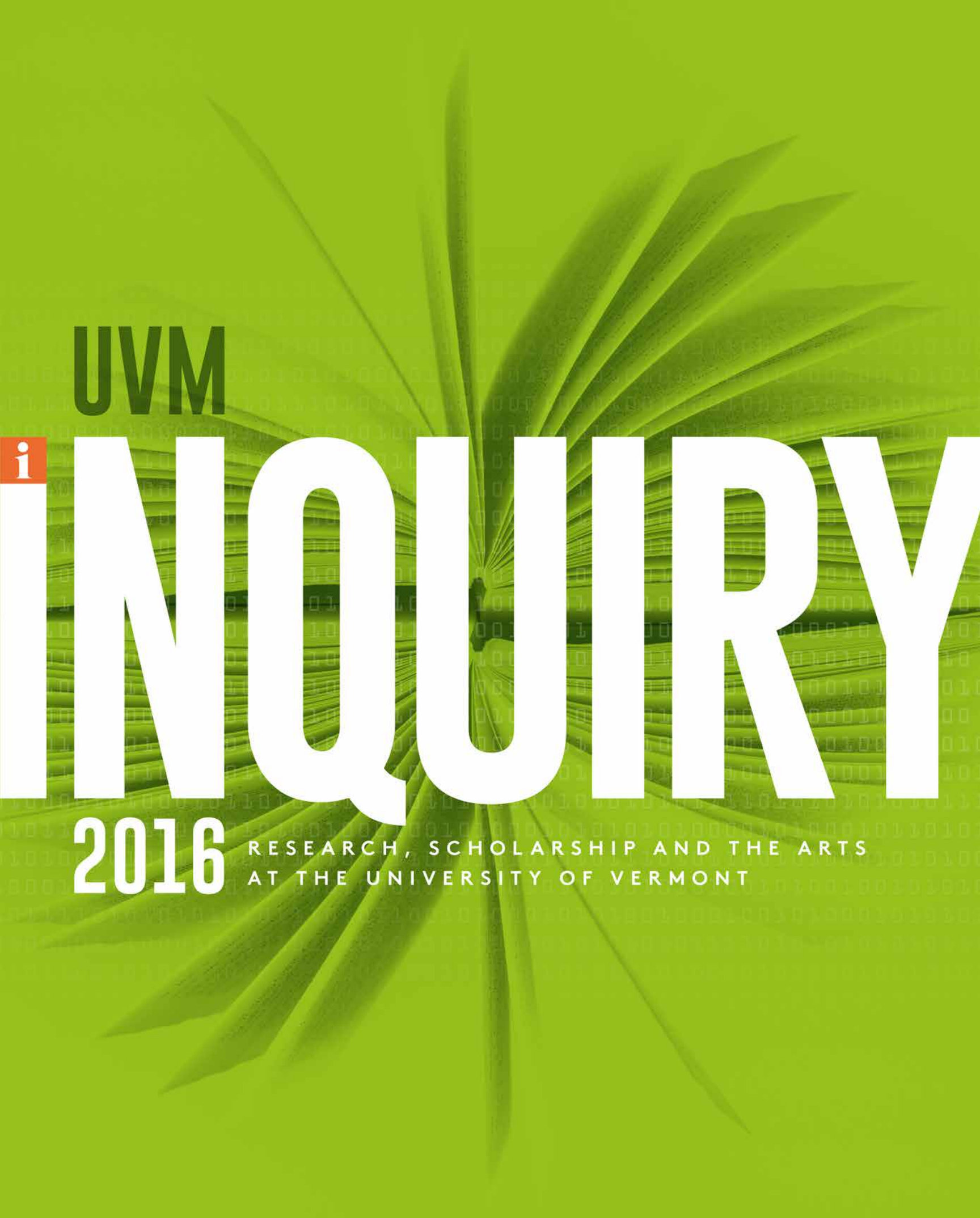

UVM
INQUIRY
2016
RESEARCH, SCHOLARSHIP AND THE ARTS
AT THE UNIVERSITY OF VERMONT

# Advancing the Public Good through Research and Scholarship

Two-hundred-twenty-five years ago this autumn, in a land that was then largely wilderness, the founders of the State of Vermont chartered this University, the fifth oldest institution of higher learning in New England. It was a bold and extraordinary act of affirmation for the value of education and the pursuit of discovery and knowledge in what was then a brand-new state. Vermont had only joined the Union a few months before the charter was approved. This University truly has been a part of the fabric of the state from its very formative days.

That same deeply rooted respect for the power and impact of knowledge in the Green Mountain State guided the crowning achievement of Vermont Senator Justin Morrill in the 1860s — the establishment of the Land Grant Act that gave rise to public universities across the nation. Since that pivotal moment, Vermonters have continued to play important roles in expanding the educational life of all Americans.

The faculty of the University of Vermont continues this societal legacy as they discover and pursue new knowledge, develop new creative works, and educate the next generation of knowledge seekers. ***UVM INQUIRY*** presents a selection of the research, scholarship, and the creative arts produced by our faculty over the last academic year. While by no means all-inclusive, it seeks to showcase a broad sampling of efforts from across all the colleges and schools of our institution, demonstrating that the spirit of inquiry, creativity, and collaboration is thriving in every corner of the University.

***UVM INQUIRY*** is also a testimonial to the fostering of the teacher/scholar at the University of Vermont, what we believe to be an absolutely vital force in the improvement of life in our society. The extraordinary teacher/scholars who are our faculty drive the engine of inquiry that brings new discoveries, innovations, and economic opportunities to people throughout our region, the nation, and the world. Their commitment engenders what I like to think of as a form of magnetism, a pervasive force that continues to attract top students, researchers, and creative minds to this state.

I invite you to read, learn, and experience more about the exceptional thinkers, innovators, educators, artists, and entrepreneurs who make up the faculty of the University of Vermont. Their work as showcased here and elsewhere advance and elevate all humankind.

Tom Sullivan

**TOM SULLIVAN**
President
University of Vermont

# UVM INQUIRY 2016

RESEARCH, SCHOLARSHIP AND THE ARTS AT THE UNIVERSITY OF VERMONT



**SHORT TAKES:**

# UNIVERSITY OF VERMONT FACTS

## THE UVM MISSION

To create, evaluate, share, and apply knowledge and to prepare students to be accountable leaders who will bring to their work dedication to the global community, a grasp of complexity, effective problem-solving and communication skills, and an enduring commitment to learning and ethical conduct.

## HISTORY

The University was chartered in 1791, the same year that Vermont became the 14th state, and celebrates its 225th Anniversary in 2016. It was established as the fifth college in New England (after Harvard, Yale, Dartmouth and Brown).

Although it began as a private university, UVM attained quasi-public status with the passage of the Morrill Land-Grant College Act in 1862 and the addition of the State Agricultural College.

Today, the University blends the traditions of both a private and public university, drawing a portion of its general fund from the state of Vermont.

## A TRADITION OF EQUALITY

Throughout its history, the University of Vermont has demonstrated its commitment to fairness and equality. It was the first American college or university with a charter plainly declaring that the "rules, regulations, and by-laws shall not tend to give preference to any religious sect or denomination whatsoever."

In addition, the University was an early advocate of both women's and African Americans' participation in higher education. In 1871, UVM defied custom and admitted two women as students.

Four years later, it was the first American university to admit women to full membership into Phi Beta Kappa, the country's oldest collegiate academic honor society. Likewise, in 1877, it initiated the first African-American into the society.

## FACULTY

**1,196** FULL-TIME

**319** PART-TIME

## TOTAL ENROLLMENT

**10,081** UNDERGRADUATE

**38%** UVM UNDERGRADUATE PARTICIPATION IN RESEARCH

(BASED ON 2014 NATIONAL SURVEY OF STUDENT ENGAGEMENT)

**1,360** GRADUATE

**457** MEDICAL

## GRADUATE EDUCATION

**50** MASTER'S DEGREE PROGRAMS

**24** DOCTORAL PROGRAMS

**1** M.D. PROGRAM

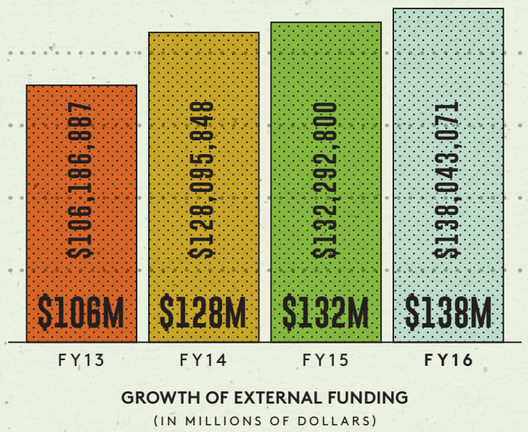
**8** INTERDISCIPLINARY GRADUATE PROGRAMS

## RESEARCH AWARDS

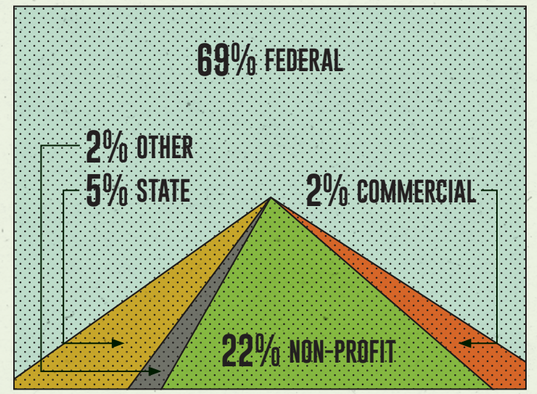
**1,179** PROPOSALS (APPLICATIONS)

**598** SPONSORED PROGRAM AWARDS

**1,504** PEOPLE SUPPORTED BY AWARDS




GROWTH OF EXTERNAL FUNDING
(IN MILLIONS OF DOLLARS)




SOURCES OF GRANTS & CONTRACTS
(FY16)

**$220** GRANTS & CONTRACTS (FUNDING PER CAPITA)

**$91,089** GRANTS & CONTRACTS (FUNDING PER UVM FACULTY MEMBER)

## ECONOMIC IMPACT IN VERMONT

**$1.33B** DIRECT AND INDIRECT IMPACT ON THE VERMONT ECONOMY

**11,287** JOBS

**$78.2M** IN STATE AND LOCAL TAX REVENUE

**$495.5M** INVESTMENT IN 88 MAJOR CAPITAL CONSTRUCTION PROJECTS SINCE 2001

**$562M** DIRECT ANNUAL SPENDING IN VERMONT

**$410M** IN COMPENSATION AND BENEFITS TO UVM FACULTY AND STAFF (EST. 2016)

**$633M** TOTAL ANNUAL OPERATING BUDGET

## PHILANTHROPY

**$449M** UVM ENDOWMENT (FY15)

**$76.75M** NEW FUNDRAISING COMMITMENTS TO UVM (FY2016)

moveMountains
The Campaign for The University of Vermont

**$305M** *MOVE MOUNTAINS* CAMPAIGN TOTAL (AS OF AUGUST 23, 2016)

# NEW KNOWLEDGE

RESEARCH, SCHOLARSHIP, AND THE ARTS NEWS FOR 2016

EXPLORE MORE ABOUT THESE STORIES AT: UVM.EDU/INQUIRY

## From Zika to Dengue, UVM Vaccine Testing Center Plays Important Role

Though first isolated nearly 70 years ago in the Zika Forest of Uganda, the mosquito-borne Zika virus gained worldwide attention only in the last two years, as it spread to North and South America and reached pandemic proportions and was declared a global health emergency by the World Health Organization in February 2016. Shortly thereafter, the University of Vermont Vaccine Testing Center (VTC), led by its director, **Beth Kirkpatrick, M.D.,** was chosen as part of the team conducting clinical trials and research on a vaccine for the virus.

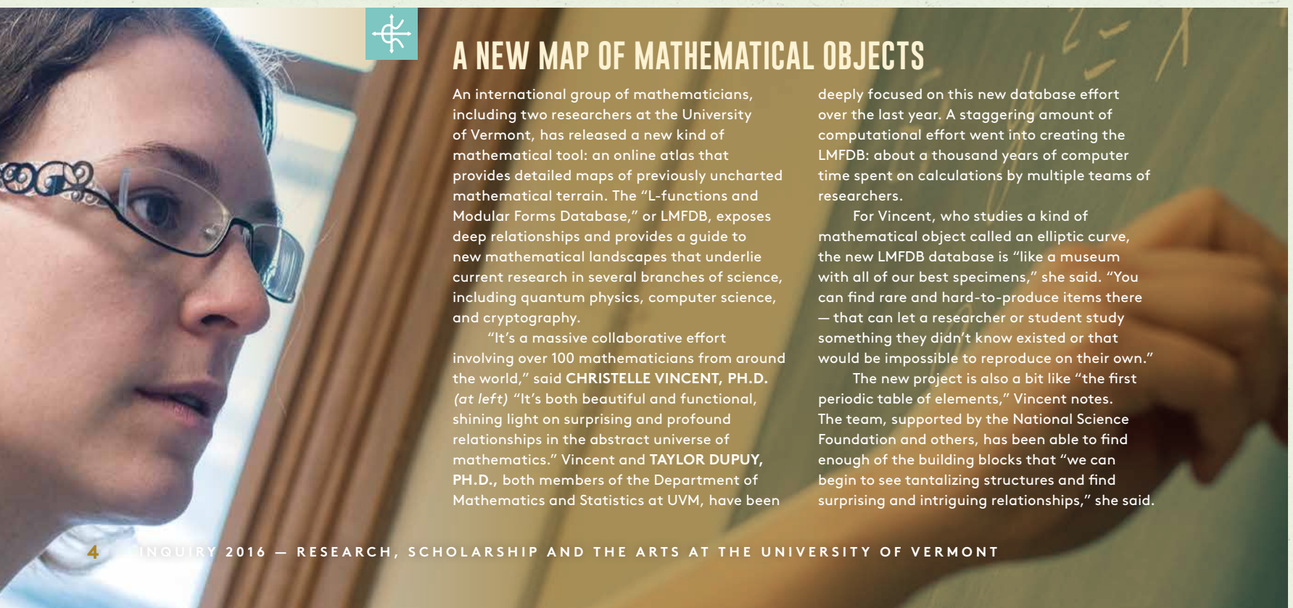
The UVM Vaccine Testing Center Staff

The VTC has a long-standing partnership with the National Institutes of Health (NIH) lab that developed a dengue vaccine and is developing the Zika vaccine, and the VTC, together with the Center for Immunization Research at Johns Hopkins University in Baltimore Md., is one of two sites testing the safety and immune response of an NIH-developed Zika vaccine candidate in humans.

**Kristen Pierce, M.D.,** an infectious disease specialist, and immunologist **Sean Diehl, Ph.D.,** have expertise in the characteristics of *flaviviruses* — a group of viruses, mostly transmitted via insects, that cause such human diseases as Zika virus, yellow fever, dengue, various types of encephalitis, and hepatitis C — and related vaccines. An infectious disease physician, Pierce has led or co-led several Dengue and West Nile virus vaccine-related trials. Diehl studies the basic mechanisms of *flaviviruses*, vaccines against *flaviviruses*, and the immune responses triggered by *flavivirus* natural infection or vaccination.

In 2015 Kirkpatrick and Diehl and their colleagues **Jon Boyson, Ph.D.,** and **Jason Botten, Ph.D.,** received a three-year $2.2 million grant from the Bill and Melinda Gates Foundation to study the immunological basis of protection from dengue fever, another mosquito-borne viral disease that affects as many as 400 million people annually. That followed on seven years of work by VTC researchers, along with collaborators at the National Institute of Allergy and Infectious Diseases (NIAID) at the National Institutes of Health and Johns Hopkins Bloomberg School of Public Health, to develop a dengue vaccine that will protect against all four strains of the dengue virus.

The VTC also began work in 2016, funded by the Gates foundation, to test new therapeutic agents against the intestinal parasite *Cryptosporidium*. Most recently, the cholera vaccine for which the center was one of three testing sites received FDA approval.



### A NEW MAP OF MATHEMATICAL OBJECTS

An international group of mathematicians, including two researchers at the University of Vermont, has released a new kind of mathematical tool: an online atlas that provides detailed maps of previously uncharted mathematical terrain. The "L-functions and Modular Forms Database," or LMFDB, exposes deep relationships and provides a guide to new mathematical landscapes that underlie current research in several branches of science, including quantum physics, computer science, and cryptography.

"It's a massive collaborative effort involving over 100 mathematicians from around the world," said **CHRISTELLE VINCENT, PH.D.** *(at left)* "It's both beautiful and functional, shining light on surprising and profound relationships in the abstract universe of mathematics." Vincent and **TAYLOR DUPUY, PH.D.,** both members of the Department of Mathematics and Statistics at UVM, have been deeply focused on this new database effort over the last year. A staggering amount of computational effort went into creating the LMFDB: about a thousand years of computer time spent on calculations by multiple teams of researchers.

For Vincent, who studies a kind of mathematical object called an elliptic curve, the new LMFDB database is "like a museum with all of our best specimens," she said. "You can find rare and hard-to-produce items there — that can let a researcher or student study something they didn't know existed or that would be impossible to reproduce on their own."

The new project is also a bit like "the first periodic table of elements," Vincent notes. The team, supported by the National Science Foundation and others, has been able to find enough of the building blocks that "we can begin to see tantalizing structures and find surprising and intriguing relationships," she said.



## Transforming Teaching with Twitter

CONVERSATIONS ABOUT SCIENCE CONTINUE LONG AFTER CLASS IS OVER IF STUDENTS ARE ENCOURAGED TO USE TWITTER

Imagine a teaching tool so effective that students look forward to using it in class and continue to seek out new information with it after the school day ends. New research offers powerful evidence that Twitter, if used properly, can produce these outcomes among middle school students and enhance the way children learn in the 21st century.

In an article published this spring in *Middle School Journal*, UVM researchers showed the potential benefits of using Twitter as a pedagogical tool based on survey results, interviews, and classroom observations of eighth-grade students in science classes. Students reported significant increases in four key areas that contributed to their learning: exposure to reputable science and leaders, like Bill Nye "the science guy," in real time; a broadening of the audience for their work outside the classroom; more opportunities for connecting science to their own lives; and new ways to communicate about science.

**Ryan Becker, Ed.D.,** a graduate of UVM's doctoral program in Educational Leadership and Policy Studies, used his middle school science classes to conduct the research in conjunction with co-author **Penny Bishop, Ed.D.,** professor of middle level education and director of the Tarrant Institute for Innovative Education. Becker and Bishop found that 95 percent of students agreed or strongly agreed that Twitter enabled them to follow real science in real time as it develops around the world. Particularly motivating was the ability to interact via Twitter with leading organizations like NASA and science-related programs like PBS' *NOVA* and NPR's *Science Friday*.

"Research on the use of Twitter as pedagogy is limited thus far," says Bishop, an expert on the use of technology in middle schools. This study, she says, "Raises new questions about the potential for social media as a lever for increasing the personalization of education."

## Integrating Behavioral Health and Primary Care

A UVM-led research team has received $18.5 million in funding to study whether patients with both medical and behavioral problems do better when their primary care physicians work in combination with behavioral health professionals including psychologists and social workers.

**Benjamin Littenberg, M.D.,** the Henry and Carleen Tufo chair in general internal medicine at the College of Medicine, gathered colleagues at UVM and across the country for their five-year research project, titled "Integrating Behavioral Health and Primary Care." The Washington, D.C.-based Patient-Centered Outcomes Research Institute (PCORI) selected Littenberg's project as one of four out of 124 original applications to receive funding. Littenberg's colleagues **Rodger Kessler, Ph.D.,** associate professor of family medicine, and **Constance Van Eeghen, Dr.P.H.,** assistant professor of medicine, will help lead the project as co-principal investigator and project director respectively.

Constance Van Eeghen, Dr.P.H., Benjamin Littenberg, M.D., and Roger Kessler, Ph.D.

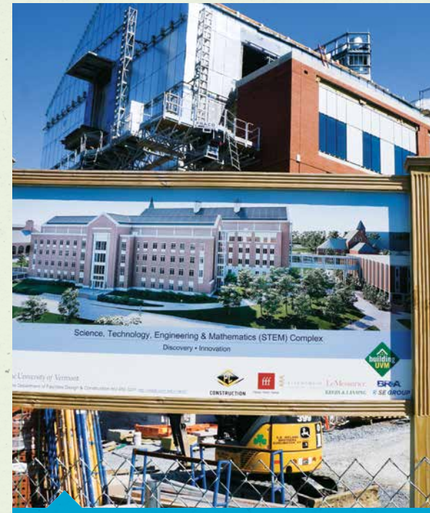
Patients with chronic illnesses, such as diabetes, heart disease or asthma that are exacerbated by behavioral difficulties — anxiety, depression, alcohol or drug abuse, poor diet, smoking, sleep disruptions or lack of exercise — particularly need to address those personal problems, but often struggle to do so. Their doctors might refer them for cognitive behavioral therapy or motivational interviewing to help them change their habits.

