University of Victoria
Science

ScienceMatters

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JUST ONE DROP:
UVic-based technology set to revolutionize standard blood tests

– By Erin King

Healthy or not, all of us at some time have been subjected to one of the most common forms of medial diagnostics—the dreaded blood test. But what if there was a way to avoid this uncomfortable process?

A team of researchers based at UVic is poised to revolutionize medical diagnostics with new, less-invasive methods that can be applied to a variety of diseases and wellness monitoring.

With the current system for disease diagnosis, each biomarker test—which refers to measurements of specific proteins in the blood associated with specific diseases—requires large, separate blood draws. Now, UVic biochemists Terry Pearson and Leigh Anderson, along with their start-up company SISCAPA Assay Technologies Inc., have developed a technique that can measure more than 25 different biomarkers at once in just one drop of dried blood.

"This is a far more efficient and economical method for the health care system, and has the added benefit of being far less invasive for the patient," says Pearson.

SISCAPA's core technology has already been adopted by the Mayo Clinic and ARUP Labs in the US—and the company is exploring similar opportunities in Canada, China and Europe.

Individuals can prepare their dried blood spots at home and accumulate samples—eventually sending them to a lab where doctors or scientists can monitor the patient's baseline levels of various biomarkers over time.

The diagnostic potential of this new technology is limitless, says Pearson. For example, studies show that knowing the normal levels of a biomarker for ovarian cancer in a woman's blood is an effective tool for monitoring her health. But long-term monitoring is even better.

"Increases of the ovarian cancer biomarker over her baseline, not simply a comparison with the average levels in a population of women, will reveal changes—a flag that cancer might be present—much earlier on," he says. "The same can be said for long-term monitoring of many other diseases as well."

Not only does longitudinal testing allow earlier detection and monitoring of diseases such as cancer, diabetes and cardiovascular disease, it also allows for monitoring of personal wellness. In fact, SISCAPA technology was used with Brazilian elite athletes during the 2015 PanAm Games to monitor a large set of biomarkers associated with training, stress and performance—work that will continue during the 2016 summer Olympics. Pearson says the technology will also allow individuals to monitor how a change in diet affects their overall health.

SISCAPA recently won the Human Proteome Organization's Science and Technology Award, which recognizes the team's efforts in making the technology widely available. That's not bad for a small start-up company that's less than three years old.

SISCAPA was developed at UVic over 13 years in partnership with Anderson in Washington DC and the company was officially formed in 2013. Undergraduate and graduate students were involved in much of the ongoing technology development, design and automation.

Photo: UVic photo services

A demonstration of this revolutionary system. With a single drop of blood, patients can prepare their own blood tests from home to be sent to a lab for testing or monitoring over time.

"Three of our six-person team are UVic alumni who started with us as students," says Pearson "They're the ones who will ultimately usher in this exciting new era in medical diagnostics."

The SISCAPA technology was developed from research supported by the Canary Foundation (California), the National Cancer Institute (US), the Natural Sciences and Engineering Research Council (Canada) and the Canadian Institutes of Health Research.

At three years old, the SISCAPA lab is still relatively small—but it's not alone. It's just one of more than 75 start-up companies emerging from UVic that have helped to push high-technology ahead of tourism as one of Greater Victoria's primary industries.

DEAN'S MESSAGE

Welcome to the Spring 2016 edition of Science Matters. We had a great start to the year welcoming alumni back on campus for Alumni Week to celebrate their academic, business, and community achievements. Our faculty was proud to award Bruce Shepherd this year's Distinguished Alumni Award. You can read more about Bruce in this newsletter.

