



SHAPING THE WORLD

Faculty of
SCIENCE
University of Alberta

SCIENCE BY THE NUMBERS

THE UNIVERSITY OF ALBERTA FACULTY OF SCIENCE is a research and teaching powerhouse dedicated to shaping the future by pushing the boundaries of knowledge in the classroom, laboratory, and field. Through exceptional teaching, learning, and research experiences, we competitively position our students, staff, and faculty for current and future success.

7

DEPARTMENTS

10

CENTRES AND
INSTITUTES

STUDENTS

1,070

GRADUATE
STUDENTS

5,940

UNDERGRADUATE
STUDENTS

45,000

ALUMNI

290

TENURE-TRACK
FACULTY MEMBERS

FACULTY MEMBERS INCLUDE

24

Canada
Research Chairs, plus
one Canada Excellence
Research Chair

22

Honorific
Chairs

PUBLICATION

REVENUE AND
DONATIONS

\$69.2M

ANNUAL RESEARCH
REVENUE

1,200+

donors give to the
Faculty of Science
each year

46

faculty named
to the Royal Society
of Canada

12

faculty who
have received the
Order of Canada

5

3M National
Teaching Fellows

OUTREACH

4,500+

attendees participate annually
in our public programs
including summer camps,
public lectures,
and science student
group events

1,500

refereed papers
published annually

137,000

students worldwide have accessed
our online education opportunities
in the form of Massive Open
Online Courses (MOOCs)
since their inception

71%

of papers published
in journals are in
those ranked in
the top 30%

10,000+

people per year participate
in education programs
hosted at facilities including
our museums and the
observatory

NUMBERS FROM 2015

THE ROAD TO DISCOVERY

AMONG THE BEST IN THE WORLD, OUR LABORATORIES, FACILITIES, AND FIELD LOCATIONS ARE PARAMOUNT TO OUR REPUTATION FOR EXCELLENCE IN TEACHING AND RESEARCH, ENABLING OUR STUDENTS AND RESEARCHERS TO REMAIN AT THE FOREFRONT OF NEW DISCOVERIES AND KNOWLEDGE.

DID YOU KNOW...

