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on the edge

UNIVERSITY OF ALBERTA

science contours

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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.

Science Contours is a semi-annual publication dedicated to highlighting the collective achievements of the Faculty of Science community. It is distributed to alumni and friends of the faculty.

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FACULTY OF SCIENCE

Tiny cell, big possibilities

UAlberta chemists explore Earth-abundant materials to build next-generation solar cells. Read more: p. 12

contents

By **KATIE WILLIS** *Photos* **JOHN ULAN**

The future of energy is looking bright

SIX SCIENTISTS CHANGING HOW WE POWER OUR WORLD

RESEARCHERS IN THE FACULTY OF SCIENCE and from across campus are honing the future of energy, with a focus on developing new technologies as well as finding solutions for the challenges presented by our legacy energy systems. ■ Doing so starts with a full-systems approach through the University of Alberta's Future Energy Systems research initiative, which connects more than 100 researchers and close to 300 graduate students from across seven faculties and campuses. Future Energy Systems is funded with $75 million from Government of Canada's Canada First Research Excellence Fund, and has launched more than 60 projects. **Learn how six Faculty of Science researchers from across disciplines are changing the face of energy in Alberta, Canada, and globally. With upwards of five new projects involving Faculty of Science researchers on the horizon, the future of energy in Canada and around the world is looking bright.**

GEOTHERMAL ENERGY

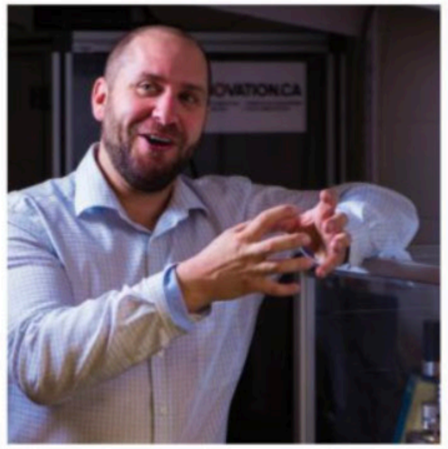
GEOTHERMAL ENERGY is the next hot thing—literally—in Alberta, with the potential to leverage a clean, renewable resource and fuel a new, sustainable industry. The concept is simple: pump hot water from underground to Earth's surface using wells. Use that heat to create power, and then inject the cooled water back into the ground at another local site, where it will heat up again. This emerging energy source has the advantage of using the same infrastructure as the oil and gas industry.

Target practice

Professor **Martyn Unsworth** (below) is using his geophysical expertise to look underground and find the best places to extract the hot water needed for geothermal energy production.

His work involves generating images of underground rock structure using radio waves and other signals to identify the best locations for drilling. "What works in one geographical location doesn't work everywhere worldwide," explains Unsworth. "We're looking at a range of energy technologies that will work together. We have to have a system in combination."

One of the challenges of developing geothermal energy is that it requires a larger initial investment for drilling wells. However, geothermal has the major advantage that it works 24 hours a day, year-round, unlike many other renewable energy sources, making it a complement to other sources of renewable energy.



Pilot project in Alberta

Research associate **Jonathan Banks** is bringing a pilot project in geothermal energy to Alberta. In partnership with local company Epoch Energy, Banks and his colleagues are working to retrofit oil wells near Hinton with the potential to provide megawatts of power to the local community.

"We'll use the same infrastructure, the same expertise, the same service providers, and the same software," says Banks. "It's really just a matter of retooling and retraining the capacity that we already have. Alberta is at a huge advantage for getting started without the steep and expensive learning curve other places are facing."

With his colleagues, Banks is working on reservoir modelling that makes geothermal energy projects possible by finding reservoirs, determining their thermodynamic properties, and modelling fluid flow.

SOLAR POWER

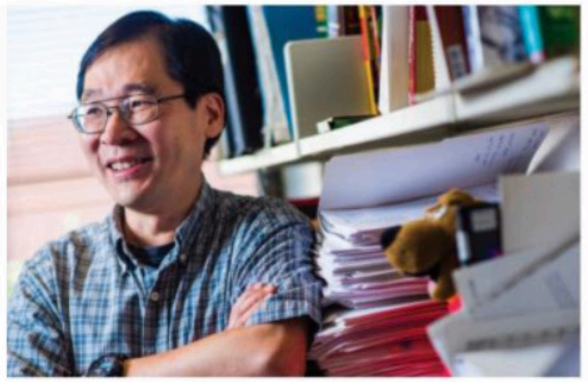
THE SOLAR CELLS that convert solar energy are notoriously inefficient to create. Traditionally composed of silicon, created from sand in an energy-intensive process, individual cells can take two to four years to recoup the initial energy required for their creation. And though solar energy is abundant, the use of solar power could be much more common than it currently is.

