

# Complex Systems Modeling

FOR ENVIRONMENTAL PROBLEM SOLVING

## Vermont EPSCoR Hosts Two National Meetings

### NSF EPSCoR Water Workshop: Water Dynamics

**O**n November 9 – 12, 2008 Vermont EPSCoR hosted a national NSF Water Workshop in Burlington, Vermont. One hundred and forty-nine researchers, administrators, students, policy makers and business members came together to share their expertise and network together on the topic of water. Dr. Beverley Wemple, Geography Dept, University of Vermont, co-chaired the workshop. An organizing committee of 26 members comprised of 16 EPSCoR states and jurisdictions contributed to creating the agenda and securing speakers for the informative two and half day event. The goals of the workshop included “sharing of information, exploration of collaborations and learning about the opportunities for research on water through NSF” according to Judith Van Houten, Vermont State EPSCoR Director and co-chair of the workshop.

Drs. Henry Blount, Office Head, NSF EPSCoR and Denise Barnes, Program Officer NSF EPSCoR, also attended.

Pamela Stephens, Senior Associate for Science Coordination, NSF Directorate for GeoSciences, Todd Crowl, Program

Director, Ecosystem Science Cluster, Robert O'Connor, Program Director, Division of Social and Economic Sciences and Teofilo Jun Abrajano, Section Head, Earth Science, NSF Program Officer, Program on Environmental Sustainability provided presentations on funding opportunities and successful grant writing practices.

Thought provoking presentations were also provided by Keynote Speaker Richard Hooper, Executive Director, CUAHSI, and distinguished speakers, Konstantine Georgakakos, Director, Hydrologic Research Center, San Diego and David Maidment, Hussein M. Alharthy Centennial Chair in Civil Engineering and Director of the Center for Research in Water Resources at the University of Texas at Austin and Jill Karsten, NSF Directorate for Geosciences, Program Director for Education and Diversity.

The workshop centered on four major themes followed by moderated discussions of each: **Change Dynamics** led by Co-Chairs Jeffrey Gaffney (Arkansas) and Mary Watzin (Vermont); **Water Research Tools** led by Lilian Alessa (Alaska) and Donna Rizzo (Vermont); **Implications for Management**, led by Barbara

Kucera (Kentucky) and Charles Somerville (West Virginia) and **Water and Society** led by Teferi Tsegaye (Alabama) and Gail McClure (Arkansas).

A poster session featuring 60 research projects encompassing a wide range of water related topics from EPSCoR states and jurisdictions was also held. The abstract book is available on line at [http://www.uvm.edu/EPSCoR/Water\\_Conference/Abstract\\_Book.pdf](http://www.uvm.edu/EPSCoR/Water_Conference/Abstract_Book.pdf).

The workshop was filmed by Vermont Public Television and an episode of “Emerging Science” (a science television series funded by VT EPSCoR) will focus on the workshop and the topic of water. The television episode will air in late February 2009 and will be available online at [http://www.vpt.org/programs/emergingscience\\_episodes.html](http://www.vpt.org/programs/emergingscience_episodes.html).

A follow on workshop on Social-Ecological Systems is scheduled to be held on May 11-13, 2009 in Anchorage, Alaska hosted by Alaska EPSCoR. All presentations from the Water Dynamics Workshop may be found on the web at [http://www.uvm.edu/EPSCoR/Water\\_Conference/](http://www.uvm.edu/EPSCoR/Water_Conference/).

Attendees from the workshop will

*Continued on page 5*



Matt Luck (UVM) at the Water Conference.

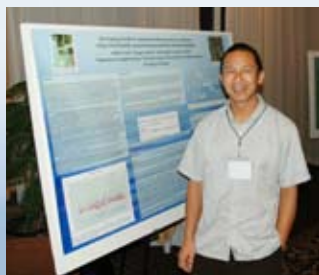
Jun Abrajano, Section Head, Earth Science, Program on Environmental Sustainability.



Discussion at the Water Conference Poster Session.



(L to R) Judith Van Houten, Beverley Wemple and Henry Blount.



Breakout Session with Pam Stephens, NSF.



Research Highlights presenters from EPSCoR states (L to R) Michelle Daley (NH), Ric Hauer (MT), Kyle Hoagland (NE), Tom Piechota (NV), Durga Poudel (LA).



It was a very busy and rewarding year for Vermont EPSCoR in 2008, and 2009 looks like it will be just as productive. We were hosts to two major events: **NSF Research Day** in June and a **NSF Water Workshop on Water Dynamics** in November. Both were very well attended by Vermont scientists, engineers, mathematicians, students and businesses as well as representatives from many other EPSCoR states, jurisdictions and leadership from various directorates at NSF. The NSF Research Day was held on the same weekend as the **VT EPSCoR Annual State Meeting and Grant Writing Workshop**. Staff from the NSF EPSCoR Office advised on the organization of the meeting and attended, including the Office Head, Dr. Henry Blount. Representatives from the NSF gave very informative presentations on the mission and initiatives of their directorates, offices and funding opportunities. Faculty and administrators from Maine and New Hampshire EPSCoR were also present as we continue to strengthen regional collaborations, not only by geographic location, but by thematic relevance. This was evidenced even more at the November Water Workshop where the thematic relevance of "water dynamics" brought together over one hundred and forty-nine attendees from across the country because of their mutual research interest in "water." Outcomes from these stimulating events include the potential for increased interdisciplinary collaborations across regions, sectors (business and academic) and departments.

VT EPSCoR has joined efforts with the New Hampshire, Maine, Rhode Island and Delaware NSF EPSCoR programs to form the **North East Cyberinfrastructure Consortium (NECC)**. Together, the NECC submitted a proposal to NSF in January 2009 for the Research Infrastructure Improvement (RII) – Track 2 program. The proposal aims "to develop resilient, high-band-width connectivity between research and academic institutions" among the partner states. If awarded, the grant will provide funding for fiber and cyber-enabled research. More on that as we learn about our funding status in the coming months.

