



Canada Excellence
Research Chairs
Chaires d'excellence
en recherche du Canada

Brain Gain

Federal investment in research attracts leading global researchers to Canadian universities

In 2008, the federal government announced a new program aimed at establishing up to 20 prestigious research chairs – Canada Excellence Research Chairs (CERC) – in universities across the country. Today, after a competitive selection process from among 130 applicants, 19 chairs have been awarded to 13 universities.

The CERC program will invest up to \$28 million each year to build a critical mass of expertise in four national priority areas: environmental sciences and technologies; natural resources and energy; health and related life sciences and technologies; and information and communication technologies. In addition to the federal funding of up to \$10 million being received over seven years, universities were encouraged to leverage funding from other sources.

“The Government of Canada will continue to invest in

attracting the best and brightest minds to Canada,” says Industry Minister Tony Clement.

“The leading institutions where they will conduct cutting-edge research will have global impact, help spur innovation and generate life-changing discoveries for our country and the world.”

While the program will be instrumental in branding Canada as a global centre for research excellence, the issues addressed by CERC researchers are also those that affect the daily lives of all Canadians, such as water security and climate change impact in the Arctic.

“Our government is proud to support research excellence at Canada’s universities that helps to strengthen the economy and improve the quality of life of Canadians,” says Minister of State (Science and Technology) Gary Goodyear.

“The program was an invitation to Canadian universities

to identify areas in which they were already strong, but in which, with the addition of these chairs, they would be among the best in the world,” says Peter MacKinnon, president and vice-chancellor of the University of Saskatchewan. “Putting together a funding package of more than \$30 million was a very inspiring challenge.”

For the successful universities, the CERCs enable a development of capacity that extends well beyond the chair, says Prof. MacKinnon. “We will immediately recruit another six faculty members in this area, and we expect to welcome researchers, including graduate students and post-doctoral fellows, in significant numbers. This is a major addition to our existing excellence capacity, and it’s only possible with partnership.”

The opportunity to extend invitations to 19 of the world’s leading scholars is a substantial

addition to Canada’s research capacity, but it’s also a stimulus to think in terms of being among the world’s leading centres of research excellence, he says. “Symbolically and substantively, the program will have a huge and positive impact.”

He notes that at the U of S the CERC adds to a unique concentration of facilities and expertise in one of the most critically important areas for Canada’s future – water security.

“You need very substantial capacity and first-class laboratories and researchers to address these large issues. And you must be able to engage industry and governments in supporting capacity-building, and in the conversation about the implications of the research for development of public policy. Partnership is essential.”

Paul Davidson, president and CEO of the Association of Universities and Colleges of

Canada, notes that research is critically important for prosperity in Canada and says the CERC program will deliver impressive results.

“It is smart and strategic: smart because we’re in a very competitive environment in terms of attracting and retaining world-class scholarship, and strategic because it is focused on the four priority areas of the government’s science and technology strategy.”

The benefits of the CERCs will reach far beyond the successful universities, he says. “Researchers work in collaboration, and this will lead to a richer research community in Canada. There are also opportunities for this research to lead to greater commercialization applications with the private sector, in part because it demonstrates that Canada is prepared for participation in the global research enterprise.”

The program builds on

Canada’s investment in research infrastructure and will result in attracting the most promising international graduate and post-graduate students, he says.

“It is an intensely competitive market for these researchers. They can work anywhere in the world, but they’re choosing to work in Canada.”

That is critical for the Canadian economy and for Canadians, he says. “During the worst recession in over 60 years in Canada, there were over 135,000 net new jobs for university graduates, while 770,000 jobs were lost to those without university education. This is another opportunity to create jobs in a knowledge-based economy. When you consider Canada’s strength and competitiveness, whether in forestry, automotive or other sectors – research innovation is the foundation of the 21st century economy.”

“The Government of Canada will continue to invest in attracting the best and brightest minds to Canada. The leading institutions where they will conduct cutting-edge research will have global impact, help spur innovation and generate life-changing discoveries for our country and the world.” Industry Minister Tony Clement

UNIVERSITY OF SASKATCHEWAN

New global water institute to tackle mounting issues of water security

Across Canada and around the world, there are increasing concerns about the quality and availability of water over the long term.

Through a just-announced \$30-million Canada Excellence Research Chair (CERC) in Water Security, the University of Saskatchewan is establishing a research and training institute that will build on one of the world’s most important clusters of water-related expertise to develop new solutions to critical problems facing both domestic and global water security.

“This is an unparalleled opportunity for Saskatchewan and Canada to make a leading contribution to the science of water security, thereby helping local, national and global communities,” says Saskatchewan Advanced Education, Employment and Labour Minister Rob Norris. “It also directly contributes to our government’s vision of a more diversified, knowledge-based, innovation-driven economy.”

Howard Wheeler, who will lead the new CERC, is one of the world’s foremost experts in hydrology and water resources management. The vice-chair of the World Climate Research Programme’s GEWEX initiative, he leads UNESCO’s arid zone water resources program.

“Worldwide, water sources are under pressure, and small changes in climate can result in big changes in water sup-



U of S vice-president research Karen Chad (top left) says a total \$30-million investment shared equally by the federal and Saskatchewan governments and the university with the help of its friends and supporters drew acclaimed hydrology expert Dr. Howard Wheeler (top middle) from the U.K. to lead the new Canada Excellence Research Chair in Water Security. Dr. Chad says the new CERC “will enable us to build on our strengths, including almost 50 years in hydrology research, to take the lead in water security research.” PHOTOS: SUPPLIED

ply,” says Dr. Wheeler, who was recruited from the United Kingdom. “This chair provides an unprecedented foundation on which to make a difference in water management.”

The partnership model of funding includes a \$10-million investment over seven years from the federal government, \$10 million from the Saskatchewan government, and a \$10-million commitment from the U of S with the help of its friends and supporters, as well as in-kind contributions from Environment Canada and the Saskatchewan Research Council.