Those personal challenges "heavily influence how their medical problems turn out," Littenberg says. "Also, their medical problems influence the severity of their behavioral problems."

The PCORI grant will allow Littenberg's team to look more closely at the benefits of fully integrating behavioral health care with medical care.

### IMPROVING THE HEALTH OF CATTLE WORLDWIDE

Foot and Mouth Disease is one of the most contagious, devastating diseases that afflicts cattle worldwide. At UVM, Assistant Professor of Animal Science **JOHN BARLOW, D.V.M., PH.D.,** has overseen testing of a new vaccine targeted at this ancient scourge.




### STEM COMPLEX PROGRESS

A year after its groundbreaking, UVM's STEM Complex is now rising over the central campus. When finished in 2019, the complex will accommodate the teaching and research needs of programs in Chemistry, Physics, Engineering, Mathematics and Statistics and Computer Science. By this summer, the exterior of the first phase of the project, the Discovery Building, was well underway.

# The Faults in the Stars

Sea stars are iconic symbols of the ocean beyond. But on the North American west coast, many of these familiar creatures have gotten so sick that they will "turn to goo and die." That blunt prognosis is in the words of **Melissa Pespeni, Ph.D.,** (at right) assistant professor of biology. In her lab in the Marsh Life Sciences Building, Pespeni, postdoc Melanie Lloyd '08, and a team of undergraduate students are studying the effects of the sea star wasting disease, which has devastated regional sea star populations. Their work is funded by a National Science Foundation RAPID grant.

"There have been outbreaks of this disease in the past, but never as extreme and as geographically extensive and as lethal as the outbreak that started back in 2013, going all the way from Alaska down to Baja California, Mexico, and affecting so many species," says Pespeni. The likely culprit is a virus that causes sea stars to develop characteristic symptoms including lesions. Eventually, says Pespeni, the stars will lose their arms, become soft and gelatinous, and expire.

Increasing environmental stressors, including pollutants and extreme temperatures, may affect the sea stars' susceptibility, as well as their microbiomes, so to begin answering this question, the Pespeni lab is performing experiments to see what role the sea stars' genes and microbiomes — the community of bacteria, viruses, and other microorganisms that live in and on the sea stars — might play in determining which individuals get sick.

There is still much to learn about this disease, including why some individuals get sick from the pathogen and others do not. "That virus is also found in museum specimens that are seventy to one hundred years old," notes Pespeni. "So it's been around, and it can be found in most individuals and even in individuals that aren't necessarily sick or showing major symptoms."

So, says Pespeni, "the big unanswered question is, why now?"

## PROMOTING FOOD SAFETY

The U.S. Food and Drug Administration this February awarded a $950,000, three-year grant to a consortium of 12 northeastern states and the District of Columbia to promote food safety on small and medium-sized produce farms and food processors in the region. The consortium, called the Northeast Center to Advance Food Safety (NECAFS), and the award will be managed through the University of Vermont Extension. **CHRIS CALLAHAN,** an agricultural engineer at UVM Extension, is project director.

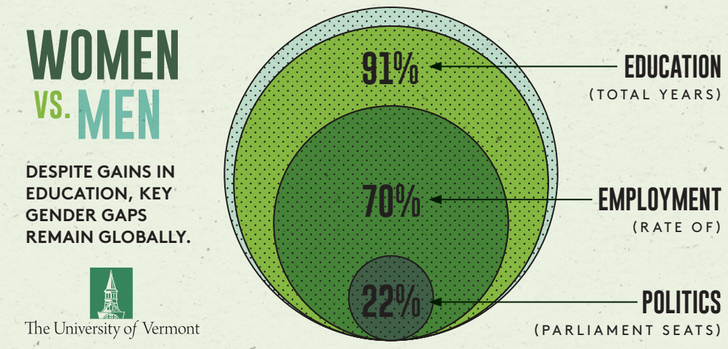
NECAFS was created to consolidate the food safety training efforts for produce growers and processors in the Northeast, where wide diversity in the operations' size and type combined with regulatory systems that differ from state to state have resulted in a patchwork of safety and education programs.

The consortium will consolidate these efforts, helping growers and processors develop more consistent, efficient and higher quality programs in comprehensive food safety training, education and technical assistance that are compliant with the Food Safety Modernization Act (FSMA).

"UVM is well positioned and primed to lead this new integrated approach for food safety training," said U.S. Sen. Patrick Leahy of Vermont, at the announcement of the grant

# Why Education Doesn't Bring Women Equal Pay

Women are closing the education gap with men, but a global study of gender equality by UVM economist **Stephanie Seguino, Ph.D.,** shows these advances are failing to bring equal access to quality jobs and government representation. The study, published in the *Journal of African Development*, which explored decades of data from more than 150 countries, finds that women have reached 91 percent of the education that men have — but only 70 percent of their rate of employment, and just 25 percent of political representation. The findings challenge the assumption that education translates into equal access to high-paying jobs, and suggest that policy action is needed to ensure women can equally earn a fair living. According to Seguino, the belief that markets will fix these gaps fails to account for centuries-old gender norms and male hierarchies that education alone can't change.






*Krishna Quells Kaliya to the Acclaim of the Gods'* is among the paintings that professor and Indian art historian John Seyller analyzes in *Deccani Paintings, Drawings, and Manuscripts in the Jagdish and Kamla Mittal Museum of Indian Art.*

# Art and its Origins

An art historian brings multiple skills to the study of a painting created nearly 500 years in the past and half-a-world away. The not-so-simple ability to see extremely well stands squarely at the core of these skills. Accordingly, **John Seyller, Ph.D.,** professor of art history and one of the world's foremost experts of Indian painting, always travels with a 10× magnifying glass tucked into his bag.

While the vibrant color, swirling forms, and historic/religious stories depicted in paintings of this era in Indian history are what immediately draw the eye, Seyller's pioneering scholarly work in Mughal painting has often involved looking beyond such things to tiny inscriptions scrawled in Persian along the margins, on the backs of pieces or even under layers of paint. The UVM professor's discovery, interpretation, and analysis of these largely overlooked notes in the 1990s have significantly altered previous notions and understanding of Mughal Indian painting. The inscriptions were instructions to the artists, in essence, Seyller says, unlocking the circumstances surrounding the creations of the paintings.

"They are work orders in many ways," he says. "They tell you when it should be made, how many days you should spend on it, with whom you should collaborate. So it broke down the sense of the patron more or less telling the artist what to do, and replaced it with an understanding of a very large workshop operation that had its own mechanisms for the production of these paintings."

A prolific author, Seyller curated the exhibit and wrote the in-depth catalog for The Adventures of Hamza: Painting and Storytelling in Mughal India, which opened at the Smithsonian's Arthur M. Sackler Gallery in 2002. In recent years Seyller has annually produced a book in collaboration with distinguished Hyderabad-based artist and collector Jagdish Mittal. Together they have already published five volumes; a sixth is in production; and a seventh is in its initial stage.

# Exercise Reduces Suicide Attempts by Bullied Teens

A study by UVM researchers has shown that regular exercise significantly reduces both suicidal thoughts and attempts among students who are bullied.

Using data from the Centers for Disease Control's National Youth Risk Behavior Survey of 13,583 high school students, the authors found that being physically active four or more days per week resulted in a 23 percent reduction in suicidal ideation and attempts in bullied students. Nationwide nearly a fifth of all students reported being bullied on school property.

The study was published in the *Journal of the American Academy of Child & Adolescent Psychiatry* in September 2015. **Jeremy Sibold, Ed.D.,** associate professor and chair of the Department of Rehabilitation and Movement Science was lead author, joined by **Erika Edwards, Ph.D.,** research assistant professor in the College of Engineering and Mathematical Sciences, **Dianna Murray-Close, Ph.D.,** associate professor in psychology, and psychiatry professor **James J. Hudziak, M.D.,** who has published extensively on the positive effects of exercise on mental health outcomes.

Previous studies have shown that exercise has positive effects on various mental health measures. This was the first, however, to show a link between physical activity and a reduction in suicidal thoughts and attempts by bullied students.

## MORE EFFECTIVE SPEECH THERAPY FOR CHILDREN WITH DOWN SYNDROME

A study published in the *International Journal of Speech-Language Pathology* indicates that children with Down syndrome who have motor speech deficits have been inadequately diagnosed, which could have a major impact on the interventions used by speech pathologists when treating patients. **SHELLEY VELLEMAN, PH.D.,** (below) chair of the Department of Communications Sciences and Disorders, and her colleagues conducted motor speech assessments on seven children with Down syndrome in comparison with typically developing children. The finding is especially significant because of the different ways in which speech pathologists work with children who have the two major motor speech disorder characteristics.

## SNOWMOBILING COULD BE HARD HIT BY CLIMATE CHANGE

Declining snowfall in Vermont, a likely byproduct of a warming climate, is sure to negatively affect the state's $600 million snowmobile industry. New research provides a sobering look at just how much.

**ROBERT MANNING, PH.D.,** professor emeritus of natural resources, was lead author of the study, which is based on an online survey of 1,450 members of VAST, the Vermont Association of Snow Travelers, in November and December of 2015.

"If connections between trails are lost, even if there's sufficient snow cover in pockets of the state, participation rates could decline sharply," Manning said.

# Exploring the Adolescent Brain

In October 2015 Professor of Psychiatry **Hugh Garavan, Ph.D.,** was named a project co-director of a landmark longitudinal national study exploring the developing minds and brains of approximately 10,000 children in an effort to answer questions ranging from the origins of resilience and creativity to identifying biological and behavioral factors that put some youth at increased risk of mental, emotional and academic problems. The effects of substance use on the still-developing teen-aged brain is a particular focus of the study.

Garavan has been a longtime participant in a number of similar studies conducted by the IMAGEN Consortium — a multicenter European project for which he served as the project leader in Dublin, Ireland — with which he has continued to collaborate. Other UVM co-investigators include **Alexi Potter, Ph.D., James Hudziak, M.D.,** and **Julie Dumas, Ph.D.** from the Department of Psychiatry, and **Richard Watts Ph.D.,** from the Department of Radiology.

More than 10,000 children between the ages of 9 and 10 will be enrolled at a number of research institutions across the country — including more than 500 children at the UVM site — and followed for ten years.

The Adolescent Brain Cognitive Development (ABCD) Study was initiated by the Collaborative Research on Addiction at NIH, a consortium of institutes that include a focus on addiction research, but several other institutes will contribute as well. The costs for the entire 10-year study, distributed across the national consortium, are expected to be about $300 million.

"I will be involved in the particulars of the study design — including who to recruit and how — and will monitor the study to ensure its adherence to the proposed design," said Garavan, who will also serve as a member of the MRI and Informatics workgroups of the Data Analysis and Informatics Center of the study.

The ABCD study will be unprecedented in scope, monitoring and investigating participants' cognitive, intellectual, social, and emotional functions; physical health; education; recreational experiences; and biological and functional maturation of their brains. Novel mobile and web-based technologies will be employed to observe development as closely but unobtrusively.


Hugh Garavan, Ph.D.

# The Non-Driving Millennial? Not So Simple.

It's a well-worn media trope. Twenty-first century millennials are leading the way to a green transportation future, moving to cities, riding public transit, biking and walking and often delaying car purchases indefinitely, to Detroit's growing dismay.

The reality is more complex, says a study by UVM researchers published in March in the *Annals of the Association of American Geographers*. Since the public discussion is mostly about the driving habits of post-college-aged 20-somethings who have moved to cities, the researchers decided to trace backward to see if there is evidence of high school-aged teens changing their behavior. Their answer: only in part, suggesting the larger narrative may be overstated. Infrastructure and land-use patterns in the community play a major role in teens' decisions about whether to begin driving when they're of age, said Professor of Geography **Meghan Cope, Ph.D.**

The study compared teen behavior in two Vermont school districts, one semi-urban, the other more rural. Both districts are suburbs of Burlington. In the more rural suburban district, teens obtained their driver's license on average within a month of their 16th birthday. In the more urban community, teens delayed several months before getting their license.

The study also looked at the way the Internet and cell phones influenced teen mobility. The authors found that technology influences travel behaviors by helping teens arrange rides and meeting up, but did not replace meeting in person.

The study's other co-author was Brian H.Y. Lee, who held joint appointments in the University of Vermont's College of Engineering and Mathematical Sciences and Transportation Research Center at the time of the study and is now a senior planner at the Seattle Regional Planning Commission.


Eric Hernandez, Ph.D., and Elli Terwiel.

## GOOD VIBRATIONS: WHAT MAKES A SKI HUM?

Last fall, UVM senior **ELLI TERWIEL** was in a course led by professor **ERIC HERNANDEZ, PH.D.,** — Advanced Structural Analysis — learning about how beams bend under a load. "And I started to think about my skis," she says. She wasn't daydreaming.

Instead, she was seeing a connection between her two passions. Terwiel is majoring in civil engineering — and she's a World Cup skier who raced in the 2014 Olympics for Canada and for UVM's ski team for several years.

"After class, she started asking me questions about the stiffness, the bending, the damping and the vibration of skis," says Hernandez. He's an expert on structures — like buildings and bridges — and how their materials change and fatigue over time. "Everything is a structure," he says, including skis.

He's developing new techniques to measure the structural health of buildings and bridges—probing their inner wear and tear by measuring various types of vibrations, whether from earthquakes or truck traffic. Together, Hernandez and Terwiel are now studying if vibration testing of skis — not during manufacturing, but on race day — could help skiers find the right pair.

Because high-level skiers are doing everything in their power to maximize contact between their ski and the snow, tuning into these vibrations — that affect how much of the ski is on the snow — could prove to be a distinct advantage.



# UVM and Smithsonian Researchers Find First-Ever Native Malaria in the Americas

Two years ago, **Ellen Martinsen '00 G'09,** was collecting mosquitoes at the Smithsonian's National Zoo, looking for malaria that might infect birds — when she discovered something strange: a DNA profile, from parasites in the mosquitoes, that she couldn't identify.

By chance, she had discovered a malaria parasite, *Plasmodium odocoilei* — that infects white-tailed deer. It's the first-ever malaria parasite known to live in a deer species and the only native malaria parasite found in any mammal in North or South America. Though white-tailed deer diseases have been heavily studied — scientists hadn't noticed that many have malaria parasites.

Martinsen and her colleagues estimate that the parasite infects up to twenty-five percent of white-tailed deer along the East Coast of the United States. Their results were published in February in *Science Advances*.

"You never know what you're going to find when you're out in nature — and you look," says Martinsen, a research associate at the Smithsonian's Conservation Biology Institute and adjunct faculty member in the University of Vermont's biology department.


Ellen Martinsen '00 G'09 and her mentor and research partner Joseph Schall, Ph.D.

The study, led by Martinsen, was a collaboration with scientists at the Smithsonian Conservation Biology Institute, the American Museum of Natural History, the National Park Service, the University of Georgia, the University of Wisconsin-Milwaukee — and UVM biologist and malaria expert **Joseph Schall, Ph.D.**

The new discovery fundamentally changes our understanding of the distribution and evolutionary history of malaria parasites in mammals, Martinsen says.

"Malaria is a top parasitic disease in humans and wildlife," Martinsen says. "It's important that we gain a better understanding of its diversity and distribution not just across humans but across other species too."

# Why Do Some Infections Persist? Blame "Bacterial Socialism"

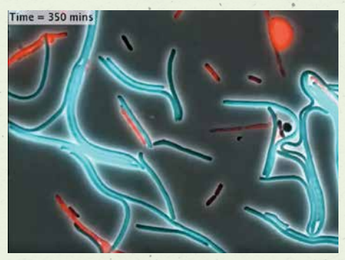
In preparing for the possibility of an antibiotic onslaught, some bacterial cultures adopt an all-for-one/one-for-all strategy that would make a socialist proud, UVM researchers have found.

The finding, published in January in the journal *Scientific Reports*, could affect how persistent infections like those associated with cystic fibrosis are treated. The paper's lead author is **Imane El Meouche, Ph.D.,** a postdoctoral scholar in the School of Engineering in the College of Engineering and Mathematical Sciences. **Mary Dunlop, Ph.D.,** corresponding author, is an assistant professor in the School of Engineering. The second author is **Yik Siu,** a technician in the school.

The group's conclusions are based on a series of time-lapse videos showing that single cells within a community of bacteria randomly use a cascade of proteins to become more or less antibiotic resistant, even when the community is not threatened by an antibiotic. A bacterial colony can regenerate if only a few cells survive antibiotic treatment.

"It's costly from a metabolic standpoint for a cell to express the proteins that enable it to be resistant," says Dunlop. "This strategy allows a colony to hedge its bets by enabling individual cells within a population to trade back and forth the work required for antibiotic resistance. That way the population will be prepared for an antibiotic threat, should one arise, but without doing the extra work that could put it at risk in other ways."

The study suggests that altering the frequency and timing of antibiotic treatment could be a way of waiting out an infection as bacteria trade off antibiotic resistance, enabling the drug to kill the entire culture.




See a video of a bacterial colony regeneration from the UVM study at **UVM.EDU/INQUIRY**

## CULTIVATING "NATURAL ENEMIES"


Margaret Skinner, Ph.D.

On a research trip to Lebanon in May 2015, **MARGARET SKINNER, PH.D.,** saw children playing in tomato crates and eating tomatoes in a greenhouse where the smell of recently sprayed pesticide permeated the air.

When Skinner's colleague from the American University of Beirut mentioned some concern, Skinner says, the farmer shrugged and said: "Those pesticides that we spray, they're not even killing the insects, so they're certainly not going to hurt the children!"

The incident fueled Skinner's drive to reduce the use of agricultural pesticides that not only threaten human health, but often fail to solve the pest problem. The UVM research professor of plant and soil science specializes in integrated pest management (IPM) — the use of "natural enemies" to eat insects that plague plants and the professionals who grow them.

Skinner has traveled three times to Lebanon and Egypt to help growers implement the Plant-Mediated IPM Systems she developed for Vermont cultivators. Instead of allowing the plant-damaging bugs to proliferate in order to feed the ones that eliminate them, growers introduce "habitat plants" such as alyssum and marigold that produce pollen and nectar to attract helpful parasites, such as thrips, which then stick around to eat aphids or other pests that arrive. That offsets the grower's high cost to buy more enemies, usually from overseas manufacturers.

## UVM STUDY SHOWS METHANE FROM FRACKING CAN FLOW TO ABANDONED WELLS

A University of Vermont study funded by the National Science Foundation has shown that abandoned oil and gas wells near fracking sites can be conduits for methane escape not currently being measured. The study, published in *Water Resources Research* in October of 2015 demonstrated that fractures in surrounding rock produced by the hydraulic fracturing process are able to connect to preexisting, abandoned oil and gas wells, common in fracking areas, which in turn can provide a pathway to the surface for methane.

"Our paper shows that fracking sites don't exist in isolation; they're part of a system that includes a network of abandoned wells that can effectively pipeline methane to the surface," said the new paper's lead author, **JAMES MONTAGUE, PH.D.,** an environmental engineering doctoral student at the University of Vermont, who co-wrote it with **GEORGE PINDER, PH.D.,** professor of environmental engineering. Pinder is a much published groundwater hydrologist and member of the National Academy of Engineering.

Kelly Rohan, Ph.D.

## TALK OUTSHINES LIGHT IN PREVENTING RETURN OF WINTER BLUES

A study published in November 2015 in the *American Journal of Psychiatry* casts a shadow on light therapy's status as the gold standard for treating SAD, or seasonal affective disorder.

While the treatment is effective at addressing acute episodes of SAD, a SAD-tailored version of cognitive behavioral therapy (CBT) is significantly better at preventing relapse in future winters, the study found. Led by University of Vermont psychology professor **KELLY ROHAN, PH.D.,** and funded with a $2 million grant from the National Institute of Mental Health, it is the first large scale study to examine light therapy's effectiveness over time on SAD, a mood disorder that affects over 14 million Americans.

# Research to Help Moms Quit Smoking, Decrease Kids' Secondhand Smoke Exposure

Disadvantaged women begin smoking at an earlier age, are heavier smokers and are more likely to be nicotine dependent and to fail at smoking cessation. When they become pregnant and have children, the behavior doesn't change. In fact, almost 85 percent of U.S. children from low-income families are chronically exposed to secondhand smoke — especially from maternal smoking. A five-year, $3.6 million grant from the National Institute on Child Health and Human Development awarded this year to the Vermont Center on Behavior and Health (VCBH) at UVM hopes to change that.