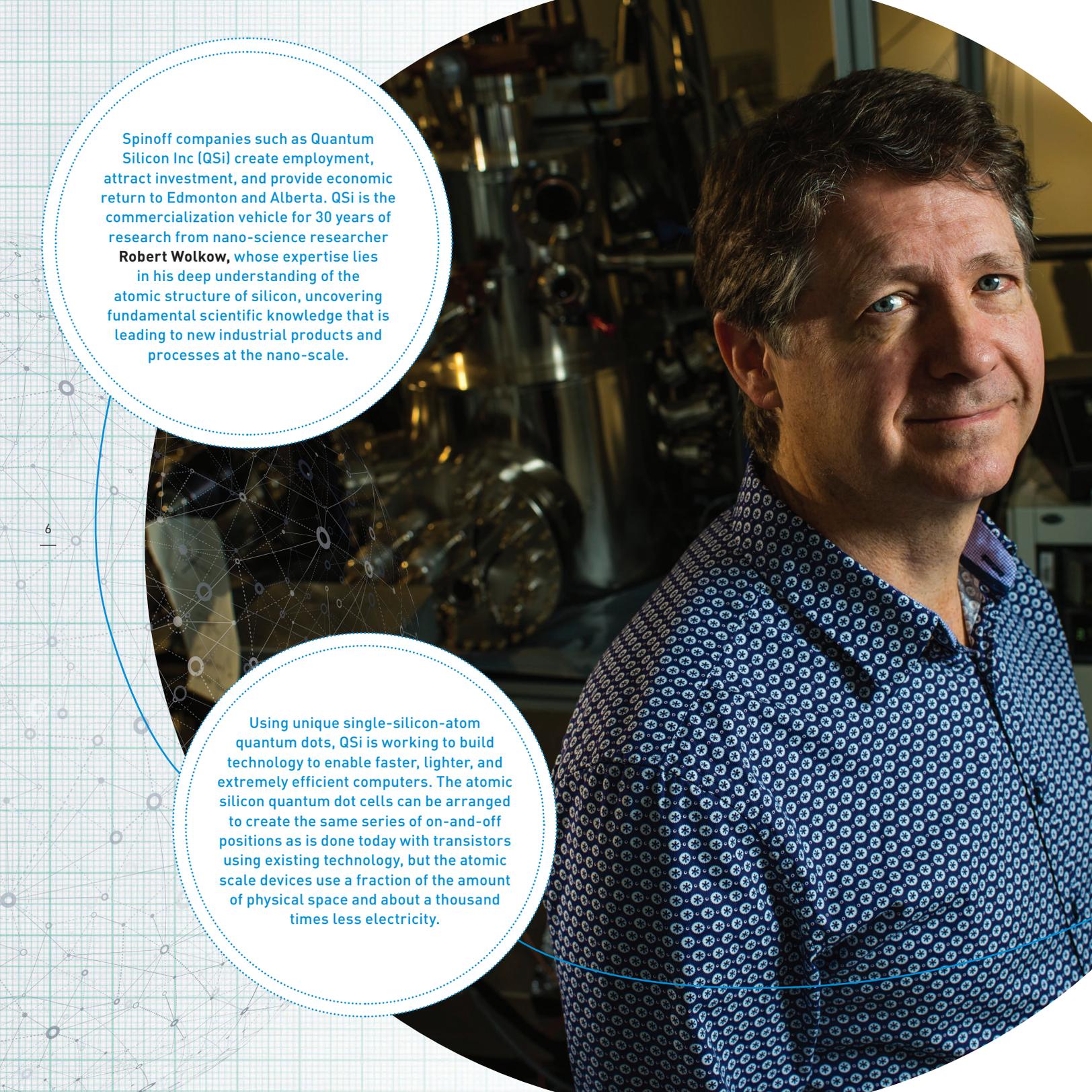
- Our leading facilities include a low-radon clean laboratory where astroparticle physics researchers build and test highly sensitive neutrino detectors. Several members of our physics department played important roles in the **Sudbury Neutrino Observatory (SNO) experiment** which led to a Nobel Prize in 2015.
- As a rich natural classroom, the physical **University of Alberta campus** provides abundant learning opportunities for science students. From the highest tree tops to the depths of Earth's core, the wealth of resources in our proverbial front yard has served to educate and inspire Faculty of Science students for decades.
- We are the future home of the **Canadian Ice Core Archive**, representing 10,000 years of ice accumulation. Spearheaded by acclaimed glaciologist Martin Sharp, the ice core collection will form an international centre for research on topics such as the history of the atmospheric nitrogen cycle, organic contaminant and black carbon deposition in the Arctic, and reconstructing past variations of Arctic sea ice.
- Housed in the Centennial Centre for Interdisciplinary Science, the **Canadian Centre for Isotopic Microanalysis** has been pivotal to many recent geochemistry and geochronology discoveries including dating Earth's earliest oxygenation.
- The Faculty of Science offers one of the most comprehensive and extensive **undergraduate field school experiences** in Canada. Our students have unparalleled access to the most coveted field locations in the world, thanks not only to the university's physical proximity to unique learning sites, but also to the international partnerships fostered all over the globe through researcher and faculty connections.



A photograph of a person with a large green backpack walking away on a dirt road in a desert landscape. The person is wearing a red shirt, khaki pants, and a brown hat. The background shows rolling hills and a blue sky with white clouds. The image is framed by a circular border with a grid pattern.

Boasting some of the world's best vertebrate paleontologists, including the internationally renowned Philip Currie, and one of the most extensive fossil collections available for research, the Faculty of Science is one of the best places in the world to study paleontology. Our proximity to some of the richest bone beds on the planet, like **Dinosaur Provincial Park**, coupled with our modern laboratories means we continue to attract the best students and researchers to our paleontology programs, like PhD candidate Greg Funston (pictured here).

