

U OF T IGNITES INNOVATION

**HOW U OF T IS
TRANSFORMING
RESEARCH FOR
ENTREPRENEURSHIP
AND PROSPERITY**



UNIVERSITY OF
TORONTO



WHAT CANADA NEEDS NOW

FIX THE INNOVATION GAP. CREATE PROSPERITY.

- Canada lags in the global push to build an innovation economy, consistently ranking among the bottom of a group of its industrialized peers.
- We have incredible innovation talent and potential. We need to get better at turning it into products and services.

OPPORTUNITIES FOR THE NEXT GENERATION.

- We live in a complex world where change has become the only constant.
- Building a career—in every sector—is tougher than it was even a generation ago.
- Post-secondary institutions must have the capacity to offer opportunities to young people so they can shape their careers.
- Some young people will use their university experience to become entrepreneurs who will create companies and jobs.
- Others will use their university education to acquire a breadth of competencies and general knowledge that can be applied—and re-applied—in any sector of the labour market over decades.

ADDRESS KEY SOCIETAL PROBLEMS.

- The world will always face challenges that compromise our lives: illness and disease, poverty, environmental degradation.
- Today, however, global society has more potential than ever before to use ingenuity and technology to effectively address these problems.

WHEN IT COMES TO INNOVATION AT THE UNIVERSITY OF TORONTO, THINGS MOVE SO FAST, IT'S HARD TO KEEP UP.

CASE IN POINT: as this special report on innovation was being prepared for printing, Professor Geoffrey Hinton and two of his graduate students from our Department of Computer Science sold their start-up company to Google Inc.

Google acquired the start-up—incorporated by Alex Krizhevsky, Ilya Sutskever and Hinton—for its research into deep neural networks. Also known as “deep learning” for computers, this research involves helping machines understand context.

This is just one example of how research that feeds innovation is thriving at U of T.

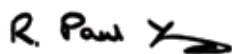
Over the last several years, the University of Toronto has redesigned our innovation portfolio. This includes activities such as technology transfer and commercialization, knowledge translation, industry partnerships and entrepreneurship education. Many of these changes were made in lockstep with our outstanding family of nine partner hospitals, the MaRS Discovery District, Toronto's world-class innovation centre, and MaRS Innovation.

This report focuses primarily on exciting developments across our three campuses. Our recent successes, however, reflect the support of a variety of partners, including the Governments of Canada and Ontario, the Cities of Toronto and Mississauga, and the business and not-for-profit sectors.

Many of the stories in this publication include U of T students. We believe research enriches the student experience and lifts the entire university.

A final point: Our innovation story doesn't end with this publication.

We look forward to welcoming you to the U of T innovation team and telling you more.



PROFESSOR R. PAUL YOUNG PhD, FRSC
Vice President, Research and Innovation



DR. DEREK NEWTON PhD
Executive Director, Innovations and Partnerships

What can a university do about it?



R. Paul Young (left) and Derek Newton (right)

CAN HAITI'S BUILDINGS WITHSTAND THE NEXT EARTHQUAKE?

CARLOS DE OLIVEIRA & MICHAEL GRAY, alumni, Department of Civil Engineering

THE PROBLEM

Most buildings today are constructed using manually-fabricated connections that anchor steel tubing to the frame of the structure. These sorts of connections can withstand wind, but they're still susceptible to earthquakes.

THE INNOVATION

Standardized connectors that allow buildings to make it through an earthquake intact.

THE APPROACH

Cast Connex incorporated in May 2007 based on the Master's research of then-student Carlos de Oliveira, who is now the company's CEO. Both he and co-founder Michael Gray, Cast Connex's vice-president, were co-supervised at U of T by civil engineering professors Constantin Christopoulos and Jeffrey Packer.

THE IMPACT

The company's connectors are in buildings around the world and will be part of the World Trade Center reconstruction. Cast Connex recently donated its products to the reconstruction of a Haitian trade school damaged by the 2010 earthquake. The steel industry is paying attention because the technology is much more economical than the status quo, but the ultimate impact is in the lives saved by making buildings safer.

WHAT'S NEXT?

Gray and de Oliveira are preparing to roll out the company's third product, a technology that will change the way energy is absorbed by buildings. It's based on Gray's doctoral research at U of T.

"We're still a relatively young company but we're fast becoming a major industry player. Five years ago I could never have imagined that I'd be the CEO of a company based on my own research. It's incredible to see my research going into buildings all over the world." – Carlos de Oliveira



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W14X48

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CAST, BONNEX H5C
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**Connectors that
allow buildings
to make it through
an earthquake
intact.**

INNOVATING EDUCATION

JANETTE PELLETIER, professor, Ontario Institute for Studies in Education and director, Dr. Eric Jackman Institute of Child Study

THE PROBLEM

Young people are faced with an increasingly complex world that places demands on them that are vastly different than even a generation ago: a shrinking and more competitive job market, a longer lifespan, rising university and college admission standards. A 2013 Toronto District School Board study found that 73 per cent of students in grades 9 to 12 are worried about their futures. Has there ever been a greater need for educational innovations that give rise to a child's creativity, curiosity and ability to change as society throws them one curve after another?

THE INNOVATION

The Jackman Institute of Child Study (J-ICS) at the Ontario Institute for Studies in Education is an innovation in itself, based around a three-pronged structure where educational researchers, Master's students preparing to be teachers, and practising teachers aim to improve on traditional models of how children learn. The focus of their learning and research happens in the Jackman Laboratory School—where 200 children from nursery school to Grade 6 receive an education based on the newest ideas in how to teach and learn.

THE APPROACH

In helping children to learn, the J-ICS focuses on “knowledge building” and children's natural curiosity. Rather than give students information, learning here begins with children's ideas. They share and compare their theories with each other, using computer technology extensively.

THE IMPACT

The impact from J-ICS innovation isn't a start-up company or product, but people. Students enter higher education and the workforce having learned to learn through their curiosity, empowering them to handle change better. Student teachers have honed their skills by way of an open environment of experimentation, which they take into the community. And J-ICS researchers use their work in this real-life setting to inform policy-makers and ministries of education.

WHAT'S NEXT?

Pelletier believes in the value of early child development and education and lauds the Ontario government's establishment of all-day kindergarten. “There is increasing understanding among researchers, policy-makers and the public that investing in early child development is absolutely critical to our future. This support must continue to grow.”

“Children go to school at J-ICS and so do adults. Our Master's students work with our professors, but their most important work is learning from the children.”







**Rather than give
students information,
learning here begins
with children's ideas.**

CAN A SUPERCOMPUTING PARTNERSHIP FIX BAD TRAFFIC?

ERIC MILLER, professor, Department of Civil Engineering

THE PROBLEM

Traffic, that's the problem. Gridlock in major cities like Toronto, where traffic jams cost the city \$3.3 billion in lost productivity each year. And that's not to mention decreased safety on the roads and an increase in air pollution and environmental degradation.

THE INNOVATION

Enter the \$210-million Southern Ontario Smart Computing Innovation Platform (SOSCIP).