VCBH Director **Stephen Higgins, Ph.D.,** leads the project, which aims to study 250 economically disadvantaged mothers of young children (age 11 and under) in an effort to help them quit smoking and decrease secondhand smoke exposure among their children. The study is based in the conceptual framework of behavioral economics — using financial incentives to motivate behavior change. Researchers at the VCBH will conduct a randomized controlled clinical trial comparing:

- Usual care for smoking cessation and reducing secondhand smoke exposure among children;
- Usual care combined with financial incentives for objectively verified smoking abstinence; and,
- Usual care combined with financial incentives and also with nicotine replacement therapy (NRT) using innovative procedures to enhance medication efficacy.

"Overall, the proposed study has the potential to advance knowledge on efficacious, cost-effective smoking cessation for maternal smokers and protection against secondhand smoke exposure in children," explains Higgins, a professor of psychiatry with 30 years of experience in the field of addiction research. "The study also has the potential to impact policies and clinical practices regarding recommended care for combating chronic secondhand smoke exposure in disadvantaged children."

Smoking among women is highly associated with socioeconomic status and is a direct contributor to health disparities. Smoking prevalence in the United States exceeds 30 percent among women with fewer than 12 years of education compared to less than 6 percent for women with graduate degrees. Smoking prevalence among disadvantaged mothers is at strikingly high levels of 40 to 60 percent.

Disadvantaged women are also at increased risk for smoking-related adverse health outcomes, including adversely impacting the health of their children through in-utero and secondhand smoke exposure. Secondhand smoke exposure increases risk for infant death, chronic respiratory infections, asthma and is estimated to increase direct medical and life-lost costs in the U.S. by nearly $5 billion annually.

Stephen Higgins, Ph.D.



# Sociology Professor's Katrina Book Details Long-Term Impact on Children

The vulnerability of children was starkly apparent in Hurricane Katrina, the most disruptive and destructive disaster in modern U.S. history. A dozen children and youth in Louisiana perished in the disaster. An untold number of children lost loved ones, were orphaned, or were left homeless. More than 5,000 children were reported missing, many of whom were separated from their family members for weeks or even months after the storm. More than 370,000 school-age children were displaced immediately, while 160,000 remained dislocated for years.

The 2015 book, *Children of Katrina,* co-authored by sociology professor **Alice Fothergill, Ph.D.,** is the first multi-year sociological study of children after a disaster. Fothergill and co-author **Lori Peek,** of Colorado State University, spent seven years after the hurricane interviewing and observing several hundred children and their family members, friends, neighbors, teachers and other caregivers. The book focuses intimately on seven children between the ages of three and eighteen, selected because they exemplify the varied experiences of the larger group.

Alice Fothergill, Ph.D.

Fothergill and Peek found that children followed three different post disaster trajectories — declining, finding equilibrium, and fluctuating — as they tried to regain stability. The children's stories illuminate how a devastating disaster affects individual health and well-being, family situations, housing and neighborhood contexts, schooling, peer relationships and extracurricular activities, and demonstrates how outcomes were often worse for children who were vulnerable and living in crisis before the storm.

See a video of Fothergill and Peek discussing their new book at **UVM.EDU/INQUIRY**

# Color Blind? Bias-Aware Whites Better for Modern Race Challenges, Says New Study

Some white Americans like to pat themselves on the back for being racially color blind. But a study published in the November 2105 *Journal of Experimental Social Psychology* finds that whites aware of their biases are better equipped to address contemporary racial challenges, where prejudice is often expressed in subtle, unintentional and unconscious ways.

"Our society is filled with negative stereotypes associated with blacks, and whites' attitudes and behaviors can't help but be affected, although often in ways they're not clearly aware of," says lead author of the study **Sylvia Perry, Ph.D.,** assistant professor in the Department of Psychological Science.

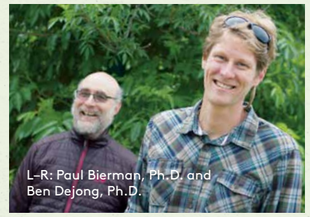
"The first step towards reducing these subtle biases and correcting behavior that is sometimes unintentionally hurtful, our research shows, is personal awareness, internalizing the fact that you may have subtle biases," she said.

The study, of 902 white Americans, employed a variety of established psychological tests to assess racial attitudes and a new assessment that gauged subjects' "bias awareness," a trait never before defined and researched.

Sylvia Perry, Ph.D.

The bias awareness test asked subjects to score a series of statements such as, "When talking to Black people, I sometimes worry that I am unintentionally acting in a prejudiced way" designed to uncover awareness of subtle bias.

Those who scored high in bias awareness were found to be more able to internalize negative feedback about their racial attitudes.



L–R: Paul Bierman, Ph.D. and Ben Dejong, Ph.D.

## WASHINGTON, D.C., SINKING FAST, ADDING TO THREAT OF SEA-LEVEL RISE

Research by a team of geologists from the University of Vermont, the U.S. Geological Survey, and other institutions confirms that the land under the Chesapeake Bay is sinking rapidly and projects that Washington, D.C., could drop in elevation by six or more inches in the next century — adding to the problems of sea-level rise. This falling land will exacerbate the flooding that the nation's capital faces from rising ocean waters due to a warming climate and melting ice sheets — accelerating the threat to the region's monuments, roads, wildlife refuges, and military installations. The results appeared in July 2015 in the journal *GSA Today*.

**BEN DEJONG, PH.D.,** who was a doctoral student at UVM's Rubenstein School of Environment and Natural Resources, was lead author on the study. UVM geologist **PAUL BIERMAN, PH.D.,** was senior author.

Sylvia Parker

## SHINING A NEW LIGHT ON BARTÓK

Over his lifetime, spanning 1881–1945, Hungarian composer and pioneering ethnomusicologist Bela Bartók manually recorded more than a thousand peasant melodies, largely in the countryside of Hungary, Slovakia and Romania. The strange scales and odd rhythms of the tunes, which were unaccompanied, inspired him musically, freeing him from the strictures of his classical training and powerfully influencing his own compositions. After studying Bartók's piano harmonizations of these songs, UVM senior lecturer of music theory and piano **SYLVIA PARKER** was so taken by the brilliant compositions, she decided to be the first person ever to record all 152 of them together in a single album. Parker's two-CD set, *Peasant Jewels,* was released by Centaur Records in 2015.

## TWITTER AS AN EARLY WARNING SYSTEM FOR BAD DRUG INTERACTIONS

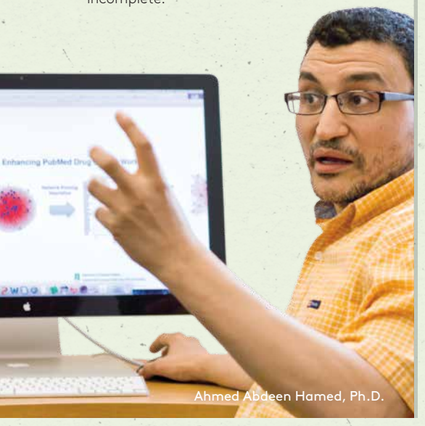
A team of scientists has invented a new technique for discovering potentially dangerous drug interactions and unknown side-effects — before they show up in medical databases, like PubMed, or even before doctors and researchers have heard of them at all.

The far-seeing tool? A computer program that can efficiently search millions of tweets on Twitter for the names of many drugs and medicines — and build a map of how they're connected, using the #hashtags that link them.

"Our new algorithm is a great way to make discoveries that can be followed-up and tested by experts like clinical researchers and pharmacists," said computer scientist **AHMED ABDEEN HAMED, PH.D.,** who, along with UVM colleagues **XINDON WU, PH.D, ROBERT ERIKSON, PH.D.,** and **TAMER FANDY, PH.D.,** of the Albany College of Pharmacy, developed the new tool. A report on how the algorithm works, and its preliminary discoveries, was published in August 2015 in the *Journal of Biomedical Informatics*.

"We may not know what the interaction is, but with this approach we can quickly find clear evidence of drugs that are linked together via hashtags," Hamed said.

The new approach could also be used to generate public alerts before a clinical investigation is started or before health care providers have received updates. And the research team also aims to help overcome a long-standing problem in medical research: published studies are too often not linked to new scientific findings, because digital libraries "suffer infrequent tagging," the scientists write, and updating keywords and metadata associated with studies is a laborious manual task, often delayed or incomplete.



Ahmed Abdeen Hamed, Ph.D.

## Bringing Better Mobility to Parkinson's Disease Patients

**James Boyd, M.D.,** a neurologist and associate professor of neurological sciences, had witnessed his patients' struggles when their Parkinson's disease progressed and sudden drops in their medications' effectiveness debilitated them.

So when the opportunity came for UVM to join a clinical trial for a treatment with the potential to help Parkinson's disease patients level out those "low periods," Boyd jumped. UVM is one of 31 institutions that tested an innovative pump-based system that delivers steady, small doses of medication throughout the day. Called Duopa, the treatment received U.S. Food and Drug Administration approval in 2015.

Parkinson's disease is a disorder of the nervous system caused by the loss of brain cells that produce the chemical dopamine. The disease impacts movement, sometimes starting with a tremor in the patient's hand with progressive loss of motor function.

The standard treatment for Parkinson's, an oral medication called levodopa, boosts the level of dopamine. The drug revitalizes


at left: James Boyd, M.D.

the patient, but when the amount in the bloodstream tapers, patients can be hindered for hours until the next dosage kicks in.

"You could be spending up to a third or half of your day incapacitated," Boyd says. The new treatment, developed by AbbVie Inc., is delivered through a tube inserted surgically through the patient's stomach and into the intestine, so medication absorption is steady and consistent.

"You're able to give people back four hours of functional time in a day," Boyd says. "It's yet another tool in our arsenal, so to speak, to maintain their function."


UVM graduate students (from left) Naveen Rawat and Lane Manning, and professors Randy Headrick, Ph.D., and Madalina Furis, Ph.D., working with a table-top scanning laser microscope.

## Building the Electron Superhighway

TV screens that roll up. Roofing tiles that double as solar panels. Sun-powered cell phone chargers woven into the fabric of backpacks. A new generation of organic semiconductors may allow these kinds of flexible electronics to be manufactured at low cost, says UVM physicist and materials scientist **Madalina Furis, Ph.D.** But the basic science of how to get electrons to move quickly and easily in these organic materials remains murky.

To help, Furis and a team of UVM materials scientists have invented a new way to create what they call "an electron superhighway" in one of these materials — a low-cost blue dye called phthalocyanine — that promises to allow electrons to flow faster and farther in organic semiconductors.

Their discovery, reported in September 2015 in the journal *Nature Communications*, will aid in the hunt for alternatives to traditional silicon-based electronics.



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## IN BRIEF

### STREAM STUDY RAISES NEW QUESTIONS ABOUT LAKE POLLUTION


For decades, phosphorus pollution has been contributing to unwanted algae blooms in many lakes — including Lake Champlain. A raft of recent research has pointed a finger at eroding streambanks, suggesting that their washed-out soils are a major source of this phosphorus flow. But a new UVM study led by **DON ROSS, PH.D.,** professor of plant and soil science, complicates that picture, raising questions about whether, in fact, streambank erosion is a culprit in Lake Champlain's phosphorus problem.

The new research shows that, indeed, eroding streambanks may increase the raw-total amount of phosphorus that ends up in the lake — but, unexpectedly, some of these soils might decrease the amount of phosphorus available for algae to use in their growth. The study appeared in the *Journal of Environmental Quality* in November.

### IRIS TRIAL POINTS TO NEW DIABETES DRUG FOR STROKE PREVENTION


Results of the Insulin Resistance Intervention after Stroke (IRIS) trial presented in February at the International Stroke Conference 2016 in Los Angeles, Calif., and published in an Online First article in the *New England Journal of Medicine,* suggest a potential new method to prevent stroke and heart attack in high-risk patients who have already had one stroke or transient ischemic attack.

UVM neurologist **MARK GORMAN, M.D.,** professor of neurological sciences, was a co-investigator in this large, international study, which was supported by the National Institutes of Health's National Institute of Neurological Disorders and Stroke (NINDS). He is also a co-author on the *NEJM* paper.

The IRIS trial is the first study to provide evidence that pioglitazone, a drug used for type 2 diabetes that targets cell metabolism, may prevent secondary strokes and heart attacks even before diabetes develops.

### GENDER QUOTAS IN MEXICO PROVED TO BE WORKING


A new study examining the impact of a series of gender quotas passed by Mexico to ensure equal representation in government shows no drop in the qualifications of women in office after two election cycles, and also refutes the widely held perception that women rely on personal connections more than men to get elected.

UVM Professor of Political Science **CAROLINE BEER, PH.D.,** was lead author of the study, published online in the journal *Politics, Groups, and Identities*. Its findings are in direct opposition to critics who argued that the new reforms would result in a wave of unqualified women in key political positions, and illustrates the importance of giving gender-based reforms time to be fully implemented and put into practice before drawing conclusions.

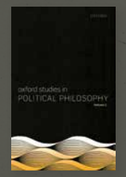
### WHEN HELICOPTER PARENTS LAND ON CAMPUS


College students whose parents lay on the guilt or try to manipulate them may translate feelings of stress into similar mean behavior with their own friends, a new study by a University of Vermont psychologist has found.

Those students' physical response to stress influences the way they will carry out that hostility — either immediately and impulsively or in a cold, calculated way, concluded **JAMIE ABAIED, PH.D.,** a UVM assistant professor of psychological science.

Building on her previous research on the effects of various parenting styles on college-age children, Abaied looked at the link between "parental psychological control" and the young adults' relationships with peers. Her study, published by the *Journal of Youth and Adolescence,* involved 180 mostly female college students and was a collaboration with Abaied's graduate research assistant, Caitlin Wagner, the lead author on the paper.

### ZAKARAS POLITICAL PHILOSOPHY ESSAY NOTED




**ALEX ZAKARAS, PH.D.,** associate professor of political science, won the prestigious 2016 Sanders Prize for Political Philosophy for his paper "Complicity and Coercion: Towards an Ethics of Political Participation."

Zakaras, whose essay was selected over 45 other entrants, presented the award-winning paper at the 4th Annual Workshop for *Oxford Studies in Political Philosophy* in Barcelona, Spain in June of 2016. His paper was also published in the journal *Oxford Studies in Political Philosophy,* which publishes the best contemporary works in political philosophy and closely related subfields such as jurisprudence, normative economics, political theory in political science departments and war theory.

### UVM SCIENTIST PEGS ANTHROPOCENE TO FIRST FARMERS


A new analysis of the fossil record shows that a deep pattern in nature remained the same for 300 million years. Then, 6,000 years ago, the pattern was disrupted — at about the same time that agriculture spread across North America.

"When early humans started farming and became dominant in the terrestrial landscape, we see this dramatic restructuring of plant and animal communities," said UVM biologist **NICHOLAS GOTELLI, PH.D.,** an expert on statistics and the senior author on the study that appeared in *Nature* in January 2016. In the hunt for the beginning of the much-debated "Anthropocene" — a proposed new geologic era defined by human influence of the planet — the new research suggests a need to look back farther in time than the arrival of human-caused climate change, atomic weapons, urbanization or the industrial revolution.

### ANIMAL DECLINES DAMAGE EARTH'S ECOSYSTEMS


A new study shows that whales and outsized land mammals — as well as seabirds and migrating fish — played a vital role in keeping the planet fertile by transporting nutrients from ocean depths and spreading them across seas, up rivers, and deep inland, even to mountaintops. But massive declines and extinctions of many of these animals has deeply damaged this planetary nutrient recycling system, a team of scientists reported in the *Proceedings of the National Academy of Sciences*.

"This broken global cycle may weaken ecosystem health, fisheries, and agriculture," says **JOE ROMAN, PH.D.,** a biologist at the University of Vermont who was co-author of the study.

On land, the capacity of animals to carry nutrients away from concentrated "hotspots," the team writes, has plummeted to eight percent of what it was in the past — before the extinction of some 150 species of mammal "megafauna" at the end of the last ice age. And, largely because of human hunting over the last few centuries, the capacity of whales, and other marine mammals, to move one vital nutrient — phosphorous — from deep ocean waters to the surface has been reduced by more than seventy-five percent, the new study shows.

# THE TEACHER-SCHOLAR AT TODAY'S UNIVERSITY:

## A CONVERSATION

University of Vermont Provost and Senior Vice President **David Rosowsky, Ph.D.,** and Vice President for Research **Richard Galbraith, M.D., Ph.D.,** share their thoughts on the driving force of research, scholarship, and creative arts at the modern university.

### Q WHAT DO WE MEAN BY THE TEACHER-SCHOLAR MODEL TODAY?

**RICHARD GALBRAITH:** Everybody understands what a teacher does, and everybody understands what a scholar or a researcher does, and it is quite possible to do one without doing the other. Indeed, that's what you'll find at some universities. But at UVM we combine the two. The scholarship faculty members engage in enhances their teaching and the depth of their understanding of a subject, and their teaching experiences further refine and hone their ability to practice their scholarship. Our goal is for all of our faculty members to be deeply engaged in both teaching and scholarship. And we use the words "scholar" and "scholarship" very intentionally when we describe this model, because we recognize scholarship in the humanities and the creative arts with the same emphasis and importance as extramurally funded research in the sciences. Scholarship encompasses all forms of inquiry and discovery.

### Q WHY IS THE TEACHER-SCHOLAR MODEL SO IMPORTANT?

**DAVID ROSOWSKY:** The Teacher-Scholar model brings value to our undergraduate teaching, to our graduate teaching, to our professional student training, to our postdoctoral research training, and to our most junior faculty up to our most senior faculty. The model has enormous importance to all of these groups. A faculty member who's at the forefront of her or his scholarly discipline brings an additional dimension to teaching. Being able to share new technologies and the latest developments and discoveries in class excites and engages students in their own learning and discovery. These faculty members also influence each other, creating powerful synergies.

"FEW UNIVERSITIES CAN BOAST A STRONGER, MORE AUTHENTIC COMMITMENT TO THE TEACHER-SCHOLAR MODEL THAN UVM. THIS IS SOMETHING THAT WE CHERISH, NURTURE, AND CELEBRATE EVERY DAY."

— Provost and Senior Vice President
DAVID ROSOWSKY

From left: David Rosowsky, Ph.D., and Richard Galbraith, M.D., Ph.D.

### Q WHAT ULTIMATELY DRIVES THE TEACHER-SCHOLAR?

DR If you think about the work that goes on at a university, the words "learning" and "discovery" stand out. Learning and discovery are outcomes, but the fuel that drives our engine is intellectual curiosity. The beauty of a comprehensive research university is its vast range of academic disciplines and perspectives. Motivated by their own curiosity, our faculty — and our students, too — are able to explore and experiment within this broad intellectual space, ultimately creating their own learning and discovery missions. That's why we talk about learning and discovery, and why we see curiosity as the root, as the fuel for what we do.

RG Curiosity really is the driver for research and scholarship. And it functions at every level, too. You can have what we often call basic research, in a laboratory setting, in which you are trying to find "how" or "why," with no hint of application — you just want to understand something — and the thing that drives you is curiosity. But then if you arrive at an understanding, that same sense of curiosity drives you to question: well, how can we use this? Could we make something work better now that we know this? Could we design some new thing? That force then leads you through to applying that research and even to starting up a business and creating jobs.

### Q SO THE EFFECTS OF THE TEACHER-SCHOLAR EXTEND BEYOND THE CAMPUS?

DR Certainly. As Richard just described, in basic research, we work to extend our knowledge, with the singular goal of furthering an area of understanding. Applied knowledge usually starts with the thought: "here's a challenge that we want to overcome, or here's something that we want to do better." Or "here's something that we want to create that doesn't exist." It's these questions of applied knowledge that are driving much of the research today. It's driving researchers to think about technology commercialization, to have an impact beyond campus — to help cure a disease or address some other challenge. We are increasingly seeing faculty who want to be a part of the process of translating research into societal goods. They don't just want to hand it off to a company, they want to be a part of the process and participate with the company or even create a new company. There's a new spirit of innovation and entrepreneurship that comes out of research universities today.

RG That spirit of innovation, of course, includes things like new inventions that lead to new manufacturing companies, but it also includes things like advances in the understanding and proliferation of new ways to teach kindergarteners. The concept of innovation in the sciences is fairly easy to understand, but thinking critically about how any novel advance impacts society is a form of innovation in itself, and there's a critical role for the humanities to play here — it's only through the lens of society and the humanities that we can evaluate the usefulness of an advance. The impact of that critical thinking extends well beyond our campus.

"STUDENTS ARE TELLING US: I NOW HAVE A DEEPER UNDERSTANDING OF WHAT THIS FIELD IS ABOUT AND WHAT DRIVES IT. SO IT MAKES THEIR EDUCATION DEEPER AND FULLER. AND IT DOESN'T MEAN THAT EVERYBODY HAS TO GO INTO SCHOLARSHIP AS A CAREER, IT JUST FUNCTIONS AS AN ENHANCEMENT TO THAT LEARNING PROCESS."