Students all over the planet can access our paleontology expertise through four massive open online courses (MOOCs), including Dino 101, taken by more than 70,000 people in just two years. We also offer three mini-MOOCs, focused on theropods and the origin of birds, ancient marine reptiles, and early vertebrates. For more information, visit uab.ca/MOOCs.

A man with short brown hair and a slight smile, wearing a blue patterned button-down shirt, is shown from the chest up. He is in a laboratory or industrial setting with complex machinery in the background. Two white callout bubbles with blue dotted borders are overlaid on the left side of the image. The top bubble contains text about Quantum Silicon Inc (QSi) and researcher Robert Wolkow. The bottom bubble contains text about single-silicon-atom quantum dots. The background features a grid pattern and a network of nodes and lines on the left side.

Spinoff companies such as Quantum Silicon Inc (QSi) create employment, attract investment, and provide economic return to Edmonton and Alberta. QSi is the commercialization vehicle for 30 years of research from nano-science researcher **Robert Wolkow**, whose expertise lies in his deep understanding of the atomic structure of silicon, uncovering fundamental scientific knowledge that is leading to new industrial products and processes at the nano-scale.

Using unique single-silicon-atom quantum dots, QSi is working to build technology to enable faster, lighter, and extremely efficient computers. The atomic silicon quantum dot cells can be arranged to create the same series of on-and-off positions as is done today with transistors using existing technology, but the atomic scale devices use a fraction of the amount of physical space and about a thousand times less electricity.

SCIENCE AT WORK

THE FACULTY OF SCIENCE IS A LEADER IN RESEARCH INNOVATION AND HOME TO AN EXPANSIVE ARRAY OF CUSTOM EQUIPMENT AND SERVICES. OUR RESEARCHERS ARE ON THE CUTTING EDGE OF NOVEL WORK IN MANY INDUSTRIAL SECTORS AND ARE WORKING WITH INDUSTRY LEADERS IN RESEARCH AND DEVELOPMENT, ADDRESSING CHALLENGES, AND ASSISTING WITH TRAINING.

THROUGH COLLABORATIONS WITH INDUSTRY, LICENSING OF NEW PRODUCTS, AND CREATION OF NEW COMPANIES, OUR RESEARCHERS ARE STIMULATING THE ALBERTA ECONOMY AND CONSTANTLY SEEKING WAYS OUR RESEARCH TECHNOLOGY CAN BE MOVED FROM LAB TO MARKET. THE FACULTY OF SCIENCE HAS LONG SUPPORTED THESE INITIATIVES, WHICH TANGIBLY DEMONSTRATE THE VALUE OF THE INTELLECTUAL CAPITAL CREATED BY OUR FACULTY, STAFF, AND STUDENTS.

The technology has attracted American advanced technology giant Lockheed Martin, who has selected QSi as one of three projects to fund through an agreement with the provincial government.

DID YOU KNOW...

- Faculty of Science spinoff company **VaxAlta**, led by microbiologist Christine Szymanski, delivers safe, sugar-based, effective, affordable, and easy-to-administer livestock vaccines that eliminate the use of antibiotics, helping to improve animal quality of life and to produce better and safer foods.
- A team of computing science students and researchers led by computing scientist J. Nelson Amaral has been working in longstanding **collaboration with IBM** to design and construct compilation tools that will be needed for the next supercomputers.
- In its first 20 years, our **Science Internship Program** has given thousands of undergraduate students a competitive edge before they transition to their careers, coordinating targeted industry placements that mutually benefit both students and employers.
- Local businesses, non-profits, and government can access research expertise at our **Science-Industry Brainstorming Sessions (SIBS)**. Partner agencies submit their specific problem or questions, and we source out expertise within the Faculty and share the results at an informal lunch-hour meeting.