At its heart is some of the best computer technology on the planet: at U of T, the IBM Blue Gene/Q, one of the world's fastest supercomputers and, at Western University, advanced cloud and agile computing infrastructure. And there is a powerful team behind the technology—seven universities (U of T, Western, McMaster, Ottawa, Queen's, UOIT and Waterloo), IBM, the Government of Canada and the Province of Ontario.

THE APPROACH

The right mix of transportation can only be achieved by understanding what's going on. Eric Miller has already established his expertise in developing computer models that can analyze overall travel demand in urban areas. His models are used by the governments of Toronto, Mississauga, Brampton and Durham Region. Now, he and U of T collaborators will use SOSCIP technology to develop even more detailed and accurate urban simulation models.

THE IMPACT

SOSCIP will enable Miller to create new knowledge about urban transportation that will provide a foundation for coordinated planning in major urban regions. And SOSCIP will be a resource to many more Ontario university researchers and small- to medium-sized enterprises, investigating areas such as health care, energy use and alternative energy distribution, water quality and pandemic planning.

WHAT'S NEXT?

Miller and his collaborators are just beginning to use SOSCIP computing technology to do their detailed analysis, which involves creating a model that integrates the transit and road transportation system of the GTA with its built form. This will enable the design of a future urban region that moves people and goods more efficiently and increases economic productivity and social well-being.

“Over 85 per cent of Ontario's citizens live in its urban regions. This number will grow. Our cities' growth cannot be planned and managed without excellent evidence-based decision-making supported by strong modeling capabilities. And that's what SOSCIP enables my team to do for the benefit of our province's future.”





An aerial photograph of a dense urban area, likely a city center, showing a mix of high-rise buildings, lower-rise structures, and green spaces. The text is overlaid on the top left portion of the image.

The right mix of
transportation can
only be achieved
by understanding
what's going on.

ADDING INTELLIGENCE TO HUMAN AND INFORMATION ASSESSMENT

HADI & MARWAN ALADDIN, alumni, Edward S. Rogers Sr. Department of Electrical & Computer Engineering

THE PROBLEM

Companies and academic institutions today conduct most of their business electronically. From employee training programs to student grades, these organizations use a variety of internal platforms to move, manipulate and assess information—and they spend billions monitoring and converting reports from different platforms into meaningful information they can act on. What's missing is a central hub that would link different platforms and reporting tools in an organization to intelligently analyze the data and convert it into outcomes and actions.

THE INNOVATION

CoursePeer, a U of T start-up that provides training, collaboration and assessment software solutions, has also developed an interface that aggregates, analyzes and organizes data from multiple sources into a single, user-friendly dashboard that can be accessed and shared by different users in an organization. Clients use the dashboard to manage their own data from diverse platforms—including CoursePeer's own solutions. The technology allows clients to transform data into outcomes and actions. Universities, corporations and governments use CoursePeer to deliver training and to manage performance, credentials and risk.

THE APPROACH

Brothers Hadi and Marwan Aladdin, both recent U of T graduates and engineering consultants for various Canadian firms, formed CoursePeer with the help of UTEST—the University of Toronto Early Stage Technology program. A joint initiative with MaRS Innovation, the program provides seed money, office space and business strategy support. UTEST advisors helped the Aladdins leverage their seed money to attract government investment. They also received advice and support from professors at U of T's Faculty of Applied Science and Engineering, which helped them attract academic clients such as Harvard and Stanford Universities.

THE IMPACT

Institutions empowered to improve their performance and productivity.

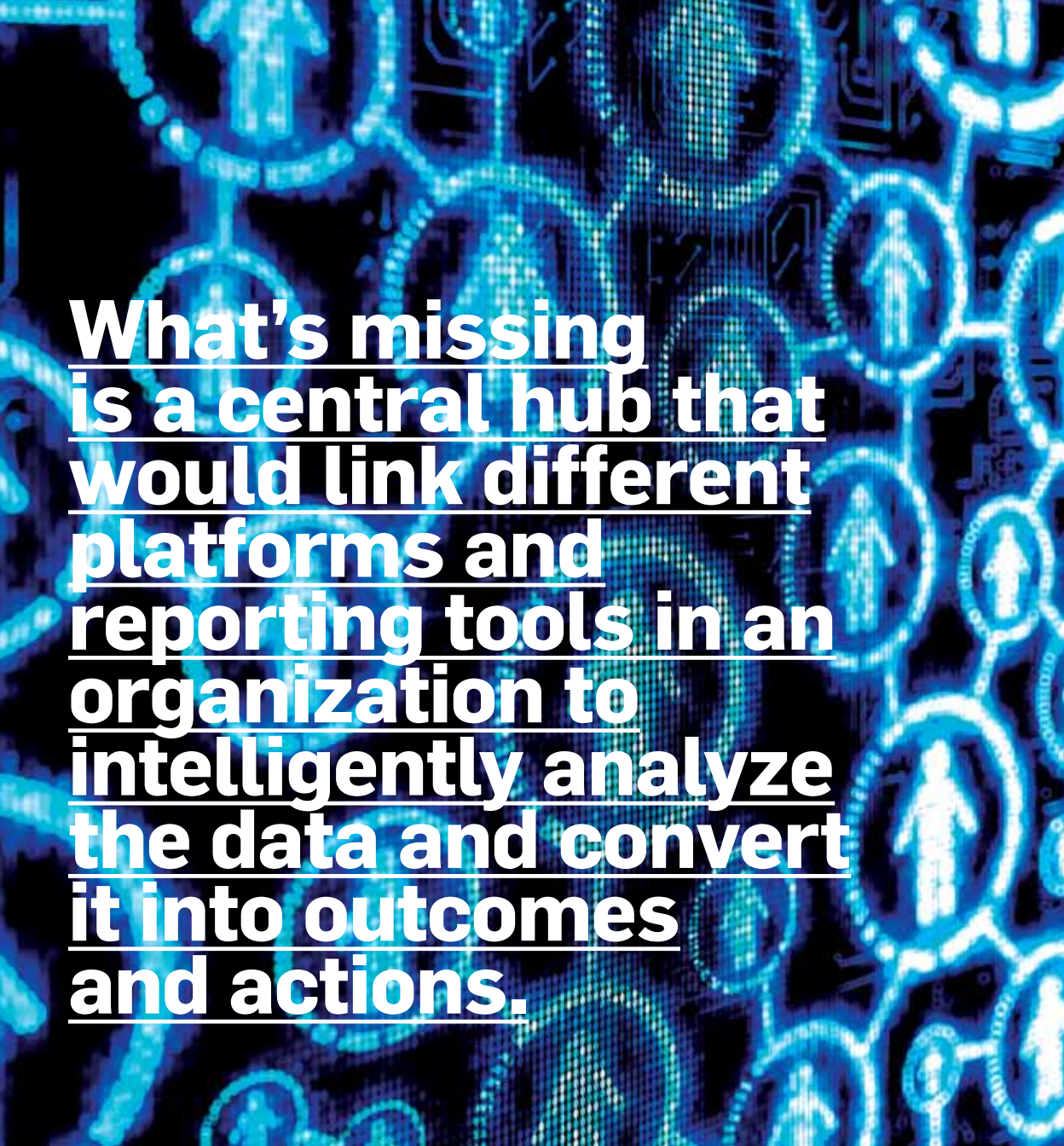
WHAT'S NEXT?