Our faculty and staff continue to gain state and national recognition for their work. **James Iatridis**, associate professor in the School of Engineering in the College of Engineering and Mathematical Science (CEMS), and Associate Project Director of VT EPSCoR, was selected to receive the distinguished and highly competitive Presidential Early Career Award for Scientists and Engineers (PECASE). **Breck Bowden**, Patrick Professor, Water Resources, and a

science leader of the VT EPSCoR *Complex Systems Modeling for Environmental Problem Solving* group is leading 13 investigators from 10 universities to northern Alaska funded by a \$5.5M award from the NSF. **Rory Waterman**, assistant professor of chemistry, was awarded a \$623,000, five-year CAREER grant to help develop his research on phosphorous-containing molecules and just launched "Project SEED". A program of the American Chemical Society, "SEED works to encourage economically disadvantaged high school students to pursue chemistry by providing genuine summer research opportunities," said Waterman. He recently attended the NSF Workshop on Diversity hosted by West Virginia EPSCoR as a member of the VT EPSCoR delegation. **Arne Bomblied**, assistant professor in the School of Engineering in CEMS, recently joined UVM, provided with funding, in part, by VT EPSCoR. His research interests include hydrology and environmental drivers of disease transmission. **Christian Skalka**, associate professor in the Department of Computer Science (CEMS),

outreach coordinator for the VT EPSCoR program. These are just a few of the many accomplishments that have occurred over the last several months. Look for more updates on the web at [www.uvm.edu/EPSCoR](http://www.uvm.edu/EPSCoR).

Outreach and workforce development efforts through the **STREAMS** project continue to grow as we head into the second year the program. A new funding opportunity for undergraduate students to participate in summer research at the **El Verde Field Station** in Puerto Rico is underway. A new opportunity for **Vermont small businesses** to compete specifically for grants to foster research and development projects for the Streams project that use distributed remote-sensing and an integrated educational component has also been announced. We look forward to seeing the applications for these opportunities.

Three new people have joined the **Complex Systems Group (CSYS)** at UVM: **Matt Luck**, a Post Doctoral Candidate working with Josh Bongard and Maggie Eppstein; **Bree Mathon**, a graduate student working with George Pinder, Donna Rizzo, and Lori Stevens; and **Kristen Hallock** the CSYS Database specialist.

*Emerging Science*, a science television series produced in partnership with Vermont Public Television and VT EPSCoR has entered its second season showcasing the high level of research excellence in Vermont and its relevance on the regional and national level. If you wish to see any of the episodes, visit us on the web at <http://www.vpt.org/programs/emergingscience.html>.

There are now **four** funding opportunities for Vermont businesses to compete for: The **SBIR Phase (0)**, **Innovation Fund (IF)**, **Use of Facilities**, and the **new Streams Business Award**. Applications are due beginning in mid March through late April 2009. Check the web at [www.uvm.edu/EPSCoR](http://www.uvm.edu/EPSCoR) for more details. Return on investment multipliers can be large with these programs. MicroStrain, Inc., for example, has leveraged EPSCoR Phase (0)'s into significant Federal R&D: "8 Phase (0)'s amounting to about \$60K has resulted in 11 Phase I, 5 Phase II and 3 Phase III awards totaling about \$8.2M" (Steve Arms, President, MicroStrain, Inc.)

Please read more about these exciting advancements in this newsletter and on the web. We'll have a new look unveiled for our web site next month at [www.uvm.edu/EPSCoR](http://www.uvm.edu/EPSCoR).

In 2009 we look forward to crafting a proposal to NSF for the next phase of RII funding for VT EPSCoR. And a brief reminder that our Annual State Meeting and Grant Writing Workshop will be held on **June 2-3, 2009. Save the date!**

## From the Director

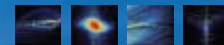


Judith Van Houten, Ph.D.

## 2008 Year in Review Looking Ahead

received a 2008 Air Force Young Investigator Research Program (YIP) Award. He was awarded a \$284,000 grant for his project entitled: "A Language-Based Approach to Wireless Sensor Network Security," from the U.S. Department of Defense (DoD) Air Force Office of Scientific Research's Young Investigator Program. **Mandar Dewoolkar**, **Nancy Hayden** and **Donna Rizzo**, professors of civil and environmental engineering (CEMS), were awarded a two-year \$525,000 grant from the U.S. Defense Threat Reduction Agency (DTRA) to study chemical and biological contaminant transport in building materials. Dr. Rizzo is also a member of the Complex Systems Modeling (CSYS) group. **Gayle Bress**, program coordinator for the Hughes Endeavor for Life Science Excellence (HELIX) project was presented with the Sister Elizabeth Candon Distinguished Service Award at the annual meeting of the Vermont Women in Higher Education for her commitment to the advancement of women and underrepresented minorities in sciences and higher education. Bress is also the high school





## Vermont EPSCoR Hosts Two National Meetings *Continued from page 1*



*Theme One on*



*Konstantine Georgakakos, Director, Hydrologic Research Center, San Diego.*



*Todd Crowl, Program Director, Ecosystem Science Cluster and fellow NSF Program Officers.*

be surveyed for the next two years help document outcomes like collaborations, implementation of programs that enhance diversity, implementation of programs that involve community based research and STEM workforce development, impacts on water policy. Outcomes will be posted on line.

### NSF Research Day, Annual State Meeting and Grant Writing Workshop June 6 & 7, 2008

VT EPSCoR hosted its first NSF Research Day in June 2008. The Research Day was combined with the Vermont EPSCoR Annual State Meeting and Grant Writing Workshop at the Davis Center on UVM campus in Burlington, Vermont.

NSF Research Day started off the two day event with the introduction of eleven distinguished representatives from various directorates at NSF who made invaluable presentations to faculty, administrators, business persons and students from Vermont, New Hampshire and Maine on the mission

and initiatives of their individual directorates, offices and funding opportunities available therein. Dr. Henry Blount, NSF EPSCoR Head of Office, and Simona Gilbert, Administrative Manager of the NSF EPSCoR Office, were instrumental in securing the wide range of program directors, deputy directors, deputy assistant directors and senior science advisors that traveled to Vermont for the event. Vermont Governor, James Douglas, welcomed the participants and guests to the morning session. Small breakout sessions for individual questions and networking followed the larger presentations.

The Vermont Annual State Meeting followed the NSF Research Day and began with a poster session with networking period for all funded personnel. Fifty research posters were on display. Dinner featured remarks by the Vermont Public Television Executive Producer, Joe Merone, of the new science television series, *Emerging Science*, as well as a viewing of one of the episodes – with out-takes!