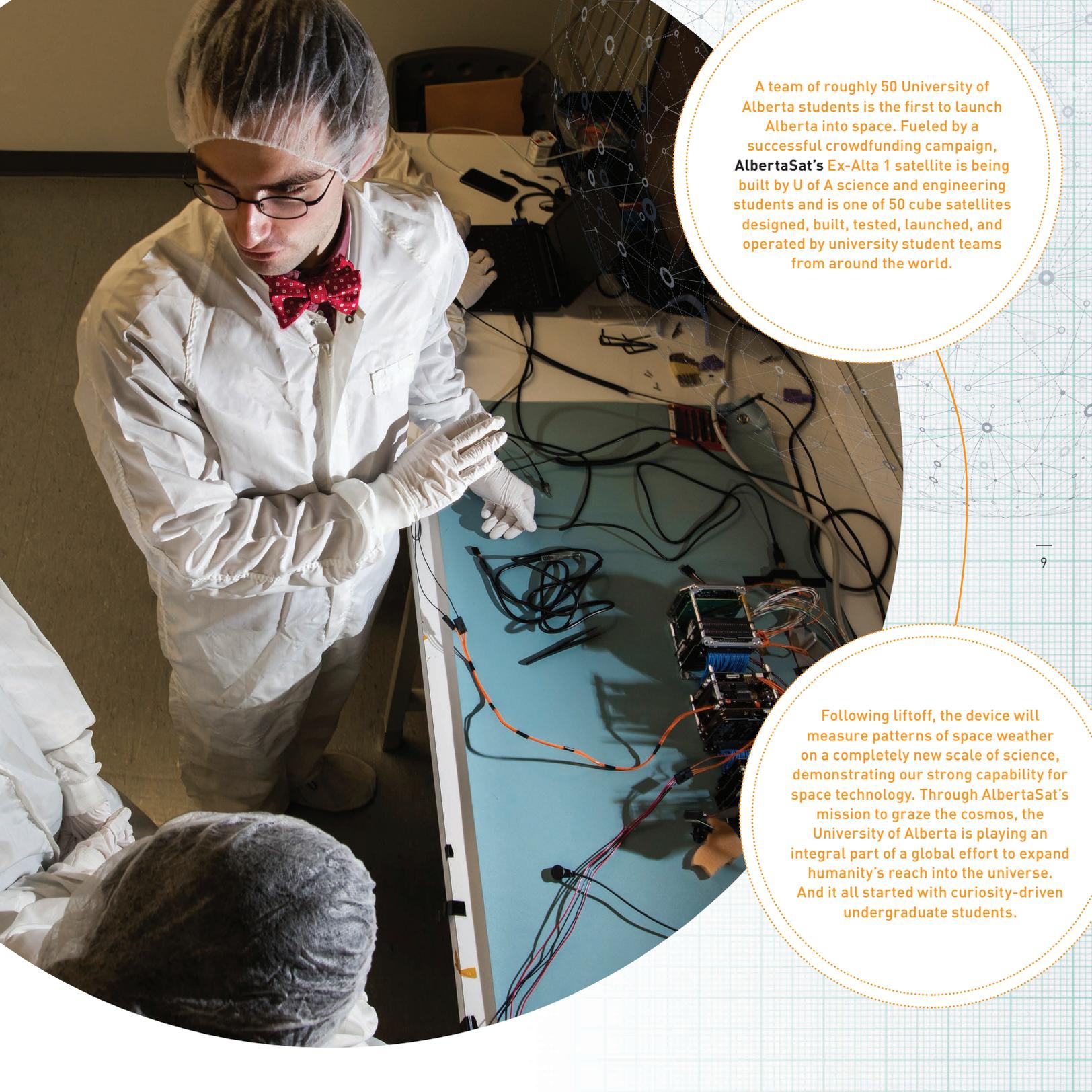
LEARNING SPACE

THE FACULTY OF SCIENCE IS REDEFINING THE CLASSROOM AND GIVING OUR STUDENTS THE TOOLS THEY NEED TO SUCCEED IN THE WORLD. WE ARE REVITALIZING TEACHING AND LEARNING BY ADOPTING INNOVATIVE METHODS BOTH INSIDE AND OUTSIDE OF CLASS. WITH A 360° APPROACH, WE ARE DRIVING ONLINE DELIVERY, INTERNATIONAL EXPERIENCE, ADVANCED TECHNOLOGY, AND EXPERIENTIAL LEARNING, PROVIDING MULTIPLE PATHWAYS TO SUPPORT STUDENT SUCCESS.