Since the launch of its cloud offering in September 2012, CoursePeer's clients now include some of North America's top universities and Canada's largest airline and flight operations training facilities. The company is negotiating partnership opportunities with some of the world's largest publishing groups.

“Our vision is to create a standard protocol that bridges the gap between the different platforms that generate assessment reports.” – Hadi Aladdin







**What's missing
is a central hub that
would link different
platforms and
reporting tools in an
organization to
intelligently analyze
the data and convert
it into outcomes
and actions.**

REINVENTING THE TOILET— AND SAVING LIVES

YU-LING CHENG, director, Centre for Global Engineering
and professor, Department of Chemical Engineering & Applied Chemistry

THE PROBLEM

Forty per cent of the world's population—that's 2.6 billion people—lives without access to basic sanitation. Western-style sanitation systems require expensive and extensive sewer and waste processing infrastructure and so are not adaptable to the developing world.

THE INNOVATION

A cheap, off-the-grid toilet that processes waste quickly and safely. It uses a sand filter and UV light to disinfect liquid waste and a smoldering process (similar to a charcoal barbecue) to incinerate solid waste that has been flattened and dried.

THE APPROACH

In 2011, the Bill and Melinda Gates Foundation awarded eight teams worldwide \$400,000 each to develop promising processing and design concepts. The U of T team, led by Yu-Ling Cheng, and with collaborators from the University of Edinburgh and Western University, recently came in third in the foundation's Reinvent the Toilet Challenge and was awarded an additional \$2.2 million to continue its work.

THE IMPACT

The World Health Organization estimates that 1.5 million children die each year of diarrheal disease. This preventable disease is the leading cause of death in children under five. An inexpensive and effective toilet would make an enormous difference in the health of developing communities worldwide.

WHAT'S NEXT?

Cheng and her team are working with partners in Bangladesh and plan to have an operational prototype in place by December 2013. A design goal is to use materials and equipment that can be maintained locally.

“We have proven that our concept works technically. We are now busy trying to make sure it will work for the users—some of the 2.6 billion people in the world who do not have access to basic sanitation.”



ENTERING
FALL BACK

DATE: 23 FEB. 2012



VILL + ELDERLY CUSTOM. POTTY

SOAP

LAVINEN + SHOWER

BACK SUPPORT

FILL WANTED!

TAP

STAND

CHERING

FILL BACK

5 YRS

Forty per cent of the world's population lives without access to basic sanitation.

REINVENT TOILET FAIR

24

A toilet that sanitizes feces and urine to recover resources and energy

University of Toronto

Canada

Reinvent the Toilet Challenge Grantee



Project

Lead Advisor
Sponsoring Institution

Sand Filter

Use all the water
to get the maximum
and filtered to
the water and
will continue to
the water.

BUILDING A BETTER MARS ROBOT

TIMOTHY BARFOOT, professor, University of Toronto Institute for Aerospace Studies

THE PROBLEM

Due to their constantly changing positions in relation to each other, it's difficult to pinpoint the exact distance from Earth to Mars at any given time. At a minimum, the planets are 56 million kilometres apart; at a maximum, the gap spans 399 million kilometres. In terms of communication, though, it can take 20 minutes for instructions in a radio signal from Earth to reach a mobile robot on the surface of Mars. And waiting for the machine to follow orders isn't exactly a good use of time.

THE INNOVATION

Timothy Barfoot is enhancing the efficiency of robots involved in planetary exploration by reducing their dependence on human commands. His algorithms and software programs help a robot independently move from one location to another by undertaking a series of small and important steps—from taking pictures of extreme terrain and selecting a safe route, to monitoring its progress on the way and recognizing when its destination has been reached.

THE APPROACH

To further advance his research, Barfoot has partnered with the Canadian Space Agency and MDA Space Missions, which includes the former SPAR Aerospace, the company behind the Canadarm. His work also involves researchers from U of T, Western, Queen's, York and Ryerson Universities.

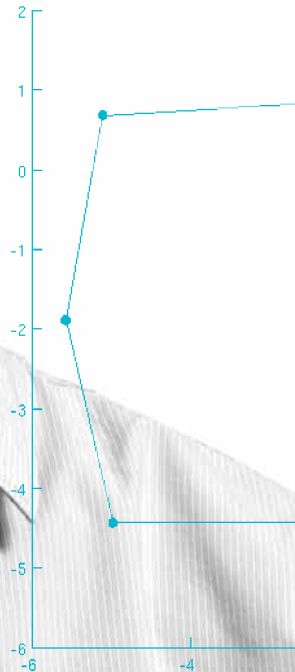
THE IMPACT

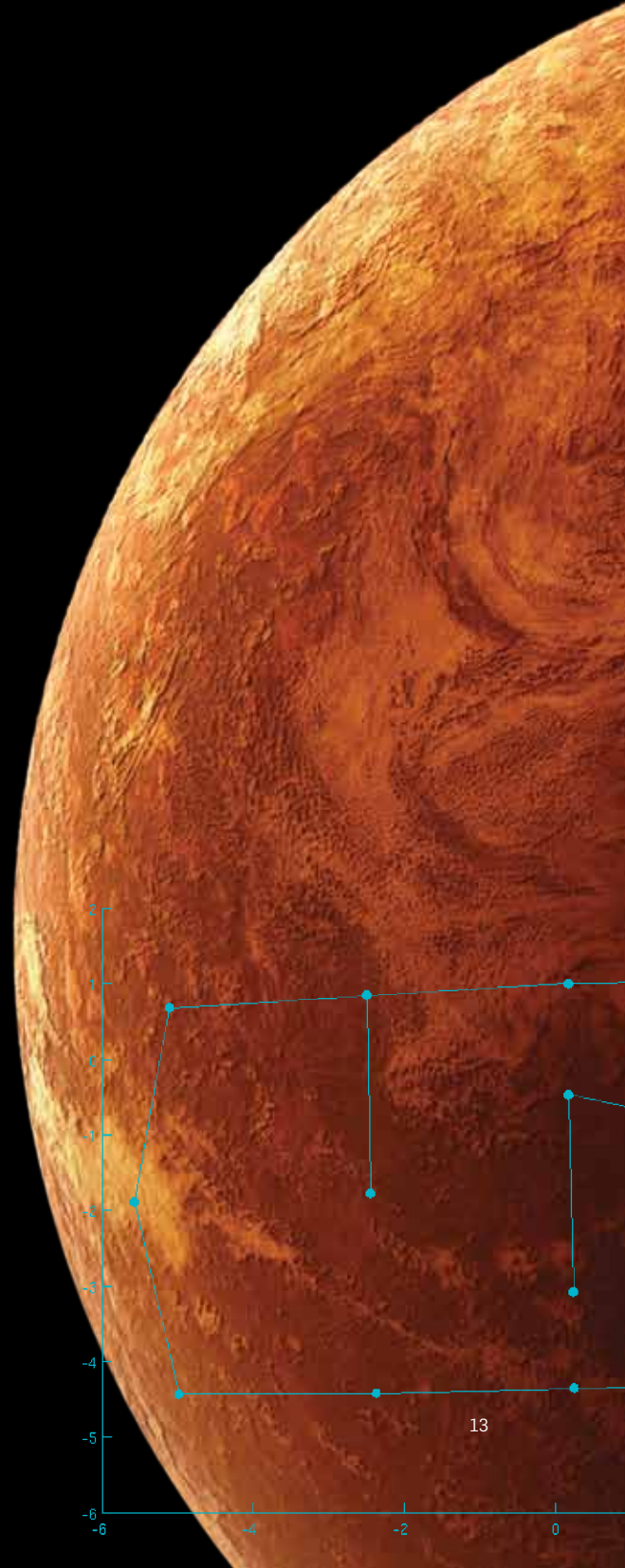
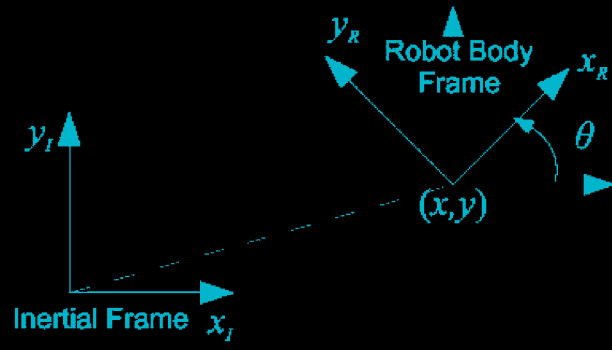
When human interaction with a Mars rover is kept to a minimum, the mobile robot can cover larger areas and collect data more effectively. And ultimately, learning more about the Red Planet will help improve the value of space missions.

