist Pierre Azoulay and colleagues recently imagined an alternative history where NIH was 40% smaller and dispersed less money – a budget akin to current federal proposals. They argued that more than half of the drugs FDA approved since 2000 are tied to NIH-funded research that would have been cut under this scenario. This thought experiment underscores how valuable those basic research dollars are.

Even seemingly out-of-touch or abstract studies may precede discoveries with major impact. Basic research into bee nectar foraging and movement around the colony, recently mentioned on “Last Week Tonight with John Oliver,” led to the development of an algorithm that distributes internet traffic between computer servers, which now powers the multibillion-dollar web-hosting industry. Learning about applications of research with visible societal impacts can help people understand and appreciate the role of funding in the scientific enterprise.

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