

NSF GRANTED workshops to be held throughout the state

WVU and WVSU collaborate on AI pepper project

Undergraduate Research Day at the Capitol happens February 22

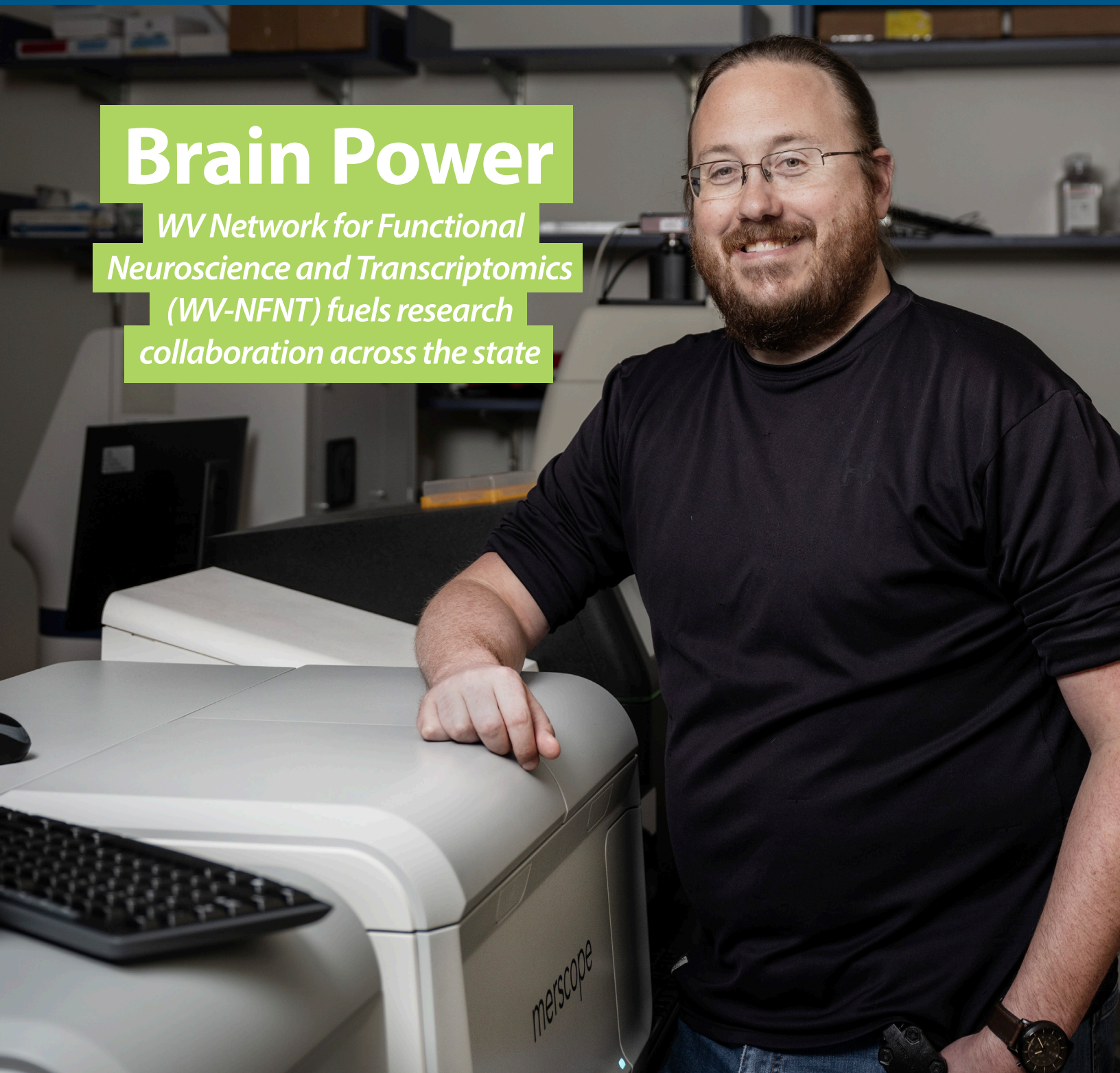
NEURON

Volume 19 Issue 2

Science, Technology & Research in West Virginia

Brain Power

WV Network for Functional Neuroscience and Transcriptomics (WV-NFNT) fuels research collaboration across the state



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VOLUME 19 ISSUE 2

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ABOUT

STaR Division: Science, Technology & Research at the West Virginia Higher Education Policy Commission provides strategic leadership for the development of competitive academic research opportunities in science, technology, engineering and mathematics (STEM).

FUNDING

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FROM THE DIRECTOR

NSF EPSCoR Track-1

Federal funding that benefits West Virginia

"Waves of the Future," the recently completed EPSCoR Grant from the National Science Foundation, focused on building research infrastructure in West Virginia in two research areas: Gravitational Wave Astronomy (GWA) and the Appalachian Freshwater Initiative (AFI). Both were specifically chosen because of their importance to the state.

GWA researchers utilized the state's Green Bank Telescope as well as other sources of data obtained through partnerships which were enhanced by the project. The computational infrastructure for data mining and creating new machine learning algorithms to interpret fast radio bursts and other types of astronomical data were strengthened. Researchers from West Virginia University, Marshall University, Shepherd University, and West Virginia Wesleyan College collaborated within the state and with partners all over the world to make important advances in GWA. The Center for Gravitational Waves and Cosmology was created at WVU as a result of the project.