Sunnier prospects

Chemist **Jillian Buriak** is working to develop inexpensive and manufacturable solar cells. Called the 24-hour solar cell, this technology aims to recoup the energy needed to make it in the space of a single day. The technology grows out of a collaboration with the group of Arthur Mar, and uses machine learning to develop efficient solar cells much faster.

"It's kind of a dream. Realistically, right now, we're looking at recouping that energy in the space of a few months; but compared to silicon solar cells that require about two years, we are in a strong position," explains Buriak, Canada Research Chair in Nanomaterials for Energy.

Buriak and her research collaborators are exploring Earth-abundant alternatives to silicon—and the prospects look extremely sunny. In addition to alternatives to silicon, Buriak's group is looking for more flexible, lightweight materials that can be rolled on or spray-coated to a surface, noting that this will help decrease capital and labour costs during initial installation.



The power of AI

Part of the challenge in identifying alternative materials is the labour required to weed out materials that won't work. Enter **Arthur Mar**, UAlberta chemist, who is harnessing the power of artificial intelligence to identify new materials to be used on solar cells.

"My lab is acting as the bridge between the computing scientists who develop the algorithms of machine learning tools and those who want to apply this information to make new things," says Mar.

Using these algorithms, Mar and his team will screen many potential materials to identify the required components of the ideal solar cell material in hopes of building more efficient and powerful cells. From here, Buriak and her research team will investigate the proposed materials over the next two to three years.

BIOFUELS

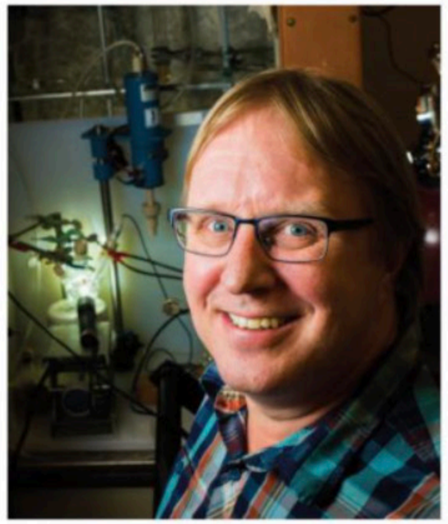
THE TRADITIONAL METHODS of producing energy, including the extraction and refinement of oil and gas, produce emissions that contribute to the greenhouse effect. In some cases, these emissions are byproducts of production, such as carbon dioxide. There are also "fugitive" emissions, when there is not enough of a particular byproduct produced to become something useful but too much to release into the atmosphere without consequence. But what if it were possible to capture these emissions and make them into something useful while also mitigating their negative impact on our environment?

Carbon: zero

Chemist **Steven Bergens** is looking for ways to reduce the carbon footprint of oil refinement to nearly zero—all with the help of a seemingly simple chemistry equation.

"The idea is to take carbon dioxide and create something valuable—like fuels and chemical building blocks," says Bergens. "Our job is to develop efficient, inexpensive catalysts that are connected to solar energy collectors that make these chemical reactions possible."

Specifically, Bergens hopes to combine carbon dioxide, water, and sunlight to create liquid fuels, carbon monoxide, or methane. Using fuels and products made from carbon dioxide, sunlight, and water would dramatically reduce the total amount of carbon dioxide released into the atmosphere. And with a few promising systems already in the works, the future is looking bright.



Small but mighty

Microbiologist **Lisa Stein** is developing bacteria that will create useful biofuels from oil and gas production waste products, such as methane. In conjunction with colleagues across campus, Stein is developing a small-but-mighty bioreactor that will capture waste methane emissions and convert them into something useful.

"Essentially, we take single carbon molecules and create complex organic materials, thereby adding a lot of value to these waste products," says Stein. "Combining that waste methane with our bacteria, we can create biofuels like biodiesel and isoprene."

Smokestack flares are the result of "fugitive" methane emissions in many industries, from water treatment plants to paper mills to oil and gas refineries. The proposed bioreactor will have the capacity to make this fugitive methane useful. Stein's bacteria combined with this technology will effectively close the loop in our legacy energy system.

NEW WINDOW INTO THE nanoworld

By Suzette Chan Photos John Ulan

SCIENTISTS COMBINE THE ULTRA-FAST WITH THE ULTRA-SMALL TO PIONEER MICROSCOPY AT TERAHERTZ FREQUENCIES

The scanning tunnelling microscope in Frank Hegmann's physics lab is the product of nearly a decade of work and two generations of graduate students.

Frank Hegmann (right) with PhD student Vedran Jelic (left) and former graduate student Tyler Cocker ('12 PhD, centre)

IN 2008, Frank Hegmann opened the door to a new lab in Phase 1 of the Centennial Centre for Interdisciplinary Science, a new underground facility adjacent to the biological sciences building. He was waiting for his new equipment to arrive in hopes of building an apparatus that could take microscopy to the next level. The thing was, he had no idea whether it would work.