“Our partners have shown great foresight by investing with us in research talent, innovation and knowledge through this CERC,” says vice-president research Karen Chad. “It

will enable us to build on our strengths, including almost 50 years in hydrology research, to take the lead in water security research.”

To better understand and manage the complex interactions among water, land use and climate change, the new institute will bring together the fields of ecology, toxicology and hydrology into a new state-of-the-art science – ecotoxicohydrology.

New predictive modelling and risk assessment tools will be developed to help address Canada’s large-scale water management challenges, particularly those affecting rivers, lakes and large water systems in Western Canada.

“We want to use our research as a springboard for developing tools, techniques and policy approaches appli-

cable around the world,” says Dr. Wheeler.

He notes the new technologies will help policy-makers make long-term water resource management plans to address issues such as water stewardship, drought management, agricultural water use and pollution, oilsands reclamation and management of waste from mine sites.

A total of 85 people will be recruited including six new faculty, 20 post-doctoral fellows, 24 PhDs and 24 master’s students.

The institute will draw on the unique breadth of expertise among more than 65 faculty researchers across campus, including five Canada Research Chairs in water-related areas of research and leading experts in areas as diverse as freshwater biology,

agriculture, health, social science and policy.

“This holistic approach brings together diverse experts to probe the complex interactions at the crux of many water issues and promises to provide new tools for risk assessment and remediation, improve water management and advance water policy,” says Dr. Chad.

Dr. Wheeler’s team will work closely with Environment Canada’s National Hydrology Research Centre and world-class research centres on campus including the new Aquatic Toxicology Research Facility, the Toxicology Centre, and the Centre for Hydrology, and two of Canada’s top science projects – the Canadian Light Source and the International Vaccine Centre – as well as three new

graduate schools in public health, public policy and environment and sustainability.

Dr. Wheeler, who has received prestigious international awards for his research in the Middle East, Africa and the U.S., notes that the range and depth of expertise both at the U of S and Environment Canada’s Saskatoon water research centre creates an exceptional concentration of related research skill and knowledge.

“To address these complicated problems, to balance the human need for water with what the environment needs to sustain water supply, we have to work as a community. This is a unique opportunity to do that.”

Cameco president and CEO Jerry Grandey notes that leading-edge science and innovation is a strong driver of economic growth, and is helping Saskatchewan to prosper.

“We are highly impressed with the world-class calibre of scientist that the U of S has been able to attract as a CERC,” he says.

“His renowned expertise in leading interdisciplinary environmental research teams and forming high-level international links with universities, government and industry will not only advance the science needed to solve water-related challenges but will create unprecedented training opportunities for aspiring young scientists and engineers in Saskatchewan, Canada and even internationally.”

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UNIVERSITY OF MANITOBA

Investment solidifies Canadian research pre-eminence in climate change impacts affecting Arctic North

Already internationally renowned for its leadership in climate change research, the University of Manitoba has solidified its pre-eminence in Arctic research with a new \$10-million Canada Excellence Research Chair (CERC) in Arctic Geomicrobiology and Climate Change.

At the very forefront of the research into the causes and

consequences of a warming Earth is a world-class team from the University of Manitoba's Centre for Earth Observation Science (CEOS). Joining this team to combine the science of Earth observation with the relatively new science of geomicrobiology, Dr. Søren Rysgaard will study geomicrobial transformations in Arctic sea ice with researchers at

CEOS.

"This [enables] us to do much more comprehensive work, both geographically and in terms of expertise and research," says Dr. Rysgaard, founder of the Center of Marine Ecology and Climate Impact at the Greenland Institute of Natural Resources. "The people working at the University of Manitoba are

known internationally for their excellence. We have worked together on joint projects in the past, and now have the opportunity to work together on a daily basis, year round, with excellent facilities."

Dr. Rysgaard is the world's leading researcher in the geomicrobiology of the brine channels in sea ice. The sea ice equivalent of capillaries,

brine channels harbour diverse bacteria and viruses vital to the environment, making atmospheric elements such as nitrogen usable by the base of the ecosystem's food chain, algae, and pumping carbon dioxide (CO₂) in and out of the ocean.

Until a few years ago, it was assumed that sea ice worked as a sort of lid, preventing the release of CO₂, says Dr. Rysgaard. "Now we understand that it is much more complicated. Our preliminary research suggests that sea ice is one of the main players in controlling CO₂ in the Arctic Ocean. Very little is known, however, and its effect isn't included in current climate models."

The research to date has, by necessity, focused on sea ice on a small scale, says Dr. Rysgaard. "We don't know, for example, if sea ice processes are different around the Arctic Ocean and the Antarctic. We do know that there is a huge uptake in CO₂ in the polar regions, but nobody really knows why. This strengthened co-operation between our international research teams will benefit us all."

Dr. David Barber, Canada's Research Chair in Arctic System Science and director of CEOS, led one of the world's largest climate change research studies during the International Polar Year of 2007-2009, with over 200 international scientists participating in a unique overwintering study. It was their work that helped determine that sea ice is disappearing much faster than formerly estimated, highlighting the speed at which climate change is affecting our environment.

"It's very important that we develop a much clearer understanding of how the planet functions and what the consequences of our actions are on natural, physical and biological systems," says Dr. Barber. "Over the course of my career, I have watched the Arctic sea ice change before my eyes. That change affects everything, even the temperate and tropical parts of our planet."

"This Canada Excellence

Research Chair will bring [an even greater] level of expertise to Canada to investigate the fundamental underpinnings of these changes and their consequences."

