



## ***Building Innovative Research Capacity and Building STEM Infrastructure for Next Generation Scientists and a Vibrant Economy in Vermont***

### **RESEARCH**



Vermont EPSCoR was awarded a new Research Infrastructure Improvement (RII) Track-1, \$20M award on June 1, 2016 for research on Lake Champlain Basin Resilience to Extreme Events (BREE). The research will inform public policy and support economic and workforce development. Research questions examine what makes some parts of the Lake Champlain Basin and its watersheds resilient in the face

of extreme weather events, increasingly common in a warming Vermont, while other parts fail to recover and rebound. The award from the National Science Foundation will help answer those questions, providing much needed information to decision-makers as they govern the basin and develop policies that reach far into the future. The five-year project will support research teams from UVM and colleges across the state that will collect data from sensors in streams, soil, and the lake. Research teams will also gather information on land use, economic impacts of poor water quality, and more. Seven social and ecological computer models that are calibrated our collected data will be linked together. The resulting integrated model can be used to test impacts of management scenarios on Lake Champlain water quality, and can identify strategies for preserving infrastructure, environmental health and drinking water quality as Vermont's landscape continues to change and the climate continues to show a rise in extreme precipitation.

- The project will be undertaken by a diverse group of scientists and stakeholders working together with Vermont EPSCoR. In addition to UVM, other partner institutions include Johnson State College, Lyndon State College, Castleton State College, Middlebury College, Saint Michael's College, and Dartmouth College. Also participating in the project will be key stakeholders, including the Lake Champlain Basin Program and the Vermont Agency of Natural Resources and partners from Quebec and Lake George, NY.
- NSF made the award to Vermont EPSCoR partly because both natural and social scientists work together across disciplines on the project in creating their predictive models.
- The BREE award was announced at the White House Water Summit on World Water Day, March 22, 2016.
- A key element of the award will be the work performed by the Vermont EPSCoR Center for Workforce Development and Diversity at Saint Michael's College (CWDD), which will offer research opportunities to Vermont high schools, middle schools and undergraduates from across Vermont, including the Community College of Vermont and a new partnership with Landmark College.
- Scholarships will be available to Abenaki students and first-generation college students who are seeking science, technology, engineering or mathematics (STEM) majors.
- Girls will be supported through the Vermont Works for Women, Rosie's Girls Program.
- Small businesses will also be able to participate through pilot awards and funding from the Small Business Innovation Research Phase (0) program and support through Innovate HERS and Launch VT.



Malayika Cinotta, MS student Geology Dept. UVM, installs zero tension soil solution samples in soil pit during wetland site installation in the Wade Brook Watershed.



A RII Track 2 award funded the **North East Water Resources (NEWNet)**, a three state consortium with Delaware, Rhode Island

and Vermont in 2013. With VT EPSCoR as the lead, the NEWNet consortium has created an advanced sensor network in watersheds for gathering very high-frequency, spatially-extensive water quality and quantity data and a network of lab and field-based experiments. Social systems models are used to align sensor data and their visualization with utilization by stakeholders. Across the network, undergraduates carry out summer research teams with graduate students and faculty.

The University of Vermont (UVM) Social-Ecological Gaming and Simulation Laboratory (SEGS Lab), established with funding from NEWNet, takes an experimental gaming approach for bringing the dynamics of human decision-making into models of ecosystem-level problems. The SEGS lab allows the researchers to “place farmers and producers into virtual worlds to see how they react to different situations,” said Scott Merrill, a research assistant professor in UVM’s Department of Plant and Soil Science and one of the lab’s designers. “Data collected using experimental gaming and simulation can be used to develop models that will help us understand decision-making, which will allow for improved communication with and education of policy makers.”



Arkia Wynn (URI) and William Nupp (UVM) present their poster, “How Farmer’s Decisions Change in Response to Weather and Price Uncertainty,” at the University of Rhode Island.

The **NEWNet Education Outreach Diversity (EOD)** team integrates students and teachers into NEWNet research while increasing the diversity of participants.

- In 2016-2017, fifteen undergraduate students received summer research funding to work on NEWNet research in Delaware, Rhode Island and Vermont.
- Interns visited Salve Regina University (RI) for a 2-day short course, which included presentations by NEWNet faculty introducing students to climate change in the northeast, experimental economics, and regional water quality issues. Interns spent the next 10 weeks studying topics related to water quality and agent based modeling.
- In August, interns returned to Rhode Island for the NEWNet Undergraduate Research Symposium where they presented their summer research with a 5-minute talk and a research poster at the University of Rhode Island (URI).