The following day, the Annual Grant Writing Workshop was held with over 70 participants in attendance. Welcoming remarks by Drs. Henry Blount, Office Head NSF EPSCoR, and Judith Van Houten, State Director, VT EPSCoR, were followed by panel presentations on “Successful Grant Writing” techniques by Carol Van Hartesveldt, Program Director for the Integrative Graduate Education and

Research Traineeship (IGERT), and local faculty members Paul Bierman, UVM, who spoke about his successful CAREER award and Mark Lubkowitz, St. Michael's College, who spoke about his successful RUI proposal. Presentations continued after a question and answer period with Timothy Fossum, NSF/DHS Federal Cyber Service program officer, Thomas Allnutt, NSF SBIR and Steve Arms, President, MicroStrain, Inc. ■



*Governor Douglas provides opening remarks.*



*Poster session participants Will Hackett and Andrea Pearce (UVM).*



*Audience Members at the Grant Writing Workshop.*



*Dr. Henry Blount makes introductions.*



*Steve Arms, President MicroStrain Inc.*



*Thomas Allnutt, NSF SBIR and panelists at the Grant Writing Workshop.*



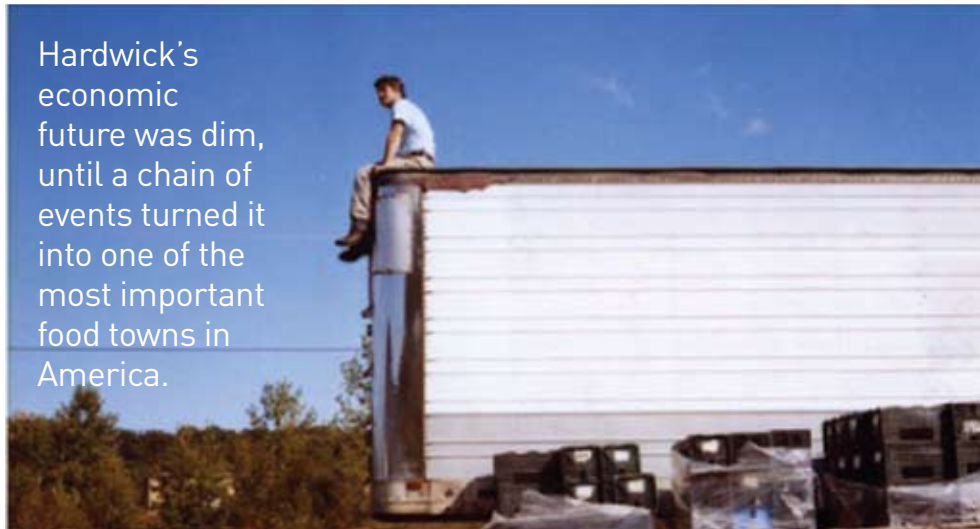
## Spotlight on SBIR Phase (0) Award Winners

# The Town That Food Saved

by Ben Hewitt

If you come into the town of Hardwick, Vermont, from the east, you'll come in on Route 15, weaving through a series of curves that begin as gentle sweeps and get progressively sharper. Route 15 becomes Main Street, and Main Street lasts for about a quarter mile before it hits the town's only traffic light, which consists of a single, flashing orb at the junctions of Routes 14 and 15. If you turn right, continuing on 15, you'll immediately pass the Amateur Boxing Club (it's for sale), a garage, a gun shop, a pizza place, and a lumberyard, in that order. A bit farther out, there's a bank and a tractor-repair business. A Ford dealership. A gas station. If you go straight through the light onto 14 South, you'll pass two auto-parts stores, a school, a cemetery, and a series of residences, many of which are in disrepair. In either direction, you'll be through Hardwick in

Hardwick's economic future was dim, until a chain of events turned it into one of the most important food towns in America.



Richard Fowler

two minutes or less, pushing on the accelerator as the speed limit rises again to 50 and the road unfurls across the lush Vermont countryside, helping you forget about the forgettable small town you just left behind. In this way, Hardwick is not unlike scores of other small, hard-bitten towns scattered throughout the American landscape, still clinging to the vapors of whatever industry brought the population together in the first place. In Hardwick, it was granite (Hardwick granite is built into the Pennsylvania State Capitol and Chicago's City Hall). But the granite industry

in Hardwick slowed decades ago, and the town of 3,000 languished. The village developed a reputation as little more than a gallery of rogues; the local drinking establishment, Benny's, was known throughout northeastern Vermont for its cheap beer and frequent skirmishes. The town earned the nickname "Little Chicago."

Hardwick softened over the years, as its affordable real estate and pastoral beauty (within town limits, there are 37 miles of paved road and 51 miles of dirt) lured a small clutch of white collar workers willing to brave the 30-

mile commute to the state capital of Montpelier. But the economy still suffered: In 2003, the per capita income was a mere \$14,287, twenty-five percent below the state average; and last year, Hardwick's unemployment rate was nearly 30 percent higher than the state average.

But something's happening in Hardwick, and it's happening because of food. It could have started with the Buffalo Mountain Food Co-op and Cafe, a small, earthy joint on Main Street that's been active since 1975. The co-op serves the multitudes of left-leaning back-to-the-landers scattered through the surrounding hills and provides a market—a modest market, but a market—for the local farmers eking out a living from the land. Or maybe it started before that, with Hardwick's topographical good fortune to be located in a region of ample, fertile farmland and a culture of working the soil. Perhaps it would have happened anyway, the only rational response to a global food system on the brink of crisis and a town desperately needing something on which to hang its future. While the beginning might be hard to identify, the present is not. That's because, during the past two years, Hardwick has developed a local food infrastructure that is unlike anything to be found in North America. It is at once an amalgamation of a stunning number of food-based businesses in the region (Vermont Soy, Jasper Hill Farm, Pete's Greens, Patchwork

Farm & Bakery, Apple Cheek Farm, Claire's Restaurant and Bar, and Bonnieview Farm to name only a few) and the keen business savvy of the (mostly) youthful entrepreneurs who spend their days tending livestock, fields of lettuce, and racks of cloth-bound Cheddar. In the evenings, they convene to quaff beers and brainstorm the next step forward for this little settlement, which just might become one of the most important food towns in the United States.

Tom Stearns has a carnival huckster's energy and a self-confidence that never seems to bleed into arrogance. He is of medium height, with wavy, dirty-blond hair and a long, angular face. He wears thin-rimmed glasses and has a habit of scrunching his nose, which flares his nostrils and makes him look momentarily unhinged. He laughs loudly and often. Thirteen years ago, when Stearns was 19, he started High Mowing Organic Seeds, an organic vegetable, flower, and herb seed company that's now located in Wolcott, one town west of Hardwick. Today, the business has 30 employees and does between \$1.5 and \$2 million in annual sales. Because of his energy, charm, and drive, Stearns has become the de facto mouthpiece for Hardwick's rapidly evolving food scene and the president of the recently formed, nonprofit Center for an Agricultural Based Economy, whose mission is to nurture and promote a sustainable local

agricultural economy. I first met with him at a potluck dinner party at Heartbeet Lifesharing, a residential community for special-needs adults, who participate in all aspects of farm operations on the sloping 150 acres of field and forest. There was drumming and a bonfire and small children running across the sunlit lawn clutching rabbits to their chests. A herd of cows grazed on a pasture below the house. Stearns's vision is to provide the world with a model food system that serves the local population while enriching its producers in ways that range from the cold, hard tangibility of cash to the less precise metrics of social improvement and regional pride. Stearns is not a dogmatic localvore; he believes it is economically and environmentally justifiable to ship products that are financially dense (a pound of liquid milk wholesales for about \$0.20; a pound of Jasper Hill's Bayley Hazen Blue cheese wholesales for \$9.75). He sees Hardwick as an antidote to a global food system that's teetering beneath the weight of energy prices and the capriciousness of nature. "Who's the biggest user of energy? Agriculture! Who's the biggest user of land? Agriculture! Who's the biggest user of water? Agriculture! Who's the biggest polluter? Agriculture!" He stabbed a finger in the air for emphasis. "All we have are models of broken plans to look at." He