WHAT'S NEXT?

Barfoot is investigating other applications for his research and hopes to begin work on self-driving cars, autonomous trains and mobile robots in the mining industry.

"Instead of telling the machine to move two inches to the left, we will tell it to go find 10 interesting rocks, put the spectrometer against those rocks and get a reading."





More autonomous
space robots
will improve
the value
of planetary
exploration
missions.



FOR THOSE WITH HIV IN DEVELOPING COUNTRIES, A LAB-ON-A-CHIP THAT COMES TO THEM

STEWART AITCHISON, professor & **JAMES DOU**, PhD student,
Edward S. Rogers Sr. Department of Electrical & Computer Engineering

THE PROBLEM

To maintain good health and avoid infection, the body relies on CD4 cells, a collection of white blood cells that do battle with bacteria. These immune system warriors, however, are destroyed by HIV. For that reason, it's vital to keep a close eye on the body's number of CD4 cells and when the total falls, provide HIV-positive people with antiretroviral drugs. But what if those patients live in a developing country, far from a health clinic and the medical equipment necessary to monitor their condition?

THE INNOVATION

Stewart Aitchison and PhD student James Dou developed a portable, hand-held device that can analyze a patient's CD4 count outside of the laboratory and within 15 minutes. This "lab-on-a-chip" is simple to use, requires little maintenance, can tolerate a range of temperatures in the field, and is aimed at improving the accessibility, efficiency and affordability of the blood-testing process.

THE APPROACH

In order to bring their research to market, Aitchison and Dou—along with biotechnology expert Rakesh Nayyar—founded ChipCare Corporation. The start-up company, which has a working prototype of its signature product, is currently seeking seed funding to expand its operations.

THE IMPACT

According to the World Health Organization, more than 30 million people worldwide are living with HIV. Sub-Saharan Africa in particular has been hit hard by the disease. So the ChipCare technology stands to make a significant difference in the treatment of HIV in that region. Rural areas of Canada could also benefit from the mobile technology.

WHAT'S NEXT?

The researchers intend to modify the "lab-on-a-chip" technology to detect even more illnesses, such as malaria, tuberculosis and sepsis.

"In rural settings here and in developing countries, people don't have access to centralized testing. People in sub-Saharan Africa might walk a long way for a test, but then they also have to come back two weeks later for results. And with HIV it's important to monitor the blood regularly in order to customize treatment. As it stands, people in sub-Saharan Africa don't have easy access to health care." – Stewart Aitchison





HIV/AIDS IS REAL

PROTECT YOURSELF



According to the World Health Organization, more than 30 million people worldwide are living with HIV.

CREATIVE, TALENTED PEOPLE

- Our students and faculty make U of T a global knowledge generator, ranked 21st in the world in the 2012 Times Higher Education rankings.
- Our nearly 7,000 faculty members are experts in hundreds of disciplines. And they are recognized for their expertise—U of T wins more faculty awards and prizes than any other Canadian university.
- Sixty-eight per cent of U of T inventions include a student or post-doc as a co-inventor. Students are top executives of many U of T start-up companies.

MARS DISCOVERY DISTRICT AND MARS INNOVATION

- U of T is a founding member of the MaRS Discovery District, which works with partners to catalyze, accelerate and amplify innovation. It supports entrepreneurs building Canada's next generation of growth companies.
- MaRS Innovation represents the commercialization interests of U of T and its partner hospitals, as well as other Greater Toronto Area universities and colleges. As a single entry-point to member-based activity of \$1 billion in annual research and development, it is a gateway for investors and licensees to access technology assets.

HOW U IGNI INNOVA

THE INNOVATIONS & PARTNERSHIPS OFFICE (IPO)

- U of T's hub for industry partnerships, commercialization and entrepreneurship.
- The goal—to get new technology out into the world and to enable university-industry partnerships.
- Professionals who can connect government and business with U of T researchers.
- From 2007 to 2011, our inventors disclosed 774 inventions. In the same period, we filed 253 patent applications, signed 166 licenses and formed 63 start-ups.

The result? An innovation ecosystem that is:

U OF T TEST ATION

BANTING AND BEST CENTRE FOR INNOVATION & ENTREPRENEURSHIP

- Business mentorship and cross-disciplinary collaboration opportunities for U of T faculty and students developing early-stage enterprises and start-ups.
- Named for Frederick Banting and Charles Best, discoverers of one of Canada's greatest innovations—insulin.

U TEST

- Joint project of IPO and MaRS Innovation.
- Provides emerging software start-ups with work space, mentoring and business strategy support.
- UTEST start-ups receive seed funds.
- Gives companies in the earliest stages of idea generation an opportunity to grow, before they're ready for traditional incubators.

TECHNO—ENABLING STUDENTS TO BECOME ENTREPRENEURS

- Hands-on workshop series for science and engineering students.
- Students turn their scientific discoveries into products, services and companies.
- Mentorship in IP strategy, product development, finance, human resources, business plans and presentation skills.
- Techno workshops have resulted in the formation of more than 30 start-up companies.

- ➔ Growing and adding new incubators for faculty and students
- ➔ Creating jobs and prosperity
- ➔ Enabling U of T students to invent their own careers
- ➔ Producing technology, products and services that are improving lives around the world

TURNING THE DOCTOR'S OFFICE INTO A ONE-STOP SHOP

SHANA KELLEY, professor, Leslie Dan Faculty of Pharmacy & Department of Biochemistry,
Faculty of Medicine

THE PROBLEM

When it comes to getting diagnostic test results, minutes matter. Treatment options must be considered and important decisions must be made. Unfortunately, clinical specimens often have to be sent away for analysis, and it can take days and even weeks to receive a diagnosis.