— Vice President for Research
RICHARD GALBRAITH

### Q HOW DOES THIS RELATE TO STUDENTS?

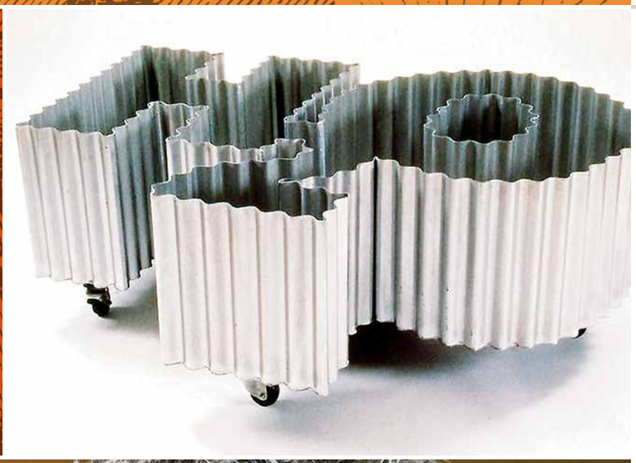
DR We acknowledge more often now than in the past that teaching and research and scholarship go hand in glove. Often those faculty who are most successful in their scholarship are actually the best teachers and mentors on the campus. And that's not a coincidence. They're at the cutting edge of their respective disciplines. They themselves are very excited about their own learning and discovery, and they're able to convey that in the classroom. We increasingly see undergraduate students who want to participate in that discovery process. They're looking for ways to best complement their curricular education — their classroom and laboratory education — with a research experience or a scholarship experience, whether it's work in a laboratory, scholarship in a library, creating a work of art, or perhaps even a service-oriented scholarship activity in the community. They're coming to us not only wanting to benefit from the Teacher-Scholar model, but wanting to be a part of the Teacher-Scholar model.

RG And those students are telling us: I now have a deeper understanding of what this field is about and what drives it. So it makes their education deeper and fuller. And it doesn't mean that everybody has to go into scholarship as a career, it just functions as an enhancement to that learning process.

### Q SO WHAT'S NEXT IN THIS EFFORT?

RG We'll continue to recruit faculty who are committed to both teaching and scholarship, and who want to excel at both. And we'll further our commitment to the model by providing opportunities for faculty members to learn about each other's work, to work collaboratively, and to hone their skills in both of these critically important areas. We want to support the model in every way possible.

DR The Teacher-Scholar is part of our culture at UVM, and something that we seek to do better than other universities. Few universities can boast a stronger, more authentic commitment to the Teacher-Scholar model than UVM. This is something that we cherish, nurture, and celebrate every day.




# The Creative Mind

**WHERE DOES A POET FIND A FIRST LINE OF VERSE? WHAT DRIVES A JAZZ TRUMPET SOLO? ALONE IN THE STUDIO LATE AT NIGHT, HOW DOES A SCULPTOR MAINTAIN ENERGY AND FOCUS? THREE ACCOMPLISHED UVM FACULTY ARTISTS DISCUSS THEIR CREATIVE PROCESSES — WHAT INFORMS AND INSPIRES THEIR WORK.**

BY THOMAS WEAVER

While teaching a fundamental lesson of jazz, trumpet player and senior lecturer in music **Ray Vega** will say, “Let’s have a conversation.” Then, the instant his student talks, Vega interrupts, jabbering incoherently. Looking confused, maybe insulted, the student asks the professor what he’s doing. “I’m not listening,” Vega replies. “And that’s exactly what is happening as we’re playing right now. You gotta be in there and you’ve got to be *in… the… moment.*”

Vega hammers that truth as he discusses the art of musical improvisation. “You have to be ready to respond to changes at any given moment. The whole thing with jazz is that it is an interactive, completely democratic art form. Everybody’s gotta negotiate and everybody’s gotta be having that conversation and listening.”

A native of the Bronx and longtime New Yorker, Vega speaks with the rapid-fire inflections of his city. He shares a memory from his teens: Fourth of July 1977, a house party/jam session at a friend’s apartment in Brooklyn, with the windows wide open. “I knew stuff about tunes and I had good ears, but I just remember sitting there and playing with all of these older, black musicians. All old enough to be my father. Working things out, checking out what they were doing. It was amazing. It was an epiphany.”

Today, when Vega takes a solo, the insights of that long-ago July afternoon are still in his mind. Likewise, his lessons as a young journeyman horn player with the humility to learn from veteran musicians who built their own chops playing with greats such as Duke Ellington, Count Basie, or Stan Kenton.

“The music jazz, as we know it under that name, has been in constant morph since 1917,” Vega says. “Audacity is an amazing thing, because all of the great innovators were audacious. But all of the great innovators were well schooled about what they were being audacious *about*, what they were stepping away *from*.”

That sort of schooling is going to keep a musician safe from the temptation to merely “get house,” applause and shouts from the audience for the cheap thrill of a piercing high note or a showy run. Vega warns his students about the siren song of getting house.

But if not house, then what? Something deeper. Vega makes a game attempt to explain the perhaps unexplainable — the intellectual and emotional forces that drive one of his horn solos “It all depends on what is happening at that moment in my life. If there is melancholy going on, those things may come out. If there are joyful moments, that will come out,” he says. “You cannot depend on what worked yesterday. You cannot depend on what worked five minutes ago.”

Ghosts of jazz greats like Dizzy Gillespie, James Moody, and countless musicians Vega has shared the stage with are in the back of his mind. “I’ve got my own voice, but I’m grabbing things. Artists are funnels,” he says. “I’m grabbing elements of this and that, throwing them in. Whatever comes out, that is who we are. But we need to tap out of a river of water with a lot of depth.”

## THE NEED TO SEE

Wannabe. Has been. This dismissive shorthand of fevered aspiration and faded achievement intrigues artist **Nancy Dwyer, M.P.S.** She’s drawn to the meaning and cultural context of the words. On a visual level, she finds interest in the sheer forms of

the letters and commonalities of the words. Wannabe. Has been. Seven letters each. In terms of meaning, she talks about the idea that the often-neglected concept of "now" perches on the thin cusp between wannabe and has been, and that a work of art can be a subversive way to communicate a message that might otherwise be ignored. She assumes a mock sanctimonious tone and says, "You know, you never really are in the present!" followed by a roll of her eyes. "That's not fun. That doesn't catch me."

> "I GET MOTIVATED BY WANTING TO SEE IT; THAT'S THE BIG MOTIVATION. I WANT TO SEE THIS THING THAT I HAVE PLANNED. AND THE ONLY WAY TO SEE IT IS TO DO IT."
>
> — NANCY DWYER, M.P.S.

So might begin a sculptural work for Dwyer as she considers how words relate to one another and how that relationship might find expression in a piece. "The ideas often just come from the zeitgeist," the UVM professor of art says. "They usually come from a phrase or a word that seems to resonate. A lot of times it is a sense of irony or something that is all around us. But then when I look at it again, it has much deeper resonance."

Dwyer has pursued this sort of visual word play since the mid-1980s. Her work is manifested in multiple ways — sculptural objects and installations, videos, printed wallpaper, and public art. If you are a Cleveland sports fan, you might have sat on her red granite sculptures, which spell out "MEET ME HERE" outside of Quicken Loans Arena and "WHO'S ON FIRST" at a Jacob's Field entrance. A member of "The Pictures Generation" of the mid-1970s, Dwyer's work was included in a New York Metropolitan Museum retrospective exhibit of these artists' work in 2009. More recently, the Fisher Landau Center for Art in New York City hosted a solo retrospective of Dwyer's work, "Painting & Sculpture, 1982–2012," in 2013.

Dwyer's ideas take form in her studio in a ramshackle old industrial space on Pine Street. Depending on her current focus, the space might look like a papier-mache factory, a carpenter's wood shop, or a print studio. Most likely music will be on, classic Motown or the funk she came of age with in seventies NYC. "It depends on where I am in a project. If I'm really in the jam, it's quiet and I'm figuring things out, and I don't even notice that I'm not listening to music. But as soon as there is any movement, it's physical, I need music," she says.

Posed with a naïve question about whether these long nights in the studio are "fun," Dwyer offers a deadpan stare. "Sometimes. It is not *not* fun. It is not horrible," she says. "I get motivated by wanting to see it; that's the big motivation. I want to see this thing that I have planned. And the only way to see it is to do it."

## CREATIVE DESTRUCTION

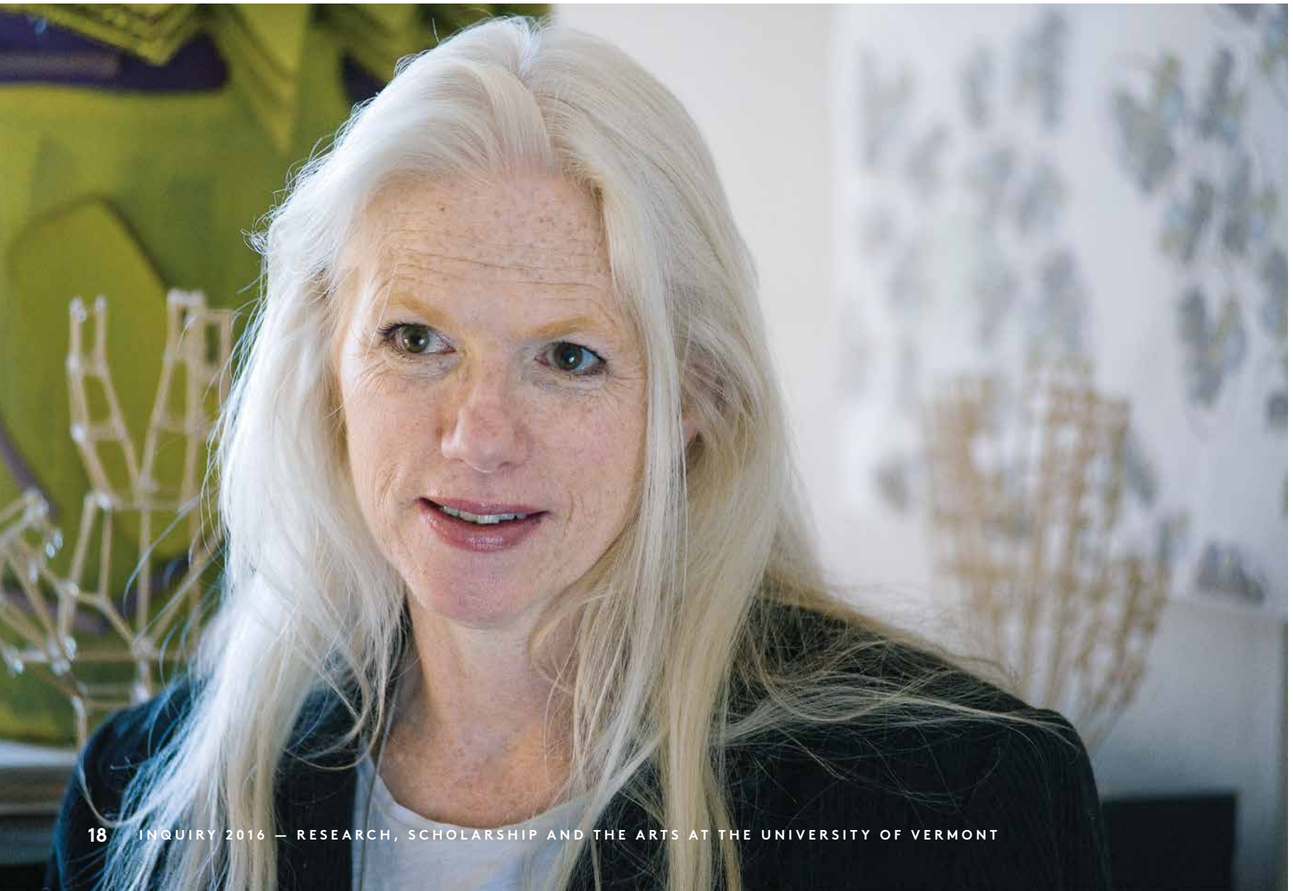
Texts, photos, playlists, and all of those apps to distract from and navigate daily life are the usual stuff gobbling the gigabytes on our phones. **Major Jackson, M.F.A.,** poet and University Distinguished Professor of English, adds another file to the mix, the seeds of poems. Sitting in a booth in the Waterman Building's café, he scrolls through his screen to "Ideas for Poems," a long list captured on the go to be explored later at the quiet of his desk.

"I have not disappeared." That simple declarative sentence echoed in Jackson's mind and held a place on his list for several years before it began to take form as a poem, "On Disappearing," which appears in his 2015 collection *Roll Deep*.

"It hooks into your soul at some point like a rhythm or a song that you know well. It becomes the engine behind the poem," Jackson says of these beginnings. "If I reach a lull in my thinking, I'll return to those words. Then it will push me a little bit further. As the sentences are coming to me, I recite them out loud, and I'm listening. I'm trying to hear what is in the universe as it relates to whatever word or phrase that generates it."

When he was a younger man, Jackson says it was his habit to write at the end of the day, when "my brain had absorbed all of this experience, I'm exhausted, and I'm going into that space where consciousness starts to stretch thin and reveal that which is most salient." But as a professor, husband, father, and poet with a national profile, who travels often for readings and lectures, he finds that writing has to happen when and where it can.

The scraps in the "Ideas for Poems" file on Jackson's phone might be called inspiration, but the poet himself would likely give that word a skeptical glance. Jackson emphasizes the simple truth that writing poems is work as he begins with that "engine" and drafts multiple revisions. "As I write I'm transcribing the associative and linear leaps that my mind makes with the hopes that a reader will simply enjoy that experience, as well as the stops along the way, the metaphors, the images, the pacing of the poem as it unfolds."



> "I TELL MY STUDENTS A GOOD POEM ARRIVES AS A RESULT OF HOW MUCH THE AUTHOR IS WILLING TO DESTROY THEIR EARLY DRAFTS."
>
> — MAJOR JACKSON, M.F.A.

When his creative process stalls, Jackson walks to his office bookshelf and opens a volume of another poet's work. He reboots with lyricism he admires or finds a certain comfort in a kindred spirit — "I need to hear their voice a little bit in my head."

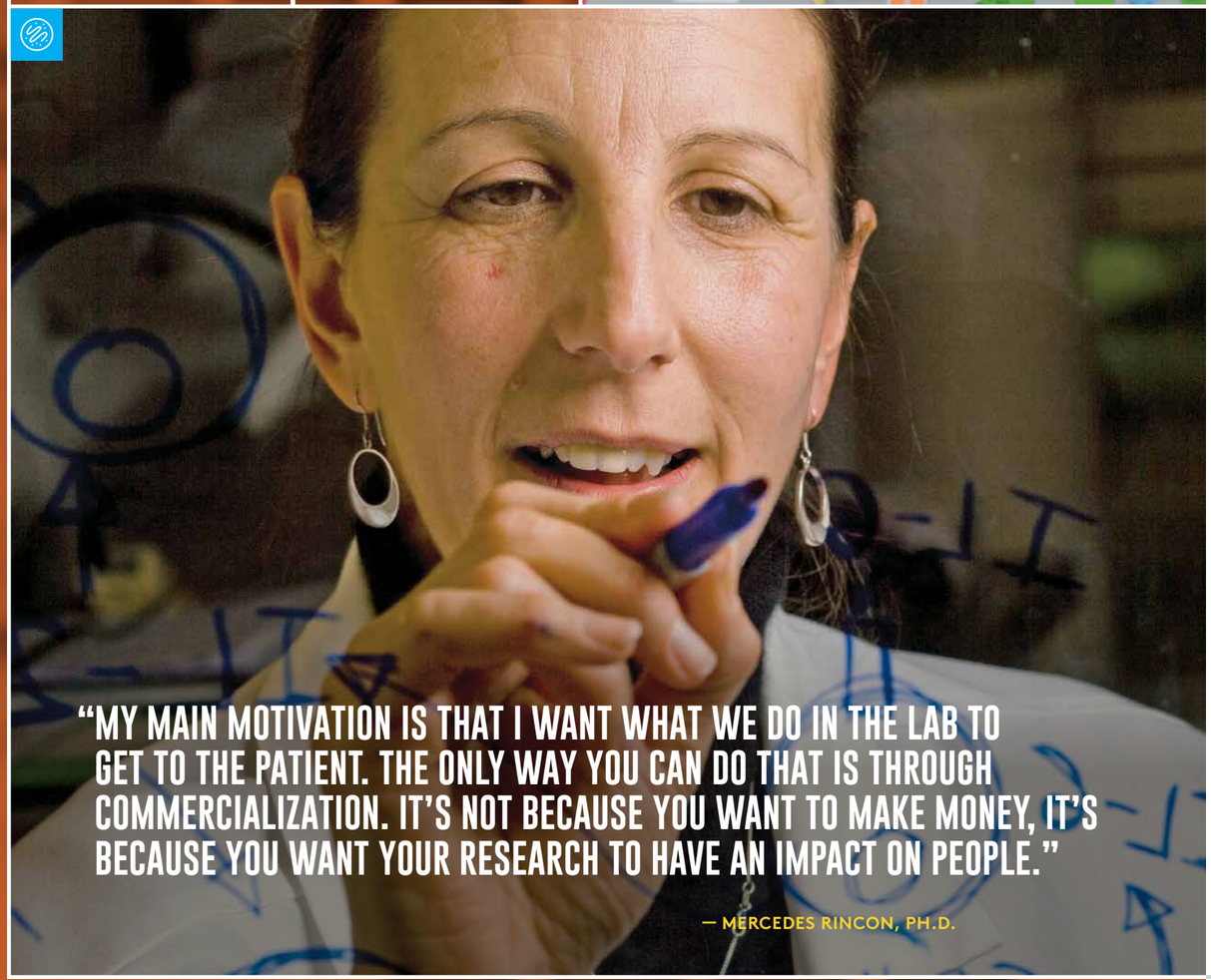
A writer's group with fellow poets in Vermont is also an essential part of his process. Jackson reads aloud from works-in-progress, eager to gauge the immediate reaction, which he feels is the most genuine and valuable. A good deal of the feedback he receives from his peers will find its way into the work the next time Jackson returns to his desk.

"I tell my students a good poem arrives as a result of how much the author is willing to destroy their early drafts," Jackson says. "Experiment with what is on the page rather than believing that those first words are some kind of sanctified speech."

At left: Associate Professor of Art Nancy Dwyer, M.P.S. Above right: University Distinguished Professor Major Jackson, M.F.A.

# CONTINUING THE STORY

The Carolyn and Leonard Miller Center for Holocaust Studies draws upon the expertise of distinguished faculty from across the University to promote scholarship, education and public awareness about the events that brought about, comprise, and continue to issue from the Holocaust. In 2016 the center also sponsored an exhibition at the Fleming Museum of the paintings and drawings of Samuel Bak, a survivor of the Vilna, Poland ghetto. For such efforts the Center was recognized with the New England Board of Higher Education's 2016 Robert J. McKenna Award for Program Achievement. "We are greatly honored to receive this award," said **ALAN STEINWEIS, PH.D.** director of the Holocaust Center (shown here at the Fleming Museum exhibit with museum Director **JANIE COHEN**). "It recognizes the collective efforts of many people in the extended UVM community — faculty, administrators, students, donors and local supporters — who have contributed to the success of the center since its founding a quarter century ago."



"MY MAIN MOTIVATION IS THAT I WANT WHAT WE DO IN THE LAB TO GET TO THE PATIENT. THE ONLY WAY YOU CAN DO THAT IS THROUGH COMMERCIALIZATION. IT'S NOT BECAUSE YOU WANT TO MAKE MONEY, IT'S BECAUSE YOU WANT YOUR RESEARCH TO HAVE AN IMPACT ON PEOPLE."

— MERCEDES RINCON, PH.D.

# Innovate and Incubate

## THE INSPIRATION AND RESEARCH OF UVM FACULTY MEMBERS LEAD TO THE DEVELOPMENT OF COMMERCIALLY VIABLE PRODUCTS THAT IMPROVE DAILY LIFE.

BY JEFFREY WAKEFIELD

It hardly looks like the setting for a Eureka moment: a small room with barely enough space for a computer screen, microscope and chair. But what Professor of Medicine **Jeff Spees, Ph.D.,** saw on a microscope slide in that monkish cubbyhole off his main lab at UVM's Colchester Research Facility — an army of healthy cells successfully grafted to heart muscle — was a watershed moment in regenerative medicine.

The grafted cells adhered and thrived in great number — breaking the record for graft success by a huge margin — thanks to a biochemical cocktail derived from bone marrow Spees had bathed them in.

"When I looked on the scope, and there was a beautiful graft on the heart, I was so amazed I actually shed a tear," says Spees.

This trailblazing achievement is one of several Spees discoveries that are clearing a plausible, and promising, path to the holy grail of cardiac medicine; regenerating healthy new heart muscle in the necrotic area of a heart attack. The work clearly has great clinical significance. Because of patents Spees and the University hold or have applied for on key elements of the work, it has potentially sizable commercial import as well.