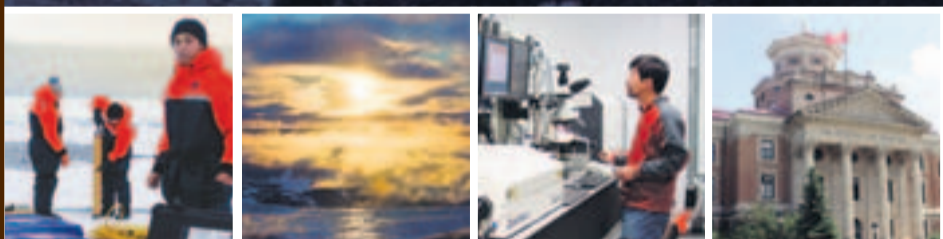
The Centre for Earth Observation Science will double in size to about 80 researchers, with three new tenure-track faculty members and six research associates in addition to the new CERC. The CERC team will also work closely with investigators in ArcticNet, Canada's premier polar Network of Centres of Excellence; a new Sea-Ice Environmental Research Facility, on the U of M campus, and access to the CCGS Amundsen, a retrofitted ice breaker turned floating laboratory, will allow the team to do sea ice experiments never before possible.

"People think of the Arctic as being remote, as the domain of the polar bear, glaciers and sea ice," says Dr. Barber. "But the rest of the world must see what is going on there, and the speed at which it is [occurring]. There's an immediate need to understand the causes of the changes we're seeing because, by extension, it can prepare us to manage these kinds of issues in the more temperate and tropical parts of our planet. The Arctic is a harbinger of things to come."

There is a broad range of issues relating to Canada's North of great interest to our government and industry, including sovereignty, access to resources, cultural and community development, says Dr. David Barnard, president and vice-chancellor. "Understanding the North, and what an increased presence of people and technology will mean there, is going to be very important."

"This investment by the government of Canada – and the activity that is resulting from it on the part of all the universities involved – is not only going to pay off in the specific [research] areas where these chairs are working, but will increase the visibility of Canadian research. It will help strengthen the climate of curiosity, investigation and innovation in our universities and in the country."

LEADING THE WORLD IN ARCTIC CLIMATE CHANGE RESEARCH.



THE UNIVERSITY OF MANITOBA RECEIVES CANADA EXCELLENCE RESEARCH CHAIR AND \$35 MILLION IN FUNDING FOR ARCTIC RESEARCH.

The key to global climate change may lie deep within Arctic ice. The University of Manitoba has been recognized with one of the country's most prestigious research awards – the Canada Excellence Research Chair (CERC) in Arctic Geomicrobiology and Climate Change – to help uncover the secrets of global warming.

The new chair will be held by **Dr. Søren Rysgaard**, a distinguished geomicrobiologist from Greenland. He will join the 100-plus team from the University of Manitoba's Centre for Earth Observation Science in the

Clayton H. Riddell Faculty of Environment, Earth, and Resources. This world-renowned group will be the first to explore the Arctic on a micro scale.

With the CERC award and the support of other partners totalling \$35 million in funding, the team's focus on the Arctic's role in global climate change will cement the University of Manitoba's position as a leader in environmental and climate change studies.

For more information, please visit umanitoba.ca

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University of Manitoba researchers including Professor Norm Halden (top left) and Dr. David Barber (top right), Canada Research Chair in Arctic System Science, welcome renowned expert Dr. Søren Rysgaard (bottom) of Greenland who will now contribute directly to Canadian efforts to better understand climate impacts in Canada's Arctic. "We have worked together on joint projects in the past, and now have the opportunity to work together on a daily basis, year round, with excellent facilities," said Dr. Rysgaard, who now holds the Canada Excellence Research Chair (CERC) in Arctic Geomicrobiology and Climate Change. PHOTOS: SUPPLIED



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DALHOUSIE UNIVERSITY

Renowned marine chemistry expert adds to formidable Canadian capacity to study and address complex issues affecting world's oceans

From almost any point at Dalhousie University in Halifax, the Atlantic Ocean is never more than 300 metres away, attracting some of the world's top marine scientists to a campus that's renowned for oceans research.

Dalhousie draws experts from around the globe – researchers, scholars and students committed to understanding the ocean's vast resources and unlocking secrets relating to everything from climate change to harnessing tidal power. Chemical oceanographer Dr. Douglas Wallace, Dalhousie's new Canada Excellence Research Chair (CERC) in Ocean Science and Technology, who joins Dalhousie next summer from the Leibniz Institute for Marine Sciences and the University of Kiel in Germany, will help take the university's oceans research to an unprecedented level.

"That's what these CERC chairs were designed to do, to take something that was a strength area but move it up to the next level, so that Canada truly becomes an international leader in the area," says Dr. Martha Crago, Dalhousie's vice-president, research.

Dr. Wallace, an expert in marine chemistry who earned his PhD from Dalhousie in



Dr. Douglas Wallace of the Leibniz Institute for Marine Sciences and the University of Kiel in Germany will assume Dalhousie University's new Canada Excellence Research Chair in Ocean Science and Technology. PHOTO: SUPPLIED

1985, will lead Dalhousie in developing solutions to complex problems that span disciplines, while building on existing relationships and synergies among the university, government institutions and industry.

"The appointment of Dr. Doug Wallace brings us to a new level with nearly limitless potential to develop solutions to some of the most pressing challenges of our time, many of which are rooted in the effects of climate change and direct human activities on ecosystems, fisheries resources

and chemical cycles of the ocean and atmosphere," says oceanography professor Dr. John Cullen, Dalhousie's Kilham Chair in Ocean Studies. "Studying these processes requires unprecedented cooperation across disciplines and among institutions, within Canada and around the world. This can only happen with true scientific leadership – Doug Wallace is such a leader."