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# QuantaLeap

A Burlington lab is building a state-of-the-art food pathogen detector.

by Suzanne Podbaizer

You're strolling through the supermarket produce department, cellphone in hand. Pausing at a display of greens, you use your phone to shine a tiny laser beam on a promising bag of verdant spinach. A moment later, a text message pops up on the cellphone, proclaiming the vegetable is clean. Reassured that it's free of both *Salmonella* and *E. coli*, you drop it in your cart and move on to the tomatoes.

Sound futuristic? It is. But Ken Puzey, owner of Burlington's **QuantaSpec, Inc.**, is determined to make it happen. Asked what his business does, he tries to put it simply: "QuantaSpec develops applications using infrared light to detect *bad things*. To elaborate: 'Bad things' means chemical agents, toxins, pathogenic organisms, explosives." He pauses for an instant. "Those are all bad things, right? Although explosives have their uses."

"Bad things" in food are making people nervous these days — a tomato scare dragged on for months this past summer and, in Vermont, more than a ton of *E. coli*-tainted local

ground beef was recalled just last week. Puzey rattles off the stats: "Food-borne pathogens caused an estimated 76 million illnesses, 325,000 hospitalizations and 5200 deaths this year. I'd be willing to bet that most Americans aren't cognizant of how big a problem this is." Puzey himself was once hospitalized for food poisoning, and "it wasn't pretty," he says.

With a \$93,000 grant from the FDA, Puzey has patents pending for infrared technology that can speedily detect the pathogens that cause food-borne illness. And so far, he claims, he's been able to do it with 100 percent accuracy.

In January, QuantaSpec will learn if it can expect a \$750,000 follow-up grant from the FDA, which would allow Puzey to create prototypes of his bad bacteria detectors. Meanwhile, QuantaSpec has other projects under way: Puzey recently received funding from the **Vermont Experimental Program to Stimulate Competitive Research (EPSCoR)** to investigate a new way to diagnose breast

cancer. The U.S. Army Medical Research Command is paying him to develop a method of identifying malarial infections in the field and determining which patients are suffering from drug-resistant strains.

But in essence, it all goes back to light. And bad things.



QuantaSpec, located in a one-room, ground-floor office on South Champlain Street, employs seven part-timers and two full-timers, including Puzey. Papers strewn around suggest a business in high-energy mode. High-tech gadgets are everywhere, including a special theft-proof box to hold the explosives — devising ways to detect them necessitates having some around — and a "very powerful" laser designed for the Air Force that Puzey isn't at liberty to talk about.

Tall and thin, with an easy smile and a tendency to lean in close as he eagerly explains complex concepts, Puzey holds Bachelor's and Master's degrees in electrical engineering

— from the University of Illinois at Urbana-Champaign and the University of Colorado at Boulder, respectively. He came to Vermont as an employee of IBM "on loan" to the Essex facility and moved here for good after finishing his degree in 1997. At the time, he owned a company he'd started in 1995 called TeraComm Research, but the business went bust when the fiber-optics market collapsed in 2002.

After working as a consultant for two years, Puzey started QuantaSpec. In 2006, seeking applications for infrared light — and looking for projects that might attract grant funding — he began delving into the world of food poisoning. He found a colleague in **Catherine Donnelly** of the University of Vermont's Department of Nutrition and Food Sciences. She "was mostly interested in food-borne microorganisms," he relates. Indeed, Donnelly, co-director of the **Vermont Institute for Artisan Cheese**, is recognized as an international expert on *Listeria monocytogenes*.

Today, tests for food-borne pathogens are conducted on samples that must be painstakingly prepared by technicians, who use chemicals to detect the presence of harmful microorganisms. The QuantaSpec research team began with a simple question, says Puzey:

"What's the current state of the art, and what are the problems with the current state of the art?"

In answering the second question, Puzey and company realized that time and money are two of the biggies. In addition to the hours spent prepping samples, the actual tests are "pretty slow," he says. "It takes 24 to 72 hours to get a test result."

Unfortunately, many foods at risk for contamination have short shelf lives — think ground beef or salad greens — which makes it impractical to put them to the test. The chemicals used, or "reagents," aren't cheap, either — about \$20 for each pathogen one seeks to detect, says Puzey. And "for each food, you probably want to test for multiple pathogens."

Using infrared light is more efficient and



Ken Puzey

Matthew Thoren

cheaper, shrinking the time it takes to get results from days to "less than a minute," Puzey boasts. Even better, he says, "We can test for all pathogens simultaneously, or at least all the pathogens that are in our library of things we know how to identify."

Several firms are competing to develop such technology, and Puzey isn't going to divulge his secrets. But he does explain the basics of how light detection works: "Microorganisms are just a cocktail of chemicals. Basically, you shine infrared light on the

sample, and different wavelengths of light are absorbed based on the chemistry of the sample," he says. "By looking at what wavelengths of light are absorbed or not absorbed, we get detailed information on the chemistry of what we're looking at."

*Continued on page 10*



# The Streams Project



KathiJo Jankowski  
Streams Coordinator

## Faculty Leaders

**Declan McCabe**  
St. Michael's College

**Sallie Sheldon**  
Middlebury College

**Charles Goodnight**  
UVM

**Mary Watzin**  
UVM

The VT EPSCoR Streams Project has had a great first year! The project officially began June 2-6, 2008 with a week of training for 25 undergraduate students from 6 colleges around Vermont, including the University of Vermont, St. Michael's College, Middlebury College, Johnson State College, Sterling College, Green Mountain College, and Norwich

University. These students undertook their own research projects during the summer and fall as well as helped with training the 14 high school teams that participated this year. Research projects ranged from investigating the relationship of land use with communities of macroinvertebrates in streams to identifying sources of *E.coli* found in the Lamoille River watershed to

modeling the phosphorus loading from a small South Burlington stream into Lake Champlain. Several of these students have or will present their findings at local and national conferences, which include the SACNAS national conference, the Annual Benthic Ecology Meeting, the Lake Champlain Research Consortium Student Symposium and the NSF EPSCoR

National Water Dynamics Conference.