Pursuing the commercial application of research discoveries as Spees is doing, in addition to pushing the boundaries of science in the lab, is emblematic of a new culture that has swept UVM over the last decade, one that places great value on applied, as well as purely theoretical, research.

"It has become OK at UVM to think that financial value is also important; that having your research grow into being a commercial product or service is a good thing," says **Corine Farewell,** director of UVM's Office of Technology Commercialization (OTC). A sign of the new environment, Farewell says, is the record 56 invention disclosures the University saw last year, a 40 percent increase over the prior year, a signal not only of robust intellectual activity, but of a new faculty willingness to reach out to Farewell's office and share the innovations.

In keeping with this new spirit, UVM Provost **David Rosowsky, Ph.D.,** notes that the University is putting systems in place that energize and promote faculty entrepreneurship and is attracting talented new faculty who "want to play in this space."

"All of these things are driving us forward," he says.

## DESTINATION PATIENT

Faculty motivations for commercializing research vary but are rarely purely financial, says Professor of Medicine **Mercedes Rincon, Ph.D.**

"My main motivation is that I want what we do in the lab to get to the patient," Rincon says. "The only way you can do that is through commercialization. It's not because you want to make a lot of money, it's because you want your research to have an impact on people."

Rincon's has the potential to significantly impact patient care in two areas that have eluded modern medical treatment: resistance to chemotherapy among some breast cancer patients and treating fatty liver disease, which affects a quarter of the world's population. The therapies Rincon is in the process of developing and commercializing, via a start-up company called Mitotherapeutix rely on her discovery of the special talents of a single protein called MCJ.

At left, top to bottom: Professor of Medicine Jeff Spees, Ph.D., in his Colchester laboratory; Professor of Medicine Mercedes Rincon, Ph.D.


Left to right: Dryver Huston, Ph.D., and Tian Xia, Ph.D., test their mobile ground menetrating radar system on the UVM campus with graduate students Yu Zhang and Dan Orfeo.

MCJ, Rincon has found, regulates the metabolic activity of cells by acting as a kind of brake on the mitochondria, the peanut-shaped protein tangles in a cell's nucleus that control its energy output.

She draws on an analogy to explain. "If you're going 80 miles an hour in a car, you're using a lot of energy," she says. "You slow down and use less energy when you put the brake on. That's what MCJ does. It decreases the activity of the mitochondria, which is the engine that produces the cell's energy."

For breast cancer chemo-resistance, Rincon has shown that giving mice a therapy that mimics MCJ greatly reduces their chemo-resistance, perhaps slowing down the mechanism, she speculates, that some cells use to eject foreign substances like the chemotherapeutic agent. She has published some of her results, patented the therapy and applied for federal grants to take the research and the commercialization effort further.

By contrast, Rincon has shown that treating fatty liver disease requires the opposite approach: speeding up cell metabolism. When mice given a special therapy that reduces their MCJ activity were fed a fatty diet that leads to the condition, they burned off the fat in the liver and were protected, while a control group with normal MCJ activity levels developed the disease. What's more, the livers of mice with an advanced state of the disease given the same therapy miraculously healed — a signal result, since no medications exist for treating fatty liver disease, which eventually leads to potentially fatal cirrhosis. Rincon has applied for patent for her therapy.

Given the magnitude of the problems Rincon is addressing and the clear promise of both MCJ therapies, she would seem poised for major commercial success. But the path to commercialization is an arduous one. "We have mouse data, but that's just the beginning," she says. To advance further, she'll need to win more competitive grants and raise venture capital, the prospect of which leaves her cautiously optimistic.

Rosowsky sees faculty entrepreneurship as a way for research universities like UVM to fulfill a 21st century version of their land grant mission, providing value of a new kind to their home states.

"It's part and parcel of the land-grant mission," he says.

## HELP FROM THE HIGGS

It's hard to imagine a skill set more perfectly matched to contemporary community needs than the one possessed by mechanical engineering Professor **Dryver Huston, Ph.D.,** a serial inventor who's thriving in UVM's new entrepreneurial culture. Where Huston was once on his own with his legion of ideas, he's now supported by an entire system that encourages faculty innovation and entrepreneurship.

Huston and his collaborator, Associate Professor **Tian Xia, Ph.D.,** a colleague in electrical engineering, were winners in the University's 2015 SPARK-VT program, a new Shark Tank-like competition among faculty with innovative ideas that awards $50,000 to each of four winning proposals a year. Their project was a ground penetrating radar, or GPR, system that can be hauled over bridges at highway speeds to detect structural defects. This innovation addressed the Achilles' heel of GPR when used to diagnose bridge integrity, a key application on any of America's 600,000 aging bridges. Unless driven at a crawl, which requires bridges to be closed, traditional GPR systems had to emit so many radio waves to get accurate readings of bridge integrity that they interfered with the navigation systems of aircraft, and the Federal Communications Commission banned their use at high speeds. The challenge Huston and Xia set themselves was how to obtain the same below-the-surface information with many fewer waves.

Huston found his answer in an unlikely source: particle physics, which used the advanced technology in supercolliders hunting for elusive molecular particles like the Higgs boson. Physicists at the University of Chicago generously shared the hardware they had developed, which Huston and his colleague adapted for GPR. They obtained just the results they had hoped for.

As useful as the technology is for bridge diagnostics, its real promise and commercial value may lie elsewhere — in plumbing the depths of the nation's municipalities, where it can render 3-D images of below-ground infrastructure that are easily read by non-specialists.

That's a capability cities around the country are in need of says Beth Anderson, chief innovation officer for the city of Burlington, which has teamed with the UVM researchers, the city of Winooski and an internet-of-things company called Kardinal Microsystems to field an entry using GPR, sensors and other tools for a competition called the Global City Teams Challenge, co-sponsored by the national Smart Cities Initiative and U.S. Ignite, a National Science Foundation-backed partnership that promotes the development of next generation apps.

"When you hear how cities are struggling because their infrastructure is old and hasn't been maintained, people think of things like roads and bridges," she says. "But it also completely applies to underground infrastructure. The first step is to know what's down there, and what condition it's in. That's exactly what this system does."

The team will pilot the new technology this coming year in the two cities and has hopes of winning grant funding in the Smart Cites competition to expand the work.

## RANDOM ACTS OF INSPIRATION

One reason Jeff Spees was so moved by the grafting success he observed in his lab was that he had failed miserably in his attempts to graft cells over the previous eight years.

"I'd given up," he says. "We were trying to figure out, is this the best way to inject (the cells) in the muscle? Or inject them in the vasculature? How should we use these cells? And it didn't matter, because no matter what you did, they were gone in a few days."

The idea of conditioning the cells in a bath of factors derived from bone marrow occurred to Spees randomly. After the initial success, "the real work began," Spees says — isolating which of the more than 1,000 factors were doing the work.

A tedious three-month screening process yielded the two instrumental ones: human growth factor and insulin.

Spees is patenting the potent duo as Cell-Kro. The product will have an immediate market among researchers around the world trying graft adult and embryonic stem cells, who had hit the same wall Spees had.

> "WHAT I LIKE ABOUT JEFF'S PORTFOLIO... IS THAT IT'S ALMOST A ONE-STOP SHOP FOR CARDIAC REPAIR. THAT'S THE BASIS OF A COMPANY."
>
> — KERRY SWIFT

Spees has already solved a problem other researchers, unable to graft cells at all, haven't begun to grapple with: getting grafted cells to travel to the area where they're needed: in Spees' case, the dying tissue of a heart attack. To do that Spees relied on the built-in traits of the heart's epicardial progenitor cells, stem cells found at the surface of the heart that function as the organ's repair kit, traveling to an area of need and transforming themselves into whatever kinds of tissue are needed.

Spees developed and patented a process for isolating, purifying and replicating the peripatetic cardiac progenitors. Along with the progenitor cells and Cell-Kro, Spees has developed a third complementary product: a biologic called VasaPlex that the cardiac progenitors, once grafted and mobile, deliver to the dying area of the heart after a blocked artery is opened, whose toxic contents spill downstream and cause further muscle death. By protecting the heart tissue awash in the toxic arterial flow, VasaPlex can cut the size of the dead tissue — the "infarction" — nearly in half.

"People typically die after a 35 percent infarction of the left ventricle," Spees says. "If we cut that to 10 percent or less, then it's pretty mild. You can have a full, normal life."

"What I like about Jeff's portfolio of IP right now is that it's almost a one-stop shop for cardiac repair," says **Kerry Swift,** technology licensing officer at the OTC. "That's the basis of a company." A company with bright prospects, considering that over 735,000 heart attacks occur each year in the United States alone.

Spees, also a SPARK-VT winner, has attracted wide interest from venture capitalists and recently won a $1.6 million grant from NIH to continue his work.

**David Schneider, M.D.,** director of the Cardiovascular Research Institute of Vermont, sees the greatest promise in the work that's just ahead for Spees: his plans to collaborate with other researchers involved in cell "reprogramming" to find the recipe for transforming Spees's mobile cardiac progenitors into heart muscle — one tissue they can't make on their own — once they reach the destination of the infarc.

Spees doesn't think all the dead tissue would need to be replaced; only enough to create a lattice of new muscle the heart's natural reparative system could build on.

"If we can get that matrix to form, I'm pretty hopeful we'll get a lot of repair done," he says.

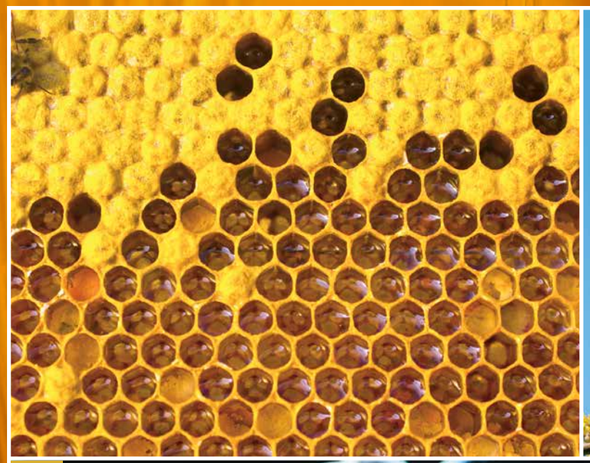
"That would be a game-changer," says Schneider.

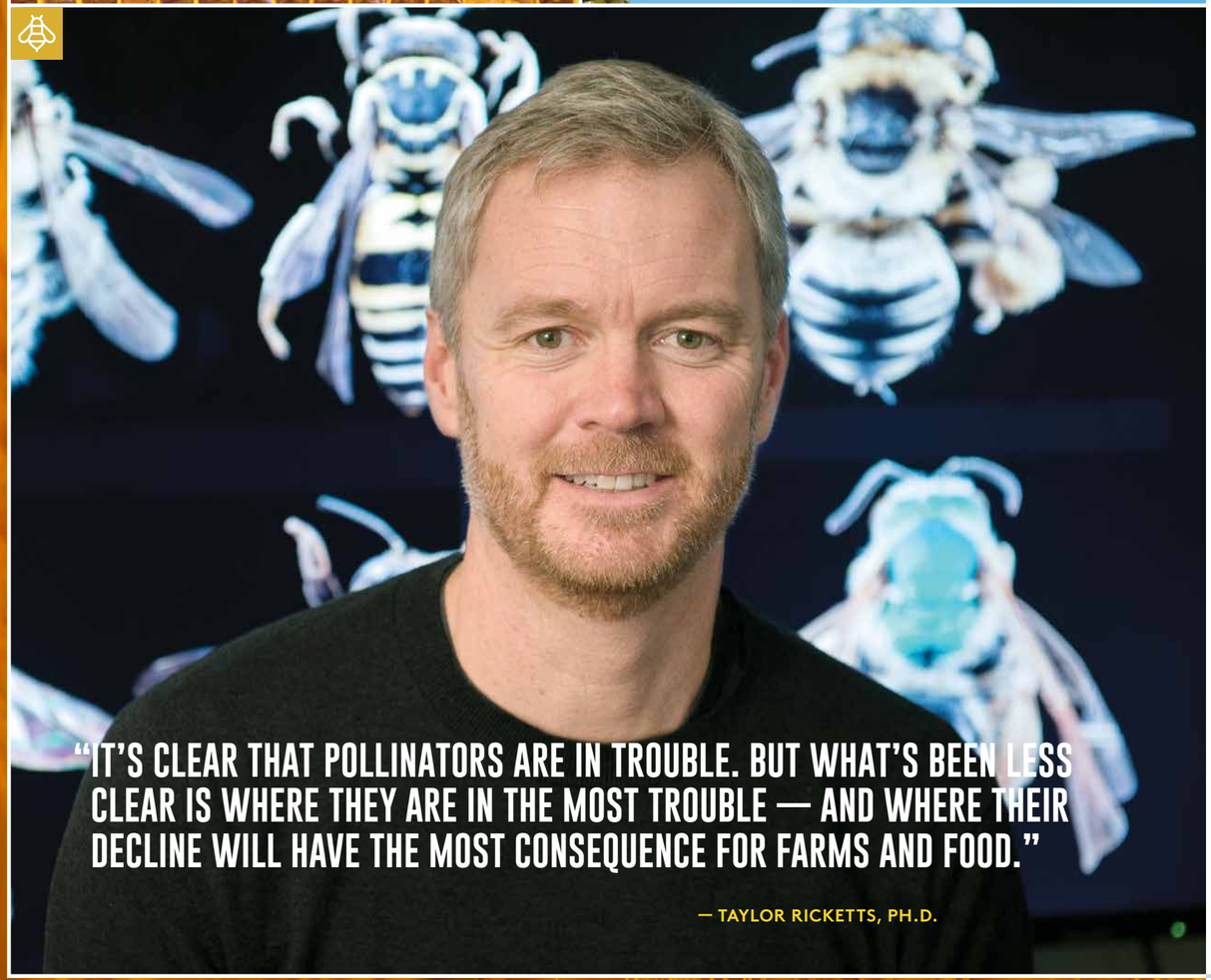
In the work of faculty like Spees, Rincon and Huston and in the evolving culture driving innovation, UVM's vice president for research, **Richard Galbraith, M.D., Ph.D.,** sees a synergy developing that will be of broad benefit to the University.

"As we have more people interested, we will be having more disclosures, we will be filing patents for better inventions, we will be developing them faster because of things like SPARK-VT," he says. "But more importantly there will be an increase in the intellectual component of entrepreneurial activity at the University and among our students and faculty, and that will benefit everyone."

# BIG DISCOVERIES IN IN THE NANO WORLD

Assistant Professor of Physics **ADRIAN DEL MAESTRO, PH.D.,** won a prestigious five-year CAREER grant in 2016 from the National Science Foundation that will fund his study of entanglement — the seemingly bizarre reality of atomic particles where measuring one photon in an entangled pair instantly determines the state of its partner particle, even if they are miles apart — and how entanglement might be applied to create a new generation of ultra-fast quantum computers. This follows on Del Maestro's work published last year on the behavior of individual atoms through the controlled space of a infinitesimally small "nano faucet" — work that could someday help everyone in the full-sized world by contributing to improved sensors for GPS systems.






# As Bees Go, So Goes Our Food Supply

## UVM RESEARCHERS PRODUCE HARD EVIDENCE ON THE DECLINE OF A CRUCIAL POLLINATOR.

BY JOSHUA BROWN

UVM researchers leading the first national study to map U.S. wild bees suggest that the insects are disappearing in many of the country’s most important farmlands — including California’s Central Valley, the Midwest’s corn belt and the Mississippi River valley.

If losses of these crucial pollinators continue, the nationwide assessment indicates that farmers will face increasing costs — and that the problem may even destabilize the nation’s crop production.

The findings were published in December 2015 in the *Proceedings of the National Academy of Sciences.*

“It’s clear that pollinators are in trouble. But what’s been less clear is where they are in the most trouble — and where their decline will have the most consequence for farms and food,” says **Taylor Ricketts, Ph.D.,** professor in the Rubenstein School of Environment and Natural Resources and director of UVM’s Gund Institute for Ecological Economics. Ricketts is the senior author of the study.

The research team, led by **Insu Koh, Ph.D.,** a postdoctoral research associate at the Gund Institute, estimates that wild bee abundance between 2008 and 2013 declined in 23 percent of the contiguous U.S. The study also shows that 39 percent of U.S. croplands that depend on pollinators — from apple orchards to pumpkin patches — face a threatening mismatch between rising demand for pollination and a falling supply of wild bees.

In June of 2014, the White House issued a presidential memorandum warning that “over the past few decades, there has been a significant loss of pollinators, including honey bees, native bees, birds, bats, and butterflies.” The memo noted the multi-billion dollar contribution of pollinators to the U.S. economy — and called for a national assessment of wild pollinators and their habitats. The report that followed the White House memo called for seven million acres of land to be protected as pollinator habitat over the next five years.

“Until this study, we didn’t have a national mapped picture about the status of wild bees and their impacts on pollination,” says Koh. This despite the fact that each year more than $3 billion of the U.S. agricultural economy depends on the pollination services of native pollinators like wild bees.

“Now we have a map of the hotspots,” adds Koh. “It’s the first spatial portrait of pollinator status and impacts in the U.S.” — and a tool that the researchers hope will help protect wild bees and pinpoint habitat restoration efforts.

The new study identifies 139 counties in key agricultural regions of California, the Pacific Northwest, the upper Midwest and Great Plains, west Texas, and the southern Mississippi River valley that have the most worrisome mismatch between falling wild bee supply and rising crop pollination demand.

At left: Taylor Ricketts, professor in the Rubenstein School of Environment and Natural Resources and the senior author of the UVM bee mapping study.

**The research team estimates wild bee abundance between 2008 and 2013 declined in 23 percent of the contiguous U.S.**

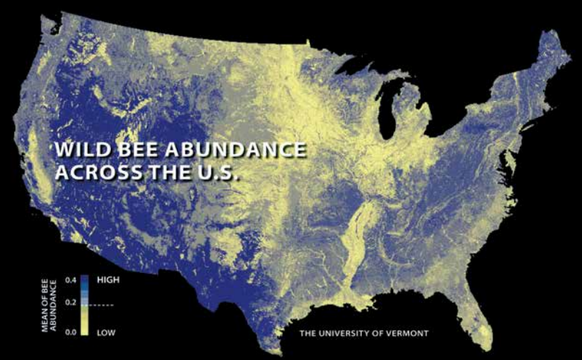
## MAPPING THE RANGE OF THE BUSY BEE

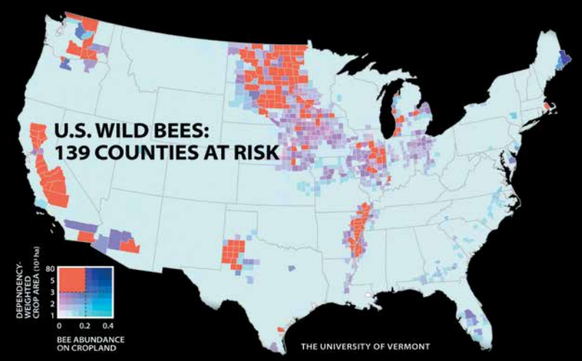
The team of seven researchers who published the study in PNAS — from UVM, Franklin and Marshall College, University of California at Davis, and Michigan State University — created the new maps by first identifying 45 land-use types from two federal land databases, including both croplands and natural habitats. Then they gathered detailed input from 14 experts on bee ecology about each type of land — and how suitable it was for providing wild bees with nesting and food resources.

Averaging the experts' input and levels of certainty, the scientists built a bee habitat model that predicts the relative abundance of wild bees for every area of the contiguous United States, based on their quality for nesting and feeding from flowers. Finally, the team checked and validated their model against bee collections and field observations in many actual landscapes.

The model's confidence is greatest in agricultural areas with declining bees, matching both the consensus of the experts' opinion and available field data. However, the study also outlines several regions with greater uncertainty about bee populations. This knowledge can direct future research, especially in farming areas where need for pollination is high.

"We can now predict which areas are suffering the biggest declines of wild bee abundance," says UVM postdoctoral researcher **INSU KOH, PH.D.,** "and identify those areas with low bee supply and high bee demand, that are the top priority for conservation."




These counties tend to be places that grow specialty crops — like almonds, blueberries and apples — that are highly dependent on pollinators. Or they are counties that grow less dependent crops — like soybeans, canola and cotton — in very large quantities.

Of particular concern, the study shows that some of the crops most dependent on pollinators — including pumpkins, watermelons, pears, peaches, plums, apples and blueberries — have the strongest pollination mismatch, with a simultaneous drop in wild bee supply and increase in pollination demand. "These are the crops most likely to run into pollination trouble," says Taylor Ricketts, "whether that's increased costs for managed pollinators, or even destabilized yields."