The CERC appointment will build on strengths already firmly established at Dal-

housie. The statistics speak for themselves: the university hosts the Ocean Tracking Network, a \$168-million conservation project that's uniting scientists from around the world as they conduct the most comprehensive examination ever of marine life and ocean conditions; around the campus, more than 100 faculty members from several disciplines conduct oceans-related research; in the past decade, Dalhousie has received 23 per cent of all NSERC awards in oceanography; 10 of the uni-

versity's 50 Canada Research Chairs are in ocean studies. Scientific researchers examine the oceans from every perspective, including biodiversity, storm surge and weather prediction, the oceanic crust, fish and mammal populations, sustainability, sediment movement and acidification.

Dalhousie's expertise extends beyond areas traditionally associated with oceans. The university's Marine and Environmental Law program has 30 years of experience in ocean law and governance. The multidisciplinary Marine Affairs Program incorporates issues relating to coastal zone management, sea use planning, marine law and policy, maritime transport, protection of coastal and marine environments, tourism, maritime law enforcement and conflict management. Dalhousie engineering professors developed a data collection and analysis system for the Canadian Coast Guard more than a decade ago. And Professor Mary Brooks, from the Faculty of Management, is an appointed member of the Marine Board of the U.S. Research Council.

Students – from undergraduate through to PhD – are drawn to Dalhousie from around the globe to work with some of the world's best

oceans scientists. Their classrooms extend beyond the campus to the living laboratories created by the Atlantic Ocean and the coastal waters that embrace the province.

Like their professors, many of these students will go on to create knowledge and acquire expertise critical to the oceans sector in Canada and around the world. The importance of their contributions cannot be underestimated. In Nova Scotia alone, more than 60,000 people depend on oceans industries. A March 2009 report completed for the Nova Scotia and federal governments stated that \$5 billion in direct and indirect economic activity – 15 per cent of the provincial economy – comes from the sea.

Dr. Wallace's appointment "will move Dalhousie to a pre-eminent position in ocean studies worldwide and could serve as one of the key economic drivers of the region," says Chris Moore, dean of Dalhousie's Faculty of Science.

With this new CERC appointment, Dalhousie's contributions to the sector – whether through enabling economic growth, technological development, marine management or enhancing oceans sustainability – will cement the university as a world centre of oceans expertise. ■

"The appointment of Dr. Doug Wallace brings us to a new level with nearly limitless potential to develop solutions to some of the most pressing challenges of our time, many of which are rooted in the effects of climate change and direct human activities on ecosystems..." Dr. John Cullen



Taking ocean knowledge to unexplored depths

The ocean holds vast potential to sustain and improve life on this planet. Dr. Doug Wallace wants to turn that potential into reality and he's bringing his quest to Dalhousie University.

A world-renowned researcher at the Leibniz Institute of Marine Sciences and the University of Kiel in Germany, Doug is now Dalhousie's Canada Excellence Research Chair in Ocean Science and Technology.

He'll lead a \$10-million project that will strengthen the formidable contribution Dalhousie researchers make to resolving the mysteries and restoring the health of the ocean. Doug's coming home to a rich concentration of experts in ocean and marine law, engineering, management and science.

Our knowledge of the ocean is about to go deeper than ever. Dr. Doug Wallace will help take us there.



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UNIVERSITY OF PRINCE EDWARD ISLAND

Global experts unite to advance Canadian study of health of animal populations

The Atlantic Veterinary College (AVC) at the University of Prince Edward Island (UPEI) is an internationally recognized leader in both fish health and epidemiology – the study of health in populations of animals.

This expertise has put UPEI in a rare and important position among Canadian academic research institutions—and is setting the stage for an even higher level of global impact.

The federal government has awarded funding to the Charlottetown-based university for a Canada Excellence Research Chair (CERC) in Aquatic Epidemiology, with a focus on sustainable aquaculture and aquatic ecosystems, and managing disease in farmed fish. The prestigious CERC program provides up to \$10 million over seven years for chairholders and their teams to conduct research in areas of strategic importance to Canada, including environmental and life sciences.

UPEI's chair is one of just 20 to be funded under the program, achieving success in a competitive field that included many larger universities with considerable resources.

"We are very proud that the CERC adjudication team recognized the calibre and international importance of our work," says Wade MacLauchlan, president of UPEI. "The fact that we have achieved this as a smaller uni-



Scientists at the Atlantic Veterinary College at the University of Prince Edward Island, including new Canada Excellence Research Chair in Aquatic Epidemiology Dr. Ian Gardner (top centre); Dr. Larry Hammell, Innovation PEI Industry Research Chair and director of AVC Centre for Aquatic Health Sciences (bottom centre); and Dr. Mark Fast, Novartis Chair in Fish Health, are part of the school's internationally recognized research team focused on sustainable aquaculture, aquatic ecosystems and managing disease in farmed fish. PHOTOS: SUPPLIED

versity, speaks to our focus on building research excellence in an area critical for growth and prosperity in Atlantic Canada and Canada as a whole. We have continued to concentrate on what we do best, building on our strengths over the past several decades."

One of the CERC program's goals is to attract top researchers to Canada. The UPEI chair will be held by Dr. Ian Gardner, a leading scientist in veterinary medicine and epidemiology, who was most recently at the UC Davis School of Veterinary Medicine at the University of California.

"Dr. Gardner is the best in his field in the world," says Mr. MacLauchlan. "We are convinced that we will be making a big impact globally through his efforts."

The four Atlantic provinces established the Atlantic Veterinary College at UPEI in 1986. Today, it includes a Centre for Aquatic Health Sciences (CAHS), which conducts research into health and related issues affecting the region's aquatic-animal food industries. The college's Centre for Veterinary Epidemiological Research (CVER) studies health and disease in populations of both

land-based and aquatic animals. The AVC faculty includes nine externally funded research chairs, and the college has more graduates entering aquaculture practice than any other veterinary school in North America.

