Response to Senator Paul's "2018 Festivus Report"

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 "2018 Festivus Report" illustrate examples of promising NSF-funded research awarded support through the merit review process.

RAPID: Testing for hurricane-induced natural selection that reverses the direction of morphological adaptation in Anolis lizards
NSF Award 1806420
2018 Festivus Report: "Blew leaf blowers at lizards"
University of Rhode Island

Hurricanes occur frequently, with devastating consequences for natural ecology. In general terms, this research on 'model' experimental organisms – lizards – could lead to an improved ability to model and predict how populations of small animals respond to catastrophic natural events. In addition, this project highlights the ability to measure how the process of evolution unfolds in real time, including in response to natural disasters.

This scientific study started with the observation that the relationships between various physical structures in lizard populations changed rapidly and in unexpected ways after a hurricane. The scientists then tested specific hypotheses to explain this observation. The study allowed quantification of biomechanical performance and fitness benefits of the changes in the measured shape of lizard limbs, which would allow the lizards to resist the strong wind forces that animals would experience in their natural environment during a hurricane. Rather than use expensive and complex wind tunnels, the scientists used a more cost-effective strategy – simple and inexpensive leaf-blowers to produce known rates of air flow under controlled conditions. The researchers discovered that hurricane-force winds are a source of natural selection on the morphology of the lizards, and that extreme events, such as hurricanes, must be incorporated to understand how the temporal dynamics of natural selection shape animal functional morphology and survival in natural populations. The research has resulted in two papers in high-impact journals – Nature and Proceedings of the National Academy of Sciences of the United States of America. The project has also provided training and field research experiences for faculty, post-doctoral fellows, and graduate students from five universities, as well as international collaborations.

The Origins of Equid Domestication
NSF Award 1311551
2018 Festivus Report: "Studied horse and donkey hunting on the ancient Anatolian Peninsula"
University of North Carolina at Chapel Hill

This project used a combination of cutting-edge research techniques to examine the domestication of the horse as one of the most important technological achievements of early civilizations, which radically changed how people lived, worked, waged war and engaged in commerce. Studying the historical impact of technology gives us better insight into today's world. Although modern technological innovations may be more complex than animal domestication, this research can help us to understand fundamental patterns of technology adoption in humans that remain relevant today.

The horse industry is a substantial contributor to the U.S. economy. The following is from the American Horse Council Foundation's 2017 National Economic Impact Study[1]: "The horse industry contributes approximately $50 billion in direct economic impact to the U.S. economy, and has a direct employment impact of 988,394 jobs. Additionally, the industry itself contributes $38 billion in direct wages, salaries, and benefits. From those direct effects, the horse industry's contribution ripples out into other sectors of the economy. Adding these ripple effects results in an estimate of the total contribution of the horse industry to the U.S. economy of $122 billion, and a total employment impact of 1.7 million jobs."

NSF consistently has more highly rated proposals than available funding for awards, so the decision to make any award, including the one in question, is never based on any sort of "use or lose" premise. In fact, in fiscal year 2013, when this particular award began, NSF had to decline approximately $1.82 billion in research from proposals that were of equal quality to those it funded.

This project was evaluated according to NSF's merit review process, which is the worldwide "gold standard" for evaluating research proposals. Through merit review, NSF seeks to ensure that proposals submitted are reviewed in a fair, competitive and in-depth manner. Advancing fundamental knowledge has been part of NSF's mission since the agency's creation. For decades, investments in basic research have led to advances that improve the U.S. economy, national security and the nation's position as a global innovation leader.

[1]https://www.horsecouncil.org/resources/economics/

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