Developing a microscope that can take snapshots of electron dynamics inside a single atom has been a longstanding scientific goal. On one hand, researchers could acquire images of single atoms and molecules on surfaces, but not their electronic motion. On the other hand, ultrafast lasers could be used to record the dynamics of many atoms and molecules at once. After years of working on these older systems, Hegmann wondered how he could improve the process. "I got to thinking, 'What if I could kill the proverbial two birds with one stone?'"

The leading edge technology at the time was the scanning tunnelling microscope (STM). "To actually see single atoms and to manipulate them into structures opened up a whole new world of being able to visualize nature," Hegmann says. "But scanning tunnelling microscopes are not very fast instruments. They can only do slow scans. On the ultra-fast side, there's this whole field of people using these very short laser pulse sources to examine very fast processes in nature."

After joining the University of Alberta as a faculty member, Hegmann eventually applied to the Canadian Foundation for Innovation for a grant to develop an instrument to look at single molecules and even smaller-scale material.

"People were telling me it was risky. We said right in the application that we had no idea if it would work," Hegmann says. "One of the best Christmas presents I ever got was an email from the Research Services Office, just a few days before the holidays, saying that the grant was funded. I couldn't believe it."

Youthful inspiration

MEANWHILE at the University of Victoria, an undergraduate student named Tyler Cocker had become fascinated with ultra-fast terahertz technology. He decided to do a master's degree at the University of Alberta with Hegmann.

"As Frank was planning the equipment for this new lab, it became a possibility that I could change into the PhD stream and work with Frank on this idea for a new terahertz STM," says Cocker. "At the time, the lab was an empty room, so this involved some planning. For four years or so, I did terahertz spectroscopy and pre-planning for what we expected to happen when we coupled the terahertz pulses with the STM tip."

Progress on this brand-new, might-not-actually-work technology proved to be anything but a straight path. "There were many moments of discouragement and then elation, and then a point where I would think, 'OK, that's as far as it can go.' And then maybe we need a break, or a pep talk."

Cocker's efforts eventually paid off. "I'm not sure I would have guessed that, as a student working on it, it would get this far so quickly because, at first, it seemed noisy and difficult to do. Now,


A look inside the world of lasers in Frank Hegmann's lab.

we can take snapshots of atoms or electron densities around molecules, and it's remarkable."

Next generation

HEGMANN made additions to the lab. He bought equipment and recruited researchers, including Vedran Jelic ('12 BSc), who was then a University of Alberta undergraduate looking to do research as a summer student.

"When I started working in the lab with Tyler, the microscope was sitting on the optics bench, which is not really the ideal environment for such a sensitive instrument," Jelic remembers. "After Tyler finished his PhD, our plan was to move the microscope into the ultra-high-vacuum chamber to hopefully study features on the atomic scale. Again, we didn't know if this was going to work, since our model suggested that we might not have enough strength in our laser to see the effect. Thankfully, after a few years of trial and error, we were rewarded with some spectacular results."

After Cocker went on to a post-doctoral fellowship at University of Regensburg in Germany—where he built the world's second terahertz STM—Jelic stayed at the University of Alberta to complete his PhD while further refining the terahertz STM. The duo will reunite this fall, when Jelic begins a post-doctoral fellowship under Cocker's supervision at Michigan State University, where Cocker was recently hired as an assistant professor of physics.

Together, Cocker and Jelic will be working on what could be the first terahertz STM built in the United States. It would be among at least a dozen other terahertz STMs being developed across the globe.

Hegmann, who years ago couldn't believe he got the initial funding for the project, is amazed by what his team has developed. "The terahertz STM is now a tool that takes an image of what's happening locally—to actually see the energy go from here to here over a few atoms' length scale."

With eyes to the future, terahertz STM may one day revolutionize the speed and efficiency of current technology, ranging from solar cells to computer processing.

Advice from the Terahertz STM lab

The future of condensed matter physics began with an empty room—specifically the lab in which Frank Hegmann (physics) developed the world's first terahertz scanning tunnelling microscope. Now, there is global interest in the terahertz STM from the condensed matter physics community.

Professor Hegmann, soon-to-be post-doctoral fellow Vedran Jelic, and assistant professor Tyler Cocker expect to continue working together, and have some advice for aspiring physicists in the field.

Jelic advises students to be open to the project that they end up working on. "I didn't know what I was getting myself into with terahertz STM. I just sort of dove into it and tried to make the best of it, and it turned out really well in my case." He adds, "There's some persistence to it, too. Just stay on track and trust that the project might work out."