"Dr. Gardner's work will bring together aquatic health sciences and veterinary epidemiology, two areas for which we are internationally recognized," says Dr. Ian Dohoo, CVER director. "I don't think there's any question that this will make us the pre-eminent institution in the world." Dr. Dohoo developed the proposal for the CERC,

along with CAHS director Dr. Larry Hammell, CVER researcher Dr. John VanLeeuwen and Dr. Crawford Revie, Canada Research Chair in Population Health/Epi-informatics.

Sustainable fish production through aquaculture is an issue of growing global importance. "Fish production from wild fish capture has reached a plateau," says Dr. Dohoo. "There is a world requirement for high-quality protein, and aquaculture is the only really viable source."

Aquaculture is a \$1-billion-a-year industry in Canada and worth \$70 billion worldwide.

With an annual growth rate of 10 per cent, it is the fastest growing food production sector in the world. Yet, the industry faces challenging issues, such as its impact on the aquatic ecosystem and disease transmission between farmed and wild stock.

These are the kinds of issues Dr. Gardner and his colleagues will tackle. "I was attracted to UPEI because of its team and because of its science, integrity and vision for the future," says Dr. Gardner. "And this research is an opportunity to take a holistic, integrated approach by studying the health of fish, the health of the environment and production of healthy food, and how these interact – which has very important policy implications. I look forward to providing leadership and assisting in policy development in these key areas."

One of the key focuses will be protection from disease for both wild and farmed fish, adds Dr. Gardner. "There's evidence that the spread of infections and parasites can go in either direction. It is critical to address the question of how do we protect wild fish and raise healthy farm-bred fish in a way that is economically sustainable and also sustainable to the rest of the ecosystem."

Dr. Gardner and his colleagues believe finding the answer to this question and others will not only strengthen Canada's industry, but will also help foster sustainable aquaculture around the globe. ■



UPEI
UNIVERSITY
of Prince Edward
ISLAND

UPEI WELCOMES Dr. Ian Gardner CANADA EXCELLENCE RESEARCH CHAIR IN AQUATIC EPIDEMIOLOGY

Dr. Ian Gardner is an international authority on animal epidemiology, and a proven *innovator* in the United States and his native Australia. He joins the Atlantic Veterinary College's Centre for Veterinary Epidemiological Research at the University of Prince Edward Island—a respected world leader in animal population research, with a focus on fish health.

As wild fish stocks undergo unprecedented decline, aquaculture becomes an increasingly important source of high-quality protein for a hungry planet. UPEI is pioneering the science needed to secure *healthy fish, healthy environments and healthy food*—at home and around the world.

The Canada Excellence Research Chairs program is an initiative of the Government of Canada to attract Canadian and international leaders who can positively contribute to this country's global competitiveness, future prosperity and well-being, as well as provide a deeper understanding of the human dimension of technological change.

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UNIVERSITÉ LAVAL

New research chairs boost Quebec school's advancement of Arctic and photonic knowledge frontiers

On the outskirts of historic Quebec City, Université Laval is North America's first French-language university and is Canada's oldest educational institution. With the recent award of two Canada Excellence Research Chairs (CERCs), this venerable institution is also poised to help shape Canada's future.

Dr. Marcel Babin has been appointed Canada Excellence Research Chair in Remote Sensing of Canada's New Arctic Frontier. Climate change is altering the Canadian Arctic in dramatic ways that we have only begun to grasp – unlocking natural resources and driving unprecedented industrialization. Dr. Babin and his research team will work to expand vital knowledge of the impact of these transformations on the ecosystems of Canada's last remaining frontier.

"Our research will apply the most recent advances in satellite remote sensing to



Joining Université Laval are Dr. Marcel Babin (left), Canada Excellence Research Chair in Remote Sensing of Canada's New Arctic Frontier, and Dr. Younès Messaddeq, Canada Excellence Research Chair in Enabling Photonic Innovations for Information and Communication. PHOTO: RAMON TERRADO/ARTICNET

track how current and future Arctic ecosystems respond to climate change," says Dr. Babin. The chair will develop new observing technologies, advanced computer modeling of the Arctic environ-



ment, and an "intelligent archiving system" to enable storage and analysis of vast amounts of Arctic data. "Improved access to this knowledge will help stakeholders in government, indus-

try and northern communities make informed decisions about sustainable resource development and ecosystem stewardship."

A dual citizen of Canada and France, Dr. Babin is an internationally recognized authority in marine optics and remote sensing. He made his research career at the Laboratoire d'Océanographie de Villefranche, France, and will maintain close collaboration with this world-leading team. While taking up the chair at Université Laval, he is a research scientist at the world-leading Laboratoire d'Océanographie de Villefranche, France. His CERC program establishes numerous international partnerships with U.S. and European institutions, including a Joint International Centre for Arctic Ecosystem Surveillance and Modelling, linking Canadian Arctic scientists and the Centre National de la Recherche Scientifique of France.

"This research will change the way the world sees the Arctic, and will help position Canada as an international leader in understanding northern climate and environmental change," says Université Laval rector Denis Brière.

Université Laval's second CERC award will support research into vitreous (glass) fibre optic materials and development of innovative optical devices. The Canada Excellence Research Chair in Enabling Photonic Innovations for Information and Communication is held by Dr. Younès Messaddeq – one of the world's most accomplished researchers in materials development for optics and photonics. Most recently, he steered the scientific direction of the Institute of Chemistry UNESP in Araraquara-SP, Brazil.

"Dr. Messaddeq's research program is perfectly in line with Université Laval's current expertise and infrastructure in fibre optic research,

including our new optical-fibre fabrication facility," says Mr. Brière. "His work in photonics promises successful and immediate applications for industry, particularly in the biomedical field, national security and defence, and other areas of strategic importance to Canada."

The chair's research, for example, will support development of new fibre lasers for dentistry, already underway at Université Laval, as well as advances in laser technologies for medical imaging, diagnosis and surgery.