Our high school program has also gotten off to an exciting start. At the end of June 2008, 14 high school teams came to UVM to participate in a week-long training event where they learned the basics of stream ecology, Lake Champlain watershed biology and water quality monitoring techniques. Faculty and undergraduates from various Vermont colleges participated in training these students. Since July, these teams have been collecting data on streams near their high schools every 2 weeks and will present their findings at the 1st Annual Streams Project Symposium April 27 at the Sheraton Hotel in Burlington. Several teams have also expanded their projects by including additional students from their high schools, monitoring other parameters or other sites or by applying for grants to integrate the project into their at their schools. Several of our students were featured in a video created by Vermont Public Television, footage from which will

be included in their new series "Emerging Science".

We have worked closely with several partners to share data and expertise. We were able to work with the Lamoille River watershed coordinator, Jim Ryan, and the Lamoille County Natural Resources Conservation District to collect phosphorus and *E. coli* data on tributaries of the Lamoille River that are of interest to the local community. In addition, we collaborated closely with the LaPlatte River Watershed Partnership to collect data on Munroe Brook throughout the summer and fall. Three high schools, Champlain Valley Union High School, Vermont Commons School and Rice Memorial High School, collected samples once a month that were sent to the state lab for analysis and will be included in the Partnership's annual report.

We are in the process of getting all of our first year's data online. The first half of this year's data set and the macroinvertebrate

data for nearly all of the sites can be viewed and downloaded at: <http://www.uvm.edu/~streams/?Content=DatabaseAndResults>. More data is continually being added and updated!

We have lots of plans in the works for the Spring and Summer, including plans to include more high schools from around the New England area, including Maine, Rhode Island and the Bronx, NY. We have also launched a new funding opportunity this year for the Private Sector to participate in the project by providing technical assistance or innovation to aid the project's goals. We will be continuing and expanding our partnership with 2 universities in Puerto Rico to provide research experiences for our students at the El Verde Research Station as part of the Luquillo Forest LTER in Puerto Rico and for their students as part of the Streams Project in Vermont. Please view the website and check out all the different ways to Get Involved in the Streams Project!



Jackie Cote assists an MHS student to ID macros in December 2008.



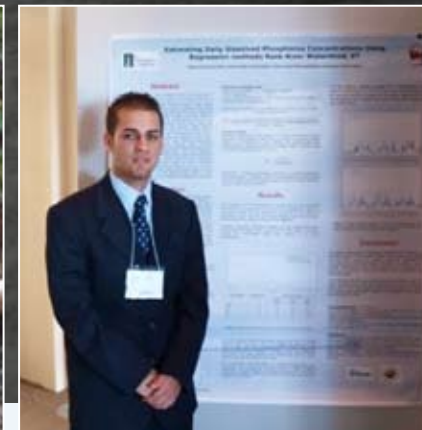
Liam Connors, Leslie Appleget and Will Warren and Will's daughter.



K. Rios Rodriguez at the UMet Symposium.



Ian Myers and Alex Canepa clean insects out of a net.



E. Garcia Rios displays his poster at the UMet Symposium.



High school students training.

## APPLICATION DEADLINES

UVM Undergraduate Award  
**March 4th**

Baccalaureate College Undergraduate Award  
**March 4th**

Puerto Rico Stream Ecology Research Award  
**March 4th**

High School Program  
**March 13th**

Streams Private Sector Funding  
**March 18th**

Summer of Science (for high school teachers)  
**April 21st**

## The Streams Project in the News:

Sterling College News:

<http://sterlingcollege.edu/email/08augsept/08augsept-page2.html>

Lamoille County Natural Resources Conservation District:

<http://www.lcnrcd.com/Newsletters/2008winternewsletter.pdf>

SMC News:

[http://www.smcvt.edu/admission/news/news\\_story.asp?iNewsID=1187&strBack=%2Fnews%2FDefault.asp](http://www.smcvt.edu/admission/news/news_story.asp?iNewsID=1187&strBack=%2Fnews%2FDefault.asp)

Feature story on SMC student:

[http://www2.smcvt.edu/marcom/MAJORS/biology/fall08/articles/StudentSpotlight\\_ErinDoyle.htm](http://www2.smcvt.edu/marcom/MAJORS/biology/fall08/articles/StudentSpotlight_ErinDoyle.htm)

## IMPORTANT DATES

Streams Symposium  
Sheraton Hotel & Conference Center  
**April 27, 2009**

Undergraduate Training Week  
St. Michael's College  
**June 1 - 5, 2009**

High School Training Week  
St. Michael's College  
**June 28 - July 2, 2009**





# 2008 Award Results

## Graduate Research Assistantship Awards (UVM)

### Andrea Pearce

Lori Stevens (BIO), Donna Rizzo (CEE)  
ANNs to investigate problems with interrelated components that interact in a non-linear and dynamic manner: Model developed with data from the Schuyler Falls landfill plume within the Lake Champlain watershed

### Karim Chilaksy

Maggie Eppstein (CS)  
Robert Costanza (RSENR)  
Breck Bowden (RSENR)  
Watershed Modeling Project

### Zhenyu Lu

Josh Bongard (CS)  
Automated Topological Modeling of Spatially rich, temporally poor Datasets

### Joshua Payne

Maggie Eppstein (CS)  
Evolutionary Dynamics on Complex Network Topologies

### Biyou Liang

Jeff Frolik (EE, CE)  
X. Sean Wang (CS)  
Building dynamic, complex and resilient sensor networks with simple autonomous agents

### Daniel L Erickson

Sarah Taylor-Lovell (PSS)  
Food System Driven Alternative Landscape Futures - Development of a Spatially Explicit, Complex Adaptive, Agent Based, Landscape Change Modeling System

## Pilot Awards for UVM Faculty

### Jeff Marshall (CEMS)

Role of Parametric Contractions on Particle Clustering, Aggregation and Mixing in the Human Colon

### Brian Beckage (Plant BIO)

Investigating the dynamics of savanna communities through computer simulation

### Maggie Eppstein (CS)

Dynamics on Complex Networks

### Paul Hines (EE)

Complex system modeling to estimate the benefits, costs and risks of large-scale wind energy systems

### Josh Bongard (CS)

de novo complex systems modeling from spatially rich datasets

### Donna Rizzo (CEE)

Development of a Complex Systems Modeling Tool Applied to Two Lake Champlain Watershed Systems

### Lori Stevens (BIO)

Complex Systems Modeling Using Artificial Neural Networks

### Nick Gotelli (BIO)

Climate change and community structure: Integrating ecological experiments with predictive agent based models.