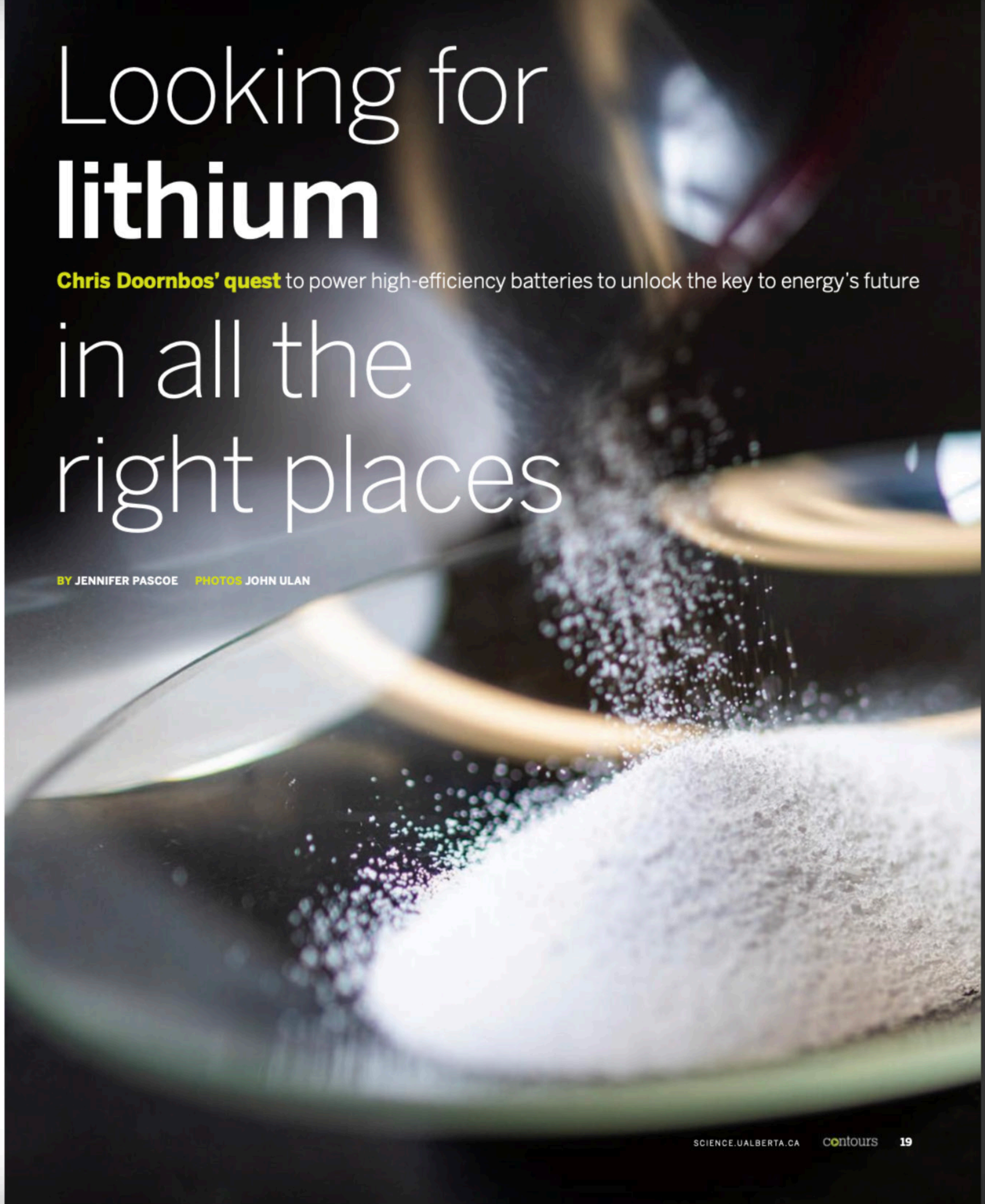
Cocker says, "My advice from being a post-doc would be not to be afraid of trying new things that are a little outside your wheelhouse. You've got a new chance to learn something else new. Take the opportunity to try something out, try something different." He adds: "And choose a good mentor!"

Hegmann's advice to newly hired assistant professors is to hang in there. "The pre-tenure years are quite challenging. There's a lot of work to be done. It is nice when you go into the lab and see some new results, so just take pictures along the way. And enjoy it. Enjoy the little moments. You've got an empty lab space now, and it's not going to be empty for long."

Looking for **lithium** in all the right places

Chris Doornbos' quest to power high-efficiency batteries to unlock the key to energy's future

BY JENNIFER PASCOE PHOTOS JOHN ULAN



“Once we get this project going, we will be able to definitively claim that we are producing the **greenest lithium** on the planet,” says geology grad Chris Doornbos ('05 BSc) from his Calgary office.