Authentic research experiences were provided to high school students and teachers through the Pulsar Search Collaboratory and a citizen-science program called Black Holes @ Home. The Science Public Outreach Team (SPOT) trained undergraduates to present STEM research at K-12 schools throughout the state. The AFI researchers focused on managing environmental contamination to ensure a



clean water supply in West Virginia, an area of concern after the chemical contamination of the drinking water of 200,000 people in the state in 2014. Researchers from West Virginia University, Marshall University, and West Virginia State University formed a statewide network for research on acid mine drainage, water quality modeling,

aquatic toxicology, and sensors for contaminants. Specific activities for K-12 students and teachers were funded by the project, as well as Project WET (Water Education Today) summer camps and the PERT program (Preservice and Early Career Research for Teachers).

Over 500 publications and an equal number of presentations resulted from the project, and 227 undergraduates, 159 graduate students, and 29 post-doctoral students participated. Overall, 410 K-12 teachers and 556 research and administrative personnel were involved. Funding for many of these research and outreach projects continues beyond the end of the grant in the form of follow-on funding and support of the activities by partners.

Julie

Juliana Serafin, Ph.D.

Senior Director of Science & Research, West Virginia Higher Education Policy Commission, and Project Director, WV EPSCoR

News briefings



STaR Division to host regional NSF-funded workshops for faculty interested in learning about grant applications and management

STaR Division was awarded \$99,000 from the National Science Foundation's Growing Research Access for Nationally Transformative Equity and Diversity (GRANTED) program to address systemic barriers within the nation's research enterprise by improving research support and service capacity.

Many principal investigators lack support when developing project ideas. This puts talented PIs at a disadvantage and prevents advances in impactful science. The West Virginia

GRANTED project will allow faculty and grant administrators to learn from each other.

Three regional meetings will be held prior to a statewide convening in May 2024 at Stonewall Resort. Registration for the Northern, Eastern, and Central Meeting on January 19 is now open. The Southern Meeting will be held on March 27 and the Western Meeting will be March 28 with registration available soon. For more information on GRANTED, visit wvresearch.org.

Fairmont State University receives funding through Appalachian Regional Commission's POWER Initiative

Fairmont State University has been awarded \$34,604 in grant funding through the Appalachian Regional Commission's (ARC's) Partnerships for Opportunity and Workforce and Economic Revitalization (POWER) Initiative to lay the groundwork for industry/higher education partnerships in Marion, Barbour, and Preston counties.

POWER offers federal support for workforce and economic development in Appalachian areas that have been affected by job loss within the coal industry. In response to this initiative, Fairmont State University has partnered with the Barbour and Preston County Economic Development Authorities and Glenville State University to develop a project titled, Exploring, Building, and Developing: Industry/Higher Ed Partnerships in West Virginia. The planning grant from ARC will support a series of partnership-building activities to investigate how the universities' STEM departments can collaborate with county Economic Development Authorities and regional STEM industries to address the needs of Appalachia's changing economic landscape. The project will be led by Dr. Robert Niichel, associate professor of mathematics at Fairmont State, and Dr. Erica Harvey, visiting professor of chemistry at Fairmont State.

News briefings



Undergraduate Research Day at the Capitol to take place Thursday, February 22 in Charleston

College students from across West Virginia will showcase their research projects during Undergraduate Research Day at the Capitol (URDC) on Thursday, February 22 from 9-11:30 a.m. The event offers students the chance to present their work to legislators and the general public during the legislative session.

In the past, approximately 100 projects have been presented with topics ranging from biochemistry to engineering.

Viewing will be available outside of the House and Senate chambers.

URDC is held annually during the legislative session. This direct access to policymakers can further the understanding of how undergraduate research projects impact a student's education and future career prospects.

West Virginia State University and West Virginia University collaborate on AI pepper project

West Virginia State University (WVSU) and West Virginia University (WVU) are making strides in the field of artificial intelligence (AI) by using it to predict genetic modifications on habanero peppers.

Led by project head Dr. Umesh Reddy, WVSU professor of genetics and genomics, the research aims to support the prevention and treatment of genetic diseases in the future. The team is working on an AI program that can predict the effects of certain genetic modifications on organisms and is currently focusing on predicting key attributes of habanero peppers such as size, color and taste.

The project has received a three-year grant from the National Science Foundation for \$600,000, with \$350,000 for work at WVSU and \$250,000 for work at WVU. The study will be conducted using genetically modified habaneros grown in Reddy's WVSU lab to test the predictions of AI models developed at WVU by Donald Adjero and Professor Gianfranco Doretto.

The larger focus of this research is Pattern Association Discovery (PAD), which aims to find patterns across "loosely coupled domains" such as genetic code and level of spiciness, which overlap in ways too complex for humans to easily identify.

The researchers are using computational methods to look at

the genes that determine the nature of a pepper and are figuring out which genes should be manipulated if a farmer wants to make peppers that are redder or bigger.

The AI methods will predict the response based on the genomic data, and then WVSU will go to the lab to validate that through biological experiments. Finally, the researchers will investigate the relationship between the phenotype and how spicy human taste testers perceive its flavor to be.

Marshall student's work included in federal publication

Marshall University engineering student and Yeager Scholar Tyler Hebert became a published writer in the Winter 2024 issue of Public Roads, a magazine published by the U.S. Department of Transportation and the Federal Highway Administration.

Hebert's essay, "Intumescent Paint Protection in the Transportation Industry," is featured as part of a student writing competition. Her article, recognized for its clarity and engaging style, addresses key transportation issues and proposes innovative solutions.

Public Roads is a 105-year-old publication used to highlight work done nationally. The Winter 2024 issue will be featured at the Transportation Research Board's Annual Meeting in January 2024, providing Hebert's work with substantial exposure.

