



Response to Senator Lankford's "Federal Fumbles, Vol. 7"

The National Science Foundation (NSF) has been the backbone of America's science and engineering research enterprise for over 70 years. In fact, NSF is the only federal agency that supports all fields of fundamental science and engineering research and education. NSF supports cutting-edge research projects — many of which serve as bellwethers for solutions to the myriad complex issues facing society. NSF programs also traditionally integrate research and education, fast tracking innovation excellence via hands-on learning to train our next generation of researchers and innovators.

Each year, NSF competitively awards thousands of grants that collectively advance our nation's scientific capabilities and engage the talents of hundreds of thousands of researchers, postdoctoral fellows, technicians, teachers and students in every field of science and engineering.

NSF is the primary source of federal funding for non-medical basic research, providing approximately 12,000 new awards annually. Through its merit review process, NSF ensures that proposals submitted are reviewed in a fair, competitive and in-depth manner. Competition for funding is intense, with only about one out of five proposals ultimately being approved.

Each proposal submitted to NSF is reviewed by science and engineering experts well-versed in their particular discipline or field of expertise. All proposals submitted to NSF are reviewed according to two merit review criteria: *Intellectual Merit* and *Broader Impacts*. NSF's merit review process is widely considered to be the "gold standard" of scientific review. Perhaps the best evidence of NSF's success is the repeated replication of its merit review model for discovery, education and innovation around the globe.

The results of this process — funding the best and brightest ideas through competitive merit review — have been profound. NSF-supported research has underpinned multitudinous discoveries leading to new inventions — the Internet, web browsers, Doppler radar, Magnetic Resonance Imaging, DNA fingerprinting, and bar codes — to name a few. These diverse examples underscore NSF's significant contributions to our nation's prosperity, health and wellbeing. NSF-funded discoveries have expanded our understanding of the world in which we live, led to life-saving medical advances, enhanced our national security, improved our everyday lives and yielded insights into the creation of the universe.

NSF's task of identifying and funding work at the frontiers of science and engineering requires keeping close track of research around the United States and the world; maintaining constant contact with the research community to advance the horizons of inquiry; and choosing the most promising people to conduct the research.

The following grants cited in the report illustrate examples of promising NSF-funded research awarded support through the merit review process.

NSF Postdoctoral Fellowship in Biology: How Overwintering Life-Stage Affects Vulnerability to Winter Warming in Butterflies

NSF Award 2208982

Federal Fumbles, Vol. 7: “European Butterflies”

This project supports the development of U.S. STEM talent through a multinational research experience on a topic that has implications for our understanding of life at all stages across a myriad of species.

The results of the study can be used to understand and avoid the effects of invasive species like the imported cabbageworm (*Pieris rapae*) and other such **insect species that cause billions of dollars in economic loss to the U.S. each year**. Indeed, at least two of the species selected for the study have already been reported in the continental U.S. with the potential to negatively impact crops as their caterpillars can eat crucifers such as cabbage, broccoli, and other economically important plant species. So, although the postdoctoral scientist has outlined basic physiological research pertaining to the chosen study species, **there is clear value for the results from the study in the agriculture sector with potentially high payoffs for that sector of the U.S. economy.**

Empowering STEM talent is a critical component of NSF’s mission and supports the advancement of science and engineering. Particularly, support at key career transition points like postbaccalaureate, postdoctoral, and early career faculty helps retain individuals in the STEM workforce. The Postdoctoral Research Fellowships in Biology (PRFB) program furthers this goal by supporting early-career postdoctoral scientists in the biological sciences, and is the only program managed by the Directorate of Biological Sciences at the NSF to focus on this career stage. In addition to securing the STEM workforce, in and of itself benefiting society, PRFB awards also result in novel understanding of life at all stages and across the myriad species on Earth. These awards are made after careful review of proposal content and in a highly competitive funding environment that involves hundreds of proposal submissions that are reviewed by dozens of scientists.

This award funds a U.S. postdoctoral scientist to work in an international setting that includes host scientists from three countries, including the United States; the study is international in scope with academic experts serving as co-sponsors for this project residing in Germany (Dr. Lehmann), South Africa (Dr. Terblanche), and the United States (Dr. Ragland). International scientists provide valuable support to the postdoctoral scientist through the use of their facilities and the time they contribute as mentors even though they, themselves, are provided with no funding from the award. The work will provide the postdoctoral scientist with specific training in physiological modeling of insect dormancy (“diapause”) during winter months. The work is novel for examining butterfly species as they spend the winter months in particular areas because many factors (e.g., temperature, moisture, etc.) can vary during this period of time and thereby impact the emergence of species in the subsequent spring or summer months of the year. This insight is invaluable in understanding the responses of countless other insect species including pollinators and crop pests.