Pesticides, climate change, and diseases threaten wild bees — but the new study also shows that their decline may be caused by the conversion of bee habitat into cropland. In 11 key states where the new study shows bees in decline, the amount of land tilled to grow corn spiked by 200 percent in five years — replacing grasslands and pastures that once supported bee populations. "These results reinforce recent evidence that increased demand for corn in biofuel production has intensified threats to natural habitats in corn-growing regions," the new study notes.

"By highlighting regions with loss of habitat for wild bees, government agencies and private organizations can focus their efforts at the national, regional, and state scales to support these important pollinators for more sustainable agricultural and natural landscapes," says Michigan State University's Rufus Isaacs, one of the co-authors on the study and leader of the Integrated Crop Pollination Project, a USDA-funded effort that supported the new research.

> "UNTIL THIS STUDY, WE DIDN'T HAVE A NATIONAL MAPPED PICTURE ABOUT THE STATUS OF WILD BEES AND THEIR IMPACTS ON POLLINATION."
>
> — INSU KOH, PH.D.

Over the last decade, honeybee keepers have lost many colonies and have struggled to keep up with rising demand for commercial pollination services, pushing up costs for farmers. "When sufficient habitat exists, wild bees are already contributing the majority of pollination for some crops. Even around managed pollinators, wild bees complement pollination in ways that can increase crop yields," says Neal Williams, a co-author on the study from the University of California, Davis.

"Most people can think of one or two types of bee, but there are 4,000 species in the U.S. alone," says Ricketts. "Wild bees are a precious natural resource we should celebrate and protect. If managed with care, they can help us continue to produce billions of dollars in agricultural income and a wonderful diversity of nutritious food."

Below, Insu Koh, Ph.D., a postdoctoral research associate at the Gund Institute for Ecological Economics.

# A Hive of Research Activity

There is a growing buzz at the University of Vermont as scientists join the global effort to stop bee declines. UVM researchers have recently released groundbreaking studies — highlighting bees' importance to food, health and the environment.

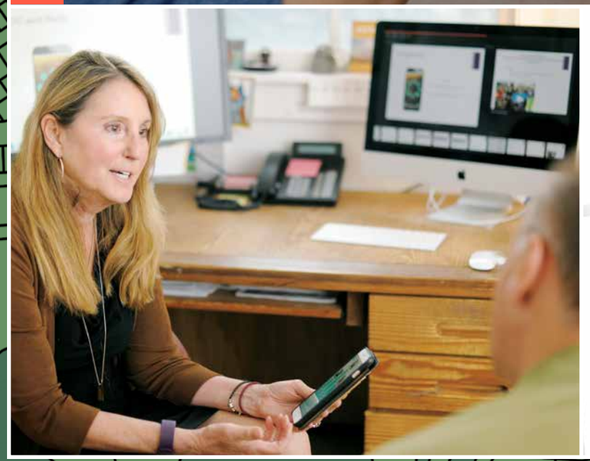
### SOME SELECTED EXAMPLES OF KEY UVM PROJECTS ON BEES AND POLLINATION:

- A United Nations 2015 report, with contributions from **TAYLOR RICKETTS, PH.D.,** of UVM's Gund Institute finds that bees and other species important for agricultural pollination are declining. (In 2016 Ricketts made Thomson Reuters' prestigious list of the world's most-cited scholars in his field for the second consecutive year.) Another study by Ricketts and global colleagues calculates wild bees' economic value to the food system in the billions. The results provide a powerful economic rationale for conserving wild bees. Ricketts and his co-author **ALICIA ELLIS, PH.D.,** from the College of Medicine found in 2015 that pollinators contribute to human nutrition and health, in the world's first study to test this connection. Research in Vermont by Ricketts' advisee, doctoral student **CHARLIE NICHOLSON,** aims to assess the economic impact of wild bees on blueberry crops.
- Climate change is dramatically shrinking bumblebee habitats in North America and Europe, a study co-authored by postdoctoral researcher **LEIF RICHARDSON, PH.D.,** finds. As temperatures rise, bumblebees are losing their southern ranges, yet unable to gain new territory in the north. Richardson has also found that plant chemicals naturally present in flower nectar and pollen can reduce bumblebee parasites, causing some bees to "self-medicate" by seeking out these chemicals.
- Forthcoming research by **INSU KOH, PH.D.,** investigates how wild bees can enhance pollination of almonds. Certain managed wild bees are effective almond pollinators, but farmers must install artificial nests to house the bees. As farmers face higher honeybee costs, Koh is exploring optimal investment strategies to help this important U.S. industry to increase pollination diversity and stability.
- A study of Vermont blueberries led by Professor of Biology **ALISON BRODY, PH.D.,** suggests a novel combination of plants, pollinators and fungi could increase crop yields. Early results indicate that select fungi can make blueberry plants more attractive to bees by increasing flower size and nectar rewards. Co-investigators include **TAYLOR RICKETTS, PH.D., LEIF RICHARDSON, PH.D., JEANNE HARRIS, PH.D.,** and **BEN WATERMAN** of UVM Extension.
- **SAMANTHA ALGER,** a doctoral student in the Department of Biology, is researching Vermont bee viral diseases, the role of plants in virus transmission, and the effects of pesticides on bee health and behavior. She leads Vermont's involvement in the U.S. National Honey Bee Survey, gathering baseline data on diseases and pathogens, and works closely with beekeepers, providing educational workshops on bee health and disease management practices.
- Agronomist **SIDNEY BOSWORTH, PH.D.,** at UVM Extension is leading the Forage Legume Bee Project, a collaboration with the Vermont Beekeepers Association, which seeks to increase clover varieties to provide nectar for pollinators. This effort explores the use of hay and pasture crops that are more "bee friendly," that still provide quality forage food for dairy and other livestock.
- Working with Extension Professor **LEONARD PERRY, PH.D.,** Plant and Soil Science doctoral student **ANNIE WHITE** is investigating ways to enhance flowering plant selection for pollinators, and to incorporate native pollinator conservation into sustainable landscapes and agricultural practices.

For links to UVM research articles and videos on the state of bees, go to: **UVM.EDU/INQUIRY**

# GOOD TASTE EXPLORED

Trained as both a cultural anthropologist and chef, **AMY TRUBEK, PH.D.,** associate professor and Faculty Director of the UVM Food Systems Graduate Program, examines in her teaching and published work the history of the culinary profession, globalization of the food supply, the relationship between taste and place, and cooking as a cultural practice. At this year's UVM Food Systems Summit, she helped explore the central topic: What makes food good? "To decide what makes food good is complex," she says. "In fact, we all use many and varied means to arrive at conclusions, for ourselves, for our communities, and for our society."

# A Place Called Home

OVER THE LAST 20 YEARS, THOUSANDS OF REFUGEES HAVE BEGUN REBUILDING THEIR LIVES IN VERMONT. UVM FACULTY WORK IN MANY WAYS TO BRING BETTER UNDERSTANDING AND HELP IN EASING THE TRANSITION.

BY CAROLYN SHAPIRO

A family designated as refugees arrives at Burlington International Airport with just a few bags of belongings. They speak little or no English. They have no idea where they will live — other than among strangers. They must find places to buy food, navigate the school system and learn to drive. At some point, sooner or later, they’ll need to see a doctor. Many arrive traumatized and grief-stricken. They’ve left behind loved ones in war-torn areas or witnessed them murdered, raped or tortured. Some suffered such violence themselves in their homes or in refugee camps.

In Vermont, they will join some 7,000 people with refugee status, many living in neighborhoods of Burlington and Winooski — within the shadow of the University of Vermont. Their connection to the University has grown beyond physical proximity. Some of the institution’s most esteemed faculty have devoted time, attention, scholarship and research to better understand and ease the transition for those forced to leave their home countries and resettle in the United States.

The relationship between UVM and the refugee community stems from a fundamental responsibility to the greater public good as part of the university’s land-grant mission, says **Pablo Bose, Ph.D.,** associate professor of geography and an expert in refugee migration.

“This is one of the big issues facing the country as a whole — the demographic shift, the changing nature of our different cities and towns, what the influx of new people brings in terms of both possibilities and challenges,” he says. “An institution like UVM is well-poised to take on a lot of these interdisciplinary and multifaceted challenges.”

At left, clockwise from top: Associate Professor of Pediatrics Andrea Green, M.D., Associate Professor of Geography Pablo Bose, Ph.D.; Professor of Psychology Karen Fondacaro, Ph.D.

UVM scholars learn much from the refugee community, which forces them to approach their work from a different point of view, says **Andrea Green, M.D.,** associate professor of pediatrics and director of the New American Clinic, part of the University of Vermont Children’s Hospital.

“We forget that the way we understand medicine is through our own personal cultural lens,” she says. “So one of the great things with working with refugees is they teach you new ways of thinking, new ways of problem-solving, new ways of managing health problems that we may not have thought of before.”

## SOCIAL WORK FROM “A DIFFERENT SET OF LENSES”

**Susan Comerford, Ph.D.,** associate professor of social work, wants to prepare her students to better understand the people with refugee status whom they might meet in the field when they practice in Vermont.

“They will not go to that meeting blind. They will go to that meeting with a depth of understanding,” says Comerford, who teaches both an undergraduate course and a master’s seminar on working with refugees, as well as an undergraduate course on diversity. “I’m trying to increase their awareness of the many possible stories that people of refugee status carry.”

Such empathy for those coming from vastly different backgrounds helps future social workers, even if they don’t see refugee clients, learn to recognize their preconceptions and personal biases and step outside of their own experience. Working with refugees teaches them to consider the larger systemic and contextual circumstances that lead to individual struggles.

“Try to think about it with a different set of lenses,” Comerford says to the 13 students in her master’s seminar. Comerford often shares her own experience with her students,

Above: Associate Professor of Social Work Susan Comerford, Ph.D., leads her social work students in a seminar on working with refugee populations.

going back to her days right out of college, when she was in her early 20s and worked for nonprofit groups on the Thai-Cambodian border and other conflict-riddled parts of Southeast Asia. The human resilience she saw in the face of horrific acts still resonates with her today.

Since that initial exposure, Comerford has kept one foot in refugee work. She is a consultant for the Vermont Refugee Resettlement Program, as well as programs in other states. She provides many of her services pro bono, quietly and behind the scenes.

During a gathering of her master's class this past spring, part of the discussion focused on the appropriate level of personal involvement that a social worker should have with clients. The students questioned whether typical professional boundaries should shift when new American clients follow their own customs by offering a gift or a dinner invitation to their homes.

"It's a very Western notion," Comerford explained of the inherent "power imbalance" and line drawn between a professional and the person served. "The amount of clear distinction we have in the U.S. is a culturally bound notion."

## TECHNOLOGY TO TACKLE TRAUMATIC STRESS

Soon after she began working with refugee families in Vermont, Clinical Professor of Psychology **Karen Fondacaro, Ph.D.,** broke her own rules about keeping a personal distance from clients, attending their weddings and funerals and a Bhutanese religious ceremony called a *puja*.

She spent time in the Somali Bantu and Bhutanese communities, trying to overcome their skepticism about therapy. Fondacaro, who is the director of UVM's Connecting Cultures clinical science program that provides mental health services for resettled refugees, has since helped hundreds of refugees address the extreme trauma they faced before, during and after their arrival in the United States.

The unique experiences of those with refugee status goes beyond the typical diagnosis of post-traumatic stress disorder, or PTSD, and the traditional methods to treat it, Fondacaro says. She recently coined a new designation: Chronic Traumatic Stress. It recognizes that these torture survivors struggle with ongoing anguish.

"We're not just dealing with post-traumatic events," Fondacaro says. "We're still dealing with it." The new designation includes a package of 10 "modules" for treatment, including coping techniques for debilitating episodes of disassociation or depression. With language barriers and gaps in understanding, however, clients who are refugees may have trouble recalling those steps at home between sessions.

In late 2015 Fondacaro received a Small Business Innovation Research Grant through the National Institute on Minority Health and Health Disparities to create an interactive smartphone application that guides participants through the exercises they would do with their therapists. Under development by Gametheory, a Burlington-based tech company, the mobile app uses only images — no words — and personalization options to encourage at-home practice by patients.

Fondacaro is currently testing a prototype with a group of clients. She and the developer are collecting usage data and to see how the app works in actual practice. Then, Fondacaro will apply for a second SBIR grant to roll out the product and run a full-scale trial.

"The research is so challenging in that it's really different from using a Western measure with Western folks to understand a concept," she says. "The challenges are: are we asking the right questions? Are we using the right measurements? Do we have the right constructs? Are we respecting the cultures, and are we distributing it in a way that makes sense?"

> "I'M TRYING TO INCREASE THEIR AWARENESS OF THE MANY POSSIBLE STORIES THAT PEOPLE OF REFUGEE STATUS CARRY."
>
> — SUSAN COMERFORD, PH.D.

## A DATA-DRIVEN DEPICTION

Pablo Bose quietly has studied refugee resettlement patterns for more than a decade, but his work recently was thrust into the political spotlight with the Syrian refugee crisis and presidential campaign debates over national security.

The heightened interest — including some backlash against refugees — only reinforces Bose's drive to tell the real story, correct misinformation and guide better policy decisions, he says. "A lot of the work that I was doing all of a sudden became much more relevant for moving away from the kind of myths that we tend to have about who's coming, where they're going, and what they're doing."

Over the past few decades, the influx of new Americans has shifted from the traditional big cities with infrastructure and resources — New York, Los Angeles and Chicago — to places such as Burlington and Rutland. Bose is now in the final phase of a three-year project studying resettlement in small- and medium-sized communities.

The project includes interactive maps and an annual survey to gauge Vermonters attitudes about resettlement. This summer, he and his team interviewed refugees who resettled in the previous 30 days about their expectations for housing, employment, and income. They'll revisit the same group for two succeeding years afterward.

This summer Bose began what he calls a "PhotoVoice" project, in which ten new Americans and ten longtime non-refugee residents will each get a camera and follow prompts to take certain pictures: something they want to change; something they want to stay the same; something that represents America; something that represents community. They will write explanations for their choices, then Bose and his students will gather the participants into separate groups to discuss their photos and impressions.

"One of the hopes out of this overall three-year study is to create a model for understanding how resettlement is going," he says. "If we want to make policy that is evidence-based, what is the evidence we want to base that on? And right now, when we look at refugee resettlement in the U.S., we have very incomplete data."

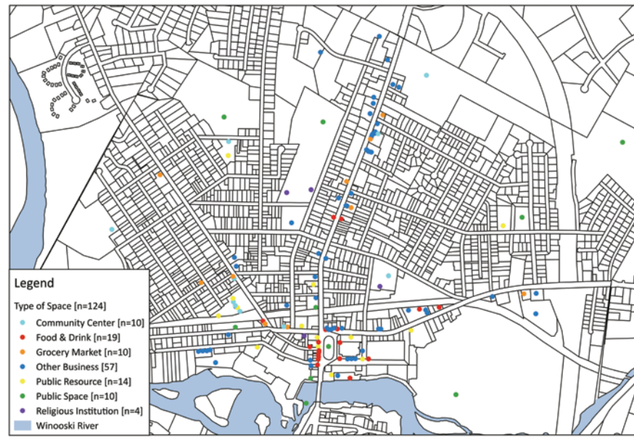
Bose intends to replicate his work in four similar-sized U.S. resettlement locations outside the Northeast. Om a planned sabbatical next year he will expand and apply his research to small towns in Canada, Sweden, Denmark and Norway.

## CLINICAL CARE CONNECTED TO THE COMMUNITY

When Andrea Green took over the New American Clinic in 2004, it already had a goal to serve as a "one-stop shop" for refugee children's primary care. Her patients come to see the doctor, but they get much more.

Green has moved beyond the individualized, single office visit and into a "community pediatric practice." She networks with other service providers, schools and government agencies. She builds relationships with elders in the refugee communities. She brought in funding for an in-house social worker to help families deal with household complications, such as trouble paying bills.

"The immigrant community can be used as a lesson in understanding barriers to care," Green says. "The barriers are really obvious: You have the barriers of lower socioeconomic status. You have the barriers of communication and understanding. And I think if you can work in this group and overcome those barriers, then you can take that model and extend it everywhere, because the barriers are with every patient population."




Above: Pablo Bose's work includes mapping and analyzing the infrastructure that supports new refugee communities in small and medium-sized cities.

Green is part of a cross-disciplinary Hatch Grant from the U.S. Department of Agriculture along with Bose and colleagues from the College of Agriculture & Life Sciences and the Department of Nutrition & Food Sciences, for a project related to food insecurity. With her own interest in obesity and the social determinants of healthy eating, Green and the team will study refugee families' food choices and "what's in their cupboards," to understand their views of food in the United States and whether those change over time.

Through her creative funding efforts, Green has launched several refugee-related programs: an annual bike helmet/car seat awareness day; smoke detectors for refugee families provided by the city fire department; swim and water safety lessons, including 80 slots from the city Parks & Recreation department and "modest Muslim swimwear" that Green found so refugee women would feel covered and comfortable.

"You need to change the way you're practicing to match the cultural values of the people you're working with," she says. Green goes to new Americans' homes to check out their décor, so she can address any child-safety concerns. When asked about taking these extra steps on her own time, without compensation, she gets choked up.

"You go into pediatrics because you believe in the value of creating healthy children, supporting children so they can become healthy adults."

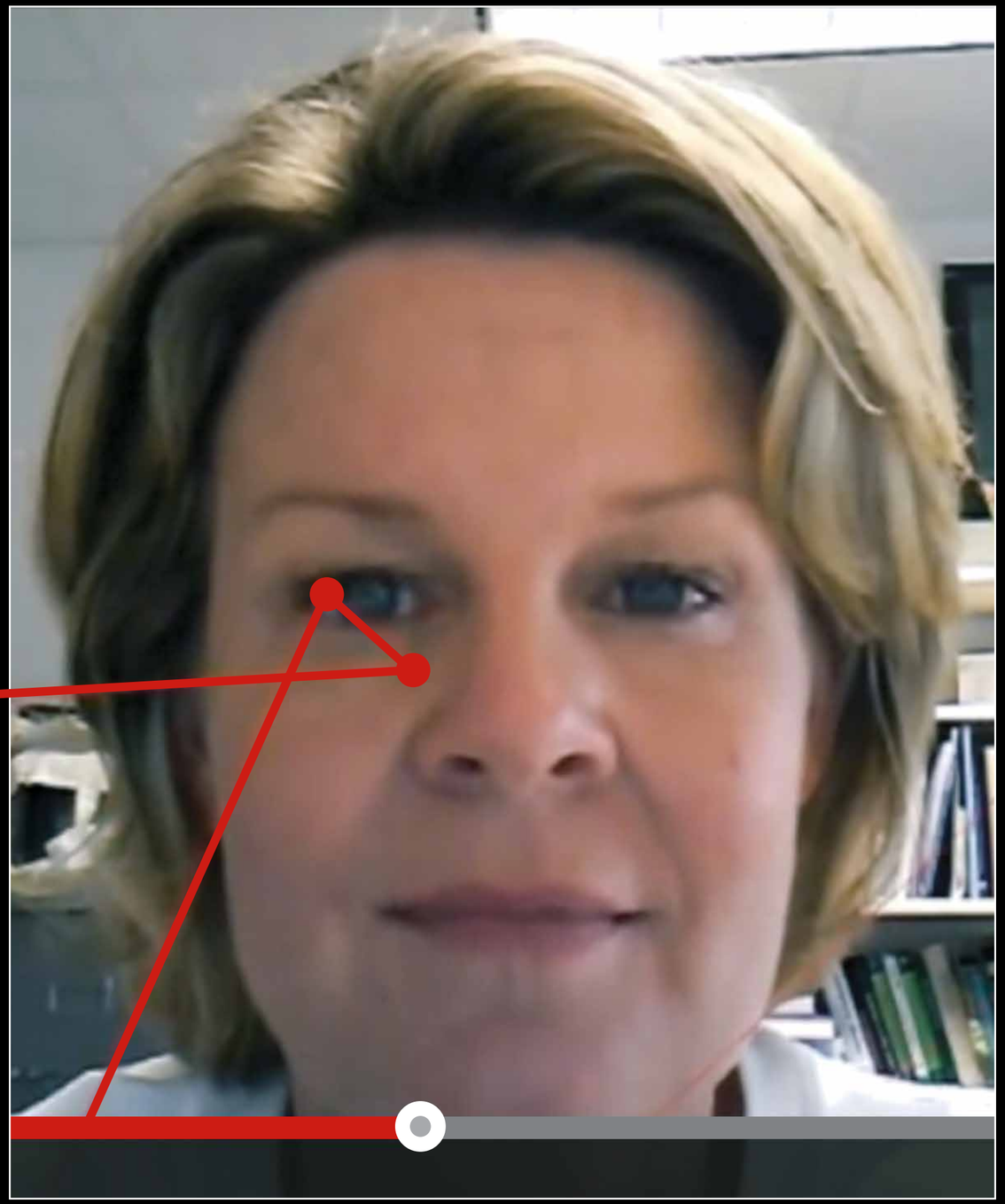
Work with refugee patients takes problem-solving skills, open-mindedness and flexibility — sometimes just to deal with the logistics, Green says.

