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## \$27.7 MILLION

NSF Funding at Vanderbilt in FY 2021

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## 20

Active NSF CAREER Awards in FY 2021

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## 4

New NSF CAREER Awards in FY 2021

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### NSF Convergence Accelerator Program

The new National Science Foundation Convergence Accelerator program seeks to test new models for innovation in government, industry and academia. NSF’s convergent approach is designed to speed basic research toward impactful problem solving by bringing together scientists from different fields, business practitioners and nonprofit leaders to holistically understand problems and craft solutions. As part of the program, NSF has awarded a highly competitive Phase II \$5 million grant to Vanderbilt University to develop technology to detect biological threats and predict disease outbreaks in major U.S. cities. In the first year, the effort will focus on monitoring and predicting mosquito-borne diseases, which affect nearly 700 million people globally each year.

### NSF I-Corps Program at Vanderbilt

The NSF Innovation Corps program prepares scientists and engineers to explore the potential of their ideas and research beyond the university and accelerates the economic and societal benefits of NSF-funded research projects that are ready to move toward commercialization.

To date, the Vanderbilt I-Corps site has supported more than 260 teams of researchers and aspiring entrepreneurs in identifying product opportunities for their ideas; 64 percent of the teams have been led by underrepresented minority entrepreneurs. In FY 2021, the Vanderbilt University I-Corps site opened up its programming to local HBCUs, community colleges and state universities. This led to the first-ever team from Meharry Medical College being accepted into the National I-Corps program.



*The NSF Convergence Accelerator is funding a virtual-reality system that helps autistic adults learn to drive and get to work. (Vanderbilt University)*

Teams have worked on ideas ranging from a 3D-printed hand orthosis for stroke victims, to a hemorrhage control device for use during trauma surgeries and a blockchain-based workforce development platform. Since fall 2017, more than 22 teams of Vanderbilt students and faculty have been accepted into the national I-Corps program, each receiving a \$50,000 grant to explore the commercial potential of their research. These grantees gain skills in entrepreneurship through training in customer discovery and product market fit, with guidance from established entrepreneurs. Fourteen teams have received highly competitive Small Business Innovation Research or Small Business Technology Transfer grants. Teams from the Wond’ry, Vanderbilt’s Innovation Center and home of the Vanderbilt I-Corps site program, have raised more than \$50 million in funding from grants and venture capital.

### Recent CAREER Awards at Vanderbilt

NSF’s Faculty Early Career Development (CAREER) program offers the foundation’s most prestigious awards in support of early-career faculty who exemplify the role of teacher-scholars through outstanding research, excellent education, and the integration of education and research within the context of their organizations.

An assistant professor of psychology received a CAREER Award to explore the influence of stressful experiences and supportive caregiving on the developing brain. Understanding when and how exposure to stress shapes the brain is essential for advancing knowledge

about long-term health and functioning. The research will address fundamental questions regarding infant brain plasticity and provide insights that can be used to inform prevention and intervention efforts for children at risk for stress exposure in early life.

An associate professor of biomedical engineering received a CAREER award to develop techniques for using ultrasound imaging to measure and interpret brain activity and integrate ultrasound-derived information with existing techniques. Doing this will provide faster and more precise measures of brain activity through the development of portable ultrasound helmet prototypes and solutions.

## **Designing tech-driven decision-making and disaster response tools**

Supported by NSF, an assistant professor of civil and environmental engineering is developing and deploying tools to intelligently aid in disaster preparation, response and recovery. The project is centered in Harris County, Texas—a region that suffered through the winter storms of 2021—and includes the Houston Food Bank as a key community partner. The goal is to produce technology-enabled and data-driven decision-making tools that improve the resilience and coordination of Houston Food Bank and its supply chain. The project's objectives include designing tools that assess relief organizations' capacities and map area food needs using computational game theory, plus rapidly collect and sort key data from vulnerable populations while protecting their privacy.

## **Supporting detection of gravitational waves**

With a five-year, \$17 million grant, NSF has renewed its support of the North American Nanohertz Observatory for Gravitational Waves Physics Frontiers Center, a collaboration of scientists working to detect and study very low frequency gravitational waves—a cosmic messenger signal that holds great potential for understanding “dark” objects, like black holes. The Vanderbilt node of NANOGrav is led by an assistant professor of physics and astronomy. The team will lead the development of new methods and techniques to search for the elusive signature of the gravitational wave background, individual gravitational wave signals, and other exotic phenomena which will allow for mining a huge amount of astrophysical information from the datasets, which are constantly being improved.