THE INNOVATION

Shana Kelley has developed an automated instrument that can test samples on demand and on the spot, quickly and cost-effectively. The AuRA™ (Amplified Redox Assay) technology, which uses electrochemical detection methods to study specimens on a chip, can provide results in 15 to 20 minutes. What's more, the tool can be used easily by a variety of health-care practitioners.

THE APPROACH

Kelley founded her start-up company, Xagenic, in 2010 with U of T engineering professor Ted Sargent and with the help of U of T's Innovations & Partnerships Office. The company's name is a mix of multiple references, including the extreme amplification that is required to read a specimen, the microorganisms that the instrument identifies and the electric circuits that the technology employs.

THE IMPACT

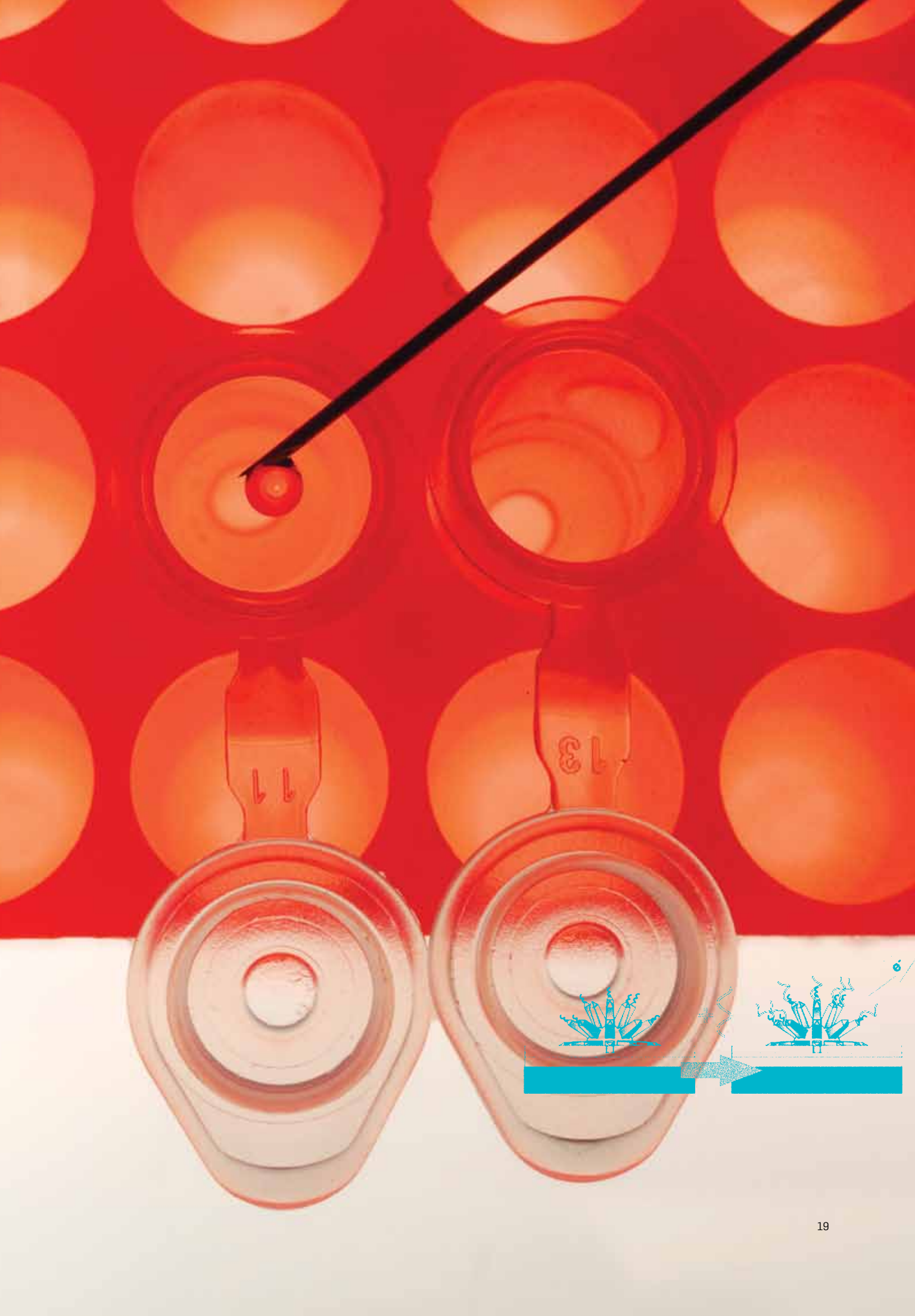
Aimed at the diagnosis of infectious diseases, the instrument can determine which germs caused a condition and whether or not the microbes are resistant to antibiotics. Therefore, in the future, patients will only need to visit the doctor once in order to be diagnosed with, and treated for, an illness. This streamlined process will improve patient care and reduce health-care costs.

WHAT'S NEXT?

Although Kelley's invention must still undergo clinical testing, the goal is to bring it to market by 2015. Down the road, the technology may also be introduced in developing countries.

"You need rapid results to make quick decisions."





**When it comes to
getting diagnostic
test results,
minutes matter.**

ECO-TEC: FIGHTING POLLUTION, CREATING JOBS AND PROSPERITY

ROCKY SIMMONS, alumnus, Faculty of Applied Science & Engineering

THE PROBLEM

Global society depends on industry. To have what we have come to want and need—from air travel to cars to medical devices to house construction to milk—we need industry. The problem is that industry needs to use chemicals that can, without the right practices, pollute the air, land and water.

THE INNOVATION

In the late 1960s, Rocky Simmons was a new graduate student in the Department of Chemical Engineering at U of T. He was fortunate to study, under Professor Irving Spinner, an innovative ion exchange process invented by Professor Robert Hunter. That process was destined to solve serious global environmental issues.

THE APPROACH

Simmons joined a manufacturing company—Wix—and was able to bring Spinner, Hunter and Wix together to create Eco-Tec. The company combined highly skilled engineers and manufacturing capability to exploit this new technology, thus saving natural resources, eliminating serious pollution issues and making industrial processes more efficient and viable.

Eco-Tec has, for example, developed world-leading products to purify produced water from oil wells for reuse. Other applications are in oil and gas refineries, metal finishing, pulp and paper, and high purity water, all geared to sustainability development.

THE IMPACT

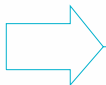
Eco-Tec technology enables industries to make their products in an environmentally sustainable manner. The company is also making an economic impact. Eco-Tec has 100 employees (many of them U of T alumni) at its Pickering, Ontario, headquarters and supplies more than 2,000 systems in 60 countries.

WHAT'S NEXT?

Eco-Tec's next steps are focussing on moving the company to new levels of sales and capacity, based on innovative, sustainable solutions for large-scale operations.

"It's in our blood to be innovative. We were able to take research from U of T and create a successful Canadian company that is a leader in its field around the world. That continues to inspire me."