DID YOU KNOW...

- The Faculty of Science has more **lab contact hours** in first-year undergraduate courses than any other university in Canada.
- Our students are learning how to communicate not only across disciplines but also across cultures. The **Alberta/TUM (Technische Universität München) International Graduate School for Hybrid Functional Materials (ATUMS)** with German partners is geared towards training young elite scientists and engineers in essential skills, enabling them to play key roles in revolutionizing and revitalizing the polymer-materials sector of the Canadian economy.
- In 2015, the first Canadian **undergraduate research certificate** in science was approved in the Faculty of Science. Led by the Department of Biological Sciences and officially recognized on students' transcripts, students complete three research experiences, a technical skills course, and a data analysis course and present their work at a conference. A second certificate, led by the Department of Psychology, has been approved, and plans for certificates in other departments are in progress. We are the only research- and teaching-intensive institution to provide students with credentials for research skills. The research certificates complement our Certificate in Computer Game Development and our soon-to-be completed Citizenship and Engaged Leadership Certificate in Arts and Science, both joint with the Faculty of Arts.
- In an increasingly globalized science community, opportunities like our **Southern African Field School** not only provide our students with rich first-hand fieldwork experiences, but they also introduce students to the global science network much earlier in their careers.





A team of roughly 50 University of Alberta students is the first to launch Alberta into space. Fueled by a successful crowdfunding campaign, **AlbertaSat's** Ex-Alta 1 satellite is being built by U of A science and engineering students and is one of 50 cube satellites designed, built, tested, launched, and operated by university student teams from around the world.

Following liftoff, the device will measure patterns of space weather on a completely new scale of science, demonstrating our strong capability for space technology. Through AlbertaSat's mission to graze the cosmos, the University of Alberta is playing an integral part of a global effort to expand humanity's reach into the universe. And it all started with curiosity-driven undergraduate students.

Anyone who has travelled the postcard-perfect landscapes of British Columbia may be familiar with the shocking sight of a forest in the red death-throes from the mountain pine beetle. In 2011, a University of Alberta-led research team determined the mountain pine beetle had invaded jack pine forests in Alberta, opening up the possibility for an infestation stretching east across the Prairies all the way to the Atlantic.

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So far, more than 19 million hectares of forest land in Western Canada have been affected by the outbreak. This has resulted in losses of more than 1 billion cubic metres of mature pine trees, with additional damage dealt to the forest industry, recreational opportunities, plant and wildlife habitats, watersheds, and a range of ecosystem services.



CONNECTED TO THE COMMUNITY

THROUGHOUT OUR FACULTY'S HISTORY, OUR RESEARCHERS, STUDENTS, AND ALUMNI HAVE ENDEAVORED TO TAKE SCIENCE BEYOND THE LAB WHERE IT CAN HAVE AN IMPACT IN LOCAL COMMUNITIES AND AROUND THE WORLD.

Led by director **Janice Cooke**, **TRIA-Network** is a national collaboration of 18 scientists (including six from the University of Alberta), government forestry officers, and representatives from industry and the not-for-profit sector. This national enterprise is "Turning Risk Into Action" to protect Canadian forests through science-based strategies to control the spread of the mountain pine beetle in Canada. Cooke tests lodgepole and jack pine seedlings in her lab to discover whether northern and southern pine trees react differently to the fungus carried by the pine beetle.

DID YOU KNOW...

