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Reuven Gordon

Photo: UVic Photo Services

CANCER DETECTIVES: UVIC RESEARCH DISCOVERS A PROMISING NEW WAY TO DETECT LUNG CANCER

– By Suzanne Ahearne

This article first appeared as a KnowlEdge story prepared by UVic Communications and Marketing

It's good to have a fast metabolism if you're talking about maintaining a healthy body weight. But cancer cells are also fast metabolizers. It's what makes them more active and faster-growing than healthy cells. And it's what makes them so dangerous.

But their speed also makes them vulnerable. Long before cancer cells are detectible to most screening tests, their quick-metabolizing behaviours will still give them away—if you know where to look and what to look for.

A University of Victoria research team led by engineer Reuven Gordon and chemist Fraser Hof, in partnership with Vancouver-based Biomark Diagnostics, is developing an inexpensive, non-invasive way to detect cancer in urine.

In the trial now underway, a person swallows a dose of the prescription drug Amantadine, which is a common antiviral. When the drug metabolizes in the body, it creates a molecule (or biomarker), which is excreted in urine. Cancer cells metabolize the drug faster and in a characteristic way. If you have cancer, the levels of this metabolized marker in your urine will be higher.

It's what Gordon calls an "indirect measure" of having cancer—what it shows is how your body is processing this drug, and clinical trials are proving that it's a reliable way to tell if someone has an increased risk of having cancer. In addition to screening for family history, smoking and other lifestyle risk factors, this could save lives by diagnosing early-stage cancers before a person is symptomatic.

Lung cancer is Biomark's primary target for the discovery. Lung cancer represented 24 per cent of all new cancer cases in Canada in 2014 and is the leading cause of death from cancer for both men and women, representing 27 per cent of all cancer deaths.

Other types of hidden cancers like colorectal could also be targeted. A positive reading on a urine test would be followed up with other tests to determine the location of a tumour.

Gordon and his engineering team used Raman spectroscopy—a technology that employs a laser to identify individual molecules—to create a detection platform that would make the urinalysis cheaper and more easily available to labs. Hof and his group were responsible for the chemistry involved in biomarker capture.

"This approach is really unique," says Hof. "We aim to create a process that is fast, convenient, and cheap enough to enable trials with thousands of patients. We hope to improve decision-making prior to the elaborate scans and invasive biopsies that doctors currently use to diagnose lung cancer."

The researchers have shown that their technique works in the lab on mock urine samples and that it achieves the desired sensitivity. Now they're starting tests on clinical samples.

"As a scientist, the most significant thing for me is getting this type of research and analysis from the lab into the clinic," says Gordon. "I'm happy to be developing something that will make a difference in society."

As the Canada Research Chair in Nanoplasmonics, Gordon looks for innovative ways to "squeeze" light at the nanoscale (invisible molecular level). His research is applicable in a range of fields, from the development of sensors for the early detection of cancers, to the manipulation of viruses for study, to more efficient solar energy conversion.

"The students in my group are fascinated with pushing the boundaries of nanotechnology," says Gordon. "Being able to hold on to single proteins, virus particles—that was impossible a few years ago. Listening to the unique acoustic vibration of the proteins as we're doing now, would have seemed even more unbelievable in the recent past."

The partnership with Biomark came together under a Natural Sciences and Engineering Research Council of Canada (NSERC) Engage Grant and is proceeding with funding from Genome BC.

MESSAGE FROM THE DEAN

I am delighted to say that Art Makosinski, Laboratory Manager in Mechanical Engineering, won the President's 2015 Excellence in Service Award. Art has been with the Mechanical Engineering since the 1980's and has contributed in no small way to the success of this highly regarded department. Read more below.

This year's Distinguished Alumni Award winner in Engineering, Josh Blair (EE, '95), now in a senior management position with Telus, engaged in discussions with Biomedical Engineering students when he was on campus in February.

In the last few years the Faculty of Engineering has experienced strong student demand for both the engineering and computer science programs. To support the additional students we hired three new professors last year and expect to hire several more in the coming year. New recruits this year include UVic grad Tom Gleeson who joined the Civil program from McGill University. His research is in the area of deep ground water. Phalguni Mukhopadhyaya has also joined the Civil program; he comes from NRC, and works in the area of building science, where he is an expert in high efficiency insulation. Jooeun Ahn is a new faculty member in Mechanical Engineering. He comes from MIT and his research is in the area of biomechanics and control.

Canada Research Chair, and leading Software Engineer, Peggy Storey, was appointed Director of the Software Engineering program in January.

I hope you enjoy reading this newsletter and thank you for your support.