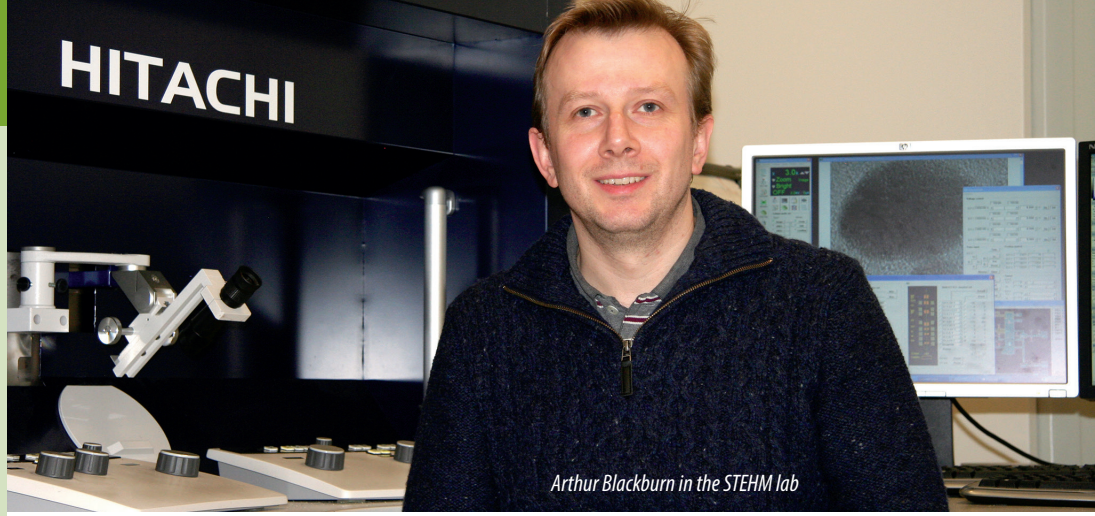
Science hosted nine events for UVic's Ideafest this March to bring UVic science to the public. Faculty and graduate students participated in public events including a pechakucha poster exhibit, a family-oriented interactive Chemistry show and a presentation/performance on magical mushrooms—an event that combined art, music, and science to explore UVic's latest research on fungal symbionts and pathogens. Congratulations to students Armaghan Attar (School of Earth and Ocean Sciences) and Tom Iwanicki (Department of Biology) for participating as finalists in a three minute thesis competition. In it's fifth year, Ideafest continues to grow every year by popular demand.

In faculty news, I would like to congratulate Stan Dosso on his appointment as Director of the School of Earth and Ocean Science and Neil Burford, who will start his second term as Chemistry Chair in July.

Enjoy this newsletter and please keep in touch. I encourage those of you who can, to join us for our many public lectures and celebrations we hold on and off campus like HonoursFest and Café Scientifique.

We welcome your feedback and hope to see you on campus soon.

Kathy Gillis
Acting Dean of Science



Arthur Blackburn in the STEHM lab

World's highest resolution microscope ever built now has a world class expert to run it

– Edited by Brian Case

The University of Victoria not only possesses the world's most powerful microscope, it now has a world-class expert to run it.

Dr. Arthur Blackburn moved here after a stint with Hitachi Cambridge, UK. Hitachi is the company that built the mammoth microscope in Japan. While at Hitachi, Blackburn gained extensive expertise in electron optics and holography. He is now putting that knowledge to good use, as a research scientist for what is referred to as the "STEHM".

STEHM stands for "scanning transmission electron holography microscope". It is the highest resolution microscope ever built, capable of magnifying 20 million times greater than the human eye, allowing scientists to see the world of the incredibly tiny, such as atoms. At 4.5 meters high, and weighing in at seven tonnes, the microscope is housed in the Centre for Advanced Materials and Related Technology (CAMTEC) on campus—but not without some initial "housing problems." When the microscope arrived at UVic in 2012, the boxes it was packed in were too large to fit in the building's elevator. So workers had to cut a larger opening in the elevator shaft in order to get STEHM to its final location in the CAMTEC building.

CAMTEC serves as a training and research centre for industry leaders and academics from around the globe. The centre serves a broad spectrum of disciplines in Science and Engineering. It leads research in such specialized areas as nanophotonics and nanomagnetism, as well as biomaterials and medical applications.

Dr. Blackburn's move here opens the door to a variety of new opportunities for UVic, not only for exploring research frontiers in materials science, but also in establishing new research partnerships with industry.


Photo credit: Beth Doman
Ainsleigh Hill, Co-op student of the year

Science student wins Co-op Student of the Year —Optional and Professional Co-op Programs

Each year, UVic recognizes three co-op students who have made outstanding achievements in academics, workplace performance and community involvement. At 19 years old, Ainsleigh has demonstrated a passion for problem solving and an aptitude for science well beyond her years. When a standard mathematical expression commonly used to measure data was yielding inappropriate values, she was able to modify the expression to remedy the issue—the new expression is now referred to as the "Ainsleigh index".