Salt





Filter Waste

Produced Water

Coagulant Addition by Eco-Tec (tank or tote by others)

Skid #1 By Others

Skid #2 By Eco-Tec

Skid #3 By Eco-Tec

Existing Clarifier Feed Tank 1000 bbl

Primary Oil and TSS Treatment

Surge Tank 250 bbl

Spectrum Plus Micro Media Filters

Blended Water Tank 1000 bbl

Cartridge Filters (2 x 100%)

To Water Disposal Wells

Existing Water Disposal Tank 500 bbl

Backwash Pump - by Eco-Tec

Salt

250gpm 250psi

Recirculation



**Technology that saves
natural resources and
eliminates pollution.**

TRACKING TRENDS ON SOCIAL MEDIA

NICK KOUDAS, professor & **NILESH BANSAL**, PhD student,
Department of Computer and Mathematical Sciences, University of Toronto Scarborough

THE PROBLEM

At any given moment, the world of social media is abuzz with conversations about companies, brands and current events. But what exactly is being said? And is the overall tone good or bad?

THE INNOVATION

Nick Koudas and his PhD student Nilesh Bansal developed software that uses key words to do a real-time search for information on social media. The resulting content is then analyzed to determine what people are saying about a product, service or issue, and if their opinions are positive or negative.

THE APPROACH

In 2007, Koudas and Bansal went public with their invention and launched Sysomos, a social media monitoring and analytics company. Greek for “everything together,” Sysomos was acquired three years later by Marketwire, a news release distribution company. Today, the Sysomos team has grown considerably, and serves 70 per cent of Fortune 500 brands globally. Koudas and Bansal work part-time for the company, serving as its president and chief technology officer, respectively.

THE IMPACT

By providing access to billions of social media conversations, both here-and-now and historical, Sysomos gives corporations, marketers, advertisers and public relations agencies an insider’s view of themes and trends as they emerge on Facebook, Twitter and blogs. Knowing how their brands are perceived in the marketplace can help companies better engage with, and respond to, their customers.

WHAT'S NEXT?

Koudas and Bansal plan to use their knowledge of the commercialization process to bring other technologies to the market in the future.

“To really understand how your brand is doing, you have to know what people are saying and how they are saying it.” – Nick Koudas





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**Sysomos:
Greek for
“everything
together.”**

HELPING CROPS SURVIVE DROUGHT— AND FARMERS TO THRIVE

JULIAN NORTHEY, alumnus, Department of Cell & Systems Biology

THE PROBLEM

When prolonged drought strikes an area, crop yield, livelihoods—and the economy—can be destroyed. And drought may well intensify around the world as climate change causes huge variations in precipitation and temperature.

THE INNOVATION

While he was a U of T graduate student, Julian Northey began focussing on abscisic acid, a phytohormone involved in a plant's response to drought. He discovered a genetic pathway that hyper-sensitizes the plant to that hormone, making the plant more drought resistant.

THE APPROACH

Northey started a company, Frontier Agri-Science Inc., and worked with U of T's Innovations and Partnerships Office to license his technology to develop and mature the seed technology. Frontier recently signed its second licencing agreement with a multinational agricultural company, which will test the technology's usefulness in corn and wheat.

THE IMPACT

Northey is confident the seed technology will enable crops to grow in areas where droughts strike often. He also sees a second area of impact, where control of the crops is kept in the farmers' hands. Northey prefers an open access model, which involves giving seed directly to farmers and allowing them to save and replant it. Remuneration for the technology could then be based on a farmer's yield, eliminating the need for upfront costs. "It's a built-in crop insurance—if you produce little, you pay little."

WHAT'S NEXT?

Frontier is now working to extend the genetic research further into various crop models. Northey and his team will use two approaches. One is based on direct genetic modification, where scientists tweak the genetics of an organism. The other method is breeding or inducing mutations within the genome and then looking for plants that have the desired genetic characteristics.

"In addition to enabling crops to grow in areas ravaged by drought, we feel our open access business model is more sustainable and advantageous to the farmer. Rather than maximizing profit to a corporation, it is maximizing value to the farmer."





An aerial photograph of a vast agricultural landscape. The foreground is dominated by a field of tall, golden-brown grasses. Beyond this, a large expanse of land is covered in rows of green crops, likely corn, planted in a precise grid pattern. The rows stretch across rolling hills, creating a strong sense of perspective and order. The lighting is soft, suggesting early morning or late afternoon, with a pale sky above the horizon.

**Control of the crops
is kept in the
farmers' hands.**

IN KINGSTON GALLOWAY/ORTON PARK, UTSC HELPS A COMMUNITY RISE UP

SUSANNAH BUNCE, professor, Department of Human Geography, City Studies Program & **MALCOLM CAMPBELL**, professor, Department of Biological Sciences and vice-principal, research, University of Toronto Scarborough (UTSC)

THE PROBLEM

The City of Toronto has designated the Kingston Galloway/Orton Park (KGO) region in Scarborough a “priority neighbourhood”—one of 13 underserved city communities confronted with the more intense challenges of modern urban living, including poverty and abandonment by residents and businesses. These complex issues rob communities of their vitality, and without investments in the physical and social infrastructure of urban neighbourhoods, they can decay.

THE INNOVATION

To help invigorate KGO, Susannah Bunce and Malcolm Campbell, along with others, spearheaded a partnership between UTSC and the community group East Scarborough Storefront (ESS) to build on existing community revitalization efforts. With funding from the United Way and the Galin Foundation, the collaboration has led to many new initiatives including several educational and recreational programs for KGO community members. UTSC students have also been able to volunteer with local charities and service agencies, and conduct research on subjects of importance to neighbourhood residents and organizations, including housing, public transit and green space. Additionally, with support from CERIS/The Ontario Metropolis Centre, Bunce has studied housing and newcomer settlement issues within KGO.

THE IMPACT

New social supports have helped to strengthen the KGO neighbourhood and improved residents' quality of life. The partnership is also having an important positive impact on UTSC students, who have had opportunities for hands-on learning, and the university as a whole has demonstrated its ongoing commitment to the surrounding community.

WHAT'S NEXT?

UTSC plans to use the lessons learned from its current partnership to innovate together with other communities across the city, country and world.

“This is about more than giving back. It's about understanding communities.” – Susannah Bunce

“Collaborating hand-in-hand with our neighbourhood partners, we conduct the research and create the social innovations that positively transform communities.”

– Malcolm Campbell







It's about
understanding
communities.

OUR COMMUNITY

SWITCHING OFF CANCER

PATRICK GUNNING, professor, Department of Chemical & Physical Sciences,
University of Toronto Mississauga

THE PROBLEM

Cancer is the leading cause of death in Canada and it's projected to cost \$177.5 billion in direct health care costs over the next 30 years. Two proteins, called Stat 3 and Stat 5, are implicated in 70 per cent of all cancers. When working normally, they switch on for a few minutes to help cells grow. In cancer, they don't switch off, and go on to promote tumour growth. To date, no one has been able to design a drug that effectively targets these proteins in living organisms.

THE INNOVATION

Patrick Gunning's team has developed new molecules that cure several types of cancer in mice and kill cancer cells in tumours extracted from humans. To be effective in living systems, a drug must be capable of passing through cell membranes, must be the right size to pass through the small intestine, and must not be metabolized by the body. Gunning's molecules are the first to meet these criteria. They work by binding to Stat 3 and Stat 5 and switching them off. Significantly, healthy cells don't suffer side effects.

