The University of Chicago

Science at Stake: An Analysis of the National Science Foundation in the New Trump Era

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A project essay submitted for partial fulfillment of the the requirements for

a Bachelor of Arts degree in Public Policy

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Undergraduate Program in Public Policy

May 18, 2025

Abstract

The National Science Foundation is an independent federal agency responsible for supporting fundamental research and education across all non-medical fields of science and engineering. In the past several months of the new Trump administration, the NSF has faced various changes, both through direct policy and due to a new culture of uncertainty surrounding the availability of federal funding for research. In this paper, I aim to evaluate the impacts of the new administration on the NSF and on US science as a whole. Through analyzing news and literature coupled with personal experiences working in science, I find that the NSF has significantly curtailed its usual work via less grant approvals, reducing the size of integral programs, and more. Specifically, I argue that these impacts are most salient for students and early career scientists, and have the potential to significantly erode the position of the US as a global leader in science and innovation.

Science at Stake: An Analysis of the National Science Foundation in the New Trump Era

I was nine when I watched Superstorm Sandy ravage my state– I remember seeing hundreds of dead rabbits littering the grass of the shore towns I grew up visiting, friends' houses with incredible flood damage, and boardwalk rides floating in the ocean. As I got older, I adjusted from sledding in a foot of snow several times a year to a few inches once a winter. Just before I left for college, I waited out a tornado in the back room of the math tutoring center I worked at as several houses in the neighborhood directly behind the building were demolished. And this was just New Jersey; my family in Florida, like many throughout the United States and beyond, dealt with much worse. The rate of sea level rise continues to accelerate, and sea level along the coast of the continental US is predicted to rise by as much as 12 inches by 2050. [1] In the next 50 years, parts of the planet will become uninhabitable due to hotter temperatures and more extreme humidity. [2] Already, climate migrants exist, as people flee drought-hit areas of Latin America, Africa, and Asia where farming has become impossible, and consequently rural life has become unsustainable. Growing up through and around this crisis fostered, for me, an acute desire to study climate, to understand what's happening and to figure out what we need to do to fix it. This was my entry point into science, and so it seems natural to discuss the gravity of the climate crisis as inextricably linked to the far-reaching consequences of the Trump administration on the National Science Foundation and on the federal research infrastructure more broadly.

Just four months into the new Trump administration, the NSF has faced significant changes. On January 27th, the Office of Management and Budget (OMB) released a memorandum stating the following:

> Career and political appointees in the Executive Branch have a duty to align Federal spending and action with the will of the American people as expressed through Presidential priorities. Financial assistance should be dedicated to advancing Administration priorities, focusing taxpayer dollars to advance a stronger and safer America, eliminating the financial burden of inflation for citizens, unleashing American energy and manufacturing, ending "wokeness" and the weaponization of government, promoting efficiency in government, and Making America Healthy Again. The use of Federal resources to advance Marxist equity, transgenderism, and green new deal social engineering policies is a waste of taxpayer dollars that does not improve the day-to-day lives of those we serve. [3]

This directive pauses federal grant and loan programs that violate any of the seven executive orders (EOs) signed by the president in the seven-day period since taking office on Jan. 20, including "Unleashing American Energy" and "Ending Radical and Wasteful DEI Programs and Preferencing." The NSF was immediately impacted; roughly 10% of its staff was fired [4]. Though the agency insists that it continues to operate as normal despite Trump's onslaught of orders, the number of grants distributed by the NSF since Trump's inauguration has decreased by nearly 50% compared to the same 2-month period one year ago. [5] This has reduced funds awarded by more than $400 million.

On April 18th, the NSF announced that it would begin to terminate active grants that contain language the administration perceives to be related to diversity, equity, and inclusion initiatives. [6] All new research grants were frozen, meaning grants that were previously approved for funding are being returned to program directors. NSF staffers have been asked to determine whether projects violate the various presidential directives that prohibit federal research agencies from funding research on a range of issues including combating climate change. As of now, the NSF will not make any new awards. These policies are catastrophic, but the culture of uncertainty that now surrounds funding for science is perhaps just as impactful. The ramifications are far reaching, both in tangible, practical ways— think disrupting climate change research for four years despite the fact that this crisis is already happening at a higher rate than we could possibly study it– but also in the sense that we are eroding at our scientific workforce and consequently at our ability to remain a global leader in scientific inquiry. This paper will first explore the history of the National Science Foundation as a means to understand why and how science became reliant on federal funding. From there, I'll discuss the impacts of the new Trump administration on our scientific workforce with specific regard to early career scientists, who have been among the more effected. I'll then contextualize the problem of eroding our workforce through examining the role of the university-government partnership structure in securing the US' position as a science superpower. Finally, I'll discuss the tangible consequences of disinvesting from science through the lens of climate change.