Tom Tiedje *Ph.D., FRSC, PEng.*

Low-Cost 3D printed prosthetic hands tested in Guatemala *– By Julie Sloan*

Photo: UVic Photo Services

Nikolai Dechev holds a prosthetic hand developed in his laboratory.

Mechanical Engineering professor Nikolai Dechev is leading a team that has created full-function, low-cost prosthetic hands for amputees in Guatemala, using 3D printing technology.

Amputees in the developing world can rarely afford prosthetics and are vulnerable because they often can't compete for jobs, which leaves them in a cycle of poverty. Dechev's goal is to give them enough basic function to achieve common tasks, and hopefully to find useful employment.

Dechev initially created the design as a MASc student at the University of Toronto, but the cost to produce the hand was prohibitive at $15,000 dollars, so it sat on the shelf for 15 years. Only now, thanks to the affordability of 3D printing, has he and his team been able to translate that past work into a practical, low-cost working prosthesis. Dechev was successful in getting a $112,000 grant from Grand Challenges Canada, a federally funded organization that supports innovative health projects. This has allowed him to create a design team to develop the hand, which includes Kelly Stegman, Joshua Coutts and Richard Knowlton, along with current engineering students Michael Peirone, Kalonica Christie, Alistair Kuzmick, Pranay Shrestha, Angie McDonald, Michael Richards, Natalie Smith, and Dirk Brussow. In addition, their partner Range of Motion Project (ROMP) has clinical practitioners who have provided valuable development input, and assist in clinical assessment. The efforts of all have produced a wonderful 3D printed prosthesis.

Dechev travelled to Guatemala in February for initial trails and work on customizing the socket to fit the user, which is a crucial part of making it work. The team is now about to undergo round-two field trials in Guatemala, beginning in June of this year. Eventually, the aim is to produce a large number of prosthesis to help as many amputees as possible.

Printed with spools of hard plastic, the prosthetic hand comes out of the 3D printer in several pieces, and takes three or four hours to manually assemble. It is a body-powered design, where a shoulder harness with cable attachment is used to actuate the hand to open, close and grip.

"It would be impossible to manufacture this hand at this quality and strength, at such low cost, without 3D printing," says Dechev.

NEWS

Dr. Valerie King (computer science) has been named a 2014 ACM Fellow by the Association for Computing Machinery (ACM) for her contributions to randomized algorithms. Her work allows networked computers, working together to solve a problem, to recognize invading malware so that they can ignore the information sent by bad computers and continue to coordinate with the good ones. The association recognizes ACM members' creativity and commitment to the study of computer science.

Mr. Arthur Makosinski has received the 2015 President's Excellence in Service Award. As one of our longest serving staff members, Art is the Lab Manager of Mechanical Engineering. He runs the daily operation of all teaching labs, supports all research labs, and designs and develops new lab equipment for Mechanical Engineering as well as the new engineering programs. Art is also an accomplished documentary filmmaker. Art has the rare distinction of having a 17 year-old daughter who is more famous than he is. Daughter Anne won a Google Science Fair award for inventing a body-heat powered flashlight.

In Memoriam of Dr. Joanne Laura Wegner *– By Zoumin Dong*

Beloved colleague and friend, Dr. Joanne Laura Wegner passed away on September 13th, 2014. Dr. Wegner was one of the founding members of the department of Mechanical Engineering at the University of Victoria and started her teaching career in 1988. She was an expert on Linear and Nonlinear Wave Propagation in Solids; Dynamic Behavior of Polymers; Numerical Analysis; and Computational Mechanics. She received the I.Ω. Smith Award for Outstanding Achievement within Ten Years of a bachelor's Degree in Mechanical Engineering from the Canadian Society of Mechanical Engineers in 1991.

Joanne taught many undergraduate and graduate courses at UVic, conducted active research on mechanics and related subjects, co-authored a textbook, and served on various university committees, including the Treasurer, Secretary and Vice President of the Faculty Association.

Joanne will be remembered as a dear colleague and friend to many of us at UVic and around. Her family and the department hosted a reception to celebrate her life on Saturday, October 25th, at the University Club.

Hands on Stem Cells: undergraduate work in life-changing research

– By Angie Pass

Imagine you could have the opportunity to work on a cure for spinal cord injury as an undergraduate student. Emma Bibault is doing just that. Bibault is a third year biomedical engineering student currently on a co-op work term in Dr. Stephanie Willerth's lab, where researchers use stem cell-based bioengineering to address significant biological problems in the areas of tissue engineering and regenerative medicine.