SUPPLIED

Doornbos, president and CEO of E3 Metals, is determined to drive a shift in energy's future, powered by a high-efficiency battery.

“Fundamentally, I've always believed that the key to energy's future is going to be a high-efficiency battery that's going to allow us to move electricity efficiently,” explains Doornbos. “This belief originated during my days at university, and it was renewed based on the advancement in the lithium ion battery Tesla uses to power their line of electric vehicles. When you look at the price spike in 2015, lithium as a commodity went from $7,000 a tonne to more than $12,000.”

Though Doornbos is quick to point out that lithium batteries aren't the silver bullet to society's environmental challenges, he believes it's a promising start to transition us toward a decentralized energy future.

Doornbos has had what he describes as a varied sort of career, one that—since graduating from the University of Alberta with a geology degree in 2005—has taken him from copper and gold exploration in the Yukon, northern B.C., and Australia, to oil and gas work with industry in Alberta, then back to Australia and subsequently Sweden for another stint in mineral exploration.

In Australia, Doornbos embraced his entrepreneurial leanings and co-founded a company called MinQuest. Working on two projects in Canada motivated an eventual return to his roots, where he found himself itching to start another company, this time on home turf.

“I was told by a mentor that if you can't find the right job, sometimes you have to create it.”

And so, that's just what Doornbos did. During his quest for the projects needed to start a new company, there was one mineral Doornbos was most keen to find that often eluded the tenacious entrepreneur: Lithium.

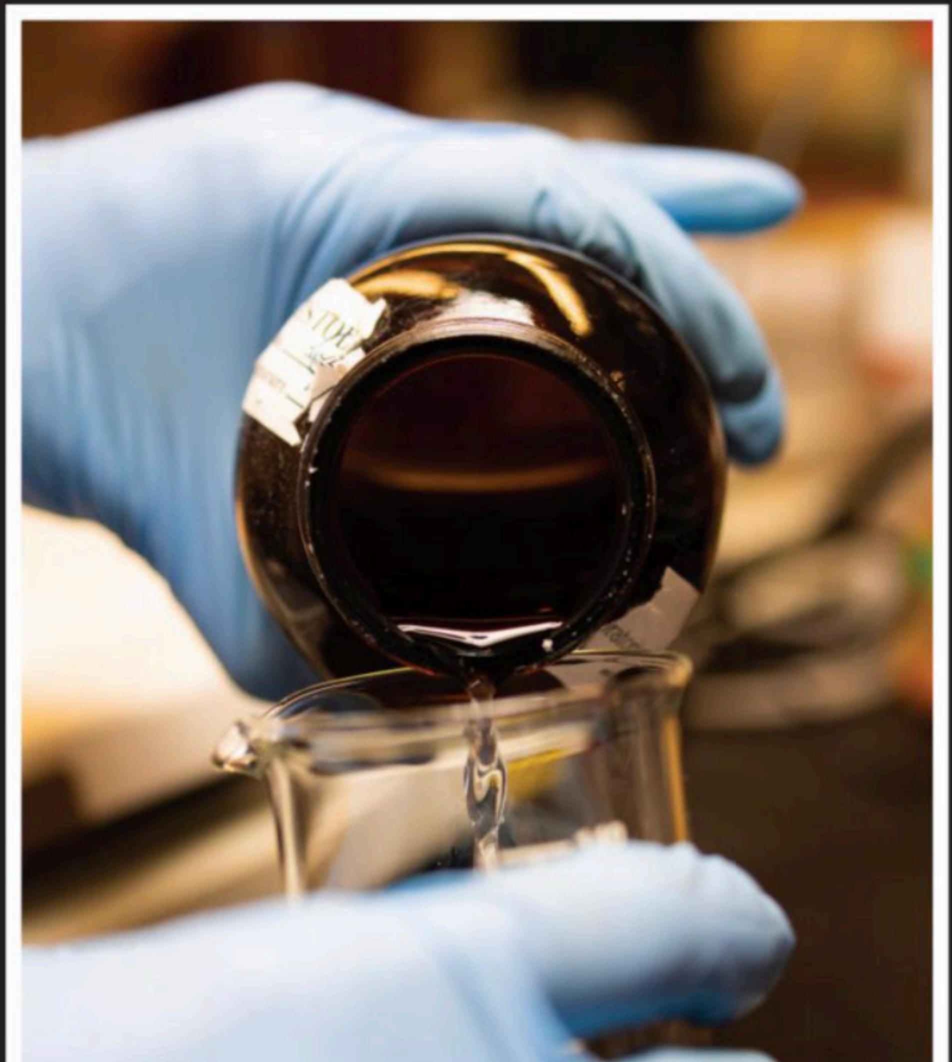
Looking for lithium took the geology grad around the world and back again to Alberta, proving that sometimes what you seek is right before your eyes.