"You have to have some patience," she says. "People are not always on time. But you have to remember what they've been through just to get here."

# TRACKING THE CONVERSATION

Where do your eyes focus during a conversation? An innovative study by UVM researchers led by Assistant Professor of Communication Sciences and Disorders **TIFFANY HUTCHINS, PH.D.,** revealed that for children with autism spectrum disorder (ASD), the answer depends on how emotional the conversation is. The study, published in the June 2016 *Research in Autism Spectrum Disorders,* showed that children with the developmental disability fixate longer on a speaker's mouth rather than the eyes when the conversation turns emotional. This is the first study of its kind to use eye tracker technology and Skype to monitor eye movement during an interactive conversation, and the results could affect the way speech therapists treat the estimated 1 in 68 children nationally who struggle with the social, communication and behavioral challenges caused by ASD.

View the YouTube video eye-tracking demonstration at **UVM.EDU/INQUIRY**





# Three Ways of Looking at the Lake

## TEAMS OF UVM RESEARCHERS WORK TO DIAGNOSE AND IMPROVE CONDITIONS IN ONE OF VERMONT'S GREATEST NATURAL RESOURCES: LAKE CHAMPLAIN.

BY JOSHUA BROWN

In Willsboro Bay, about nine miles out from Burlington Harbor, Tori Pinheiro hangs over the gunwale of the UVM research vessel *Melosira* and stares down into black water. Like the huge gray eye of a sea monster, a round concrete weight appears out of the depths. The steel cable from the boat's trawling winch keeps turning and the hundred-pound weight emerges into morning sunshine, dripping. From its underbelly, another line still dangles into the water. Pinheiro, a research technician, hauls the line, and pulls onto the deck a slimy-looking black canister the size of a large water bottle. "This is it," she says, as she turns to a laptop computer sitting on a fish-dissecting table in the middle of the deck, "one of our twenty-seven receivers. There's months of data in there."

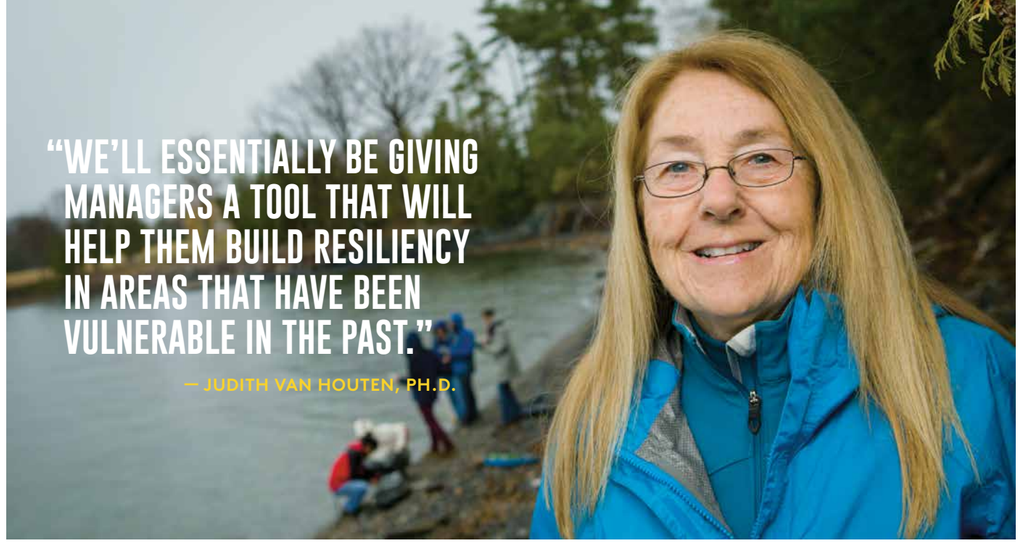
She activates the canister and soon it's downloading to the computer. What the receiver has been recording are pings — bits of noise at 69 kilohertz — that come from fish. The fish don't make the noise themselves — neither they nor people can hear a pitch that high. Instead, the noise comes from transmitters, about the size of a AA battery, that have been surgically implanted into the fish — some ninety lake trout and twenty walleye tagged by UVM scientists and seventeen lake sturgeon tagged by State of Vermont scientists. As the fish swim about, they each emit a unique pattern of pings, a kind of acoustical barcode of identity, and when they get close enough to one of the receivers it hears them. Tracking these pings over time lets scientists create a map of the fish moving and spawning.

"You can watch animals on land with binoculars or helicopters," says professor of fisheries **Ellen Marsden, Ph.D.**, who has been leading the development of this new CATOS project — for Champlain Acoustic Telemetry Observation System. "But with fish, it's incredibly difficult to know where they are and where they are going. What happens under the surface has largely been a mystery. But now we can 'see' them."

And that helps the scientists ask fundamental questions about fish behavior and health. Like: what happened to the lake trout? By 1900, native lake trout had disappeared from Lake Champlain, perhaps due to land use change. "We don't know why," Marsden says. Since 1972, the state of Vermont has been stocking the lake with hatchery-raised trout. These fish find mates, lay eggs, produce fry, and the fry swim off to deep water. But then these young fish are never seen again. "All the trout in the lake are hatchery fish," Marsden says. At least that's what the story was until last year. Then, in 2015, Marsden and others began to find wild trout in their net surveys.

To better understand the mysterious absence of wild lake trout — and the equally mysterious return of some of them — Marsden and her students have been using the CATOS network to see what the trout do on their spawning grounds and elsewhere.

At left, top: Professor Ellen Marsden, Ph.D., leads a study aboard the UVM research vessel *Melosira*. Left, bottom: Peter Isles, Ph.D. holds a handfuls of algae whose proliferation chokes many sections of Lake Champlain in summer. Above: A student in UVM's Rubenstein Ecosystem Science Lab.




With receivers strategically positioned along the whole 125-mile length of the Lake Champlain and at key causeway openings, “we can keep track of fish for years,” Marsden says. “Suddenly we have a new perspective on where fish are going” — females moving in and out of spawning reefs, a male suddenly shooting eight miles down the lake, another spending 25 days seemingly searching for an opening through the causeway at Malletts Bay.

“A lot of what we’re doing is filling in gaps in our knowledge about species that are experiencing difficulty,” says Tori Pinheiro, who completed her master’s degree studying with Ellen Marsden. “In lake trout, CATOS is helping us understand basic questions about their behavior. We can’t solve any of these problems, or create restoration plans, without a better view of the whole story.”

It’s a blue-sky, scorching hot day in July at Burlington’s North Beach. Just the kind of day to go swimming — except nobody is in the water. The lake is deadly quiet. Near the boardwalk, signs warn people to stay away because of blue-green algae blooms. These toxic cyanobacteria foul beaches in Lake Champlain some summers, and they’re becoming more frequent in parts of this lake and other lakes around the world. But, though algae end up on beaches, the root of the problem is not there. To find the sources of the problem — and there are many — a large team of Vermont scientists is following the water from beachside to lake bottom, out to inflowing brooks and rivers, and upstream to the parking lots, farm fields, forests, roads, towns, and mountains that drain the 8,234 square mile Lake Champlain Basin.

The team — within the Vermont EPSCoR program, a National Science Foundation-funded effort to support research across the state — is looking at the lake, its source rivers, and its surrounding human communities, “as a whole and complex system,” says UVM hydrologist **Arne Bomblies, Ph.D.,** an assistant professor of civil and environmental engineering and the associate director of EPSCoR.

In April of 2016, the work of EPSCoR was dramatically enhanced with a $20 million grant from the NSF, supported by U.S. Senator Patrick Leahy. The new five-year project, called BREE, for Basin Resilience to Extreme Events, is looking at how and why some parts of the lake are resilient to extreme weather events, while others face dramatic flood damage, runaway nutrient pollution, and ecological problems — like unwanted algae.

“We’ll essentially be giving managers a tool that will help them build resiliency in areas that have been vulnerable in the past,” says **Judith Van Houten, Ph.D.,** the state director of EPSCoR and University Distinguished Professor at UVM, who is directing the research effort.

“With climate change, we’re seeing increasing extreme weather events, longer rain storms, greater precipitation amounts,” Bomblies says. “Understanding the changing nature of flood risk is a big outcome of this project,” he says. And flood risk is not just about washed away bridges and lost crops. It’s also about lake water quality — larger and more frequent floods carry and circulate larger amounts of sediment and pollution in the lake — including unwanted phosphorus, one of the key drivers of algae blooms.

In order for the team to better see the Lake Champlain Basin as a whole system, the scientists have deployed a network of advanced optical sensors in streams, soils, and on buoys in the lake itself. These sensors gather a wide range of information about water conditions like turbidity, pH, dissolved oxygen and chlorophyll “which is a tracer for total phytoplankton populations” says UVM’s **Peter Isles, Ph.D.,** a lake scientist who recently completed his doctoral degree within EPSCoR, “as well as specific variables which help us trace cyanobacteria populations.”

The power of these sensors is not only the range of information that they gather, giving a rich portrait of changing water conditions, but also the high frequency with which they gather it. Some collect information every fifteen minutes, others every hour. Though climate change is a slow-moving master, storms and key changes to ecosystems can arrive rapidly. In 2012, the summer was very hot and dry, resulting in the strongest algae blooms Lake Champlain had seen in decades. Then September brought a huge storm, with more than four inches of rain, and, hour-by-hour, it “totally changed the composition of the phytoplankton and the concentration of nutrients in the lake and really shut down the bloom that year,” said Isles. “We would’ve never seen the effects of that storm event if we didn’t have high-frequency data because it comes through in a day or two.”

At the heart of the BREE project is the development of a powerful computer simulation — called an integrated assessment model — that will test policy scenarios and help identify strategies for protecting the health of the lake, infrastructure in the surrounding watershed, and water quality during and following extreme weather events. This new assessment model will draw together three other EPSCoR modeling efforts: one that explores human dynamics — such as plausible decision-making of farmers and other landowners in the Missisquoi River watershed in light of existing economic and land-use realities; another that has been building detailed physical models of watershed dynamics in a changing climate, including one that has been completed for Vermont’s Mad River Valley; and a third that is modeling the hydrology of the lake itself.

At UVM’s Rubenstein Ecosystem Science Laboratory on Burlington’s waterfront, Jessica Griffin, a senior from the University of Connecticut, carefully opens a small jar of *Mysis* shrimp collected from the bottom of Lake Champlain and places one under a powerful dissecting microscope. On a nearby monitor, the fingernail-clipping-sized shrimp appears like a giant squid. “Dissecting the stomach of these guys take some real doing and skill,” she says with matter-of-fact pride.

Griffin has come north to Vermont with nine other students from colleges across the country for a ten-week summer REU — an intensive research experience for undergraduates — supported by the National Science Foundation. “We see the lake and our facilities here at UVM as an outstanding place to cultivate and train the next generation of scientists,” says professor **Jason Stockwell, Ph.D.** He’s the director of the Rubenstein Lab and leads this summer program.

Under Stockwell’s guidance, and with help from his graduate student, Brian O’Malley, Griffin is undertaking an independent research project sampling detritus from the bottom of Lake Champlain. She aims to understand better the eating patterns of *Mysis* shrimp — and she’s learning techniques for examining their stomach contents along the way. “The conventional thought indicates that the *Mysis* rise to the top waters of the lake at night in order to take advantage of better food sources, but studies recently have found that some of these organisms never leave the bottom,” Griffin says, pointing at a large stack of scientific papers she has been reading. “They must be taking advantage of some kind of food source down there.” She’s working to find out what it is.

“If we care about sport fisheries or commercial fishing, if we don’t want algal blooms, if we want to manage invasive species — we have to understand food webs,” Griffin says. The theme of this UVM summer program is to train students in interdisciplinary research on ecological and socioeconomic interactions in the Lake Champlain ecosystem. Or, as Griffin says: “We need to know who is eating what.”

The next afternoon, Stockwell is leading Griffin and her fellow REU’s in an exercise — creating a lake. Well, not exactly, but the professor is having each student go to the whiteboard and add elements of an abstracted version of Lake Champlain. From their past courses and summer studies, the students make drawings of diatoms and cycling nitrogen, plants and clams and the sun, then sediment and copepods and an eel. A swimmer and a sailboat appear, then sewage and a “next generation” pollutant: pharmaceutical waste. The whiteboard fills with arrows and loops and labels like “thermocline” and “hypolimnetic.” “What key chemistry is not up there yet? “Stockwell asks. “Oh, dissolved oxygen,” one of the students says. “Yes, there you go,” says Stockwell. He keeps pushing them to think about the many elements that make a lake. “How about bacteria? They’re a huge driver in lake systems,” Stockwell says. “There’s a whole microbial food chain that is often overlooked.”

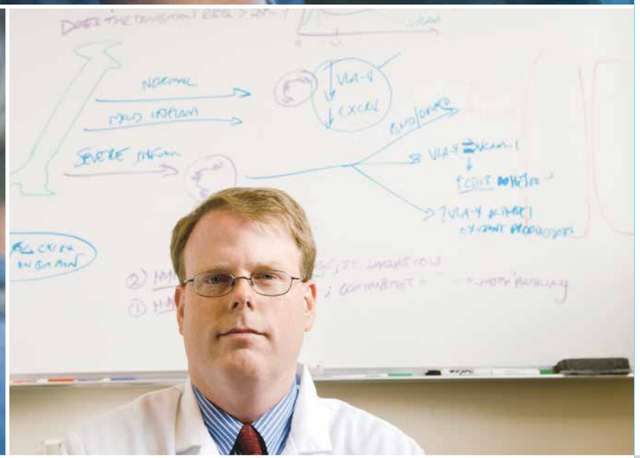
A student adds some of that element to the whiteboard and, just like that, their picture of the lake grows yet more complex.


At left: University Distinguished Professor Judith Van Houten, Ph.D., leads a new five-year lake study project. At right, top: Director of the Rubenstein Lab Jason Stockwell, Ph.D. At right: a student holds a fish-tracking device.

# BIG DATA AND BEYOND

For **PETER DODDS, PH.D.,** and **CHRISTOPHER DANFORTH, PH.D.,** "big data" — the use of extremely large and complex data sets — is a highly effective tool for gauging the likes, dislikes, and general interests of society. Their examinations of the tenor of societal happiness as felt through Twitter has drawn worldwide interest. Their November 2015 publication in *PLOS One* examined the reliability of another massive repository, Google Books, and argued that social scientists should be cautious when using data from this source to measure collective interests.

To learn more about Dodds and Danforth's research, go to **UVM.EDU/INQUIRY**

# Breathing Easier

## LUNG RESEARCHERS AT UVM CONNECT LEADING EDGE SCIENCE WITH TODAY’S CLINICAL NEEDS.

BY SARAH ZOBEL

### TAKE A DEEP BREATH.

With luck, that felt good, maybe even a little relaxing. But if you're one of the 25 million Americans living with asthma, or are among the more than 15 million who have chronic obstructive pulmonary disease (COPD), or the 221,000 who will be diagnosed with lung cancer this year alone, perhaps it didn't.

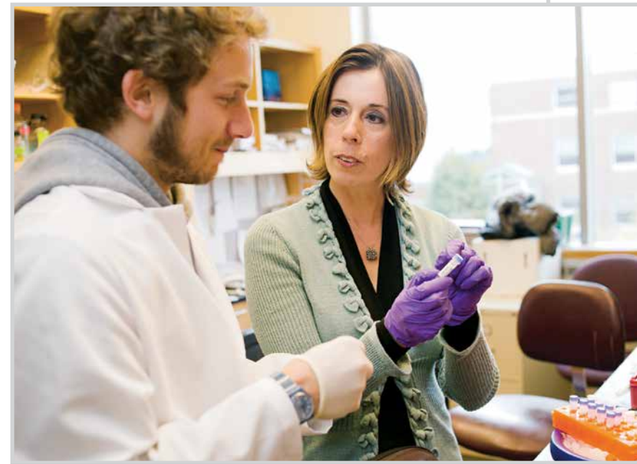
You could even suffer from airway disease but not yet know it. Twenty percent of the so-called “silent zone” of lung function can disappear before it becomes palpable. Researchers at the University have been tracing those airways to their very ends — and beyond — and in so doing, have raised UVM to a level of national and, indeed, global distinction in lung research.

Much of the reason for that prominence is due to the Vermont Lung Center, led by Professor of Medicine **Charles Irvin, Ph.D.** Irvin came to Vermont in 1998 from the National Jewish Hospital in Denver, the leading respiratory hospital in the United States, where he was the medical director of the largest lung-function lab in the country, and a professor at the University of Colorado Medical Center. But with his work divided equally between animal models and understanding basic mechanisms, he yearned to get involved in clinical research, which was not possible in Denver. Former Denver colleagues who’d moved on to UVM helped draw Irvin to Burlington, where his charge was to set up an asthma center in the Department of Medicine.

“There was a history of excellence here, and an association with the medical school and the University,” says Irvin. “And that was basis enough to establish the Center.” Soon after he arrived, a new grant was announced: the American Lung Association-Asthma Clinical Research Center program. The following year, after being awarded a Centers of Biomedical Research Excellence (COBRE) grant from the National Institutes of Health, the Vermont Lung Center fully came to life.

The first-cycle COBRE brought “serious money” — some $40 million over a total of 15 years, with successful renewals at five-year intervals, with the VLC often earning the best score in the competition. The funding cycle was successfully completed in July of 2015. Irvin takes pride in the fact that the VLC was among the small number of COBRE grantees that qualified for all 15 years of funding. Faculty members continue to receive grants from a variety of sources, and he points to those as confirmation of the VLC’s success. “There’s a track record of outstanding excellence based on peer review,” he says, “so when I say we have a terrific center, I base it on this consistent high level of peer review.”

Those grants fund continually innovative research by an interdisciplinary faculty whose members collaborate across the departments of medicine, microbiology and molecular genetics, physiology, and pathology, and the College of Engineering



At left, clockwise from top: Vermont Lung Center director Charles Irvin, Ph.D.; Professor of Medicine Ben Surratt, M.D.; Professor of Medicine Anne Dixon. Above: Professor of Pathology Yvonne Janssen-Heininger, Ph.D., works with a graduate student in her lab.

and Mathematical Sciences. Their collective basic science, translational, and clinical research focuses on a range of lung-related issues including bacterial genetics and metabolism, cell therapy, cystic fibrosis, pulmonary fibrosis, critical care, obesity, and asthma.

"That was a game-changer — when Charlie came on board and recruited all these fantastic people," says Professor of Pathology **Yvonne Janssen-Heininger, Ph.D.,** whose primary research interest is the biochemical processes underlying the chronic remodeling of airways in lung tissue. She is also behind an active research partnership between UVM and the Maastricht University Medical Center in the Netherlands, where she earned her Ph.D.

Asthma and obesity receive significant attention from UVM lung researchers — in fact, says **Benjamin Suratt, M.D.,** obese asthma is becoming its own category of asthma. He and several colleagues have conducted several clinical trials and ancillary studies to comprehend the mechanics behind it, exploring the possibility that it is an inflammatory response, and what the best treatment might be. Suratt, professor of medicine and vice chair of medicine for academic affairs, has also looked at the effects of obesity on Acute Respiratory Distress Syndrome (ARDS), which is common to hospital intensive care units and kills roughly 30 percent of patients who have it.

"Most of the work that's been done over the last 30 years has looked at cardiovascular and endocrine disease in obesity, so there's very little that's known about what obesity does to the lung, and how it modifies both the incidence of a disease like asthma, but also how it modifies the actual manifestation of the disease," says Suratt.

Together with Professor of Medicine **Anne Dixon, M.D.,** Suratt coordinates a biannual conference on these issues; "Obesity and Metabolism: An Emerging Frontier in Lung Health and Disease" which was hosted at UVM's Davis Center this past October. He also frequently collaborates with Associate Professor of Medicine **Renee Stapleton, M.D., Ph.D.,** whose own research is largely clinically based and focuses on nutrient and other supportive care interventions in the ICU, as well as communication around treatment preferences in palliative care.

"The great thing about the VLC for investigators is that it really brings together a diverse and multidisciplinary group of scientists that come from all areas of pulmonary investigation. It's a wonderful coalescence of clinical research and basic science and physiology that I think is very difficult to find at other institutions," says Stapleton. "Another thing VLC does incredibly well is manage both a very active, productive, successful basic science side as well as a very similarly active and productive clinical research side, two totally different skill sets."

"We're interested in projects that are going to have high impact, and high impact means affecting patient care," Irvin says of the group's broad research targets.