The History of the National Science Foundation

Prior to World War II, the federal government played a relatively minor role in supporting scientific enterprise. This meant that universities and research institutions relied heavily on philanthropic support or funding from private companies. In consequence, science which did not draw interest from private investors had no mechanism through which to be funded. Herbert Hoover, in his role both as US Secretary of Commerce and later as President, recognized this as a problem, and, in 1925, proposed a national research endowment to support university science through industry funds. Industry, however, did not imagine that they could benefit from research that would not yield an immediate application, and consequently declined involvement, making it so that this idea never came to fruition. [4] In 1940, however, President Franklin D. Roosevelt approved the National Defense Research Committee, headed by the former vice president of MIT Vannevar Bush. The National Defense Research Committee awarded thousands of research contracts to universities to support basic research across all scientific disciplines. It also operated with the evident goal of developing the technology necessary for World War II, and brought forth a new era of cooperation between civilian scientists and the military, a relationship which was, prior to this point, relatively tenuous. The National Defense Research Committee supported the development of World War II weaponry, most notably the Manhattan Project, but also radar, sonar, and the mass production of penicillin. [4]

This is to say that the war was driven by the successful application of science, but also that support for science had yielded advancement which transcended a military context. Given this, President Roosevelt wrote to Bush to solicit national policy recommendations on science with the aim of extending this collaboration into peacetime. This yielded Bush's 1945 report "Science: The Endless Frontier," which laid out plans for an agency which could support research at universities as a means to promote progress in science. Following this recommendation, the National Science Foundation was established in 1950 with Congress' passing of Public Law 81-507, the "National Science Foundation Act of 1950." The law prompted the creation of the agency, and also enshrined basic functions, which are stated as follows:

SEC. 3. (a) The Foundation is authorized and directed-- (1) to develop and encourage the pursuit of a national policy for the promotion of basic research and education in the sciences; (2)to initiate and support basic scientific research in the mathematical, physical, medical, biological, engineering, and other sciences, by making contracts or other arrangements (including grants, loans, and other forms of assistance) for the conduct of such basic scientific research and to appraise the impact of research upon industrial development and upon the general welfare; (3)at the request of the Secretary of Defense, to initiate and support specific scientific research activities in connection with matters relating to the national defense by making contracts or other arrangements (including grants, loans, and other forms of assistance)for the conduct of such scientific research; (4) to award, as provided in section, 10, scholarships and graduate fellowships in the mathematical, physical, medical, biological, engineering, and other sciences; (5) to foster the interchange of scientific information among scientists in the United States and foreign countries; (6) to evaluate scientific research programs undertaken by agencies of the Federal Government, and to correlate the Foundation's scientific research programs with those undertaken by individuals and by public and private research groups; (7) to establish such special commissions as the Board may from time to time deem necessary for the purposes of this Act; and (8) to maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information covering all scientific and technical personnel in the United States, including its Territories and possessions. (b) In exercising the authority and discharging the functions referred to in subsection (a) of this section, it shall be one of the objectives of the Foundation to strengthen basic research and education in the sciences, including independent research by individuals, throughout the United States, including its Territories and possessions, and to avoid undue concentration of such research and education. (c) The Foundation shall render an annual report to the President for submission on or before the 15th day of January of each year to the Congress, summarizing the activities of the Foundation and making such recommendations as it may deem appropriate. Such report shall include (1) minority views and recommendations if any, of members of the Board, and (2) information as to the acquisition and disposition by the Foundation of any patents and patent rights. [7]

These specific functions are a direct result of Bush's vision. His plan centered universities as the best place for discovery due to their ability to create an environment which was not driven by market necessity or limited by opposition to the creation of new knowledge. He saw universities as a place where researchers could have intellectual freedom without being subject to pressures of convention. He also anticipated the potential risks of state-sponsored research, and established principles which emphasized complete autonomy in methodology, personnel, and scope of inquiry. This is to say that the National Science Foundation was founded with the goal of encouraging innovation and discovery through funding basic research, but also with the understanding that political interference could be catastrophic to both academic freedom and progress within science.