“We looked everywhere for a good lithium project. We'd been in South America, Australia, and Nevada. We even looked at hard-rock projects in Quebec and elsewhere. I was talking to a geologist friend here in Calgary, and he pointed out something I knew but hadn't ever evaluated—that lithium is prolific throughout the Leduc Reservoir. This wasn't new information by any stretch. But we staked some ground that had never been staked before by anyone in Alberta.”

Thus, E3 Metals was born.

Left: Chris Doornbos on the bank of the Bow River in Calgary

Right: brine



Dan Alessi (centre) and research associates pictured in their University of Alberta lab

Doornbos subsequently secured exploration permits for metallic and industrial minerals for more than half-a-million hectares in Alberta (the Leduc Reservoir stretches from southern Calgary to northern Alberta). He simultaneously hustled to both solidify financial support and determine feasibility of the lithium-focused project, the latter bringing him full circle to the University of Alberta.

Collaborative research drives development

Returning to his alma mater, Doornbos connected with Dan Alessi, assistant professor in the Department of Earth and Atmospheric Sciences. The two quickly set to work on a collaborative research development project, supported by NSERC, to determine how best to extract and purify the lithium.

“Collaborative research is a great way to start,” says Doornbos. “And we have been really well supported by the federal government. Eventually the work needs to move away from the university so that we can speed up commercialization. So we are taking the dirty boring work out to commercial labs to allow Dan and his team to focus on the fun research and development, testing different ideas.”

Alessi and his lab are focusing on developing the chemical side of the extraction technology and will soon be shifting their attention to purifying processes to ensure the lithium meets the 99.999% pure needs of industry.

The team has aggressive goals. E3 wants to be producing lithium by 2021. To meet that time frame, they will be commercializing the extraction technology created by Alessi's team by the end of this year.

In this push to produce sources for sustainable power, Doornbos remains focused on environmentally conscious development. With a goal of no net new ground disturbance, the company will be sourcing project sites abandoned by previous oil and gas operations to minimize the need for new infrastructure.

Around the world, other lithium projects take place in mines or large solar evaporation ponds that occupy large footprints and take 18 to 24 months to produce the precious mineral. E3's process time will be hours and occupy a much smaller footprint to lead to the production of the greenest lithium on the planet.

“Our role is simply to develop greener technologies to get the lithium out of the brine,” says Alessi, who holds the Encana Chair in Water Resource Sciences. “We are developing a technology that does not require us to evaporate the brine during the extraction process, and by keeping the lithium in solution, it mitigates the environmental footprint at the surface. And it's essentially turning a waste product into a resource.”

For his part, Alessi is happy to be involved in a project that not only provides interesting research questions to answer, provides funding for post-doctoral fellows and graduate students, but also provides sustainable solutions for some of society's most pressing energy needs.

“Lithium is used everywhere now from cellphones to electric cars to aircraft. The demand is only increasing, and there's arguably a world-class lithium resource in the brine located here in the Leduc Reservoir,” says Alessi.

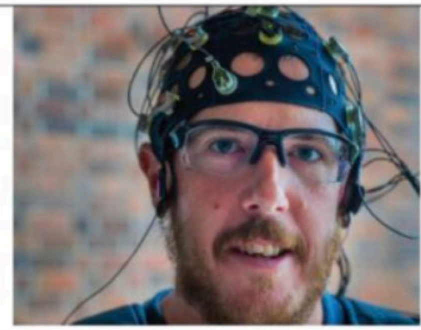
Neuroscientist Kyle Mathewson (left) and graduate student Joanna Scanlon gear up to take their research to the great outdoors.

Next up neuroscience

THE NEXT GENERATION IS OUTSIDE THE LAB

BY KATIE WILLIS / PHOTOS JOHN ULAN

MUCH OF WHAT WE KNOW ABOUT THE HUMAN BRAIN IS OVERSIMPLIFIED AND, IN SOME CASES, POSSIBLY EVEN WRONG, SUGGESTS KYLE MATHEWSON, ASSISTANT PROFESSOR OF PSYCHOLOGY. AND IT'S BECAUSE A GREAT DEAL OF NEUROSCIENCE RESEARCH IS BASED ON STUDYING FIRST-YEAR UNDERGRADUATE STUDENTS SITTING INSIDE HIGHLY CONTROLLED LABORATORIES, WHO HAPPEN TO BE PARTICIPATING IN THE STUDY FOR CREDIT IN INTRODUCTORY PSYCHOLOGY COURSES. SCARY THOUGHT, RIGHT? THE REASONS BEHIND IT ARE MANY—FROM CONVENIENT SAMPLES TO ETHICAL CONCERNS IN TARGETING OTHER POPULATIONS, AS WELL AS CLUNKY TECHNOLOGY.