THE APPROACH

Gunning is working with U of T's Innovations and Partnerships Office and has filed several patents with their help. A partnership with a major pharmaceutical company means testing is in progress and venture capital firms are evaluating his discoveries.

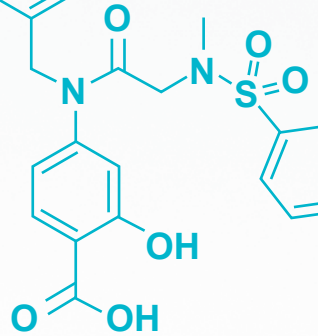
THE IMPACT

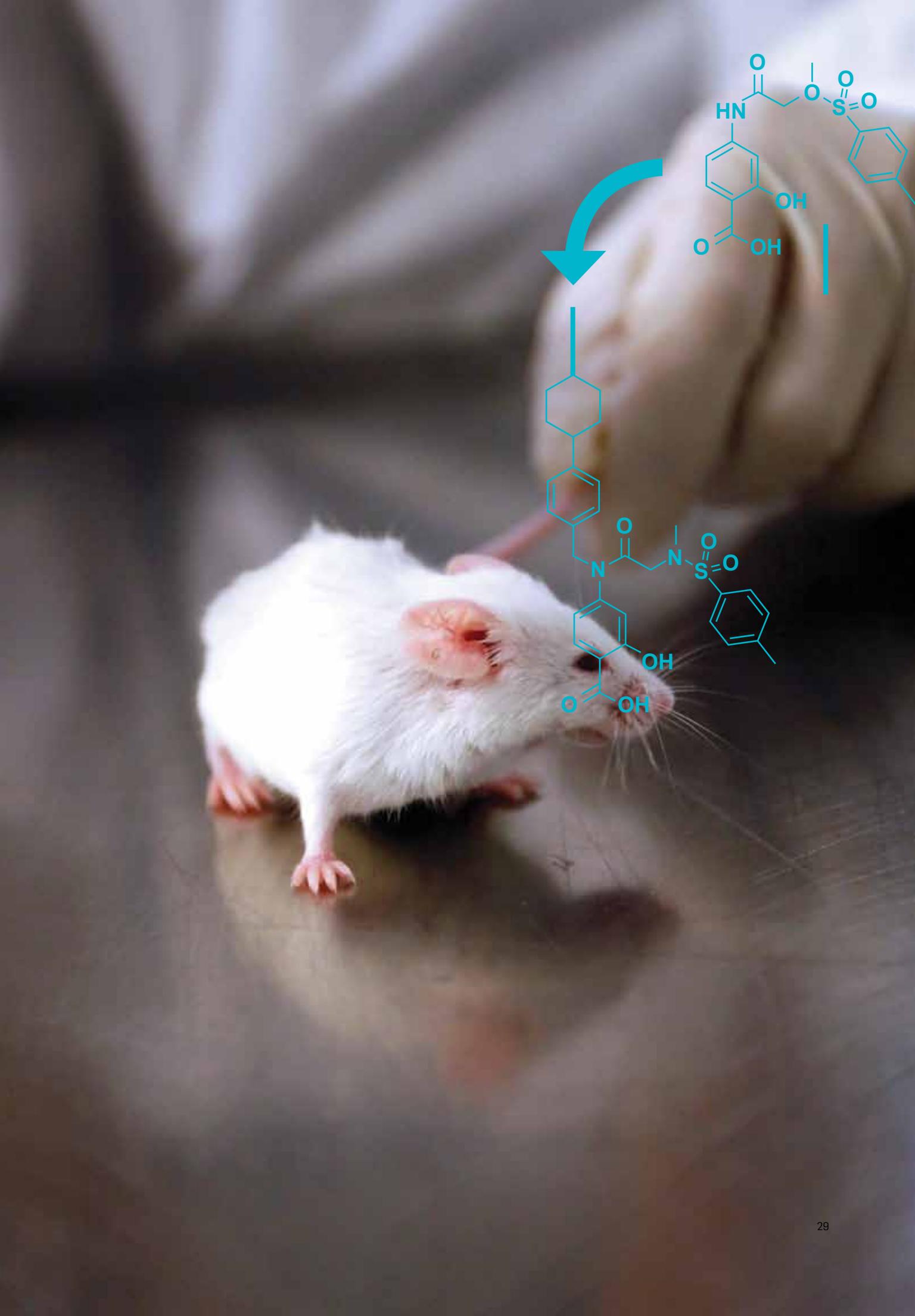
The molecules will lead to a much less aggressive chemotherapy drug, which can also be used in combination with existing drugs to reduce the harsh side effects associated with cancer treatment. They show promise in treatment of brain cancer, breast cancer, lymphoblastic lymphoma and multiple myeloma.

WHAT'S NEXT?

Clinical trials on patients with brain cancer.

"One of the things I want to do is validate Stat 3 and Stat 5 as proper cancer targets and to really turn industry's attention toward them and make them realize that this is something they should be going after. If they can put their weight behind projects to identify Stat 3- and Stat 5-targeting drugs, I think the potential for these molecules would be immense."





They work by
binding to Stat 3
and Stat 5 and
switching them off.



10

REAL-

ITIES

U OF T
IGNITES
INNOVATION

HOW U OF T IS
TRANSFORMING
RESEARCH FOR
ENTREPRENEURSHIP
AND PROSPERITY

U OF T AND INNOVATION

**U OF T AND OUR NINE PARTNER HOSPITALS
FORM CANADA'S LARGEST RESEARCH
CLUSTER WITH OVER**

\$1.2 BILLION
**IN SPONSORED RESEARCH FUNDING IN THE
LAST YEAR ALONE.**

Close to 7,000 faculty members and 18,000 graduate students and post-doctoral fellows are creating new technologies, inventions, companies and jobs.

With our partner hospitals, U of T has leveraged more than \$2 billion in research infrastructure from the Canada Foundation for Innovation in partnership with provincial agencies such as the Ministry of Research and Innovation. U of T researchers, trainees and partners—including many Canadian companies—have access to some of **THE MOST ADVANCED RESEARCH TOOLS ON THE PLANET.**

U of T is a Canadian leader in creating and protecting **MADE IN CANADA** ideas and innovations. Between 2009 and 2011, over 1,200 different U of T researchers created

476
INVENTIONS
IN OVER
38 FIELDS.

U of T also has more U.S. patents issued than any other Canadian university.**

U OF T RANKS

Nº.1
IN CANADA
IN PUBLICATIONS
AND CITATIONS
IN ALL FIELDS.*

WE RANK

Nº.2
IN THE WORLD
IN PUBLICATIONS,
SECOND ONLY
TO HARVARD.

Publication is how researchers share their findings with scholarly communities and with the world. Citations—references to researchers' work by their peers—are a way of measuring how influential that work is. This means that U of T is an international leader in generating relevant scientific knowledge.

U OF T IS

Nº. 1
IN CANADA AND

Nº. 3
IN NORTH AMERICA
IN NUMBER OF NEW
START-UP COMPANIES
CREATED

—an important way of turning ideas and innovations into products and services. We almost tripled our number of start-ups from 2009 to 2011, making us the fastest-growing major start-up cluster on the continent. And more than 90 per cent of U of T start-ups are based in the Greater Toronto Area.