## SBIR Phase (0)

### Jacob Glaser

Microbrightfield, Inc.  
User-Independent Identification of Cytoarchitectonic Boundaries for Cortical Mapping

### Matthew Gombrich

Viridis Diagnostics  
Assessment of Antibody Reagents for Rapid MRSA Diagnostic Tests

### Ted A. James

Apollo SRI, LLC  
Delivery of chemotherapeutic agents Interferon alpha and Temozolomide to human malignant melanoma cells using nanoporous silica particles

### Sergey Krivov

General System Research, LLC  
Bayesian Networks Infrastructure for Geospatial Decision Support under Uncertainty

### Benjamin Littenberg

Vermont Clinical Decision Support  
Integrating pharmaceutical and laboratory data to improve decision support in diabetes

### Daniel Pascual

Creative MicroSystems  
Microfabricated Piezoelectric Immunosensor Array for Microfluidic Application

### George Powch – SBIR NASA Awardee

Versatilis, LLC  
High Efficiency, Lightweight Thin Film Solar Cells

### Ken Puzey

QuantaSpec, Inc  
Evaluation of FTIR Spectroscopy for Breast Cancer Diagnosis and Molecular Characterization

### Frederick Raab

Green Mountain Radio Research Company  
High-efficiency power amplification using RF pulse-width modulation

### Karin Stetler Kelley

Sound Research Connection  
Automated Speech Recognition in Auditory Processing Evaluation of Children

### Alexander Wurthmann

Bryan Holmes  
Green Mountain Spark LLC  
Biofuel Production from Triglycerides by Laser-Initiated Radical Reaction

## Innovation Fund (IF) Awards

### Anju Dahiya

General Systems Research, LLC  
High-Output Conversion of Algae Biomass For Oil Production

### Yves Dubief

UVM  
A new hypothesis for synovial joint lubrication and its application to orthopedic prostheses

### Sergey Krivov

General Systems Research, LLC  
Systems Research Lab: Bayesian Networks Cyber Discovery Infrastructure

### Jeremy Singley

Jeremy Singley Industrial Design  
External Radiation Guide to Improve Lighting Efficiency

### Walter Varhue

Michael Cross  
UVM  
Production of Hydrogen via the Catalyzed Thermal Decomposition of Water

### Gary Vezzoli

Lebanon College  
Study of Cause of High Bladder Cancer Incidence in Men

## Baccalaureate Faculty Research Awards

### Jason Arndt

Middlebury College  
Development and Testing of MINERVA-DP, a Model of Recognition Memory

### Farley Anne Brown

Sterling College  
Streams Project: Wild Branch River

### Robert Genter

Johnson State College  
Phosphorus concentrations and microbial ribotyping analysis in cultivated, urban, and forested watersheds of the Lamoille River, Vermont, for the VT-EPSCoR Streams Project

### Noah Graham

Middlebury College  
Oscillons in Particle Physics and Cosmology

### Carlos Pinkham

Norwich University  
Application of the Index of Biotic Similarity (B) to the Analysis of the Data Generated by the Streams Project

### John Schmitt

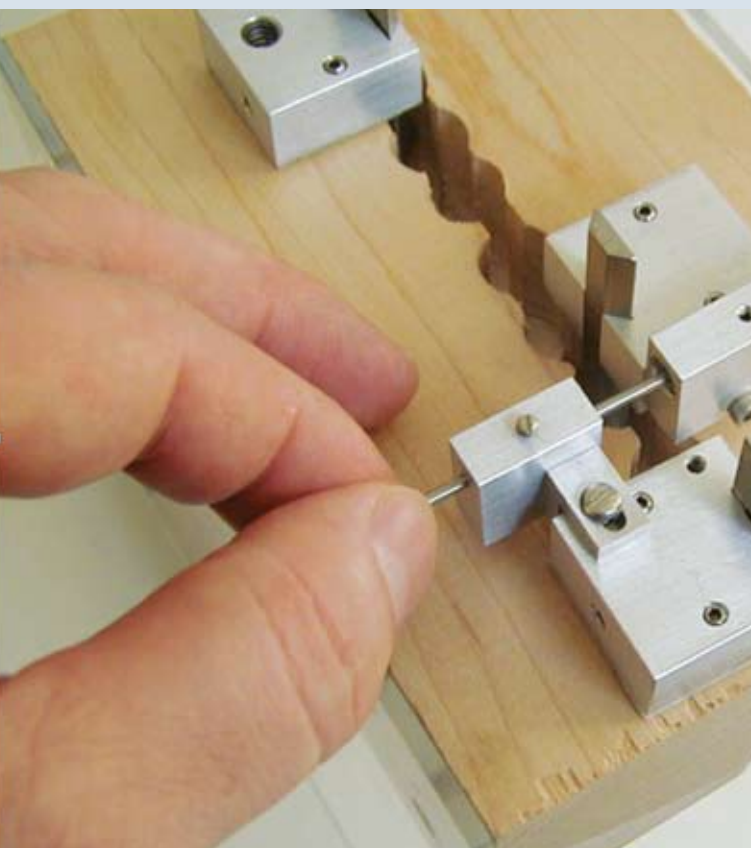
Middlebury College  
Constructing Cost-efficient Networks for the Transportation of Scarce and Consumable Resources

**“MicroStrain, Inc. has leveraged EPSCoR Phase (0)’s into significant Federal R&D: 8 Phase (0)’s amounting to about \$60,000 has resulted in 11 Phase I, 5 Phase II and 3 Phase III awards totaling about \$8.2M”**

Steve Arms, President, MicroStrain, Inc.

## Vermont EPSCoR offers over \$200,000 annually in research and development funding to Vermont small businesses

**Applications now being accepted  
Proposals due beginning in March 2009  
[www.uvm.edu/EPSCoR](http://www.uvm.edu/EPSCoR)**



### Small Business Innovation Research SBIR Phase (0)

Awards up to \$12,000 to develop proof-of-concept feasibility studies to help Vermont small businesses compete for federal SBIR grants.

### Use of Facilities at the University of Vermont (UVM)

Awards of up to \$5,000 to use facilities at UVM for data collection necessary for application to Phase (I) and Phase (II) federal grants.

### Innovation Fund (IF) Awards

Awards of up to \$12,000 to support proof-of-concept work for important, transformative, high-risk proposals in Science, Technology, Engineering or Math.

### New Business Awards for Streams Project

Awards up to \$30,000 for grants to foster research and development projects for the "Streams Project" that use distributed remote-sensing and an integrated educational component. The Streams Project is an effort by VT EPSCoR to collect long-term, high quality data on the streams in the Lake Champlain Watershed. Visit <http://www.uvm.edu/~streams/> for more info.