## **Examining the future of international shipping in the Arctic Ocean**

To determine the feasibility of navigating the Arctic Ocean as it becomes less icy, an assistant professor of civil and environmental engineering and a professor of earth and environmental sciences have been awarded an NSF grant to develop a risk-analysis framework that evaluates the economic and environmental tradeoffs between this new potential trade route and established southern routes. The Vanderbilt researchers are considering the various benefits to shippers, versus the environmental impact that could exacerbate already serious threats to the region. A preliminary analysis of a simulation comparing two routes enabled the team to make a projection for what global shipping routes could look like through 2100.

## **Optimizing public transit with artificial intelligence**

Supported by NSF, an assistant professor of electrical engineering and computer science is applying artificial intelligence to address how the essential public transit systems of Nashville and Chattanooga—WeGo Public Transit and CARTA, respectively—can maintain social distancing protocols and proactively plan bus routes and schedules in response to COVID-19. The project has two main goals: to analyze available bus occupancy data to allow passengers and drivers to maintain a healthy social distance and to understand the changes in overall demand for public transit in each city. The researchers posit that they will further be able to use their algorithm that digests occupancy data to estimate usage and seating patterns to determine the number of buses that need to be added to specific routes to ensure passenger safety. The project also has a direct and immediate connection to the development of smart city technologies and can eventually be applied to other transit agencies across the country.

## **INCLUDES Programs**

Vanderbilt received one of NSF's inaugural INCLUDES (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science) awards that supported a pilot program to find innovative ways to improve the success of students with disabilities in STEM disciplines. Additionally, a Peabody College researcher is among an alliance of researchers funded through INCLUDES who are forging pathways to STEM careers for people who are or were incarcerated. The project's mission is to make educational programming for STEM careers and college study commonplace, accessible and rigorous in U.S. prisons and reentry programs.





## NSF and Vanderbilt expand STEM education opportunities

### Graduate Research Fellowships

Fifteen Vanderbilt graduate students won NSF graduate research fellowships in FY 2021, bringing the total number of fellows at Vanderbilt to 68. The fellowships provide three years of support and are aimed at aiding individuals who have demonstrated notable potential early in their research careers and in increasing the diversity of the science and engineering workforce.

### Neurodiversity Inspired Science and Engineering graduate trainee fellowship program

Sponsored by an NSF Research Traineeship grant, Vanderbilt's Neurodiversity Inspired Science and Engineering program takes a novel approach to the training of engineers and scientists engaged in advancing the future of work at the human technology frontier. NISE engages students across STEM disciplines in all stages of the development, deployment and commercialization of FW-HTF approaches and devices that support neurodiverse individuals and/or that are inspired by their abilities. The traineeship anticipates providing a unique and comprehensive training opportunity for 150 students, including 50 funded trainees from computer science, mechanical engineering, data science, psychology, organizational science, and neuroscience. The NISE program builds on the unique strengths of the Vanderbilt School of Engineering's Frist Center for Autism and Innovation and the Vanderbilt Graduate School.

### Research Experience for Undergraduates

The Vanderbilt Institute of Nanoscale Science and Engineering and Vanderbilt Institute of Chemical Biology have provided opportunities to a combined 220 students through the Research Experience for Undergraduates program. Both programs attract undergraduates from across the country to Vanderbilt and provide valuable supplementary enrichment and social activities to the participating students.



*Supported by NSF, Engineering for US All, a national initiative to bring engineering courses to high school students, is expanding its reach and quintupling its impact with 27 new high schools and 14 new university partners. Vanderbilt University was among five universities to initiate the program when E4USA launched in high schools across the country. (Vanderbilt University/Brentwood High School)*

### Training diverse students in STEM

Vanderbilt University is committed to increasing the number of underrepresented minority students completing STEM degrees. Partnered with HBCUs and funded by NSF, Vanderbilt is working to improve the demographic representation in STEM fields.

- Tennessee State University and Vanderbilt are leading an expansion of the Tennessee Louis Stokes Alliance for Minority Participation program, an NSF-funded collaborative effort by 10 Tennessee colleges and universities to improve the academic success and retention of historically underrepresented minority students in STEM fields statewide, as well as to promote graduate education in STEM.
- The Fisk-Vanderbilt Master's-to-Ph.D. Bridge Program provides students a stepping stone from their master's degree at Fisk University to a Ph.D. at Vanderbilt. After 16 years, 162 students have enrolled in the program, 127 master's degrees have been awarded, 100 students have bridged to Ph.D. programs, and 43 students have earned the Ph.D., 30 of those from Vanderbilt. More than 90 percent are from intersecting and traditionally underserved populations - first-generation, low-income, or have physical or learning disabilities. With an 88 percent 10-year Ph.D. completion rate, the program far exceeds the national averages.