Royal Society of Canada honours UVic researchers

Frank van Veggel (Chemistry) was recently inducted as fellow of the Royal Society of Canada. Van Veggel joins an elite club of more than 2,000 scholars elected over the years by their peers for remarkable lifetime contributions to their discipline and public life. Fellowship in the RSC is Canada's highest academic distinction. Van Veggel is an international leader in the design and study of new photonic nanomaterials—extremely small materials that interact with light. The research has applications in health, computing and telecommunications. His current research focuses on ways of using optical and magnetic nanoparticles to enhance diagnostics for prostate, breast and brain cancer.

Sarah Ellison (Physics and Astronomy) is both a new member of the College of New Scholars, Artists, and Scientists and recipient of the 2014 Rutherford Medal, which recognizes outstanding achievement in any branch of physics. Described as "one of the most energetic and productive researchers in astronomy and astrophysics in Canada with major worldwide impact," Sara Ellison couples observations from powerful telescopes with computer simulations to understand how galaxies form and evolve over time.

Julio Navarro (Physics and Astronomy) received the 2015 Tory Medal for outstanding research at the Royal Society of Canada. Navarro has made groundbreaking contributions to our understanding of the formation of structure and galaxies in the universe.

MATH MAY HOLD THE KEY TO ECO-FRIENDLY PEST CONTROL

– Edited by Brian Case

What happens when a sterilized fly mates with its female counterpart? Ideally—nothing, at least in terms of offspring.

Now imagine this on a much larger scale in nature. If sterilized male flies out-competed wild (and virile) flies in mating with wild females, it could cause an entire population to collapse. This is a theory behind the Sterile Insect Technique (SIT), which has been in development since the 1950s. It has been a passion of UVic alumnus Hugh Barclay (PhD Biology '78), since the 1980s. He says SIT can be used to control the spread of pests that cause agricultural and health consequences.

The SIT method is an environmentally friendly, targeted form of pest control. The main disadvantage is that until recently it was deemed uneconomical. Today, the method is being effectively used to keep the Mediterranean fruit fly, a pest that destroys coffee crops, out of the United States and Mexico. This is accomplished through control programs being implemented in Guatemala through the "Moscamed" Program, a tri-national effort between the three nations.

The program involves dropping insects from airplanes. But effectiveness questions remain. When? Where? How many? And for how long?

In order for the Sterile Insect Technique program to be effective, another question needs to be answered—what is the optimal spacing and frequency of plane flight lines for airborne release of sterilized insects to maintain a uniform minimum coverage of steriles?

Dr. Barclay realized that he needed to enlist some more advanced mathematicians to answer this question, so he called upon UVic Emeritus Professor Pauline van den Driessche for help. She in turn knocked on Robert Steacy's office door. He is a professor of Mathematics, and an expert in what are called "partial differential equations" .

Steacy mused over the question for months. Surprisingly, he had his "ah ha" moment at home while he was sleeping.

"Knowing that every normal distribution changes concavity from concave down, to concave up, at a distance of one standard deviation from the average value, I awoke at 3 am realizing that if the flight lines were spaced exactly two standard deviations apart—so that the point where the concavity change taking place from one flight line links up with the one from the next flight line—then we would obtain a distribution which is sufficiently close to uniform coverage, for real-world purposes," Steacy says.

Central American farmer harvesting coffee cherries

This results in the insect density at the line halfway between flight lines being over 97 percent of the density at the flight lines, from one single flight. This then improves with repeated flights, he calculates.

By solving this 'simple' equation, one only needs a hand-held calculator and a few inputs to answer our original question so that farmers across the world who want to implement the SIT technique can easily do so, says Dr. Steacy.

Both Barclay and Steacy believe SIT can be effectively adapted in other similar health situations, such as the recent Zika virus outbreak by releasing sterile mosquitos. In the 1990s, SIT was used to eradicate the Tsetse fly from the whole island of Zanzibar. It posed a serious health risk for cattle and humans alike.

Steacy believes that one of the perceived barriers to effectively implementing SIT is the math. But by creating what he calls a 'pancake mix' equation—just add water—you don't need to be a mathematician because that work is done for you.

Making calculations for optimal SIT more accessible may be a key to increasing the method's impact in health and agriculture.

For more information, see the recently published article: "Modelling diffusive movement of sterile insects released along aerial flight lines" in the *International Journal of Pest Management*, by Drs. Hugh Barclay, Robert Steacy, Walther Enkerlin and Pauline van den Driessche.