The relevance of the research to various ecosystems will be communicated to the public through efforts including modular displays constructed for popular public settings like the Butterfly Pavilion in Westminster, Colorado, near one of the U.S. host institutions (University of Colorado at Denver). Overall, the work supports the career goal of the postdoctoral scientist to pursue an academic research career in the U.S. and creates a highly relevant global network for the postdoctoral scientist's career that will benefit the Fellow's future role as a scientist studying important biological phenomena at the global scale and thus the research the scholar conducts.

Understanding the Gendered Impacts of COVID-19 in the Arctic

NSF Award 2137410

Federal Fumbles, Vol. 7: “Get Well, Russia!”

A key deliverable of this project will be a publicly accessible web portal presenting findings on COVID gendered impacts in the Arctic, including data on government responses that directly address women's economic and social security, including unpaid care work, the labor market, gender empowerment, and violence against women.

The Arctic is home to almost 4 million people, including Alaska Native populations living above the Arctic Circle. **The Alaska Native population suffered disproportionate impacts of COVID, with significantly higher morbidity and mortality rates.** This project is examining these health disparities and exploring whether the pandemic exacerbated existing gender inequalities. This project was supported to better understand the impacts of the pandemic, facilitate proactive preparation for future, similar challenges, and to provide local, state and national policy makers with the scientific research needed to make informed decisions.

The proposal was evaluated and recommended for funding in October 2021, four months before the Russian invasion of Ukraine. Because of the invasion, and in accordance with White House guidance, the portion of this project that was to occur in Russia has not occurred. The research entails a comparative study of COVID impacts and health responses to the pandemic using three sites to characterize differences in pandemic responses. Understanding of U.S. Arctic community and Indigenous health is enhanced through comparison with other northern communities. Research focuses on Alaska and involves in-depth collaboration with Alaska Native participants and healthcare organizations. The City of Anchorage and the Anchorage Women’s Commission are collaborators on the project. There is no direct corollary to Alaska Natives in the continental U.S. This Alaska-focused project originally included plans for comparative research in Iceland (which is geographically and environmentally similar to Alaska) and with Indigenous Russian women in the Nenets Autonomous region.

NSF’s Office of Polar Programs’ Arctic Sciences Section supports research focused on the Arctic region and its connectivity with lower latitudes. Investments advance fundamental, process, and/or systems-level understanding of the Arctic's rapidly changing natural environment and social and cultural systems. Where appropriate, funded research aims to improve our capacity to project future change. The scientific scope is aligned with, but not limited to, research priorities outlined in the [Interagency Arctic Research Policy Committee \(IARPC\)](#) five-year plan.

This project builds upon a foundation established through a long-standing Arctic Council-sponsored project “Gender Equality in the Arctic” (GEA). GEA is jointly sponsored by multiple Arctic countries, with support in the U.S. led by the Department of State. The principal investigator of this project also played a key role in the [Pan-Arctic Gender Equality in the Arctic Phase III Report](#), published in 2021. The Report was co-sponsored by the U.S. Arctic Council delegation and was a key deliverable of the Icelandic chairship of the Council (2019-2021). The NSF-funded project *directly contributes* to US-endorsed objectives of the Arctic Council’s Sustainable Development Working Group, of which the US is a member, along with multiple Indigenous “permanent participants” representing Alaska Native interests and priorities.

Despite the inability to use a comparison population in Russia and limitations on travel to rural Alaska during the COVID-19 pandemic, this project has already been productive. Researchers have disseminated research at high-profile research conferences with relevance to the Arctic science and policymaking communities. A key deliverable of the project will be a publicly accessible web portal presenting findings on COVID gendered impacts in the Arctic, including data on government responses that directly address women's economic and social security, including unpaid care work, the labor market, gender empowerment, and violence against women.