The CERC program will enable creation of Canada's first institute for research and training in vitreous materials, helping to develop a group of Canadian experts in glass science and advanced glass-related technologies. Through partnerships with industry and other academic institutions, Laval anticipates a new level of Canadian leadership in R&D and commercialization of specialty optical fibres. ■

"This research will change the way the world sees the Arctic, and will help position Canada as an international leader in understanding northern climate and environmental change." Denis Brière, rector, Université Laval

UNIVERSITY OF SASKATCHEWAN

Research seeks path to sustainable water resources

The University of Saskatchewan lies in the watershed of one of Canada's most threatened rivers, the South Saskatchewan.

Inflows into Lake Diefenbaker, the province's single most important water reserve and water supply for more than 750,000 people, have dropped over 40 per cent since the early 1900s due to increased upstream water consumption and reduced natural flows from the river's Rocky Mountain headwaters.

"The Saskatchewan River system provides an excellent model with which to address global water security challenges such as climate change, overuse, pollution and competition between upstream and downstream users," says Howard Wheeler, Canada Research Excellence Chair (CERC) in Water Security.

The new U of S global water institute, to be led by Dr. Wheeler and housed at Environment Canada's National Hydrology Research Centre, builds on a wide variety of distinguished U of S water research, including five Canada Research Chairs in water-related areas.

• Canada Research Chair John Pomeroy is studying how snowpacks affect water supplies and climate in Western

Canada. Given that snowmelt supplies most of the river flows and replenishes prairie wetlands and soil moisture, he is quantifying how snowmelt is affected by drought, climate change, forest cover, agricultural land management and elevation.

• Canada Research Chair Monique Dubé has developed software called The Healthy River Ecosystem Assessment System (THREATS) that identifies "hotspots" when important changes have occurred in the water quality of rivers and in the health of the plants and animals that live in them.

She and engineering researcher Todd Pugsley are working with Richard Robarts, director of the United Nations GEMS/Water Programme, to develop software that will help energy developers make environmentally responsible decisions on power plant locations by determining impact on water quantity and quality in the area.

"To date, the links between water and energy have not been taken into account in developing energy technologies, making policies and managing both energy and water resources," says Dr. Pugsley.

• Canada Research Chair John Giesy studies chemical toxins in the environment that can mimic hormones such as estrogen and cause birth defects and other health problems. His team has developed a cost-effective, rapid test that screens for these hormone disruptors without using animals. American and European agencies are interested in using it to test wastewater effluent for hormone disruptors.

The test, approved for use by the United States Environmental Protection Agency and the Organization for Economic Development and Co-operation, is being adopted as a worldwide standard. The U of S recently set up a wholly owned subsidiary to market this test worldwide.

• A multidisciplinary group of U of S scientists working with companies such as Syncrude is studying how to reconstruct boreal forest landscapes disturbed by oil sands mining.

Karsten Liber, who leads the new School of Environment and Sustainability, is evaluating how wetlands can potentially be used to remove key contaminants from process water.

"The type of research we are conducting with the oil sands here in Canada is

unique," he says. Their research, which aims to help transform more than 20,000 hectares of min-

ing-impacted landscape into sustainable ecosystems, has led to improved provincial reclamation guidelines in

Alberta. The new knowledge is helping companies meet their environmental obligations. ■

From the color of the Arctic Ocean to the glass of optical fibres—here, innovation is everywhere.



Dr. Marcel Babin
Canada Excellence Research Chair
in Remote Sensing of Canada's New Arctic Frontier



Dr. Younès Messaddeq
Canada Excellence Research Chair
in Enabling Photonic Innovations for Information and Communication



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Finding an antidote to poisoned water

In Bangladesh and parts of India, low levels of arsenic in the drinking water are causing what has been termed "the world's worst mass poisoning." At least 57 million people are affected.

"Symptoms start with dark patches on the skin and progress to worsening lesions, skin and internal cancers and eventually death," says Ingrid Pickering, Canada Research Chair in Molecular Environmental Science at the University of Saskatchewan.

Arsenic has a curious property: a lethal dose of certain forms of arsenic can be completely counteracted by a similar dose of selenium. The relationship has been known for several decades, and Graham George, U of S Canada Research Chair in X-ray Absorption Spectroscopy, Dr. Pickering and collaborators recently used synchrotron light to uncover the mechanism behind it: a molecule containing one atom of arsenic bound to one atom of selenium forms in the body and is rapidly excreted, taking both elements with it.

In Bangladesh and India, the afflicted areas are very low in dietary selenium, an essential element that, among other things, helps protect against cancer. Arsenic from the drinking water seems to eliminate the already scant selenium in the body, making the population highly selenium-deficient.

An American-led clinical trial has tested the effect of selenium supplements with promising results. While the rural Indian and Bangladeshi population may be resistant to a nutritional supplement in the form of pills, selenium in a dietary staple such as lentils may be welcomed.

"Saskatchewan soils – and the lentils grown on them – are rich in selenium. It could just be that a Saskatchewan crop and the synchrotron measurements hold the key to health for people on the other side of the world," says Dr. Pickering.

Read more about preeminent U of S water research at usask.ca/water.



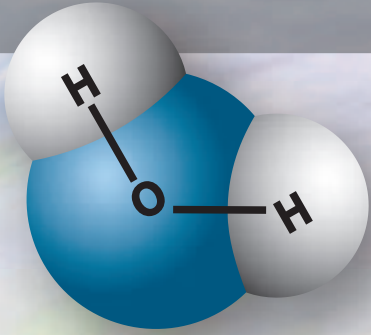
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“Ecotoxicohydrology”

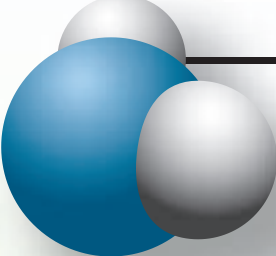
...n. a new science that will transform how the world uses and manages water



It's not a common word yet, but with the University of Saskatchewan's \$30-million Canada Excellence Research Chair (CERC), it will be.