*For information related  
to any of these programs,  
please contact:*

**Lillian Gamache**  
Project Coordinator, VT EPSCoR

eMail: [epscor@uvm.edu](mailto:epscor@uvm.edu) • [802] 656-7969 • [www.uvm.edu/EPSCoR](http://www.uvm.edu/EPSCoR)





## The Town That Food Saved *continued from page 4*

sipped his beer and turned to face me squarely. "In five years, we will have people from all over the planet visiting Hardwick to see what a healthy food system looks like."

Stearns's ambition is shared by many in the community, including Andrew Meyer, who grew up on a dairy farm in Hardwick before leaving for Washington to work on ag policy with the now retired Senator Jim Jeffords. Meyer returned to Hardwick five years ago to open Vermont Soy and its sister company, Vermont Natural Coatings, which produces whey-based, low-toxicity finishes for furniture and floors. Meyer and Stearns are close friends, though Meyer is quieter, with an aw-shucks demeanor that belies his business savvy and on-the-fly resourcefulness. The launch of his business happened largely from the crest of a pile of topsoil on his brother's farm; it was the only place he could get a cell signal. "We started to whisper about Hardwick as an ag center in 2004," Meyer told me. We were in his "office," a box of plywood walls built into the corner of the coatings factory. "Everyone laughed. Literally." The laughter that recently echoed through Hardwick's struggling economy has largely been silenced, and any last vestiges of ridicule should die a quick death in the coming months, with the arrival of the Vermont Food Venture Center, a food distribution (and

packaging and development) center that's to be built next to Vermont Soy. It will serve as a cooperative facility to local producers, enabling them to get their products to market with minimal investment. The recent opening of Claire's Restaurant and Bar hasn't hurt, either. Located in the space that once housed Benny's, Claire's is a "community supported restaurant." Local believers purchased \$1,000 coupons that they can redeem in food over a four year period. Claire's opened in May 2008, sourcing 70 percent of its ingredients from within a 15-mile radius; in the first two months, the restaurant had done 200 percent more business than even the most optimistic projections. The momentum in Hardwick is clearly building. "You can say a lot of things, set policy, et cetera, et cetera, but unless you have blood that's been dripped, risks taken—it's just not going to happen," said Meyer. His enthusiasm was beginning to show through his rural Vermont

reticence, and he leaned his compact body forward. "It's happening now."

There is still much work to be done, though. In a way, Stearns is having to backtrack a bit: The rapid success and expansion of Hardwick's artisanal-food-based industry has gotten ahead of the sort of careful analysis that normally focuses such ventures. In order to create a true

model, one that might be replicated and implemented in other towns, Stearns and his entrepreneurial farmer friends will need rigorous methodology. One goal is to establish a local-food baseline against which to measure their progress in feeding the community. "We need to measure what percentage of consumption in the region is being produced in the region," Stearns said. "Then we can say, 'Okay, we want to increase that by five percent a year, and here's how we're going to do it.'" Perhaps more crucially, they'll need the support of a

blue-collar citizenry that wants for \$20-a-pound cheese and organic tofu like a swordfish wants for sunscreen. "One of the things that's most critical

**"In five years, we will have people from all over the planet visiting Hardwick to see what a healthy food system looks like"**

Tom Stearns,  
High Mowing Organic Seeds

## QuantaLeap *continued from page 4*

Having created a model of the wavelengths of light a particular combo of chemicals — say, those that compose *Salmonella* bacteria — absorbs or reflects, Puzey can seek that same pattern in his samples. Industrial-strength cleaners and food additives don't get in the way: Infrared rays are "unaffected by sanitizers, preservatives or the food matrix," Puzey declares. "Food matrix" is the sci-fi-sounding term for the bacteria's organic host: In this case, it's animal or vegetable.

QuantaSpec's test can pick the bad guys out of a complex soup of microorganisms. When one bacterium is benign and another will put you in the hospital, the devil is in the details — not just the difference between *E. coli* and *Listeria*, but between the deadly *Listeria monocytogenes* and its relative, the harmless *Listeria innocua*. "Everyone who's been doing

research using infrared light has always done it with pure cultures," says Puzey, explaining how he's distinguished himself from his competition. "If you want to apply this to food safety . . . You need to be able to pick out pathogenic bacteria hiding in that flora. Is there a wolf in with the sheep? Since no one had ever done it, they didn't think that could be done."

While Puzey is aware of "at least half a dozen" companies attempting similar research, he's convinced his results are superior. "Based on the literature, no one has ever been able to tell apart two subspecies of organisms as accurately as we have," he claims. "We get 100 percent accuracy. Before, the record was 80 percent."

UVM Professor and Analytical Chemist **Giuseppe Petrucci** calls

Puzey "one of the most inventive scientists I've ever met." He worked with Puzey on the

brainstorming phase of the project, and believes his work shows "phenomenal promise."

"He's really working at the forefront of detection technology to solve these very important problems," Petrucci notes.

Why has Puzey succeeded where others have failed? "My guess is that I have a stronger math background, being an engineer," says Puzey. "Most people who do this work are biologists." Math comes in handy when he processes his data: "All of our intellectual property revolves around how you interpret the spectra," Puzey explains. To safeguard his work, he doesn't share his algorithms with anybody, even his own staffers. The secrets are between him and his computer.



Puzey's findings could have far-ranging applications in the food industry, and not just for shoppers. He also hopes to design devices for food processors so they can analyze raw materials as they enter the plant and finished ones as they leave. For example, there's still plenty of debate about the safety of raw milk. On-farm testing could eliminate the risk altogether.

Who's going to analyze all the data gathered by cellphone-wielding consumers in the produce aisle? "It could be run through the Internet," Puzey says. "They'd send us the spectral data,

**Puzey recently received funding from the Vermont Experimental Program to Stimulate Competitive Research (EPSCoR) to investigate a new way to diagnose breast cancer.**





is that we're not perceived as outsiders doing something elitist." It's a delicate balancing act, both economically and socially: In order to fund their enterprises and create the jobs that might further spur Hardwick's renewal, the region's agricultural entrepreneurs are obliged, at least in part, to create products that their neighbors might not be able to afford. It's not such an unusual arrangement in 21st-century America, but it seems antithetical to the local-foods movement, and it's surely antithetical to the very goals Stearns laid out for me. Can the Hardwick food collaborative bridge this divide? Stearns thinks so; Andrew Meyer thinks so. As does Mateo Kehler, maker of said \$20 cheese. And Kristina Michelsen, one of the four partners of Claire's. But then, of course they do. They're not exactly unbiased. But they are persuasive. Imagine that their \$20 cheese being sold in Boston and New York can produce a lot of jobs in Hardwick; they're getting their margin from out-of-state markets and selling to locals at cost. Wouldn't that be a start? "I've heard it said," Roger Allbee, Vermont's secretary of agriculture, remarked, "that Vermont's way ahead of the curve regarding sustainable agriculture." The proof is mounting in Hardwick. ■

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and we'd send back the interpretation."