U of T is creating a host of opportunities for students to become entrepreneurs. At this time, we offer 27 entrepreneurial initiatives focussed on student involvement in innovation. And in 2012 alone, more than 12,500 people (many of them students) participated in MaRS Discovery District programs like Entrepreneurship 101. And it's working—more than

TWO-THIRDS
OF INVENTIONS AT U OF T INCLUDE A
STUDENT OR POST-DOC AS A CO-INVENTOR.

U of T students are in demand—

OUR UNDERGRADUATE EMPLOYMENT
RATE AFTER TWO YEARS IS

91.7%.

Companies around the world continue to look to U of T for future leaders and talented individuals who can grow their businesses.

THE U OF T RESEARCH ENTERPRISE IS
AN ENGINE THAT CONTRIBUTES

\$5.7 BILLION
TO THE ONTARIO ECONOMY EACH YEAR
THROUGH INCREASES TO PRODUCTIVITY.

In the process of creating new knowledge and making discoveries, research has a real, tangible effect on our economy.

STARTUP GENOME RANKED TORONTO

THE WORLD'S
8TH BEST ECOSYSTEM
IN THE "GLOBAL STARTUP REVOLUTION."***

U of T is at the centre of a region that is consistently ranked among the best in the world when it comes to turning ideas into new products, services, companies and jobs.

COMPANIES NEED
NEW IDEAS TO
MAKE PRODUCTS
THAT ARE SAFER
AND GREENER.

U OF T IS

Nº. 6
IN LICENSING
TECHNOLOGIES
TO INDUSTRY**

—and 61 per cent of these technologies stay in Canada.

* Source: InCites™, Thomson Reuters for 2007-2011.

** Sources: Association of University Technology Managers (AUTM) for 2009-2011, MaRS Innovation "2011 Summary Report on 'AUTM Compatible' Indicators." Fiscal year varies by institution, U of T's is May to April. Institutions which report as systems are excluded.

*** Source: Startup Genome "Startup Ecosystem Report 2012: Part One."

For more detailed information visit www.research.utoronto.ca.

INNOVATION AND ACHIEVEMENT

NEW START-UP COMPANIES CREATED IN LAST 5 YEARS

KNOWN AS AT APRIL 9, 2013

Ablazeon Inc.
Aereus Technologies Inc.
AMP Bioinformatics Inc.
Anatomy Software International Inc.
Arda Power Inc.
ATutorSpaces Inc.
Bionym Inc.
Biostring
BlockJAM
BregLabs Inc.
Bump Technologies Inc.
CanCog Technologies Inc.
Candaru Scientific Enterprises Ltd.
Captual Technologies Inc.
CHAR Technologies Inc.
Chematria Inc.
ChipCare Corporation
CognoVision Solutions Inc.
Cream.hr
Crowdmark Inc.
Cytospan Technologies
Dalenyi Biosurfaces Inc.
DNNresearch Inc.
Dreamcube Technologies Inc.
Ecoatra Inc.
Eitan
Encycle Therapeutics Inc.
Engineered Privacy Inc.
FilLaser LLC
FIRST Hydrogen
FlowJEM
FOTA Technologies Inc.
Frontier Agri-Science Inc.
Genesys Biotech
GridCentric Inc.
Incise Photonics Inc.
InDanio Bioscience Inc.
Induce Biologics Inc.
Insight Nanofluidics Inc.
InVisage Technologies Inc.
Kaplex Inc.

Kinetica Dynamics Inc.
KMKP Engineering
LabInvasion
Lumentra Inc.
Luminautics Inc.
Lunanos Inc.
MixApart
Muses Visuals
MusIQkids Corporation
MyVoice Inc.
Nutrigenomix Inc.
Oncotek Drug Delivery Inc.
Optimal Maintenance Decisions
(OMDEC) Inc.
OTI Lumionics Inc.
Patobios Ltd.
Peraso Technologies Inc.
Phantin
PRISED Solar Inc.
Psiphon Inc.
Pueblo Science
Quantum Dental Technologies
RenWave
ScatterApps
Science Rendezvous
Scinventions
Sense Intelligent
Shape Collage Inc.
Simple Systems Inc.
Snowbush Microelectronics
Sonola Imaging Technologies
SoundOptions
Sylleta Inc.
Thotra Inc.
Touch Unicom
Transport Innovations Inc.
Tree of Life
VertoNova Analytical Inc.
WoZnew Inc.
Xagenic Inc.
Zagros Biotech

EDITORIAL: Maya Collum, Paul Fraumeni, Jenny Hall,
Derek Newton, José Sigouin, Dana Yates

CONCEPT AND DESIGN: Hambly & Woolley Inc.
PORTRAIT PHOTOGRAPHY: Finn O'Hara

SELECTED U OF T AWARD WINNERS

U OF T INVENTORS OF THE YEAR:

2012	2011
Stewart Aitchison <i>(Co-inventor: James Dou)</i>	Scott Tanner
Sachdev Sidhu	Shana O. Kelley
Peter Zandstra	Andrei Yudin
Peter McCourt	Yu Sun
Eugenia Kumacheva	Constantin Christopoulos
Aleksandar Prodic	Geoffrey Ozin
Aaron Wheeler	Nick Koudas <i>(Co-inventor: Nilesh Bansal)</i>
Tom Chau	Ronald Baecker <i>(Co-inventors:</i>
Eyal de Lara & Michael Brudno <i>(Co-inventors: Andres</i>	<i>Alexander Levy,</i>
<i>Lagar-Cavilla, Adin Scannell,</i>	<i>Aakash Sahney,</i>
<i>and Joseph Whitney)</i>	<i>and Kevin Tonon)</i>
Dimitrios Hatzinakos	V. Kumar Murty

CONNAUGHT INNOVATION AWARDS:

2012-13:	2011-12:
Constantin Christopoulos	Michael Glogauer
Carolyn L. Cummins	Constantin Christopoulos
Pierre E. Sullivan	Milos R. Popovic
Ping Lee	Dwight Seferos
Adam Rosebrock	Howard Lipshitz
Dwight Seferos	Shahrokh Valaee
Yu Sun	Molly Shoichet
Paul Yoo	Timothy Bender
Axel Guenther	Yu Sun
Zheng-Hong Lu	Eugenia Kumacheva
Ridha Ben Mrad	Stewart J. Aitchison
Shahrokh Valaee	

NSERC & OCE AWARDS:

NSERC INNOVATION CHALLENGE

2011 – Michael Montgomery (top prize)
2010 – Irena Barbulovic-Nad
2010 – Daniel Kirouac
2009 – Nigel R. Munce
2008 – Darren Kraemer (top prize)
2008 – Jiang Liu
2007 – André Arseneault (top prize)
2007 – Carlos de Oliveira

NSERC SYNERGY AWARD FOR INNOVATION

2012 – J. Paul Santerre
2011 – Eugene Fiume
2009 – Elizabeth Edwards
2007 – University of Toronto (in "Large Company" category)

OCE MARTIN WALMSLEY FELLOWSHIP

2012 – Alexander Levy
2007 – Carlos de Oliveira



**UofT is ready
for Canada's future.**

**Let's innovate
together.**

www.research.utoronto.ca



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