Howard Wheater,
Canada Excellence
Research Chair



Led by Howard Wheater, one of the world's foremost hydrologists, the CERC team will develop this new cutting-edge science—and the tools, techniques and policies to manage the world's freshwater resources sustainably.

Working with partners in Environment Canada, the Saskatchewan Research Council, and industry, Wheater will establish a world-leading research and training institute to solve water challenges and train the next generation of water scientists.

Our new global institute will recruit 85 people—including six new faculty, 20 post-doctoral fellows, 24 PhDs, and 24 master's students.

These researchers will have access to two of Canada's top science projects—the Canadian Light Source and the International Vaccine Centre—and will work closely with three new graduate schools in public health, public policy and environment and sustainability.

With our world-class facilities, five Canada Research Chairs in water-related areas, and a unique breadth of expertise among 65 researchers in diverse disciplines, the U of S is in the forefront of efforts to find solutions to water quality and water supply issues around the world.

Protecting our clean and safe water supply is a top priority of the Saskatchewan government which has invested \$10 million in the new CERC.

www.usask.ca/water



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UNIVERSITÉ DE SHERBROOKE

Expert supercharges school's bid to make quantum leap in computing technologies

With the award of a Canada Excellence Research Chair (CERC) in Quantum Signal Processing, the Université de Sherbrooke has reaffirmed its position at the frontier of quantum science. Quantum information, an emerging field combining physics, computer science and engineering, aims to harness the laws of quantum mechanics in revolutionary ways.

Around the world, leading researchers are at work on quantum computers that can potentially execute certain tasks exponentially faster than current technologies. One of the critical components of this effort, quantum signal processing, is the research focus of university's new CERC, Bertrand Reulet.

"All commercial information processors revolve around solid-state physics, and this is also the most promising avenue with which to build a quantum information processor. But the electronic noise affecting these systems during their operation is a major obstacle," says Dr. Reulet. "Our research will deepen our understanding of this noise, and improve the interfaces between quantum devices and classical apparatus, paving the way to scalable quantum tech-



As Canada Excellence Research Chair in Quantum Signal Processing, Dr. Bertrand Reulet is contributing to Université de Sherbrooke efforts to develop quantum computers, devices with the potential to exponentially outperform current computing technologies. PHOTO: SUPPLIED

nologies in the solid state."

Building on his award-winning research accomplishments on noise to date, Dr. Reulet will explore the mechanisms at the origin of electronic noise at very low temperatures, in the simple, solid-state nanostructures (such as quantum wires and junctions) that constitute the building blocks of future quantum processors.

"We will study the laws of quantum mechanics as they apply to the laws of electrical current. The properties of electrical current are well known to all engineers. But beyond that, once you push beyond a

certain limit, you have to use quantum mechanics to identify the new laws of electrical current. That's what I find intriguing," he says.

In co-operation with other leading researchers at Université de Sherbrooke, Dr. Reulet will study the ways in which quantum properties of the signals from such devices can be processed by classical instruments. His experiments are expected to shed new light on how quantum processors could be read out by current computers, with broad applications for advancing information technology, especially

microelectronics.

His interdisciplinary approach will bring together experimental and theoretical physicists, and rely on superb nanofabrication facilities in engineering, explains the rector of Université de Sherbrooke, Professor Luce Samoisette. "With Dr. Reulet's arrival, the Université de Sherbrooke will be positioned as one of the leading global institutions in quantum computing," she notes. "Understanding and working with the fundamental noise limits of quantum devices is going to be crucial in solving the scientific

hurdles in this field, which in turn will allow us to eventually move forward towards practical quantum computers and applications."

The work of a very strong research group on superconductors in physics, whose members have been leaders in this field for over two decades, led to the recent creation of a research group in quantum computing and the hiring of three young researchers. These extremely promising faculty members quickly achieved a significant impact in this field of research, which laid the foundation for the CERC, says Rector Samoisette. "The quality of our researchers, the existing facilities for material characterization and highly specialized nanofabrication laboratories, and our expertise were all major factors in obtaining this chair."

Together with the three new faculty members, Dr. Reulet and his team will be backed by the Canadian Institute for Advanced Research, whose work with the university's physics department will further help establish its quantum computers research program. "The department is already internationally known for its work on superconductivity, a phenomenon on which future quantum devices

will likely depend," says Rector Samoisette.

Dr. Reulet's research program may well prove to be of crucial importance for the future of quantum information processing. The CERC brings extremely high visibility to research in quantum signal processing, which, together with the activities of the existing research group, can lead to eventual breakthroughs in the area of quantum computing.

"This visibility will allow Université de Sherbrooke to attract the best students in the field, and, consequently, contribute in attracting and retaining the best research scientists," she says. "It is vital that Canadian researchers be involved in this rapidly evolving technology, and the CERC will be instrumental in achieving this objective."

Before assuming his Canada Excellence Research Chair at the Université de Sherbrooke, Dr. Reulet was director of research at the Centre national de la recherche scientifique, in the Laboratoire de physique des solides at the Université Paris-Sud XI, France. He has also served as professor at the École Polytechnique, France, and spent four years at the Department of Applied Physics at Yale University. ■

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Excellence
is part
of the program

- Achieving excellence in quantum physics research
- Building first-generation quantum computers
- Defining the future of quantum applications

www.USherbrooke.ca

The Université de Sherbrooke is proud to welcome Bertrand Reulet, a world-renowned research scientist and holder of the Canada Excellence Research Chair (CERC) in Quantum Signal Processing.

The Université stands in the vanguard of research in quantum information, an emerging area of great strategic importance for Quebec and Canada.