Puzey doesn't plan to charge manufacturing plants a lot for his services — mainly, he talks about eradicating food-borne illnesses and saving lives. But if his prototypes become food-industry standards, he stands to make a tidy profit.

How has his work with microbes affected his day-to-day life? "I would never eat a hot dog straight from the package," he vows. Burgers? Puzey orders them "medium-well instead of rare. With steak, the contamination is only going to be on the surface. With ground beef, the surface can be anywhere inside." He still eats raw vegetables and fruit, but points out, "I think many people don't realize that there are bacterial contamination risks with those."

Not everyone is so paranoid in the produce section. But given recent food-safety scares, many of us have fretted about the microscopic hitchhikers on our tomatoes or alfalfa sprouts — fears our ignorance only exacerbates. Someday, if Puzey and the FDA have their way, we may be able to prevent food-borne illness by shining a light into a romaine's heart of darkness. Until then, we'll have to take our chances. ■

*Reproduced with permission from an October 22, 2008 article in **Seven Days** newspaper.*

# Vermont EPSCoR Notables

## Five Affiliates Attend NSF Workshop

**Dana Hard**, Affirmative Action/Equal Opportunity Assistant Director at UVM; **Rory Waterman**, Assistant Professor, Chemistry, at UVM; **Gayle Bress**, HELIX Program Coordinator and VT EPSCoR High School Outreach Coordinator; **Lillian Gamache**, Project Coordinator, VT EPSCoR; and **Jim Vigoreaux**, Professor and Chair, Biology, at UVM attended a NSF workshop on "Building Diversity in Higher Education: Strategies for Broadening Participation in the Sciences and Engineering" sponsored by the West Virginia Experimental Program to Stimulate Competitive Research (WV EPSCoR) in October 2008.

## Complex Systems Modeling (CSYS) News

The Complex Systems Modeling (CSYS) group is growing!

**Matt Luck** has joined the group as a post doctoral student working with faculty advisors Josh Bongard and Maggie Eppstein.



*Matt Luck*

Matt explains: "I am currently working on developing a genetic programming model to evolve differential equations of cyanobacteria algae and toxin production in Lake Champlain. My background is in landscape ecology and I have experience in GIS and water quality."

Matt recently attended the Santa Fe Institute's Complex Systems Summer School program "Foundations and Frontiers



*Matt Luck's group in Argentina.*

of Complex Systems" in San Carlos de Bariloche, Argentina for two weeks (Dec. 1-14) where students attended lectures and worked on small group projects. For more information there is a website for the program at [http://www.santafe.edu/events/workshops/index.php/CSSS\\_2008\\_Argentina](http://www.santafe.edu/events/workshops/index.php/CSSS_2008_Argentina).

**Bree Mathon** has also joined the CSYS group as a Graduate Student working with faculty members George Pinder, Donna Rizzo, and Lori Stevens.



*Bree Mathon*

Bree is working on: Complex systems modeling to link biodiversity and stream habitat disturbance.

**Kristen Hallock** has joined the CSYS



*Kristen Hallock*

group as the Environmental Database Specialist.

Kristen is working with "EPSCoR staff & watershed modeling group to gather/maintain/store data that will be used in complex systems models for the Lake Champlain Watershed Modeling Project. I am currently working on taking existing datasets and importing them into the CUAHSI Hydrologic Information System format. I have also been helping out with the web data-entry pages and database management for the STREAMS project and working with KathiJo Jankowski to get those up and running."



Experimental Program to Stimulate Competitive Research

Judith Van Houten, Ph.D.  
*State Director*

Kelvin Chu, Ph.D.  
*Associate Project Director*

James Iatridis, Ph.D.  
*Associate Project Director*

Lillian Gamache, M.A.  
*Project Coordinator*

KathiJo Jankowski, M.S.  
*Streams Coordinator*

Troy Krah, M.B.A.  
*Project Business Manager*

Nora Joyal  
*Administrative Assistant*

**Vermont Technology Council**

Frank Cioffi  
*Chairman*

Paul Hale, Ph.D.  
*Executive Director*

**Front cover images (upper right)**

These images represent four models of a mechanical pendulum, generated by an algorithm that automatically synthesizes models of complex systems. Provided by Dr. Joshua Bongard.

## Upcoming Meetings & Events

**December 2008****Emerging Science Season 2 Podcasts begin**

See them on the web at [http://www.vpt.org/programs/emergingscience\\_videopodcas.html](http://www.vpt.org/programs/emergingscience_videopodcas.html)

**January 27, 2009****Emerging Science Tuesday evenings after NOVA – Season 2 Premiere**

Full episodes on the web at [http://www.vpt.org/programs/emergingscience\\_videopodcas.html](http://www.vpt.org/programs/emergingscience_videopodcas.html)

Episode One: *Energy*

Episode Four: *Transportation*

Episode Two: *Food Webs*

Episode Five: *Water – featuring scientists from*

Episode Three: *Technology of*

*the Water Workshop!*

*Social Sciences*

**April 27, 2009**

**Streams Symposium** Sheraton Hotel and Conference Center, Burlington, Vermont

**June 1–5, 2009**

**Streams Undergraduate Training Orientation Week**

**June 2&3, 2009**

**VT State Annual Meeting, Grant Writing Workshop**

**June 29–July 3, 2009**

**Streams High School Training Orientation Week**

**September 15, 2009**

**NSF Day – sponsored by OLPA**

**AWARD APPLICATION DEADLINES** *Full RFPs available at [www.uvm.edu/EPSCoR](http://www.uvm.edu/EPSCoR)*

**March 4, 2009** UVM Student Summer Research Support: Stream Ecology in Puerto Rico

**March 4, 2009** UVM Student Summer and Academic Year Research Support

**March 4, 2009** Undergraduate Student Summer & Academic Year Research Support at Baccalaureate Institutions

**March 18, 2009** Business Awards for Streams Project

**March 30, 2009** Pilot Awards for UVM Faculty Research in Complex Systems Modeling

**April 15, 2009** Innovation Fund (IF) Awards

**April 30, 2009** SBIR Phase (0) Awards

**April 30, 2009** Small Business Innovation Research Proposals for Use of Facilities at UVM

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Experimental Program to  
Stimulate Competitive Research



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