Research Challenge Fund

Established by the state legislature in 2004 to support research and development projects at institutions of higher education in West Virginia

Funding for undergraduate research experiences awarded to colleges and universities statewide

Eight West Virginia institutions received a total of \$339,880 in state funding to support undergraduate research on their campuses for the next three years.

The Science, Technology & Research (STaR) division of the West Virginia Higher Education Policy Commission awarded Summer Undergraduate Research Experience (SURE) grants to support approximately 120 students per year seeking substantial, hands-on learning in science, technology, engineering and mathematics (STEM) research at public and private four-year colleges and universities.

Participating schools include Marshall University, Shepherd University, West Liberty University, West Virginia University, West Virginia State University and West Virginia Wesleyan College as well as first time awardees Fairmont State University and West Virginia University Institute of Technology.

“Providing STEM undergraduate students with opportunities to do research, either in the summer or during the academic year, is critical to workforce development,” said Dr. Juliana Serafin, senior director of STaR. “We are also excited to be able to add two additional universities to the SURE program this year.”

SURE grants are supported by the Research Challenge Fund, which was established by the West Virginia Legislature in 2004 and is administered by STaR.

Faculty at five West Virginia colleges and universities receive state-funded grants to upgrade STEM equipment and enhance instruction

Faculty at five West Virginia colleges and universities received \$155,000 in state-funding to purchase scientific equipment and enhance student opportunities.

The Science, Technology & Research (STaR) division of the West Virginia Higher Education Policy Commission awarded two Innovation Grants and four Instrumentation Grants to purchase modern instrumentation and enhance study in science, technology, engineering, and mathematics (STEM). Innovation Grants fund scientific equipment,

curriculum improvements, minor renovations, and classroom instruction. Instrumentation Grants purchase scientific equipment for advanced undergraduate teaching laboratories and research to encourage students to pursue STEM careers.

These grants are primarily supported by the Research Challenge Fund, established by the West Virginia Legislature in 2004 to build research capacity and competitiveness at the state’s colleges and universities.



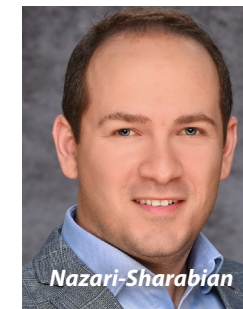
Dr. Stephen Kuehn, associate professor of geology at Concord University and director of the CU Electron Microprobe Laboratory, was awarded an Innovation Grant of \$40,000 for “Upgrade of Electron Probe Microanalyzer (EPMA) to Enhance Teaching, Research, and Educational Outreach.” He will use the funds for one part of a set of major upgrades to Concord University’s electron microprobe laboratory, the only facility of its kind in West Virginia.



Dr. Winnie Fu, assistant professor of mechanical engineering at West Virginia University Institute of Technology, was awarded an Innovation Grant of \$39,600 for “COBOT: Undergraduate Collaborative Robotics Curriculum Development at WVU Tech.” She will use the funds to enhance manufacturing automation curriculum through the purchase of a FANUC CRX-i5A industrial collaborative robot (cobot), that will better prepare engineering students for manufacturing positions at companies in West Virginia.



Dr. Daniel Sadowsky, assistant professor of chemistry at Fairmont State University, was awarded Instrumentation Grant of \$20,000 for “Acquisition of a Fourier-Transform Infrared Spectrometer to Support Laboratory Courses Across the Core Chemistry Curriculum.” He will use the funds to purchase the new instrument which will allow for further practical experience with IR spectroscopy in core curriculum as well as undergraduate research projects.



Dr. Mohammad Nazari-Sharabian, assistant professor of civil engineering at West Virginia State University, was awarded Instrumentation Grant of \$19,394. He will use the funds to acquire six high-performance laptops, enabling the integration of cutting-edge computational fluid dynamics modeling software into curriculum and research activities.



Dr. Zachary Musselman, associate professor of geosciences at Shepherd University, was awarded Instrumentation Grant of \$20,000 for “Shepherd University - Ground Penetrating Radar Equipment.” He will use the funds to purchase ground penetrating radar (GPR) equipment for environmental monitoring and hazard and resource evaluation.



Dr. Jemma Cook, assistant professor of psychology at West Virginia University Institute of Technology, was awarded Instrumentation Grant of \$16,008 for “Instruments to Establish Student/Faculty Research on Substance Use at WVUIT.” She will use the funds to establish an animal model of drug self-administration to compliment current curriculum and extend laboratory experiences.

NSF EPSCoR

**National Science Foundation
Established Program to Stimulate
Competitive Research**

A program that enhances research competitiveness of targeted jurisdictions (states, territories, and a commonwealth) by strengthening STEM capacity and capability through a diverse portfolio of investments from talent development to local infrastructure



Grant No. OIA-1458952

Grant No. OIA-2242771



Dr. Janet Rorrer joins STaR as Associate Director

Dr. Janet Rorrer was recently named the new Associate Director of the Science, Technology and Research (STaR) division at the West Virginia Higher Education Policy Commission.

Rorrer joins STaR with over 25 years of higher education experience. She previously served as Department Chair for Natural Sciences and Mathematics and Assistant Professor in Biology at the University of Charleston. Her content areas include human anatomy and physiology, statistics, research and athletic training.

Rorrer earned her bachelor's degree in athletic training from Western Illinois University, her master's degree in kinesiology from Georgia Southern University and her doctorate in leadership studies and higher education administration from Marshall University.