Bush also envisioned universities as a training ground for the next generation of scientists. Concerned about the cost of higher education serving as a barrier for talented individuals, Bush proposed grants and fellowships for undergraduate and graduate students in addition to support for advanced training. This has become a core component of what the NSF does through programs like Research Experience for Undergraduates (REU) and the Graduate Research Fellowship Program (GRFP). In 2024, 357,000 researchers, postdoctoral fellows, teachers, and students were directly supported by the NSF. [4] This doesn't include NSF programs which impact millions, especially young children, through museum partnerships and outreach programs. These training initiatives, namely the REU and GRFP programs, have been among the most impacted by the Trump administration's cuts.

Impact on Student and Early Career Scientists

The NSF Research Experience for Undergraduates (REU) program was founded in 1987 with the goal of encouraging access to research for students at small institutions. REUs function as summer internships, wherein a student conducts research at a host institution. There are 1,300 REU programs across the country, with opportunities in all scientific disciplines. [8] Students participating in an REU often receive free room and board, a stipend for their work, and reimbursement for costs associated with travel to both the program and to academic conferences. This level of accessibility is important; undergraduate research is associated with higher levels of academic performance, retention in STEM fields, and an increased likelihood of entering a scientific field. [8]

I participated in an Earth Science REU at Columbia's Lamont-Doherty Earth Observatory last summer and experienced the benefits of these programs firsthand. I was able to conduct paleoclimate research that I loved and that completely shifted my conception of what I wanted to do after graduation. I was connected to mentors and resources who both aided in my research and, even now, continue to help me navigate the science field. We had twice-weekly lectures hosted by professors across various Earth Science disciplines, career presentations, and were funded through the program to present our work at the American Geophysical Union Fall Meeting. It was also one of the very few opportunities where I could be paid well to do full-time research in an academic setting, and that compensation made it easier to choose a program like this over an industry internship.

REUs across the country have been broadly impacted by the new Trump administration, both materially and because of the uncertainty surrounding science funding which is now the cultural norm. REUs are funded on a three-year cycle, meaning that an institution applies to be an REU site once every three years when their program is up for renewal. Under the new administration, many site leaders have had their proposals rejected or received no response from the NSF. [8] In an article for Inside Higher Ed, Keivan Stassun, who runs Vanderbilt's Physics and Astronomy REU, said that he heard from the department's program officer at the NSF that the program was being recommended for funding. This means that the grant is all but guaranteed and even that the recipient can begin to spend money before the funds officially come through. In early March, however, he received word that this REU, which had been operating successfully since 2006, would actually not be funded. This site specifically had a very high return on investment; 72% of its participants continued on to graduate education. This is not unique to Stattsun's program. Tony Wong, who runs Rochester Institute of Technology's School of Mathematics and Statistics' REU on STEM education research, a program that has run successfully for 10 years, never received an answer either way on funding, prompting the cancellation of the program without soliciting applicants. A program director at the NSF stated that multiple REU leaders were told that their programs would be recommended for funding, only for them to be later rejected. The director stated that the NSF would likely be able to fund roughly half of the REUs it supports in a typical year. This is especially surprising given that, in

2024, the entire NSF REU program cost an estimated $85 million to run. This is a fraction of the agency's $9 billion budget, and the impact to this program seems disproportionate.

Beyond these tangible funding cuts, other REU programs are struggling with the uncertainty caused by the Trump administration. Some universities have cancelled their programs out of caution, worried that funding would later be revoked, leaving students without a summer opportunity. [8] The program director for the REU I participated in is currently crowdfunding on LinkedIn, with the goal of receiving enough money to support this summer's students should they unexpectedly lose funding for their program.