**WORKFORCE DEVELOPMENT**



The VT EPSCoR Center for **Workforce Development and Diversity (CWDD)** located at Saint Michael’s College integrates students and teachers into

BREE research while increasing the diversity of participants including students who are under-represented in STEM research: veterans, economically disadvantaged, first generation, minorities and disabled. The CWDD continues to broaden participation in STEM through scholarships to Native American and first generation Vermont students pursuing a STEM major.

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Burlington High School special education class on a field outing to Potash Brook for macroinvertebrate identification.

# Vermont IDeAs

## BUILDING VERMONT'S BIOMEDICAL SCIENCE INFRASTRUCTURE



### Vermont Genetics Network (INBRE)

The Vermont Genetics Network (VGN) is in its third phase of funding with a five-year \$17.8 million award from the IDeA Networks of Biomedical Research Excellence (INBRE) program of the National Institute of General Medical Sciences (NIGMS) at the National Institutes of Health (NIH). The mission of VGN is to build human and physical infrastructure in Vermont for biomedical research. At the lead institution, the University of Vermont (UVM), we have developed state-of-the-art facilities for Microarray and Proteomics to provide to researchers across Vermont the resources they need to carry out world class research and compete for federal funding. To address workforce development and its diversity, we build cultures of research by supporting faculty and student research at our Baccalaureate Partner Institutions: Castleton University, Johnson and Lyndon State Colleges, Middlebury College, Norwich University, Saint Michael's College and Green Mountain College. We also work with students in college lab classes throughout Vermont in order to bring state-of-the-art research resources into their education, including at the Community College of Vermont and Landmark College.



**Vermont Genetics Network**  
IDeA Networks of Biomedical Research Excellence

VGN impacts STEM employment in Vermont by supporting faculty and staff members at UVM and BPIs: 4 full time faculty at UVM and Norwich University, 3 part time faculty at UVM and 28 at BPIs, and 5 full time staff at UVM and Norwich University. Since 2005 VGN has funded 31 graduate students, 104 project, 69 pilot awards and 15 small awards to BPI faculty members, 135 student summer research awards to BPI undergraduate students and use of facility awards to 12 UVM faculty members. Our students' careers in medicine, biomedical research and STEM teaching have been influenced by opportunities made possible by VGN. The principal investigator is Judith Van Houten, PhD (Judith.Vanhouten@uvm.edu). To learn more, visit: <http://vgn.uvm.edu/>

### Vermont Center for Immunology and Infectious Diseases (COBRE)

The Vermont Center for Immunology and Infectious Diseases (VCIID) is designed to integrate the studies of immunology and infectious disease since the primary function of the immune system is a defense against infection. Microorganisms interact with two fundamental components of the immune system, the evolutionary older innate immune system using largely invariant nonpolymorphic receptors, and the newer adaptive immune system that uses highly polymorphic receptors. Center investigators are examining genes that regulate the pathogenicity of infectious organisms as well as how the immune system responds to these agents. Some of the findings will lead to better vaccine development.



The goals of the VCIID COBRE are to build a robust and vibrant center that supports and mentors talented young faculty, recruit additional faculty, provide a dynamic seminar series, and expand core facilities in proteomics and microarray. The Center also provides support for students, postdoctoral fellows, and retreats. A special emphasis is placed on promoting an atmosphere that fosters stimulating discussions between basic and clinical scientists. These interactions will also include the state health department in an effort to directly improve the health of Vermonters. The VCIID COBRE program centers around a 5-year award from the IDeA program of the National Institute of General Medical Science of the NIH. The principal investigator is Dr. Ralph Budd ([Ralph.Budd@med.uvm.edu](mailto:Ralph.Budd@med.uvm.edu)). To learn more, visit: <http://www.med.uvm.edu/vciid>

## Neuroscience (COBRE)



The primary goal of the Center of Biomedical Research Excellence (COBRE) in Neuroscience, created

in 2001 by a grant from the NIH National Center of Research Resources, is to enhance Neuroscience research and training infrastructure across multiple colleges at the University of Vermont. Two sophisticated multi-user research cores: an Imaging/Physiology Core, which provides access to sophisticated imaging equipment dedicated to live imaging and a Cell/Molecular Core, which provides personnel and access to sophisticated equipment required to complete cellular and molecular biology experiments, are supported by COBRE funding. These multi-user facilities are a critical, unique resource for faculty, postdoctoral trainees, residents, and graduate, medical and undergraduate students. Multiple multi-year research projects and one-year pilot projects for junior investigators were funded in the first 10 years of the award.