WV-NFNT meets to develop strategic plan

The new NSF EPSCoR Track-1 project, titled WV Network for Functional Neuroscience and Transcriptomics (WV-NFNT), held its first in-person meeting in August 2023 in order to create a strategic plan. This plan establishes the steps needed for successful implementation of the project through specific goals, objectives, and actions. The plan was finalized and submitted to the NSF in September.

Final report on Waves of the Future

West Virginia's most recent NSF EPSCoR Track-1 project, Waves of the Future, is complete. Despite delays from the COVID-19 pandemic, Gravitational Wave Astronomy and the Appalachian Freshwater Initiative (AFI) wrapped up their scheduled activities in Summer 2023. Only three institutions were involved in the final phase of the project: Marshall University, West Virginia University and West Virginia State University. Two projects were highlighted in a final report to the NSF.

First, the Pulsar Science Collaboratory designed a brand new website at pulsars.nanograv.org. High school and undergraduate students can now take an online course on pulsars and get certified to look at pulsar search data taken with the Green Bank Telescope. This infrastructure provides students with real-world research experience and encourages persistence in STEM and STEM majors. There is a particular focus on involving students from two-year colleges and building a pipeline for them to continue research.

Second, an AFI team that included graduate and undergraduate students as well as high school students and their teachers investigated how a photosynthetic protein (PSII) builds the catalyst that produces oxygen found in our atmosphere. Their research resulted in the publication of a peer-reviewed article in Scientific Reports, detailing how excess manganese increases photosynthetic activity.

Waves of the Future concluded on July 30, 2023.

Video series highlights STEM professionals working in West Virginia

The Scientist Spotlight Video Series, funded by EPSCoR, has published three new videos featuring STEM professionals working in academia, government and industry in West Virginia.

This year's videos feature: students and faculty at Fairmont State University's First2 Network Summer Immersion Experience; Jennifer Flippin, aquatic ecologist for the National Park Service; and Justin Kline, lead residential designer at Solar Holler.

All videos are now available on YouTube and Facebook at @researchwv and on the STaR website at wvresearch.org.



STEM Speaker Series hosted WVU Neuroscientist Dr. Bernard Schreurs

Dr. Bernard Schreurs, professor of neuroscience at West Virginia University and director of the West Virginia Alzheimer's Disease Registry, presented his talk titled, "Alzheimer's Disease and the Importance of Neuroscience Research," at the Kanawha County Public Library in downtown Charleston on Thursday, November 9 at 6 p.m.

The event was supported by the National Science Foundation and was free to registered guests. Approximately 65 people attended.

Alzheimer's disease, first described in 1908, is a neurodegenerative disease that causes cognitive impairment and affects 1 in 10 people aged 65 and as many as 1 in 3 by the time people reach 85. We know that, for some, there are genetic risks, but for many more there are lifestyle risk factors.

Neuroscience research focuses on brain function and has helped us understand some of the causes of this disease and begun to provide some forms of treatment. Despite these efforts, there is still a long way to go to fully understand the disease, treat it, and eventually defeat it.

The STEM Speaker Series began in 2014 with a goal of communicating science, technology, engineering and math (STEM) research to all West Virginians. The events are hosted by STaR Division: Science, Technology & Research at the West Virginia Higher Education Policy Commission.

NSF INCLUDES

National Science Foundation Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science

A comprehensive national initiative to enhance U.S. leadership in science, technology, engineering and mathematics (STEM) discoveries and innovations focused on NSF's commitment to diversity, inclusion, and broadening participation in these fields



Grant No. HRD-1834586



Dr. Heather Arnett joins STaR as First2 Network Program Coordinator

Dr. Heather Arnett was recently named First2 Network Program Coordinator in the Science, Technology and Research (STaR) division at the West Virginia Higher Education Policy Commission. Arnett supports the connections between the many academic and industrial institutions across West Virginia to help underrepresented students transition from high school into college with the ultimate goal of doubling the college graduation rate. She previously worked as a professor at the University of Charleston and helped to create the First2 program there. Arnett earned her bachelor's degree in biology and chemistry from the University of Wisconsin-La Crosse. She earned her master's in paleoecology from the Climate Change Center and her doctorate in eco-evolution, both at the University of Maine.

Save the Date for First2's spring conference

First2 Network's Spring Conference is scheduled for May 16 - 18. More information is coming soon. Past conferences have focused on learning, sharing and connecting with STEM students, faculty and industry professionals. To stay informed, sign up for the monthly newsletter at first2network.com.

First2 Network awards seven West Virginia institutions advancement supplements

Seven higher education institutions received Fall 2023 Institutional Advancement Supplement Awards. This was possible thanks to additional National Science Foundation funding awarded to the Higher Education Policy Commission to sustain First2 programs at West Virginia institutions.

Blue Ridge Community and Technical College (BRCTC): \$42,489

BRCTC will focus on leveraging the unique aspects of a two-year institution. They plan on building and expanding their official campus club to quickly integrate STEM students and provide experiences. BRCTC wants to increase its student director support with in-house orientation twice a year and a new hire to increase staff support and care.

Fairmont State University (Fairmont State): \$42,499

Fairmont State is heavily focused on student care and support. Many key funds will support specific projects, including the ability to offer faculty-led STEM study sessions and increased office hours from key STEM faculty members. Finding peer mentors and establishing embedded help sessions will also be a focus.

Glenville State University (Glenville): \$31,600

Glenville will use this funding for implementing classroom interventions through a data-driven approach. Work completed in Fall 2023 courses will be analyzed to support learning and engagement. Based on that analysis, additional funds will be used to apply new methods into two classrooms: introductory mathematics and introductory biology. Glenville is also focused on revamping introductory courses overall, including a focus on study skills. There is also a plan for faculty to host a retreat.