(R-L) pilot, alumnus Hugh Barclay (PhD Biology '78) and co-pilot about to board an airplane that is ready to release 66 million sterile medflies over a coffee plantation in Guatemala.

Photo: Hugh Barclay

Photo: Michael Clinchy

An undisturbed racoon eats a red rock crab

Fear of carnivores good for ecosystem health: study

By: Suzanne Ahearne

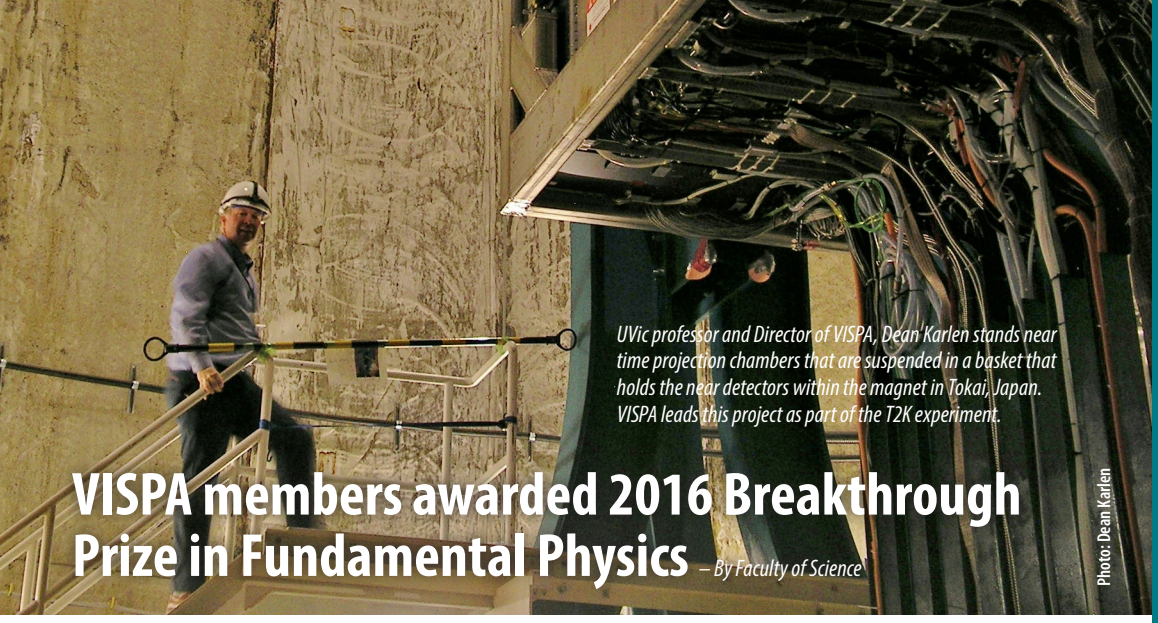
An experiment involving raccoons and speakers emitting the sound of barking dogs on tracts of beaches on British Columbia's Gulf Islands shows that the fear of large carnivores has a positive impact on ecosystem health. The study led by University of Victoria PhD student Justin Suraci with support of the Raincoast Conservation Foundation is published this February in *Nature Communications*.

Raccoons on the Gulf Islands are devastating populations of crabs and fish in the intertidal zone, and nesting songbirds on land. Suraci and co-researchers Liana Zanette (Western University) and Larry Dill (Simon Fraser University) suspected this was due to raccoons having little to fear. To investigate whether fear of dogs—a top predator since the elimination of wolves, bears and cougars from the Islands almost a century ago—could affect raccoon foraging behaviours along the shoreline, they played threatening dog sounds from speakers along extensive tracts of shoreline for one month.

They found that raccoons reduced their foraging time by 66 per cent. In that period, researchers recorded a 61 per cent increase in the abundance of red rock crab and an 81 per cent increase in intertidal fish—a prime target of raccoons.

"Humans have done an excellent job of wiping out large carnivores across the globe and we're only starting to understand what the ecological consequences of that are," says Suraci. "One of the major consequences is that when you take away the large carnivores, you get outbreaks of the species that they eat—herbivores like deer and smaller predators like raccoons. So, understanding the ways in which these large carnivores historically kept their prey in check was very important to restoring these ecosystems."