The current transitional COBRE grant, which was awarded for 5 years in 2011, continues to support the shared research cores and funds one-year pilot projects in the areas of stroke and neurovascular interactions or neural regulation of autonomic nervous system development, function and disorders. A recent highlight for the Neuroscience COBRE was the award of a \$600,000 NIH Shared Instrument grant to obtain a second Multiphoton Microscope to be housed in the Imaging Core. In sum, the Neuroscience COBRE-supports research cores that broaden faculty research capabilities and access to these core facilities has significantly increased the competitiveness of neuroscience faculty for extramural funding. The Neuroscience COBRE program centers around a 5-year award from the IDeA program of the National Institute of General Medical Science of the NIH. The Principal

Investigator is Rodney L. Parsons, PhD ([Rodney.Parsons@uvm.edu](mailto:Rodney.Parsons@uvm.edu)).

To learn more, visit: <http://www.uvm.edu/neuroscience>

## Vermont Center on Behavior and Health (COBRE)



An \$11.5 million COBRE research grant from the National Institutes of Health supports the development of the Vermont Center on Behavior and Health (VCBH) at the University of Vermont. This center studies the relationships between personal behaviors and risk for chronic disease and premature death.

This grant supports research projects led by five outstanding UVM junior faculty that include studies of weight control in breast cancer patients and overweight pregnant women; an intervention to increase cardiac rehabilitation participation in Medicaid patients; a study of heart disease risk in women with breast cancer; and, a study of the origins of obesity and heart disease risk in childhood psychiatric syndromes.

The VCBH integrates an interdisciplinary group of accomplished senior scientists, promising junior investigators, and distinguished advisors and collaborators to establish a center of excellence in an area of clinical research that is vitally important to U.S. public health. The Center, led by UVM faculty members Stephen Higgins, Ph.D., and Philip Ades, M.D., is one of only three in the nation addressing the important challenge of behavioral health from a behavioral economics perspective. COBRE PI and Director is Stephen Higgins ([stephen.higgins@uvm.edu](mailto:stephen.higgins@uvm.edu)).

To learn more, visit: <http://www.med.uvm.edu/behaviorandhealth>



## ***Vermont NASA EPSCoR Research Infrastructure Development (RID) and NASA EPSCoR Research Group Awards for FY17***

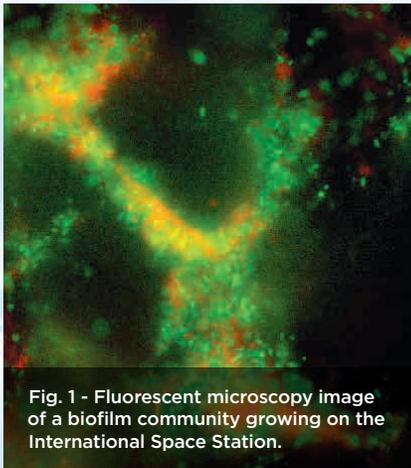


Fig. 1 - Fluorescent microscopy image of a biofilm community growing on the International Space Station.

Vermont NASA EPSCoR fosters research collaborations among faculty and students at UVM, Vermont Technical College, Norwich University, Saint Michael's College, Middlebury College, and Champlain College as well as local industry. The Research Infrastructure Development (RID) Program provides Research Small-Scale Grants and Mini-Grants for faculty researchers that are awarded based on competitive, peer-reviewed proposals.

Since 2007 Vermont has received eight national NASA EPSCoR Research Group Awards, each of these being three-year grants valued at \$750,000. The most recent project was awarded in Summer 2016 entitled "Characterization and modeling of biofilm development by a model multi-species ISS bacterial community" (see Fig. 1); the multidisciplinary research team was comprised of medical, biological, engineering and physics researchers at UVM and Johnson State College. Two of

these Research Group Awards since 2007 have led to three patents issued in 2013, 2014 and 2016; another patent application is under review.

At the local level, RID funding provides small-scale or "mini-grants" as seed funding to researchers to initiate projects relevant to NASA priorities. One recent and high-profile example is "High Integrity Software for CubeSats and Other Space Missions" in which a team of researchers at Vermont Technical College is actively collaborating with NASA Goddard Space Flight Center to provide high-fidelity flight software support for spacecraft in NASA's Lunar IceCube Mission.

RID funding also supports travel by researchers to NASA centers and workshops for the purposes of initiating new research projects or fostering existing ones. As an illustration, in the summer of 2016, RID funding supported four Vermont researchers to attend the NASA Biomimcry Summit Meeting (NASA Glenn Research Center) and five researchers to attend the NASA EPSCoR Technical Interchange Meeting (NASA Marshall Space Flight Center).