Marshall University (Marshall): \$41,997

Marshall will use this funding to focus on connectivity, shared experiences and building rapport. On campus, Marshall connects faculty and students through dinners that allow greater engagement. Many Marshall faculty members were also first generation or underrepresented students. Additionally, cross-institutional mentoring will also be a focus. This student-led project will highlight student support and shared experiences across the network.

University of Charleston (UC): \$42,434

UC is adding new members to its First2 team and working to ensure their focus is on the sustainable support of students. Their key focus is on continuing an iteration of math anxiety supported in the computer science courses. Student rapport and engagement, particularly with new faculty, will also be an important factor in continued nurturing. Student-designed impromptu lectures were previously used to shrink the perceived gap between students and faculty.

West Virginia University (WVU): \$42,449

WVU will utilize this funding to support 23 student scholars. The focus has previously been on improving the mentor-mentee experience and creating a mentor training program to help support those that take on students. The team created a variety of ways for students to communicate opportunities and experiences, both on campus and potentially across multiple institutions. WVU also hired a new staff member at the Office of First Generation to support their students and network efforts.

West Virginia University Institute of Technology (WVU Tech): \$42,500

WVU Tech will focus on recruitment and support. There is currently an effort to recruit and inform faculty on the work of First2. Supporting students, both through the club and also through major specific recruitment for increased diversity and one-on-one connection time, is also a goal. There is also support for social events such as BINGO night.

Brain Power

WV Network for Functional Neuroscience and Transcriptomics (WV-NFNT) fuels research collaboration across the state

By Angela Sundstrom

The brain is a mystery. Even in the 21st century, there is still much about the nervous system researchers simply do not understand. That mystery, and the obvious reasons everyone wants to know more about how their body functions, is why neuroscience is one of the most flourishing areas of research today.

In May 2023, West Virginia was awarded a highly competitive, five-year \$20 million grant from the National Science Foundation's (NSF) Established Program to Stimulate Competitive Research (EPSCoR) Research Infrastructure Improvement (RII) Track-1. EPSCoR enhances the research competitiveness of targeted jurisdictions – whether state, territory or commonwealth – by strengthening science, technology, engineering and mathematics (STEM) capacity and capability through investments, from talent development to local infrastructure. West Virginia's NSF EPSCoR RII Track-1 program is facilitated by the Science, Technology and Research Division (STaR) at the Higher Education Policy Commission. This funding established the WV Network for Functional Neuroscience and Transcriptomics (WV-NFNT), a statewide collaboration of neuroscientists and bioinformaticists working to position West Virginia as a center for impactful neuroscience research. The award will boost academic scientific research and upgrade infrastructure at West Virginia University (WVU), Marshall University (Marshall), West Virginia State University (WVSU) and Shepherd University (Shepherd).

"Our state is fortunate to have neuroscience researchers who can collaborate using the new techniques made possible through the EPSCoR grant and expand their research capabilities," said Dr. Juliana Serafin, senior

director of science and research at the West Virginia Higher Education Policy Commission and WV-NFNT project principal investigator. "Our students will be well-prepared for the STEM workforce by the research experiences made possible by the grant. As with past Track-1 grants, this one will help create a center of expertise in the state that can aid economic development and create opportunities to participate in world class research that is important to health and well-being."

The project is broken up into multiple goals and themes. Theme 1 and Theme 2 focus on scientific research while Themes 3, 4 and 5 emphasize education, workforce development and diversity (EWDD).

Build jurisdictional capabilities in understanding circuit plasticity regarding functional connectivity between identified cell types as they emerge or are modified

WV-NFNT is not only about neuroscience but neuroplasticity specifically.

Neuroplasticity, as described by the National Institutes of Health, is a process that involves adaptive structural and functional changes to the brain. It is defined as the ability of the nervous system to change its activity in response to intrinsic or extrinsic stimuli by reorganizing its structure, functions or connections. This could be from an internal medical event, like a stroke, or an external event, like ingesting mind-altering drugs.

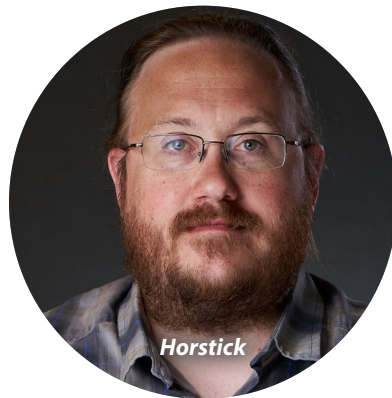
"Our brain is not static," said **Dr. Eric Horstick**, assistant professor of biology at West Virginia University. "Our brain is this ever-changing thing all through our lives. It's adapting, responding, making adjustments to handle the challenges



that we face.”

Horstick is the scientific leader for Theme 1 of WV-NFNT. He heads up the research team that will examine how visual experience during key developmental windows reshapes neural function and molecular regulation using larval zebrafish. Other project researchers at WVU will examine the cortical circuits underlying texture discrimination in mice, develop the excitation/inhibition (E/I) ratio oscillation, and develop hypothalamic stress circuitry while the Shepherd team will examine neural plasticity after developmental delay by dietary nutrient restriction.

Every cell in the human body has the exact same DNA. Yet, we know by simply looking in the mirror that every part of our body is different.



“The reason why is because, even though every single cell has the exact same DNA, certain things are activated. When I say activated, I’m talking about the specific genes in the genome,” Horstick said.

