



Response to Senator Ernst's November 2021 "Make 'em Squeal" 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 report illustrate examples of promising NSF-funded research awarded support through the merit review process.

ABI Sustaining: Maintenance of the XMA/ZMA Portal video data management systems and XMA Lab video motion analysis software for the comparative biomechanics community and Determining the source of muscle power for suction feeding in ray-finned fishes

NSF Awards 1661129 and 1655756

November 2021 “Make ‘em Squeal” Report: “The Taxpayer Turkey Trot”

Brown University

Biomechanics integrates biology with physics, mathematics, and engineering to understand how animals move, access food, and eat. The results from biomechanics research provide new knowledge about how animals move during breathing, walking, running, and feeding. All of these behaviors are critical to animal survival and have relevance in basic biology, agriculture, veterinary and human medicine, and advanced biomimetic fields like robot design.

This particular study was conducted on wild and domesticated turkeys specifically to understand how breeding for features that improve breast muscle mass may adversely affect the ability of the birds to move. Gait disorders are a primary concern in agricultural production and similarly impact a large proportion of human patients, especially the elderly. The turkeys thus represent a compelling system to understand the limits of breed development efforts and may aid in understanding gait disorders and the conditions that arise from these disorders. The new knowledge could be used to improve animal welfare and result in favorable impacts on agricultural production and profitability. The referenced study also provides testable approaches to improve stability and performance in engineered load-bearing systems (e.g., bipedal robots for industrial or military applications) and improve human health or welfare (patient prosthetics and mobility aids).

The two NSF awards acknowledged in this study have resulted in more than 25 research articles on a variety of animals, of which the turkey is just one. In addition to the individual research publications, the awards expanded the use of tools and technologies, such as X-ray Reconstruction of Moving Morphology (XROMM), which were used to train a new cadre of researchers. These tools and researchers have advanced the field of biomechanics by enabling novel approaches to understand function and movement. XROMM, developed in the U.S., has enhanced U.S. economic competitiveness through technical innovation. The researchers have made this tool available in an open-source format that allows scientists across the world to perform investigations, thus spurring development of novel results and broadening participation in the STEM workforce. The XROMM data portal also supports extensive data dissemination, discovery, and re-use to further expand the impact of federal investment in basic research.