The Graduate Research Fellowship Program (GRFP) has been similarly impacted. The GRFP offers five-year awards to students pursuing graduate studies in the sciences. Since the inception of the NSF Graduate Research Fellowship Program (GRFP) in 1952, roughly 70,000 graduate students have been supported while enrolled in PhD programs across various scientific disciplines. [9] It's a prestigious program, with only about 16% of applicants typically receiving the award; the explicit goal is to invest in people who have the potential to make the scientific workforce better. In previous years, roughly 2,000 individuals received the fellowship. This year, that number has been slashed in half. [9] In an article for Nature, Rob Denton, a biologist at Marion University who reviewed GRFP applications, pointed out that these applicants are more vulnerable because they're at the beginning of their careers. He stated that, "[this award] could be the difference between them staying in science or finding another career." [9] Like in the case of REUs, the impact of cuts to this program are outsized compared to the cost of running it. Kenny Evans, a science-policy specialist argued that "GRFPs are one of the most cost-effective ways for NSF to give out money," because they result in a trained, promising young scientist for a relatively inexpensive investment.

Cuts to both REUs and the GRFP point to the alarming consequences of the Trump administration on early career and student scientists; still, these impacts extend beyond these programs. Several universities during this PhD admissions cycle paused admissions or even rescinded offers due to funding uncertainty. [10] Northwestern University deferred accepted students this year to the following cycle. [11] Others accepted cohorts significantly smaller than their pre-Trump plans. While most universities have declined to release formal statements, prospective students have shared the unique challenges associated with this application cycle. In an article for Nature, an applicant to the physics PhD program at the University of Arizona shared that they received a letter which stated that the department was suitably impressed with the student's qualifications, and that they ranked high among applicants, but that recent federal funding uncertainties made it so that an offer of admission could not be extended. I received a similar email from a PhD program to which I applied to, and analogous stories are circulating among students who applied to a wide variety of universities.

Universities and Government- Why the Partnership Works

It's important to recognize that curtailing the future of the scientific workforce in this way is shortsighted at best. The United States has served as the world's leader in scientific discovery for the past 80 years. Research at US universities results in more than 1,100 science-based start-up companies annually, which have resulted in important innovations across various fields (including drug development, m-RNA vaccines, etc.). [12] The partnership between universities and the federal government is responsible for these advancements, but also improvements in national security and economic growth. And to be clear– it is this partnership that has launched us into being a science superpower. Prior to World War II, the United

Kingdom outpaced the US in much of science inquiry and discovery, but the UK focused on centralized government laboratories rather than working through university infrastructure, which suppressed the potential of science as a mechanism to improve society through innovation and through the resulting economic and social impacts. [12] Much of what people conceptualize as the "hot-belly" of science funded by industry– think Silicon Valley–was born of the federally funded university work.

While it might initially seem 'wasteful' to hear that private universities like Columbia and Harvard receive billions from the federal government, recognize that the system operates this way because it works. Professors at universities do research for the federal government, which accomplishes two things. First, science happens, and that's in the interest of the government. Sometimes this is basic science, meaning no direct application will immediately result, but that work results in progress that needs to happen for long-term innovation. Other times, the research is very applied and will, on a short timescale, likely result in something that will help people. This often looks like advancements in drug development, vaccines, clean energy, etc. In exchange, scientists and universities get to do the work they want to do and aren't subject to the whims of private philanthropists. It's also more efficient because universities can combine government funding with other funding sources. In 2023, US universities received $27.7 billion from charitable donations, $6.2 billion in industrial collaborations, $6.7 billion from non-profit organizations, $5.4 billion from state and local government and $3.1 billion from other sources. [12] This additional money is often also used for science or for creating the infrastructure necessary for science (like a research lab). This means that, by funneling money for science into universities, the government is benefiting from more science than it's paying for.