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Collaborative Research: Building a Framework for the Causes of and Solutions to the Pluralistic Ignorance Gap on Climate Change

NSF Award 2149329

Federal Fumbles, Vol. 7: “I’m Right, You’re Wrong”

Pluralistic ignorance is a term used to describe a common phenomenon in which people have an inaccurate perception of the opinions or positions of others. Pluralistic ignorance occurs in a wide variety of contexts. For example, people at work or in a class listening to a confusing set of instructions may each assume that everyone else in the group understands, and may thus be reluctant to ask questions.

Americans of all political persuasions share this tendency to have inaccurate perceptions of the opinions of others. These misperceptions can lead to people being reluctant to act, even in situations where the actual group consensus would support action. Many societal problems are most effectively addressed by collective action—meaning that groups and communities need to act together through policy changes in order to find solutions. Pluralistic ignorance can lead decision-makers to miss opportunities to act in ways that are supported by their constituents.

This NSF-funded project aims to investigate what factors contribute to mis-estimation of societal beliefs, and what factors can help make people’s perception of societal beliefs more accurate. Previously published research has shown that the majority of Americans think climate change is a major problem and support taking various actions to reduce that threat. However, when asked whether their fellow citizens would support action to address climate change, Americans underestimate the actual level of support for action. The researchers are examining the factors that lead people to systematically underestimate how many of their fellow citizens actually support policy changes to address climate change.

PIRE: Co-Creating Research and Education Capacities to Understand, Visualize and Mitigate Climate-Change Impact Cascades and Inequities in Central Mexico

NSF Award 2230723

Federal Fumbles, Vol. 7: “Caliente in Mexico City!”

This project re-imagines the way research, policy, and education can be brought together as tools for policy makers and communities to address challenges in water resource management in today’s dynamic environment. The approach has applications to many complex policy domains in the U.S. and elsewhere, including not only water resource management but also urban planning; economic development planning; disaster preparedness; pandemic preparedness and public health; water; and energy systems.

The news regularly brings reports of the growing impacts of extreme weather on water resources around the world: shrinking water reservoirs, severe drought, and flooding, to name a few. These impacts frequently catch communities off-guard, causing greater losses than might have been the case with greater preparedness. Impacts are accelerated by cascading effects on food and agriculture, health, ecosystems and livelihoods. Impacts tend to fall heavily on those least able to afford them.

Science and policy related to water resource management have traditionally been top-down and narrowly focused. Policy decisions involving large-scale investments are frequently made without the ability to fully visualize dynamic, longitudinal impacts across multiple sectors in an integrated manner or to compare alternative scenarios with input from a wide range of stakeholders. This award pursues an innovative approach to this challenge, integrating cutting edge mapping and visualization technology with stakeholder engagement. Bringing together interdisciplinary expertise the U.S. team, working in collaboration with Mexican researchers, creates new ways to simulate and virtually “inhabit” alternative future scenarios to be used by communities and policy makers to inform policy planning and implementation. The project re-imagines the way research, policy, and education can be brought together as tools for policy makers and communities to address challenges in water resource management in today’s dynamic environment. The research setting in the Mexico-Lerma-Cutzamala Hydrological Region, that includes Mexico City, offers a real-world laboratory where 3 water basin are linked and impacts are felt across one of the most populous regions in the world.

The NSF grant supports U.S. researchers and U.S. students to conduct this innovative research in collaboration with Mexican counterparts funded by other sources. The project leverages the team’s complementary expertise for mutual benefit. Clark University researchers bring expertise in geographical information systems (GIS), remote sensing and eXtended Reality, while researchers at Mexico’s UNAM bring their deep know-how in Systems Dynamic Models for analysis of climate, atmospheric phenomena in a variety of ecosystems. The integration of both skill sets enables the innovative project approach.

The project is a model of integration of research and education to support development of the U.S. STEM workforce. Nine U.S. masters and doctoral degree students are trained under the project. Students will hone skills in Geographical Information Systems and remote sensing, urban-economic geography, and community engagement, among other areas. Integration of experiential learning in real world settings strengthens professional development.

This is one of the first times GIS/Remote Sensing, System Dynamics Modeling, eXtended Reality decision support and Research-Education Integration are combined to confront dynamic water-related challenges. The team tests the hypothesis that mapping, modeling and visualization of impacts will increase participation in decision making and that education and increased participation can help transform governance of water resource management in a way that leads to more sustainable, equitable outcomes. The approach has applications to many complex policy domains in the U.S. and elsewhere, including not only water resource management but also urban planning; economic development planning; disaster preparedness; pandemic preparedness and public health; water; and energy systems.