These activated genes make a mRNA, an intermediate that can be turned into a protein that can ultimately impact function. These mRNA are generally referred to as transcripts. In transcriptomics, researchers can study what is turned on in tissues, like the brain, to get an understanding of how structures are built, function, and respond to stimuli – such as during neuroplasticity.

Transcriptomics is at the forefront of current, cutting-edge neuroscience research. Moreover, recent advances in spatial transcriptomics allows researchers to see how hundreds of genes are activated and where in a tissue sample.

“The transcript is important because it’s what’s going to make the cells in my eye different from the cells in my skin, different from the cells in my liver, etc.,” Horstick said. “You don’t just want to know what is on but where and sometimes it’s really challenging.”

Updated technologies offer a new experience for researchers. EPSCoR funding has allowed Horstick to purchase a Vizgen MERSCOPE – seen on the cover of this magazine - to provide spatial transcriptomics technology that is amenable to sub-cellular and high throughput characterization of transcripts in a tissue and

can accommodate experiments across a diverse array of species. Horstick has experience with characterizing RNA expression and will oversee the implementation of the MERSCOPE hardware and design of experimental protocols for spatial transcriptomic profiling used to study plasticity.

The MERSCOPE provides a readout of hundreds of transcripts in a sample tissue providing insight into how whole genetic systems are regulated in a tissue like the brain. This type of work, which could typically take months, is distilled down into days with the MERSCOPE hardware.

“Without equipment like this, teams of people could be working day-in and day-out,” Horstick said. “We are only as effective and capable as how efficient we are with our time. If we’re caught up in one thing, we’re not doing something else. Now, the MERSCOPE is a one-stop-shop.”

Synaptic structure and plasticity associated with altered function

Our surroundings have a profound influence on overall health.

Various choices, from learning a new language to what we eat for dinner, can affect the brain’s synaptic structure and plasticity. It is also our circumstances, including uncontrollable life events such as pollution or traumatic accidents, that impact plasticity.

Dr. Nadja Spitzer, associate professor of biological sciences at Marshall University and co-principal investigator of the EPSCoR grant, explains that the brain reacts to modifications in thoughts and behavior.

“Plasticity is how the nervous system changes in response to external or internal signals, or changes in brain cell function.”

Spitzer is the scientific leader for Theme 2. These studies examine changes of function at the tiny structure where



cells communicate with each other, the synapse. Some projects examine the novel role of astrocytes which are thought to contribute to plasticity at the tripartite synapse. She and other Marshall researchers are evaluating the impact of early exposure

to nicotine on long-term addiction-related behaviors, studying the effects of adolescent binge drinking on

Five Project Goals & Milestones

GOAL 1

Address plasticity under different developmental conditions, asking how circuits are remodeled through experience in different animal models.

Projects will examine how visual experience during key developmental windows reshapes neural function and molecular regulation using larval zebrafish. Cortical representations underlying texture dependent experience will be examined and how these experiences consolidate into memories using the mouse model. How dietary nutrient restriction impacts neural plasticity will be examined using *Drosophila* (fruit fly) as a model. Mouse models will be used to examine how activity patterns impact visual experience dependent plasticity and circuit formation in cortical circuits and how stress experiences remodel hypothalamic circuitry and function.

GOAL 2

How do external inputs or perturbations alter synaptic structure to modify neuronal function?

Focus on neurons and changes in their subcellular synaptic connections to identify basic biological mechanisms of synaptic plasticity in response to exogenous input or perturbations. Sex-specific changes in synaptic structure and function in the auditory cortex in responses to pup calls and in the prefrontal cortex in response to exogenous chemicals will be examined in mice. Changes in gene expression patterns underlying behavioral responses to an environmental deterrent will be examined in *Drosophila*. Expand approaches to include the astrocytic component of synaptic ultrastructure to determine basic biological mechanisms underlying synaptic changes in response to exogenous chemicals.

GOAL 3

Diversity: Use effective strategies to broaden participation in STEM among underrepresented groups (URG) and first-generation college students

At the university level, the focus will be on retention of first-generation college students in STEM majors, targeted recruitment of underrepresented groups (URG) for undergraduate research, the development of the WV STEM Alliance for URG thereby expanding West Virginia’s limited LSAMP reach, and by increasing diversity with proposed new faculty hires. Broadening participation will be supported at the K-12 level through the equity focus of CodeWV and summer camp programs.

GOAL 4

Education and Workforce Development: Improve preparation of students, teachers, and early career faculty to create a pipeline for the STEM workforce, using data science and neurosciences to generate interest in STEM

WV-NFNT will have a major impact on the STEM pipeline: expanding K-12 opportunities for students and teachers; partnering with and expanding existing programs like the First2 Network, Health Sciences & Technology Academy, CodeWV, etc. to prepare and retain college students; and partnering with companies and labs to increase internships. A significant portion of research for this project will be conducted by an undergraduate work force. Formalized training and mentorship of undergraduates in neuroscience and data science research, coupled with access to internships, will contribute to the goal of placing West Virginians in competitive post-graduate programs or employment in STEM industries.

GOAL 5

Partnerships: Develop a cooperative, mutually beneficial relationship between researchers, stakeholder groups and the community

Partnerships will be built in several ways to expand the impact and sustainability of the project. An Industry Advisory Board (IAB) will provide an opportunity for industry representatives to engage with researchers to foster collaboration and technology transfer. It will also provide an important opportunity for trainees to learn about careers in neuroscience/ data science and to develop their professional skills by interactions with IAB members. Collaborations between faculty and students at the four institutions will be strengthened to the benefit of neuroscience research and education in the state. Another key partnership to the project is that with the community at large.

tripartite synapse integrity and characterizing the effects of early life opioid exposure on neuronal and astrocytic structural synaptic development. The remaining research group includes a WVU team determining the sex-specific molecular code of functional and structural neuronal connectivity in mouse auditory cortex (AC) and WVSU researchers resolving capsaicin-induced neuronal effects through comparative spatial transcriptome. Spitzer's own research focuses on the disruption of tripartite synapse by low-level silver nanoparticles (AgNPs) in the striatum.