Finally, NASA EPSCoR also provides support for small business innovative research grants, including the SBIR Phase 0 competition that is coordinated with the VT EPSCoR Program. A notable success story is GreenScale Technologies (GST), a South Burlington technology startup, whose work on developing propulsion systems for miniaturized satellites ("cubesats") resulted in their identification as a Top 35 University Startup for 2016 by the National Council of Entrepreneurial Technology Transfer.

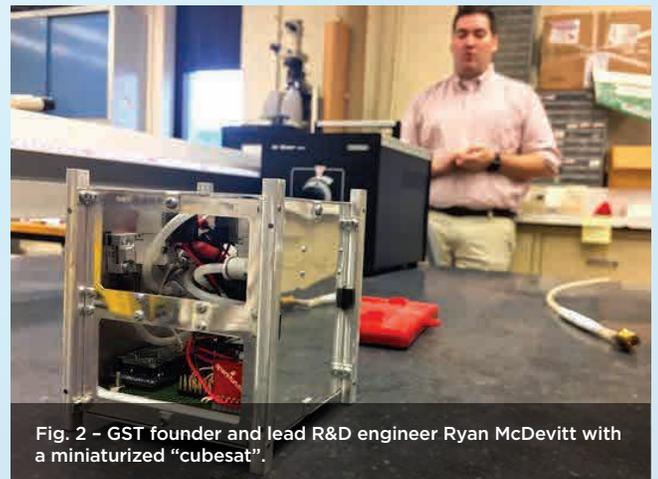


Fig. 2 - GST founder and lead R&D engineer Ryan McDevitt with a miniaturized "cubesat".

# USDA EPSCoR FUNDED RESEARCH TEAM APPLIES COMPUTATIONAL AND EXPERIMENTAL DESIGN TO STUDY BIOSECURITY PRACTICES IN U.S. LIVESTOCK INDUSTRIES



Mediated-modeling workshop with swine industry stakeholders in December 2016, Mankato, MN.

A research team at the University of Vermont awarded the largest ever USDA Agriculture and Food Initiative (AFRI) award in the College of Agriculture and Life Science at the University of Vermont to study animal disease bio risk management continues to make progress. The five-year, \$7.4 million award started in 2015 and is made possible through USDA EPSCoR funding. It is a multi-disciplinary effort, and brings together researchers and practitioners from several institutions to research safety practices for mitigating the risk of catastrophic disease outbreak in U.S. livestock populations. Dr. Julie Smith, D.V.M, a research associate professor in the Department of Animal and Veterinary Sciences at the University of Vermont, serves as team lead.

- **Emerging diseases of socio-economic importance have food security, perceived food safety, and domestic and international trade implications for the marketing of animals or animal products. Understanding the human behavioral dimensions of the introduction, spread, identification, reporting, and containment of diseases of livestock is critically important for developing effective strategies to sustain a productive and secure food animal sector.**
- **Experts in animal science and veterinary medicine, agricultural economics, public policy and decision science, anthropology, adult education, and risk communication come together to lead this USDA funded Coordinated Agricultural Project (CAP).**
- **This inter-disciplinary applied research and outreach project focuses on enhancing biosecurity practices and strategies to reduce the impact of incursions of new, emerging, or foreign pests or diseases in our livestock industries, primarily dairy, beef, and swine.**
- **Through engagement with project activities, stakeholders in U.S. livestock will be encouraged to implement practices and policies that collectively reduce the impact and threat of new, emerging, and foreign pests and diseases to the nation's meat and milk supply. Educational resources, lab and field experimental games, simulations of livestock industries at the state and county levels, and messages developed and tested during the project will be made available beyond the end of the funding period.**
- **To achieve project objectives UVM researchers are integrating disease characteristics, human risk perception and socio-economic influences on behavior to collect data using an experimental serious game environment.**
- **The UVM Social Ecological Gaming and Simulation Laboratory (SEGS Lab: [www.uvm.edu/~segs](http://www.uvm.edu/~segs)), established with funding from the National Science Foundation's Experimental Program to Stimulate Competitive Research (EPSCoR), leads this dimension of the project under the leadership of project Co-PI's Scott Merrill, Asim Zia and Christopher Koliba. The SEGS lab combines experimental, "serious" gaming and computer simulation approaches for bringing the dynamics of human decision-making into models of ecosystem-level problems, enabling researchers to determine how farmers and producers would react to disease outbreaks without exposing animals to new infectious threats.**
- **The SEGS lab is placing "farmers and producers into simulated environments to see how they react to different situations," said Scott Merrill, a research assistant professor in UVM's Department of Plant and Soil Science and the lab's managing director.**