THAT'S WHY the future of neuroscience is outside the lab, argues Mathewson, head of the Attention, Perception, and Performance (APP) Lab in the University of Alberta's Department of Psychology.

"If we want research to apply and contribute to all of society, we need to ensure that we understand how the brain works out in the world where humans actually live, work, and play," said Mathewson. "That means bringing research participants outside the lab and studying how our brains work in the real world."

In Mathewson's case, bringing studies outside the lab literally means taking them outside. For the last four years, Mathewson and his student research team in the APP lab have been working on researching the brain outdoors.

"We are already finding new phenomena that we can then take back inside the lab to isolate and investigate more precisely," explains Mathewson. "I think this is going to be a gold mine for researchers."

This is your brain outdoors.

ONE SUCH STUDY garnered international media attention this year, including a feature in Time magazine.

The study, conducted with graduate student Joanna Scanlon, had participants perform a simple cognitive task while riding a bike outdoors. Data were compared with data from the same task conducted on a stationary bike indoors. Results show that our brains process stimuli, like sounds and sights, differently when we are outdoors.

"Something about being outdoors changes brain activity," says Scanlon, who co-authored the study with Mathewson's guidance. "We noticed that brain activity associated with

Safety and biking

The use of bicycles in Mathewson's lab is no accident. A passionate biker, Mathewson commutes to campus year-round and has been a large part of the push for safe bike lanes in Edmonton. He remains an advocate for improving accessibility to all forms of transportation in and around the University of Alberta and is a proud member of Paths for People, a non-profit organization focused on improving transportation in Alberta's capital city.

Interested in learning more about bike culture and the introduction of bike lanes in Edmonton? Check out the Urban and Regional Planning program offered through the Department of Earth and Atmospheric Sciences at UAlberta.

Kyle Mathewson (left) is an assistant professor in the Department of Psychology. His brother, Kory Mathewson (right), is doing his PhD in the Department of Computing Science.

Siblings in science

Science runs in the Edmonton-based Mathewson family. Kyle's younger brother Kory Mathewson is in the midst of completing his PhD in the Department of Computing Science under the supervision of artificial intelligence (AI) experts Richard Sutton and Patrick Pilarski. In his research, Kory is exploring the ways in which interactive machine learning can make our lives easier, while also keeping our privacy safe. Kory is also the brain behind A.L.Ex—Artificial Language Experiment—an improv-performing robot that made headlines around the world last year for its performance art. Learn more about Kory's academic and recreational AI projects in the latest edition of the University of Alberta alumni magazine, *New Trail*.

Kory and Kyle have a third sibling in science. Though not at the University of Alberta, Keyfer Mathewson is working at Shopify and researching the use of machine learning in web and app development.

Together, the Mathewson brothers are beginning work on their startup company, PotentialAI, which brings together their unique expertise in human measurement and machine intelligence to unlock data's true potential.

sensing and perceiving information was different when outdoors, which may indicate that the brain is compensating for environmental distractions."

"Your brain seems like it has to work harder when it's outside in the real world," adds Mathewson. While knowing that more distractions (such as traffic noise and nature) will cause us to shift our attention, understanding just how the brain works outdoors requires a great deal of further investigation.

But none of this groundbreaking research would have been possible without the portable technology that allowed the research team to get outside—another critical element in the future of neuroscience, according to Mathewson.

Brain scanning: The next generation

IN ORDER TO STUDY the human brain, Mathewson, like many other neuroscientists, relies on an electroencephalogram, or EEG, to track and record brain activity. Traditional EEG machines are large and stationary—and are accompanied by a price tag of about $30,000. But soon, says Mathewson, these will be a thing of the past.

"Portable EEG systems are now easily accessible. You can even purchase them at Best Buy," says Mathewson. Best of all? The portable technology works anywhere, recording accurate data for the low price of $300 per machine, a fraction of the cost of traditional technology. "As we learn more and more about people's brains outside in the world, so too do the tools need to be more ubiquitous."

The applications for wearable technology are limitless in both research and teaching.

"Now, for a tenth of the cost, I can give my undergraduate students hands-on experience using this kind of technology," explains Mathewson. "We are taking what,10 years ago, was in the hands of only graduate students and faculty researchers, and giving everyone at the university an opportunity to use it."

And, just like taking portable EEG devices into the classroom or outside,

"WE ARE TAKING WHAT, 10 YEARS AGO, WAS IN THE HANDS OF ONLY GRADUATE STUDENTS AND FACULTY RESEARCHERS, AND GIVING EVERYONE AT THE UNIVERSITY AN OPPORTUNITY TO USE IT."

researchers can also bring the lab to new populations that were previously out of reach—think patients in long-term care, athletes at soccer practice, or climbers at the top of a mountain. "Most humans are adult workers, but very little neuroscience research addresses the average person going about their everyday life in their natural environment," explains Mathewson. This is a challenge that wearable, portable technology has the potential to overcome.