Silver nanoparticles are antimicrobial and can be found in everyday products like sweat resistance workout clothes, cosmetics and toothbrushes. They are also very unique, with physical properties that allow easy absorption into the bloodstream. Unfortunately, this can also lead to bioaccumulation or those nanoparticles collecting somewhere in the body, specifically the brain. Spitzer observed this in rat models that were fed silver nanoparticles. Silver levels were unchanged between brains collected immediately after treatment and those collected a month later.

"None of it had cleared," Spitzer said. "The silver was just sitting there in the brain."

The team hopes to learn more about how the nanoparticles, and other external influences, affect the brain's cells, especially how cells communicate at synapses. To further study this, Spitzer and her team will utilize funding from the EPSCoR grant to purchase a stimulated emission depletion (STED) confocal microscope at Marshall University for super-resolution microscopy of fluorescent labeled proteins, cells, and cellular processes, providing the ability to resolve and quantify fine synaptic structure. They will be targeting astrocytes, a subtype of glial cells that make up the majority of cells in the human central nervous system, with fluorescence labeling.

"We inject a marker to make some astrocytes in that area of the brain glow bright red," Spitzer said. "That means when we examine with a STED, we can see really high resolution on that astrocyte and then we'll combine that with fluorescent labeling of synaptic proteins that show the other side of the connection. This will give us really high resolution pictures of what's happening right there at the synapse."

Broadening participation, improving preparation and developing community

Research is not the only component of the WV-NFNT. Education, workforce development and diversity (EWDD) is

also a priority.

Goals 3-5 highlight the need to: use effective strategies to broaden participation in STEM among underrepresented groups and first-generation college students; improve preparation of students, teachers, and early career faculty to create a pipeline for the STEM workforce, using data science and neuroscience to generate interest in STEM; and develop a cooperative, mutually beneficial relationship between researchers, stakeholder groups and the community.

Dr. Tina Cartwright, professor of curriculum, instruction and foundations at Marshall University, has been involved with multiple NSF EPSCoR Track-1 projects in West Virginia. The Track-1 will have a major impact on the STEM pipeline through several different opportunities including a summer brain/neuroscience camp that will expand both knowledge and enthusiasm for neuroscience topics and research expertise in the state.

Additionally, students enrolled at partnering institutions will have the opportunity to participate in undergraduate research while being supported through formalized



research mentoring programs. Students in the renowned state-wide Health Sciences & Technology Academy (HSTA) will experience learning activities on data and neurosciences which will expand exposure to these important areas of science.

"Students and teachers will be able to participate in a local Brain Camp at our partnering institutions which will be week-long learning experience where they will interact directly with our researchers on important topics of scientific research in data and neurosciences specific to our institutions," Cartwright said.

Teachers who participate in the summer camps will develop teaching and learning activities to be shared across the state through the HSTA programs.

Dr. Janet Rorrer, the new associate director of science and research at STaR, is eager to work with the EWDD team.

"I am excited to be part of such a dedicated group of scientists and educators," Rorrer said. "It is clear that this collaboration has a strong working foundation, and they are willing and ready to accomplish the goals set forward in the project."

Rorrer will serve as education workforce coordinator. She emphasizes the importance of how this project will provide significant hands-on educational opportunities for a full spectrum of students and educators through trainings and camps offered throughout West Virginia.

"STEM undergraduate and graduate students will



gain invaluable experiences while immersed in sophisticated research led by distinguished West Virginia STEM researchers. These types of projects promote state-wide collaborations that strengthen our

in-state STEM networks and workforce and inspire future collaborations," Rorrer said.

Additional projects to be developed throughout the five year grant cycle include diversifying computer science pipelines, training K-12 educators on neuroscience, incorporating a mentoring structure, developing a public internship portal, and building partnerships with industry.

Potential Impact

West Virginia has now received more than \$105 million from NSF EPSCoR as funding or co-funding over the past 22 years. These projects are selected because of their promise, scientifically and geographically. Horstick believes WV-NFNT stood out because of an already strong neuroscience foundation in West Virginia, across institutions, that can provide real-world opportunity and investment in the resources and people right here.

Both Horstick and Spitzer agree that working with other scientists around the state is one of the most exciting aspects of this project. Collaboration is the heart EPSCoR.

"With a large grant like this, we're going to be impacting a lot of labs, and every lab impacts a lot of students," Horstick said. "That is going to be a driving force for interactions exchange."

"We just talked about science," Spitzer said regarding meetings with colleagues. "There are pictures of brains and we talked about problems and ways to fix them. It was so much fun. It was so invigorating, to talk science outside of your own group. You bring in slightly different ideas, slightly different points of view. It can be really transformative."

Much of the research also has the potential to directly affect West Virginians. Rorrer is anxious to see the efforts of the EWDD team providing in-state students, teachers and institutions with high quality STEM experiences while increasing the retention of students and professionals in our state.

"I also hope this project will encourage increased participation in STEM among underrepresented groups and first-generation college students," said Rorrer.

Spitzer and Cartwright were first-generation students themselves.