I bring this up in connection with the impacts of the Trump administration on early career scientists because loss of talent is an area in which there will be immediate ramifications. The US has historically served as a destination for foreign research due to its well-funded universities; approximately 43% of the US's STEM workforce was born in another country. [4] The Trump administration's policies are eroding at this status, but also at keeping home-grown talent here. In a survey sent out by Nature, 75% of responding scientists stated that they were considering leaving the country to pursue science elsewhere. [13] China, France, and several other European nations are actively recruiting US scientists with substantial incentive programs. In a different vein, some argue that it will be difficult for young US scientists to remain competitive against foreign scientists who are still benefiting from robust training infrastructure. Stassun, previously mentioned in connection with the Vanderbilt REU program, stated for Inside Higher Ed that, "We have a shortage of domestic talent, and not because those people aren't there. It's not because we don't have the best and the brightest among our own. It's because we need efforts that recruit those students, that provide the support that might be needed in order for them to be successful." [8] This to say that dismantling the partnership between universities and government, downsizing training programs, limiting grant funding, and sowing uncertainty surrounding the future of science in the US will almost certainly result in a significant injury to our scientific workforce and our ability to do science in the way that we have since World War II.

Science and Climate Change

The consequences of curtailing US academic science are far-reaching and severe, and evaluating their effects on the existing training, education, and university infrastructure is important. Still, this is not the whole story. Science impacts all of our lives, and the Trump administration's attack on science will have real, tangible ramifications for individuals in the US and globally. Because I work in climate science, it is the lens through which I understand the gravity of this situation. The climate crisis is here and is progressing in a way that is virtually unmitigated. Climate science seeks to understand the Earth system, to figure out how things operate and what might be at risk as the magnitude of anthropogenic climate change continues to increase. In the 20th century, the global average surface temperature increased by almost 2°C, and the warming rate per decade has climbed dramatically since the 1980s. To understand what this means for our future requires a lot. Climate is an incredibly complex and interconnected domain. To demonstrate this, let's engage in a short thought experiment. Let's say, for example, that we're interested in understanding how warming might impact sea level rise because constraining this relationship is an important piece of building climate models that can help us make informed decisions regarding anthropogenic climate change. To start, you need to know how the atmosphere works and how warming might proceed given carbon sources and sinks. You need to understand what that warming will do to ice. This involves constraining surface and basal melt in addition to complex ice flow regimes. But to understand basal melt– this just means the melting of ice from the underside, i.e. the part submerged in water– you need to understand the ocean. How is its temperature profile impacted? How much carbon from the atmosphere is it receiving? How much acidification will that lead to? Does this change deep water currents, and if so, to what extent? For the sake of simplicity, let's return to the ice and say that we've figured out exactly how melting works and we have data on each ice shelf to know at exactly what point each will collapse (this is not something we're even close to having). You then need to understand buttressing– how much are certain ice sheets supporting each other?

If one ice sheet collapses, what will that mean for the ones around it? Maybe all of this is impacted by larger forces like orbital cycles, which are thought to drive glacial cycling. To figure that out, you need to do paleoclimate work to build a record of ice volume changes over many millions of years. I could continue.

This to say that we are not close to being able to constrain climate risks in a meaningful way. If we could provide the New York City government with a relatively small sea level rise range, officials could prepare the infrastructure necessary to try to mitigate damage and loss. But we can't, so they can't. In fact, in April, the Trump administration dismissed the hundreds of scientists compiling the federal government's flagship report on global warming, which helps governments and private companies prepare for the effects of climate-related issues. [14]

I'm talking here about climate, but what I'm trying to get at is that so much of science is deeply impactful and relatively urgent. Real people will suffer the consequences of an administration that does not understand the importance of maintaining the federal research infrastructure. Scientific inquiry has intrinsic value, but also tangible impacts on the lives of Americans and the Trump administration's actions are subjecting people to completely unnecessary risk.

Conclusion

The National Science Foundation was founded because we as a nation recognized the need to invest in science. Its founding documents enshrine essential functions and principals, like robust training programs and absolute autonomy from the state for universities. This has resulted in a level of excellence in science that is unparalleled globally. Now, the agency faces existential threats. The Trump administration has pursued mass firings, grant freezes, content censorship, and a slashing of core NSF training initiatives, all of which have made the NSF significantly less effective at delivering on its founding purposes. These actions are eroding at our position as a global leader in science and at our talented scientific workforce. This is especially true with regard to early career scientists, who are being disproportionately impacted. The consequences of this cannot be overstated. The world will continue to advance, and so progress here must continue to be achieved, especially as we attempt to solve complicated, accelerating problems. A country that disinvests from science does so at its own peril; in less than six months of this Trump administration, we are navigating a degree of injury to the NSF and to federally funded science more broadly which will likely last far beyond the Trump term.

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