Yet another benefit of these inexpensive technologies is that curious minds all over the world who may not have had access before can now buy this technology at an affordable price—from researchers to high school students and everyone in between.

Mathewson is also working with engineers to develop the next generation of wearable electronics—sleeker, cheaper, and more accurate than what is currently available. "Currently, we're working on creating flexible, adhesive technology that can be worn on your forehead or behind your ears, making EEG technology even more portable than before," explains Mathewson.

The very near future

HE also plans to bring his work full circle by developing a research program that brings realism back into the laboratory using virtual reality and video games.

"We continue working on basic science, trying to understand how the brain works," explains Mathewson. "One way that we can develop more realistic testing situations is using virtual reality. This way, we maintain complete control over what the subject sees, while still providing a three-dimensional, interactive space." It's the perfect combination of realism and control.

For Mathewson and his collaborators, the future of neuroscience is already here. Work continues on research both outside and inside the lab, identifying new phenomena and finding new and innovative ways to isolate and investigate them, with a focus on the development and use of wearable EEG technology we can all use.

By **BROOKE BIDDLECOMBE ('17 BSc)** / Photos JOHN ULAN

Standing out in a crowd

For bachelor of science graduate Brooke Biddlecombe, tattoos are a way of commemorating experiences, accomplishments, and roads travelled. A few weeks after her last exam, Biddlecombe decided she would get not one, but two new tattoos reflecting her experience at the University of Alberta. Inked on her leg is the University of Alberta shield, and the word "science" is written across her knuckles, with a polar bear paw print at the end.

EARLY IN MY UNDERGRADUATE CAREER, I was sure I had it all figured out. I knew what I wanted to study and where I wanted my education to take me. All of that certainty took a turn rather quickly, as the stress of university and my painfully shy personality came together to amplify a lifelong struggle with anxiety to an unmanageable level. I became so overwhelmed and so unsure of myself I ended up withdrawing from my courses and taking two years off, when I lived abroad for a short while. And although I had some great experiences, what those two years really showed me was that my true passion is in science.

So, two years later, I re-enrolled, switching my degree just slightly to focus on ecology rather than animal biology. This time, I went in with an open mind, an improved awareness of my mental health, and a determination to engage in the "U of A experience." I joined a student group right off the bat where I met some great people, many of whom are still some of my closest friends. This created a chain reaction where I began to build a support system that was absolutely invaluable throughout the rest of my degree. I exposed myself to many opportunities and experiences in the latter half of my degree that I genuinely would have never considered prior.

To celebrate being the first person on either side of her family to graduate from university, Brooke Biddlecombe had the UAlberta insignia inked on her leg (right). Her mother did too (left).

With this new-found willingness to put myself out there, I made what I can easily describe as my best decision as an undergraduate. I approached the professor of my favourite course, renowned biologist Andrew Derocher, to be my supervisor for an undergraduate research project. He is now my supervisor for my master's thesis, where I am literally doing the research of my dreams.

Reflecting back on my experience as an undergraduate, I can't help but think of my proudest day just last spring at convocation. Graduating from university was a huge accomplishment for me, not just because I overcame a mental health struggle that I genuinely thought would keep me from ever finishing a degree, but because I am the first university graduate on both sides of my family. My parents made it very clear how much of an accomplishment that is for me and for our family. And as I look forward toward a life rich with the prospect of continued learning, I am so thankful for the opportunities UAlberta has afforded me. I am thrilled to be the first in what I hope is a long family line of University of Alberta graduates, who are all just as excited to embrace their inner nerd as I continue to be.

Speaking of embracing my inner nerd, as a current graduate student, it feels like a very important time to be in science. As young scientists, we have a valuable opportunity to use our skill set to investigate issues that not only interest us, but many of which will make our world better. Whether it be conservation, restoration, health, or development, science is increasingly focused on applied issues and problem solving.

Science on her skin: After graduating with her bachelor of science in June 2017, Brooke Biddlecombe began her master's degree, studying polar bears with renowned biologist Andrew Derocher.

We also have the unique opportunity of sharing our research in real time to a much wider audience, with the help of internet search engines and social media. But on a smaller scale, there seems to be a push in recent years to make research more accessible to the general public, perfectly exemplified by the Three Minute Thesis (3MT) competition happening right here at the University of Alberta. As a 3MT finalist earlier this spring, I had an amazing time not only sharing my research in a highly digestible format, but also learning about all the fascinating research that is happening on the U of A campus every day.

Platforms like this serve to make science and research more accessible, and—perhaps more importantly—they show the public just how diverse the up-and-coming faces of science really are. And as someone who has a habit of standing out in a crowd, I think that is something worth celebrating.