"Undergraduate research was critically important in my own experience as a first-generation college student at West Virginia University," Cartwright said. "This experience led me to pursue a PhD in a scientific discipline that I would have never considered feasible or attainable without that early exposure to research. However, not all undergraduate research experiences are successful. Good mentorship can be critical to ensure that the experience is a positive one which will positively impact our West Virginia students to consider research as a potential future career choice."

Spitzer added that she grew up in circumstances similar to many of her students and emphasizes the importance of accessible role models.

"With a large grant like this, we're going to be impacting a lot of labs, and every lab impacts a lot of students."

- Dr. Eric Horstick

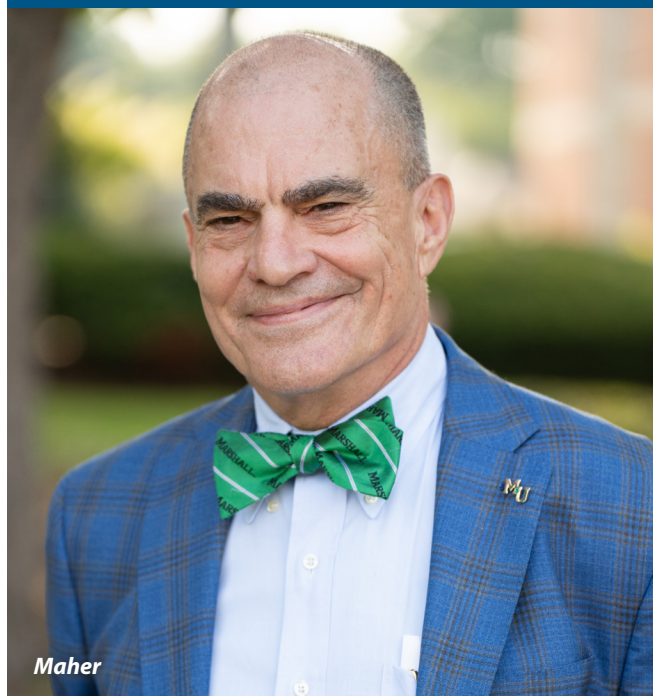
"To have the support to be able to do a better job of training the students, to be able to recruit students and demonstrate to them the effectiveness of science as a career... when I discovered that you could do science as a job, that was fantastic. To give students that opportunity and show them all the different things you can do and take them to conferences to see other things that people do, it's just so exciting. It's so exciting to see them grow."

"It's going to open doors," Horstick said about WV-NFNT. "If you want to be doing the important work that is really needed, especially in a challenging field like neuroscience, it's all feed forward. This EPSCoR grant is just a massive feed forward step in resources, in personnel, that is going to open more doors to create more opportunities."

WV-NFNT is funded by West Virginia's NSF EPSCoR RII Track-1 under Grant No. OIA-2242771. More information about the project can be found online at wvresearch.org.

Commentary

John Maher



West Virginia was one of the earliest participants in the NSF EPSCoR Research Infrastructure Improvement (RII) program. Throughout the years, the program has supported the development of the capacity to do competitive research, through acquisition of critical equipment, support of faculty hiring and faculty and student effort. The collaborative statewide programs have developed publications presentations patents, and innovations and given graduate and undergraduate students enhanced research experiences. Students, faculty and administrators from Marshall University, Shepherd University, West Virginia State University and West Virginia University have gathered regularly to interact on their research and programs. Under the guidance of the Higher Education Policy Commission's Science, Technology, & Research (STaR) office, the RII program has been managed successfully with the state Science and Research Council providing oversight for it and the NIH Idea program.

Through the period of West Virginia's participation, WVU has achieved R1 status, joining the top tier of research institutions and Marshall has achieved R2 status while West Virginia State and Shepherd have achieved significant activity. Though not entirely attributed to the EPSCoR program, these achievements owe a great deal to it. These advances are of particular value to West Virginia since advanced and applied research are important drivers of innovation and economic development.

This past July, the EPSCoR team had cause for celebration as we were awarded a five year \$20 million RII grant to support the WV Network for Functional Neuroscience and Transcriptomics (WV-NFNT), a statewide collaboration of neuroscientists and bioinformaticists working to position West Virginia as a center for impactful neuroscience research, achieving superior results through dynamic collaboration. Through investments in advanced imaging and computational biology, researchers plan to probe brain structures to provide insights into the study of changes in neurons and the connections between them as the result of developmental or environmental changes. It sounds esoteric, but the availability of such insights will play a pivotal role in providing solutions for phenomena like addiction and dementia. Along the way, the team will engage students, especially those who are rural, first-generation college students, enhancing the capabilities within our state.

While disclosing that I'm not entirely impartial, I will nonetheless assert that the array of talented faculty and students who have created this successful application are going to achieve dramatic advances of great importance to our society. I hope you'll join me in anticipation of their achievements and congratulate them as they start their important work.

Dr. John Maher is the vice president for research at Marshall University and the executive director of the Marshall University Research Corporation. From 2003-07, he was the executive director of the Chemical Alliance Zone, a statewide collaborative devoted to economic development in the chemical and allied sectors. Previously, he worked for 21 years at the Union Carbide Corporation, serving in a broad range of technical and managerial assignments in areas as diverse as catalysis research, plant technology support, intellectual property management, capital project execution and new business development. Maher received an A.B. from Cornell University and a Ph.D. in organic/organometallic chemistry from Harvard University.



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The **West Virginia GRANTED** project will hold regional meetings to bring together STEM grant administration personnel and faculty from colleges in each region to identify barriers to proposal submission and post-award grant administration. A statewide convening will be held in May.



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