"What we've shown is that we have to consider the behavioural interactions top predators have with their prey and not just the actual predation—the killing and consumption—when we're thinking about how to restore ecosystems from which large carnivores have been lost," says Suraci.



UVic professor and Director of VISPA, Dean Karlen stands near time projection chambers that are suspended in a basket that holds the near detectors within the magnet in Tokai, Japan. VISPA leads this project as part of the T2K experiment.

Photo: Dean Karlen

VISPA members awarded 2016 Breakthrough Prize in Fundamental Physics – *By Faculty of Science*

A team of UVic researchers shared in one of the world's most lucrative science awards this November.

The $3 million 2016 Breakthrough Prize in Fundamental Physics was awarded to five international experiments, including more than 1300 individual scientists, "for the fundamental discovery of neutrino oscillations, revealing a new frontier beyond, and possibly far beyond, the standard model of particle physics." Eight current and former Victoria Subatomic Physics and Accelerator Research Centre (VISPA) members are among the laureates.

The UVic researchers were awarded their part of the prize for their participation in the T2K neutrino experiment in Japan. Neutrinos, fundamental particles produced in nuclear reactions, can pass through solid matter making them very difficult to detect. In a deep underground research facility in Japan, researchers in the T2K experiment directly observed for the first time neutrinos changing from one type to another. Their discovery sets the stage for the study of differences in the neutrino oscillation process relative to their antiparticles (antineutrinos), and may help to elucidate how all the antimatter was eliminated from our universe.

Founded by internet gurus Sergey Brin, Jack Ma, Yuri Milner, and Mark Zuckerberg, the Breakthrough Prizes were established in 2012 to celebrate scientists and generate excitement about the pursuit of science as a career.

Making a Murderer: Mounting a Lethal Anti-Tumor Immune Response, wins Honoursfest first prize – *Edited by Brian Case*

Heather Derocher, a 4th year microbiology undergraduate student, took first prize at this year's HonoursFest, an exhibition of undergraduate honour student research hosted by the Faculty of Science. Derocher's research focuses on characterizing how the immune response differs across the molecular subtypes of endometrial cancer, a type of cancer that begins in the uterus. She hopes the results will influence the development of immunotherapies for the treatment of endometrial cancer.

Photo: UVic photo services

Students presenting posters to faculty members and their peers on their honours research projects at HonoursFest.

Photo: UVic photo services

Bruce Shepherd accepting the Distinguished Alumni Award to a full house at the Royal BC Musuem

Bruce Shepherd receives Distinguished Alumni Award

– Edited by Brian Case

This February, the Faculty of Science honoured Bruce Shepherd as this year's Distinguished Alumni Award recipient. Bruce completed a BSc in Mathematics and Computer Science at UVic in 1985, where, through the co-op program, he began applying classroom concepts to industrial problem solving. Following graduation from UVic, he studied at the Department of Combinatorics and Optimization, University of Waterloo where he earned his MSc and PhD degrees.

In 1997 Bruce joined Bell Laboratories, New Jersey, where he designed algorithms and produced software in areas such as optical network design, real-time network management, scheduling, and internet measurement. He also maintained an interest in the fundamental theory behind these problems, including his work with Tim Griffin and Gordon Wilfong which formulated a graph theory model to analyze the world's defacto interdomain routing protocol, BGP.

Bruce Shepherd is currently a member of the Department of Mathematics and Statistics, McGill University where he has held the position of James McGill Professor (internal equivalent of a Tier 1 Canada Research Chair) since 2007. He is also an associate member of McGill's School of Computer Science.

Giving Back

Our alumni make a difference by volunteering at events, speaking to classes, hiring co-op students or supporting scholarships. To help change the lives of our current students, you can make a donation today at uvic.ca/givingtouvic or by contacting the Development Coordinator, at 250-472-4210 or devtcoor@uvic.ca.

Planning a reunion?

The UVic Alumni Association can help by promoting your event to classmates, arranging speakers or providing door prizes. Network and keep involved by exploring the list of groups and upcoming events to find something that's right for you. alumni.uvic.ca/events/reunions.php

Alumni Newsletter

Science Matters is published twice yearly by the Faculty of Science to communicate the faculty's goals, strategic direction and activities in order to connect alumni with each other and the university. Send your story ideas and feedback to Chrystal Phan at cmphan@uvic.ca.

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