Those also include work by **Matthew Wargo, Ph.D.,** assistant professor of microbiology and molecular genetics,

Above, top: Professor of Medicine Jason Bates, Ph.D., invented a lung function measurement device called flexiVent. Above: Professor of Medicine Daniel Weiss, M.D., Ph.D., leads work on the fostering of new lung tissue growth.

> "I THINK WE HAVE A LOT TO BE PROUD OF, AND WE'VE GOT A VERY BRIGHT FUTURE, BECAUSE WE'VE GOT THE ONE THING THAT MATTERS, AND THAT IS FANTASTIC PEOPLE WHO GET ALONG AND COLLABORATE WITH EACH OTHER."
>
> — DANIEL WEISS, M.D., PH.D.

on bacterial lung infections and how various gram-negative opportunistic pathogens respond to surfactant when they get to the lung, as well as how they respond to damage to the host lung surfactant and cells and tissues and cause diseases including cystic fibrosis. Together with Suratt, Wargo is using a mouse model to determine changes in respiratory physiology during infections. The mouse model is a classic approach in studying the lung, and as at centers worldwide, they're using the flexiVent, a device that accurately measures lung function in small animals, which was created by the VLC's **Jason Bates, Ph.D.,** professor of medicine. Bates calls the flexiVent a "plug and play," but in fact it's now the industry-standard tool for measuring lung stiffness and airway resistance.

Bates, who has one foot in UVM's College of Engineering and Mathematical Sciences as well, serving as graduate coordinator for the new bioengineering Ph.D. program, wants to understand the physics of the lung: how big are the airways, how much pressure does it take to force the flow of air through, and how can the lungs be expanded? That applies to asthma, as well as to ARDS: "You have this delicate lung; how do you ventilate it in a way that minimizes the physical damage you do to it?" says Bates. He's also currently collaborating with **Matt Poynter, Ph.D.,** associate professor of medicine, to test hypotheses about allergic inflammation.

"My computational inclinations match up with his immunological knowledge, and we end up doing a lot of interesting work," says Bates. "It's always at the interface between different disciplines or different skill sets that the good stuff comes. The buzzword in research is *translational*, but here in the VLC it's a natural thing."

**Daniel Weiss, M.D., Ph.D.,** is leading work that focuses on the actual growing of lung tissue: Lung tissue bioengineering, which involves the use of a scaffold — or framework — of lungs from human cadavers to engineer new lungs for patients with end-stage disease. In end-stage lung disease, transplantation is sometimes the only viable therapeutic option, but organ availability is limited and rejection presents an additional challenge. The innovative research efforts of Weiss and his colleagues hold promise for this population, which includes an estimated 12.7 million people with chronic obstructive pulmonary disorder, the third leading cause of death in the U.S. In the last few years, Weiss's group has published a number of articles on the topic of stem cell-related lung regeneration, including several articles in *Biomaterials,* the leading bioengineering journal. And, Weiss himself has been the driving force behind the "Stem Cells, Cell Therapies, and Bioengineering in Lung Biology and Lung Diseases" conferences that have drawn hundreds of researchers from across the world to the UVM campus. The tenth anniversary conference was held at UVM's Davis Center in July 2015.

Irvin is justifiably proud of the way lung researchers at UVM work together. "The group is incredibly collaborative," he says. "We've achieved what we set out to do, and that was to develop a world-class center of lung biology and understand disease pathogenesis of the lung. I think we have a lot to be proud of, and we've got a very bright future, because we've got the one thing that matters, and that is fantastic people who get along and collaborate with each other."

# Healing with Seaweed

BY JOSHUA BROWN

**RACHAEL OLDINSKI, PH.D.,** would like to patch punctured lungs — with seaweed. One afternoon this spring, behind the doors of her lab in Votey Hall — the Engineered Biomaterials Research Laboratory — the professor points to three of her graduate students and four undergrads. "Everyone here works with alginate," she says, "which is purified seaweed."

Oldinski has a deadly serious set of goals. One is to do basic work on the mechanics and chemistry of a family of materials called hydrogels. "Can we create products that are smart — that are responsive to changing pH or temperature or biological conditions? Can we create products like skin, that stretch and reorganize themselves over and over without failing?" Oldinski asks. On the other side of the bench from her, doctoral student Spencer Fenn squirts a purple blob of alginate onto a glass slide and spins the slide inside a small centrifuge.

He then places the goo-covered slide inside a box filled with green LED lights. Because of complex manipulations he's done to the goo's chemistry, under the light the long strands of polymers within the liquid will link with other strands. After a few minutes, he takes out the slide. "See, it's become a hydrogel film. It's no longer a liquid; it's a solid."

Fenn has been spearheading a research effort to use alginate gels to create a kind of Band-Aid for the lung. Whether from a car crash or disease or battlefield injury, once a lung is punctured it is difficult to seal and heal, since it is constantly inflating and deflating. He and Oldinski and others in both UVM's College of Engineering and Mathematical Sciences and College of Medicine have developed a patch that looks promising for clinical use. Once it is freeze-dried, a surgeon will be able to cut a piece of the hydrogel, apply it to the wound and let it rehydrate from the body's own water. Then, using a scope with a green light, transform the goopy patch into an adhesive lung sealant. This innovation promises to be non-toxic and a recent study by the lab team shows that the patch can withstand lung-like pressures.

At its foundation, Oldinski's aim is to imitate nature "to replace nature," she says — but then to use the replacement materials to restore regular biological function.

# THE WORLD AS CLINIC AND CLASSROOM

From the time he was a four-year-old impoverished boy in Iran, Associate Professor of Medicine **MAJID SADIGH, M.D.,** (at right in photo) knew he wanted to become a physician, in order to help alleviate the pain and suffering he witnessed in the developing world. Now, as the director of the Global Health Program of UVM and its clinical affiliate, Western Connecticut Health Network, he has published widely on global health topics, and leads medical students, residents and physicians to resource-limited countries to be trained in understanding the complexities of healthcare delivery with the hope of reducing health inequity. One of the program's continuing relationships is with Uganda's Mulago Hospital, where this photo was taken.

# IMPACT & CONNECTIONS

## UVM & Burlington Join White House MetroLab Network

The University of Vermont and the city of Burlington have been selected by the White House to join MetroLab Network, a network of 35 city-university partnerships focused on bringing data, analytics and innovation to local government.

Members of the network research, develop, and deploy technologies and policy approaches to address challenges facing the nation's urban areas. MetroLab Network was launched by 21 founding city-university pairings in September 2015 at the White House as part of the Obama Administration's Smart Cities Initiative.

"When the city and the university collaborate effectively, the whole community benefits," said Mayor Weinberger. "I am excited about the potential of focusing the expertise and capacity of our university — and other academic institutions in the network — on some of our most complex municipal challenges. I appreciate UVM joining us in this effort and MetroLab for their confidence in the partnership."

"Over the years, UVM faculty have worked productively with the City of Burlington across a wide range of fronts," said Vice President for Research **Richard Galbraith, M.D., Ph.D.** "The MetroLab partnership will allow us to strengthen and grow these valuable interconnections. The partnership offers great benefit for our faculty; Burlington provides a diverse real world environment in which to test and strengthen their research ideas. Our hope and expectation is that Burlington will also benefit from the talent and expertise our faculty bring to the challenges facing the city."

MetroLab Network's city-university partnerships are relationships in which the university serves as a research and development arm, and the city serves as a test-bed for technologies and policies. Faculty members and students gain access to real-world laboratories to develop and test tools and programs that utilize information technology, data analytics, sensing, and more. Cities benefit from their technical expertise, leading to solutions that reduce the cost of infrastructure and services, make cities more sustainable and resilient, and improve citizens' quality of life. MetroLab Network members are working on more than 100 "research, development, and deployment" projects with broad impact on areas such as improving transportation and water systems, reducing the energy footprint in cities, advancing health and public safety goals and many more.

Burlington and UVM's first project will involve a partnership with UVM's Spatial Analysis Laboratory and multiple city departments to develop a city-wide strategy for the use of Geographic Information Systems (GIS) technology. Shared goals will be to develop a comprehensive plan to use GIS to improve operational processes and better inform decision-making within the city, as well as to expand sharing of information and thinking across city departments, the university and other partners across the region.

MetroLab Network is supported by a $1 million grant from the John D. and Catherine T. MacArthur Foundation as a research enterprise that uses data and information technologies to better understand how cities work and to improve the urban condition.

> "WHEN THE CITY AND THE UNIVERSITY COLLABORATE EFFECTIVELY, THE WHOLE COMMUNITY BENEFITS. I AM EXCITED ABOUT THE POTENTIAL OF FOCUSING THE EXPERTISE AND CAPACITY OF OUR UNIVERSITY ON SOME OF OUR MOST COMPLEX MUNICIPAL CHALLENGES."
>
> — MIRO WEINBERGER, MAYOR OF BURLINGTON, VT



## Honoring Campus Inventors

At this April's I2V Conference, the University honored faculty members and graduate students responsible for a total of nine patents. All the patents were awarded in the year since the last conference. The following patents were honored:

**A LOW-ENERGY PROCESS FOR MAKING "GREEN DIESEL" BIOFUEL**
**Alexander Wurthmann, Ph.D.,** senior lecturer of chemistry; **Bryan J. Holmes, Ph.D.,** graduate of UVM

**A MOLECULE THAT RESCUES DAMAGED BLOOD VESSELS YET PRESERVES HEALTHY ONES**
**Wolfgang Dostmann, Ph.D.,** professor of pharmacology; **Joseph Brayden, Ph.D.,** professor of pharmacology; **Nathan Tykocki, Ph.D.,** assistant professor of pharmacology; **Thomas Moon, Ph.D.,** former UVM postdoctoral fellow; **Jessica Sheehe,** Cellular, Molecular and Biomedical Sciences graduate student

**A NEW SYSTEM FOR MAPPING THE IRREGULAR ELECTRICAL ACTIVITY IN THE HEARTS OF PATIENTS WITH ATRIAL FIBRILLATION (AF) – THE MOST COMMON HEART RHYTHM DISORDER**
**Peter Spector, M.D.,** professor of medicine

**A NEW APPROACH TO PATIENT-SPECIFIC IDENTIFICATION OF THE MAGNITUDE AND DISTRIBUTION OF ELECTRICAL ABNORMALITIES DRIVING ATRIAL FIBRILLATION AND A STRATEGY FOR OPTIMIZING INTERVENTIONAL TREATMENT BASED UPON THESE MAPS**
**Peter Spector, M.D.,** professor of medicine

**A CELLULAR COMPOSITION OF HUMAN EPICARDIAL PROGENITOR CELLS ISOLATED FROM THE COVER OF THE HEART THAT CAN HELP IMPROVE CARDIAC REPAIR AND FUNCTION FOLLOWING HEART ATTACK**
**Jeffrey Spees, Ph.D.,** associate professor of medicine*

**A METHOD THAT ENABLES RESEARCH PARTICIPANTS TO HEAR AUDIO STIMULI WHILE IN A NOISY FMRI MACHINE**
**John Mantegna, M.M.,** lecturer in music

**A ZERO-POWER SENSING TECHNOLOGY THAT COULD REPLACE WIRELESS SENSORS THAT RELY ON BATTERIES, ENABLING LONG-TERM MONITORING**
**Jeff Frolik, Ph.D.,** associate professor of electrical engineering

**A METHOD FOR USING ULTRASOUND TO KILL INVASIVE SPECIES CARRIED IN THE BALLAST WATER OF COMMERCIAL SHIPS, THE PRIMARY WAY INVASIVES ARE INTRODUCED**
**Junru Wu, Ph.D.,** professor of physics

**A METHOD FOR REPAIRING INTERVERTEBRAL DISCS**
**James Iatridis, Ph.D.,** mechanical engineering**

* See story on page 22 for more about this invention.
** Dr. Iatrides did this work while at UVM, and shares the intellectual property with the university. He is now at Icahn School of Medicine at Mount Sinai in New York.

## 2016 UVM PATENT RECORD

**55** INVENTION DISCLOSURES RECEIVED
**37** from COM (**64** inventors)
**10** from CEMS (**21** inventors)
**1** from CAS (**1** inventor)
**5** from CALS (**3** inventors)
**2** Students (**5** inventors)

**12** NEW PATENT FILINGS
**11** From COM (**20** inventors)
**1** From CEMS (**2** inventors)

**8** U.S PATENTS ISSUED IN FY16
**5** from COM (**4** inventors)
**2** from CEMS (**2** inventors)
**1** from CALS (**2** inventors)

**6** OPTIONS AND LICENSES
**4** from COM (**10** inventors)
**2** from CEMS (**4** inventors)

**45** LICENSES IN FORCE

**24** COMPANIES STARTED SINCE 2000
**2** in FY16

## Entrepreneurially Minded Flock to 2016 Invention 2 Venture Conference at UVM

The 2016 edition of Invention 2 Venture, held in April, was a rousing success, with diverse mix of hundreds attending the much-anticipated event. The conference provided an engaging setting where industry leaders could share — with entrepreneurs, would-be entrepreneurs, potential investors, the private sector, researchers, government officials, and students, information and resources — the ideas that made them successful.

The sharing took place via 12 roundtables, each headed by an expert, with topics ranging from "Finding the Money and How to Speak Science to Business" to "Building Your Company in Vermont and SBIR/STTR Funding." Participants selected three topics of interest and rotated through the sessions.

The event's keynote speaker was UVM alumnus **Robert Andosca, Ph.D.,** president, CEO and co-founder of Microgen Systems Inc., the global leader in designing and manufacturing micro-power and micro-sensor products for wireless sensor and mobile electronics applications. Andosca's keynote topic was "Power to the Internet of Things." He also led a roundtable discussion on "Managing Fear."

The university also honored faculty members and graduate students responsible for nine patents. All the patents were awarded in the year since the last I2V conference was held in April 2015.


Robert Andosca, Ph.D.

# Study Shows Importance of Universities in Producing New Businesses

The number of college graduates willing to start new businesses could depend heavily on the entrepreneurial focus and structure of the universities from which they graduate, according to a study in the *Journal of Small Business Management*. The study by Steven Grossman Endowed Chair in Entrepreneurship **Erik Monsen, Ph.D.,** and Philipp Sieger from the Center for Family Business at the University of St. Gallen in Switzerland suggests that experiential entrepreneurship education that guides students through the process of starting their own firm, as opposed to more theory-based curriculum, increases confidence and the likelihood they will become entrepreneurs.

While previous studies have focused exclusively on the attributes of entrepreneurs and the reasons they start businesses, "Founder, Academic, or Employee? A Nuanced Study of Career Choice Intentions" compares the entrepreneurial intentions of students planning to become founders with those of students planning to work as an employee at an existing firm, and with those desiring to enter academia and become professors at colleges and universities.

"People become entrepreneurs because they think they are good at it and are going to be successful, but students don't always feel that way when they graduate," says Monsen. "Our findings show the need for more goal-specific programs that give students the confidence that founding one's own firm can be a controllable and potentially successful career. Founding or working in start-ups is one possible solution to keeping our best and brightest here in Vermont. Colleges and universities can play an important role in convincing students that the non-corporate path is a viable option."

Associate Professor Erik Monsen, Ph.D., speaks with UVM's Entrepreneurship Club about Sap Maple Water, a new maple-based soda and seltzer developed and sold by recent SEMBA alumni Chas Smith and Ben Tacka.

# "Base of Pyramid" Leaders Talk Business in the Developing World at UVM

In the quest to address global poverty and inequality, the scale of the problem is not lost on Anil Gupta, Ph.D., professor at the Indian Institute of Management, founder of the Honey Bee Network and guest speaker at the 2nd Base of the Pyramid (BoP) Global Network Summit that was held over two days in July 2015 at UVM.

The BoP comprises the mass of humanity, some 4 billion people, that exist on $8/day or less, and since founding the organization in 1988 Gupta has devoted his life to propelling the nameless, faceless innovators of India (and beyond) and bringing them into a network where they can thrive and prosper. "Poor people may be poor in material resources, they are not poor in knowledge, ethics and institutional networks," Anil said. "So that is why I often remind my friends that they are only at the bottom of the economic pyramid, but they are not at the base of the ethical or innovative, creative pyramids."

Anil founded the Honey Bee Network to support grassroots innovators after seeing how the rural poor of India were rich in knowledge and talent, developing numerous inventions out of necessity, but did not have the resources to convert these innovations into viable products, scale up and replicate their success across communities.

For the first time the summit, with the theme of "Sustainable Entrepreneurship from the Bottom Up," was co-hosted by the UVM School of Business Administration who partnered with Enterprise for a Sustainable World (ESW), and brought together almost 200 sustainable business experts, corporate innovators, entrepreneurs, NGO's and community leaders from more than 25 countries to learn about and discuss BoP initiatives across a broad spectrum of topics including food systems, water, energy, transportation, telecommunications, housing, health and education.

"Our summits are an important part of the BoP global network, it is the place where we bring together a community of people with the common mission of using the power of enterprise and entrepreneurship to solve social and environmental problems," said Professor **Stuart Hart, Ph.D.,** ESW founder and president. "The time is now to fully harness innovative technology with new business models and the summit explored strategies that will address growing global economic inequality and environmental degradation. I'm excited our summit accelerated that work to help build a more prosperous future for all."

Stuart Hart, Ph.D.



# Bringing 500 Trees to the City's Newest Park

The last day of classes at UVM brought more than 45 UVM student volunteers and crews from Burlington Parks, Recreation & Waterfront (BPRW) to improve the newly acquired 12-acre park space behind the former Burlington College property. This project is a partnership between the City of Burlington, BPRW and the University of Vermont's Rubenstein School of Environment and Natural Resources. Since February, **Dan Cahill,** the BPRW Land Steward and an alumnus of the school, has worked with Professor **Bill Keeton, Ph.D.** and his Ecological Restoration class on a student service-learning project at the former Burlington College site.

Students visited the park several times during the semester to collect data and make assessments. They also met with key stakeholders involved. Nine student teams designed restoration projects for the park and created adaptive management plans. After further review, Keeton pulled together the revised plans into one cohesive plan to implement on the May 4 Work Day.

"Working with the City Parks Department on a project so important to the community has been a great experience for the class," said Keeton, professor of forest ecology and chair of UVM's Forestry Program. "It helps them apply the science to the complexities of the real world. Plus, the students get their hands dirty planting trees and doing other restoration activities; which at the end of the day is a gratifying feeling for all of us, including the instructor."

Students in the Rubenstein School's Restoration Ecology class spent the last day of spring classes planting tree seedlings in partnership with Burlington Parks, Recreation & Waterfront. The work day was the culmination of a semester long project to restore a new Burlington city park.

The highlight of the day featured the planting of more than 500 native trees. Some of the trees, specifically the pitch pines, were donated by the Vermont Agency of Natural Resources and grown from locally collected seeds at a nursery operated by Green Mountain College. Additionally, two dozen disease resistant American chestnuts were supplied by The American Chestnut Foundation, providing an exciting opportunity to reintroduce this species into a site they may have occupied before blight decimated the tree species throughout its entire range in the eastern U.S. in the early 20th century.

"Being able to learn course material and then apply it to a real life situation, like the restoration plan, really increased my understanding of what restoring an ecosystem is and all the hard work it takes to bring an ecosystem back to a healthy condition," said UVM junior **Jordyn Geller.**

# Improving Care for Children in Vermont

As the proverb goes, "It takes a whole village to raise a child." Associate Professor of Pediatrics **Judith Shaw, Ed.D., M.P.H., R.N.,** has been working tirelessly for over 15 years to make sure Vermont — and the nation — has that village at the ready. On behalf of the National Improvement Partnership Network (NIPN), a multi-state coalition of child health care programs that she leads, Shaw accepted the 2015 Health Care Delivery Award from the American Pediatric Association.

Judith Shaw, Ed.D., M.P.H., R.N.

Housed at UVM, NIPN works to advance quality and transform healthcare for children and their families by establishing partnerships between public and private entities, focusing on issues like immunizations, obesity, asthma, and others. Since 1999, Shaw has also been executive director of the Vermont Child Health Improvement Program (VCHIP), an organization that recently garnered the Outstanding Collaboration Award from the KidSafe Collaborative of Chittenden County. The collaborative noted VCHIP's varied efforts, including initiatives to prevent suicide, lead poisoning, and abusive head trauma, and to promote safe sleep, gun safety and a protective environment.

VCHIP has become the "go-to" resource for any efforts to improve pediatric care in Vermont, says Shaw. She spends much of her time bringing together various entities invested in the well-being of Vermont's youth — state health officials, physicians, UVM researchers and faculty, Medicaid representatives and potential funding sources — and figuring out ways to enhance their care of children.

"Doctors don't get paid to stop and measure how they're doing and think about how to improve it," she explains. "What we do in VCHIP is help the physicians look at the systems' obstacles that stand in the way."

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**PRINTING:** Printed by Queen City Printers, Inc. Environmentally certified to the Forest Stewardship Council® Standards.

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