One such project uses naturally derived biomaterial scaffolds to promote stem cell differentiation. Bibault is in the lab daily, maintaining pluripotent stem cell lines. Pluripotent stem cells have the potential to become any kind of cell in the body. Bibault supports the growth of these cells by creating an environment in which they can replicate and divide. The cells are ultimately implanted onto the scaffolds where they differentiate into motor neurons. Scaffolds promote the survival and differentiation of cells and, when implanted at the site of a spinal cord injury, can help heal damaged tissue.

Bibault quickly realized she was passionate about this research when she had a class with Dr. Willerth in her second year. "There have been cases of neurodegenerative disease in my family and I think there is potential for this research to revolutionize how we look at medicine." Bibault sought out a work-study position in the Willerth Lab in Fall 2014 and began her co-op term in January 2015. What's her favourite part of the research? "Being able to actually see how we work with and modify cells. There's also the potential that my research will help people in the future, which is really rewarding."

Bibault is from High River, Alberta. She was attracted to UVic's small size and, since she is also a track and cross-country athlete, the ability to train outdoors all year round. When asked if she has trouble balancing the demands of being a student as well as a Vikes athlete, she says modestly, "It just means that I have to use my time efficiently. I learned that right away."

The opportunity for undergraduate students to work in research labs is a unique one. Some co-op positions are donor-funded and not only allow students access to paid, hands-on learning opportunities but also give the lab more qualified researchers. More researchers mean that our health-related research questions can be answered faster. "As a co-op, Emma provides an invaluable contribution to our lab by maintaining our pluripotent stem cell lines. She is an important member of the Willerth lab and a great team player," Willerth says.

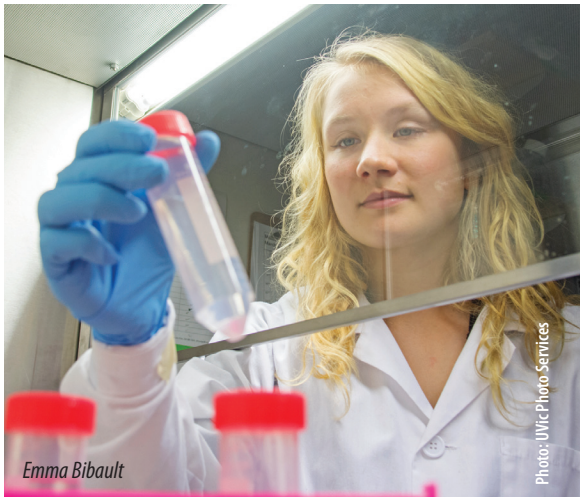
Photo: UVic Photo Services

Emma Bibault

Bibault's work is also getting recognition outside the lab. She and another co-op student researcher, Meghan Robinson, are co-authors on an article that was accepted to the journal, Biomarker Insights.

When asked what she would like to do in the future, Bibault says that she wants to continue researching neurodegenerative diseases but is also excited to look into other applications of stem-cell research. It sounds like her time in the Willerth lab is just the beginning of a long research career.

Engineering safety is no snow job

– By Suzanne Ahearne

If getting to the top of your favourite ski hill involves a tow rope this season, you might thank an engineer for the lift—and give a thought to how the profession works to ensure that a safe, smooth ride can be enjoyed by all.

The incidence of deropements of surface lifts in BC is low, but they can present real safety concerns for snowboarders and skiers. Unfortunately, because the injuries caused by deropements are rarely serious, there's less incentive for facilities to invest in design improvements.

That gap—between bottom line and public interest—was put before 450 first-year engineering design students (Engr. 110 and 112), in collaboration with the BC Safety Authority (BCSA) last Fall. Their task: design and implement safer prototypes, including testing, braking and fail safe components.

The focus of the course was the central role of safety in engineering design as well as the importance of codes and standards. BCSA engineers Jason Gill and Jeff Coleman spent more than 40 hours over the course of the term working with more than 100 student groups to refine ideas and come up with solutions—some mechanical, some electrical and some sensor-based.

Professor Peter Wild said the course surprises a lot of first-year students who underestimate how important non-technical competencies are to engineering success.

Student Michael Richards said some of the most important lessons he learned had to do with these "soft skills" of engineering: design processes, critical thinking and communication skills with both the client and team members.


Photo: Suzanne Ahearne

Colin Smith (L), retired engineer and Sean McConkey (R), engineering co-op coordinator ask first-year engineering student about design features of their group project.

After months of work, fifteen groups presented their projects to industry and academic judges and five were given awards. "The caliber of work was well beyond what I was expecting of students in their first semester at university," said Coleman, BCSA's leader of research and engineering. "We look forward to opportunities to provide real life learning experiences for students in the future."