- Psychology researcher Fred Colbourne has been working to buy time and save brain function by fine-tuning **hypothermia as a treatment protocol for stroke victims**. The now clinically-used protocol of inducing prolonged mild hypothermia came about from old observations that near-drowning victims could survive with relatively little brain damage provided they had a low body temperature.
- Biochemist David Wishart was the driving force behind the **Human Metabolome Project**, a multi-university, multi-investigator project that catalogued all of the known metabolites in human tissues and biofluids. Using advanced methods in NMR spectroscopy, mass spectrometry, multi-dimensional chromatography and machine learning, Wishart and his colleagues identified or found evidence for more than 8000 endogenous metabolites. This information has been archived on the Human Metabolome Database, a freely accessible web-resource.
- Northern ecologist David Hik is a driving force behind the **Canadian Mountain Network**, a voluntary alliance of numerous partners from universities, governments, First Nations, and businesses dedicated to the sustainability of mountain environments and communities across the country and around the world.
- Computing scientist Eleni Stroulia is building a "smart condo" outfitted with sensors and sophisticated monitoring software to research how wireless devices can promote **independent living for the elderly**.
- Faculty of Science researchers have spent decades getting to the bottom of what is happening at the top of our world. From John England's 50-year career in Arctic geography to Andrew Derocher's study of polar bears, we are leading the university's **northern strategy** to address future issues of climate change.

PRIDE IN OUR PEOPLE

WITH EXCELLENCE RANGING FROM ARTIFICIAL INTELLIGENCE TO ZOOLOGY, OUR FACULTY MEMBERS ARE LEADERS IN THEIR RESPECTIVE FIELDS AND SECOND TO NONE. RESEARCH INNOVATION AT THE FACULTY OF SCIENCE IS FLOURISHING IN A BREADTH OF DISCIPLINES INCLUDING ECOLOGY, GEOLOGY, GLACIOLOGY, GLYCOMICS, MACHINE LEARNING, MATHEMATICAL BIOLOGY, NANOTECHNOLOGY, NEUROSCIENCE, PALEONTOLOGY, PARTICLE PHYSICS, AND SPACE SCIENCE, TO NAME JUST A FEW. WE HAVE A LONG HISTORY OF EXCELLENCE, AND WE CONTINUE TO MAKE STRATEGIC INVESTMENTS TO GROW OUR PORTFOLIO OF INTERNATIONALLY RECOGNIZED SUPERSTARS AND RISING STARS.

DID YOU KNOW...

- From **Raymond “Sugar Ray” Lemieux** to **David Bundle** to **Todd Lowary**, the U of A has a strong legacy in glycomics research. Carbohydrates play a pivotal role in virtually all biological processes, making them key to solving many health issues. The Department of Chemistry is now home to GlycoNet, a national Centre of Excellence for the study of glycomics.
- Biochemist **Robert Campbell** and his team have developed a method that converts biochemical processes between proteins into colour changes that are easily visualized at the cellular level. This tool provides a versatile approach to building the next generation of biosensors.
- For more than 35 years, **Philip Currie’s** name has been synonymous with dinosaurs in Alberta and Canada. The impact of his research has been realized around the globe and has established Alberta as an internationally renowned dinosaur hub. Due in no small part to the work he has completed during his tenure, the University of Alberta is recognized as one of the premier places in the world to study vertebrate paleontology. Currie has received awards and accolades the world over, most recently with the naming of a museum in his honour in Grande Prairie, Alberta.
- One of just 25 Canada Excellence Research Chairs in the country, **Graham Pearson**, CERC in Arctic Resources, is pushing the development of new methods for dating diamonds, advancing our understanding of diamond deposits deep underground, and aiding scientists and industry in determining which deposits are economically viable. His Arctic Resources Geochemistry Laboratory is unmatched in the world.
- The legacy of one of the greatest scientific minds of our generation lives on through the Faculty of Science’s continued excellence in water research. Over an award-studded 60-year career, including the first ever Stockholm Water Prize in 1991, Professor Emeritus **David Schindler** rewrote the practice of water ecology as the inaugural director of the Experimental Lakes Area in Ontario, and is renowned as one of Canada’s most powerful environmental advocates.
- Computing scientist **Russ Greiner** is applying machine learning to medical applications. For example, the Brain Tumour Analysis Project has developed a program to automatically segment brain tumours in MRI scans so doctors will no longer have to do so manually.



University of Alberta researchers have found that abundant materials in Earth's crust can be used to make inexpensive and easily manufactured nanoparticle-based solar cells. The discovery is an important step forward in making solar power more accessible to parts of the world that are off the traditional electricity grid or face high power costs, such as the Canadian North.

Senior research officer at the National Institute for Nanotechnology Jillian Buriak and her team have designed nanoparticles that absorb light and conduct electricity from two very common elements: phosphorus and zinc. Both materials are more plentiful than scarce materials, such as cadmium, and are free from manufacturing restrictions imposed on lead-based nanoparticles. With the demand for electrical power expected to double by the year 2050, access to affordable alternative energy sources like solar power is critical. The research of Buriak and her team supports a promising approach of making solar cells cheaply using mass manufacturing methods like roll-to-roll printing (as with newspaper presses) or spray-coating (similar to automotive painting).



Researchers in the Computer Poker Research Group led by Michael Bowling essentially solved heads-up limit hold'em poker with their program Cepheus in 2015. The accomplishment made international headlines, taking the mainstream media by storm.

CHANGING THE GAME

ARMED WITH A UNIVERSITY OF ALBERTA SCIENCE EDUCATION, OUR ALUMNI ARE DOING GREAT THINGS IN COMMUNITIES THE WORLD OVER. THE GLOBAL RIPPLE OF THESE ACHIEVEMENTS IS OUR PRIDE AND LEGACY.

OUR EXCEPTIONAL ALUMNI ARE A PRODUCT OF AN INCOMPARABLE RESEARCH ENVIRONMENT, AS DEMONSTRATED BY THE TRIUMPHS OF OUR FACULTY.

There is perhaps no greater example of the power of our people than in Artificial Intelligence (AI), a field dominated by Faculty of Science talent. For more than half a century, games have been test beds for new ideas in AI, and the resulting successes have marked significant milestones.

- Led by computing science alumnus David Silver ('09 PhD), Google's DeepMind team recently developed the first **computer Go** program capable of professional-level play, drawing from decades of research in the Department of Computing Science including that of Rich Sutton, considered

by many in the field to be the father of reinforcement learning.

- Murray Campbell ('79 BSc, '81 MSc) was one of the three scientists to design DEEP BLUE, the **first computer to prevail in chess** by defeating world chess champion Garry Kasparov in 1997.
- In 2007, computing science professor and current Dean of Science Jonathan Schaeffer announced that **checkers had been solved**. His checkers-playing program Chinook was also the first computer program to win a human world championship in any game.

DID YOU KNOW...

- A theory proposed by Professor Emeritus Charles Stelck ('37 BSc, '41 MSc, '03 DSc) that coral reefs once existed in what is now the Arctic led to the discovery of oil in Alberta in 1947.
- One of the world's strongest advocates for women in STEM, Margaret-Ann Armour ('70 PhD, '13 DSc), founder of WISEST (Women in Scholarship, Engineering, Science & Technology), has dedicated her career to **increasing diversity in science**.
- Faculty of Science grads are a leading force in **science communication** across Canada. The Discovery Channel's flagship science program *Daily Planet* has been dominated by our alumni since its inception in 1995, featuring hosts Jay Ingram ('67 BSc) and Dan Riskin ('97 BSc) and Alan Nursall ('81 MSc) in his popular recurring segment *The Alan Nursall Experience*. Our broadcasting alumni also include *The Nature Nut* host John Acorn ('80 BSc, '88 MSc) and CBC Science columnist Torah Kachur ('01 BSc, '08 PhD).
- The Faculty of Science was home to the University of Alberta's only **Nobel Laureate**, Richard E. Taylor ('50 BSc, '52 MSc, '91 DSc), who won the Nobel Prize in Physics in 1990 for his groundbreaking research on deep inelastic scattering of electrons on protons and bound neutrons.