SILVIA PENKOVA – **ENGINEERING CO-OP STUDENT OF THE YEAR**

Silvia Penkova

Driven by a passion for continuous learning in her academic and personal endeavours, Silvia Penkova is known for her relentless work ethic and positive attitude. As a former Sea Cadet fascinated by ocean exploration, Silvia spent her first three work terms refitting submarines for the Royal Canadian Navy at Babcock Canada Inc. Her interest in the environment and green technology then led her to pursue a work term in the Industrial Engineering branch of the Department of National Defence. There, she worked on a wastewater treatment plant that allowed process water to be cleaned and returned to city sewage, resulting in less waste. Silvia is interested in materials engineering and is currently working on a research project on the optical properties of CdZnTe x-ray detectors.

ERIC KYFIUK – Engineer & Adventure Seeker

– By Julie Sloan

Photo: Eric Kyfiuk

Erik Kyfiuk in Namibia

Eric Kyfiuk wanted an adventure far from home, and found more than he was looking for. Eric found work in Namibia that allowed him to use his Engineering skills with a very devoted group of people in a very different culture. He managed the Cheetah Conservation Fund's Bushblok factory, which removes invasive plants from the cheetah's habitat and uses it to create compressed biomass briquettes as a carbon-neutral source of alternative energy. I had some questions for Eric:

What drew you to work in Namibia?

I wanted to see a completely unfamiliar part of the world, live somewhere warm, and contribute to making the world a better place.

In what ways do you feel the skills you gained will benefit your career?

The more unique takeaways come from the intercultural and leadership exposure I got in Namibia: I took responsibility for people, projects and facilities. That's not a common thing for a new graduate and I'm glad I got the opportunity to do that.

Would you like to have another international work experience?

I'm glad that I spent a year in Africa working for a social venture; I made good friends, I enjoyed the beauty of southern Africa and I'm proud of the work I did there, but I'm focusing on building a career in Canada and I hope to stay put for a while now.

What is your ideal job?

During my co-ops and school projects, I grew comfortable being the project manager, the primary communicator (through writing and public speaking), and the "go-to guy" for 3D mechanical design. Although I developed these skills during my time in Africa too, the hands-on teamwork component was the most fulfilling part of my job. I'm looking for a role where I can learn from people with many skill-sets, get experience with every part of the operation, and get my hands dirty once in a while. These goals suggest that I'll end up in a small company working on technical problems.

What are your plans now?

I'm looking for a job! The past month has been a lot of fun — I've been meeting with people in Vancouver both formally and informally to learn about their companies and needs. I also have a few side-project ideas including a big hiking trip, charitable design work for friends in Namibia, and a clean-tech YouTube channel. It's an exciting place to be!

Alumni Spotlight: GREENLIGHT INNOVATION

Greenlight Innovation is a Burnaby-based developer of test and industrial automation equipment for the alternative energy industry. Three of Greenlight's four partners are UVic graduates: Ross Bailey — CEO, BEng '94, Greig Walsh — Director of Sales and Marketing, BEng '01, and Mark Olfert — Chief Technology Officer, BSc '88.

Greenlight's products are focused on aiding in the development and manufacturing of hydrogen fuel cells and energy storage devices such as hydrogen electrolyzers, Redox flow batteries, and lithium ion batteries. The company's global customer base includes an impressive list of automotive companies, material suppliers, consumer electronics companies, oil and energy companies plus a variety of universities and government research labs.

The Greenlight team consists of 40 people – mostly engineers and scientists experienced in the fuel cell and battery industries. Greenlight also retains its connection with UVic. As Bailey says, "In addition to our management team, we have a few UVic Engineers on staff because we like hiring people with co-op experience."

One of Greenlight's business philosophies and core values is to 'Hold a shared belief in environmental sustainability'. Greenlight's test units enable their customers to develop environmentally sustainable products. A recent example: Greenlight has shipped a number of test systems to a Swedish subsidiary of Volvo Truck Division to provide truckers with heat and electricity in their sleeper cabs so they won't need to idle their diesel engines all night long. The fuel cell will consume just a fraction of the diesel of the large truck engine, and will operate without noise or vibration.

Says Bailey on Greenlight's success, "I'll say that running a company has been the greatest professional experience of my life. It is extremely challenging and rewarding. Fortunately we love what we do at Greenlight, so it doesn't feel like work."

L to R: Ross Bailey, Greig Walsh and Mark Olfert.

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

EngineeRing is published twice yearly by the Faculty of Engineering 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 Julie Sloan at jsloan@uvic.ca.

University of Victoria

FACULTY OF ENGINEERING
PO Box 1700 STN CSC
Victoria, BC V8W 2Y2
engr.uvic.ca
email: engralum@uvic.ca

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