UNIVERSITÉ DE
SHERBROOKE

BrainGain

"Research chairs of this calibre will create new opportunities for researchers already in Canada, and for university students at the undergraduate, graduate and post-doctoral levels."

Chad Gaffield, Chair of the CERC steering committee; President of the Social Sciences and Humanities Research Council of Canada.

Research Excellence



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Helping Canadian universities compete in the global market for research talent, the federally supported Canada Excellence Research Chairs (CERC) program has awarded 19 chairholders and their research teams with up to \$10 million over seven years to conduct research in areas of strategic importance to Canada. Here is a snapshot of the latest CERC-supported scientists now contributing to Canada's competitiveness, well-being and deeper understanding of the human dimension of technological change.



Marcel Babin
Canada Excellence Research Chair in Remote Sensing of Canada's New Arctic Frontier, Université Laval

Climate change and industrialization are unlocking the Canadian Arctic's natural resources and transforming its ecosystems and communities. The stewardship of these ecosystems, the sustainable development of Arctic resources, and the adaptation of northern communities demand a comprehensive understanding of the ongoing transformations. Dr. Babin's research will help fill these knowledge gaps by applying the most recent advances in satellite remote sensing to track how current and future Arctic ecosystems respond to climate change.



Robert W. Boyd
Canada Excellence Research Chair in Quantum Nonlinear Optics, University of Ottawa

Dr. Boyd's research will use nanotechnology to make new materials for science and engineering applications with important implications across disciplines ranging from information and communication technologies and solar energy to biomedical imaging. A global leader in the field of photonics – the study of photons and their application in telecommunications and informatics – Dr. Boyd is also a leader in quantum nonlinear optics, a field that marries the disciplines of nonlinear optics (the interaction of light with light) with quantum optics, which explores photons.



David Cory
Canada Excellence Research Chair in Quantum Information Processing, University of Waterloo

Quantum information processing – technologies with the potential to solve problems deemed beyond the capabilities of today's most powerful supercomputers – promises to touch nearly every aspect of our lives, from how we interact with each other to ways we process and store knowledge. At the University of Waterloo's Institute for Quantum Computing, Dr. Cory's research is expected to contribute toward the world's first generation of practical quantum devices – systems with applications in medicine, communications, biochemistry, physics and nanoscience.



Ali Emadi
Canada Excellence Research Chair in Hybrid Powertrain, McMaster University

Engineers worldwide are competing to build the next generation of cost-effective, energy-efficient cars, including plug-in hybrid vehicles. An expert in transportation electrification, including advanced electrified powertrains; the vehicle-to-grid interface of plug-in vehicles with Smart Grid technology; powertrain components; hybrid battery/super-capacitor energy storage systems; and adaptive vehicle control and power management systems, Dr. Emadi will advance research useful for industry and environmental policy-makers as well as Canada's auto sector and growing green technology industry.



Oliver Ernst
Canada Excellence Research Chair in Structural Neurobiology, University of Toronto

Age-related neurological diseases such as Parkinson's and Alzheimer's are on the rise. Dr. Ernst's research will contribute to efforts to create new therapies designed to enhance patient well-being and reduce the economic burden on their families and the health-care system posed by these afflictions. Continuing his groundbreaking work on rhodopsin – the light receptor in the eye – Dr. Ernst's research is expected to shed new light on the behaviour of molecules in both healthy people and those suffering from neurological diseases.



Matthew Farrer
Canada Excellence Research Chair in Neurogenetics and Translational Neuroscience, The University of British Columbia

Diseases of the brain are one of the 21st century's greatest global medical health challenges. Beyond helping establish a UBC research centre for applied neurogenetics that will use new genetic and computing technologies to study the molecular origins of brain diseases, Dr. Farrer will pioneer strategies for early detection and improved treatments for neurodegenerative diseases such as Parkinson's and Alzheimer's, and introduce a focus on degenerative disorders in children. He will also help train scientists working in clinical neurology, neurogenetics, neuroscience and neuropsychiatry.



Ian A. Gardner
Canada Excellence Research Chair in Aquatic Epidemiology, University of Prince Edward Island, Atlantic Veterinary College

Aquaculture is an increasingly important source of protein for a hungry planet. Dr. Gardner will enhance Canada's leadership in this industry by studying aquatic ecosystems and managing diseases in populations of sustainably produced aquatic food animals. He will also develop cost-effective testing strategies and surveillance programs for the prevention and control of diseases, and will investigate disease dynamics and health interactions between farmed and wild fish. Dr. Gardner's research will also help regulators make science-based decisions to maintain healthy food production in marine environments.



Michael Houghton
Canada Excellence Research Chair in Virology, University of Alberta

Hepatitis B and C viruses are major global health problems. Currently, there is no vaccine for HCV, and existing treatment methods only work for about half of infected patients. While there is a vaccine to prevent HBV, patients with a chronic infection face long-term complications. Building on his breakthrough discovery of the virus that causes HCV, and his identification of the hepatitis D viral genome, Dr. Houghton will work to develop low-cost prophylactic vaccines against HCV and therapeutic vaccines against HBV.



Adrian Owen
Canada Excellence Research Chair in Cognitive Neuroscience and Imaging, The University of Western Ontario

Addressing one of clinical medicine's most challenging topics – residual brain function in patients that are non-responsive after suffering a severe brain injury – Dr. Owen will test new theoretical models and use functional neuroimaging (fMRI) approaches to detect and measure activity in brain-injured patients who appear vegetative. In addition to studying the cognitive deficits in patients suffering from neurodegenerative diseases, Dr. Owen will also develop new brain-computer interfaces that will allow patients to communicate with the outside world and expand their therapeutic options.



Younès Messaddeq
Canada Excellence Research Chair in Enabling Photonic Innovations for Information and Communication, Université Laval

With the appointment of Canada Excellence Research Chair in Enabling Photonic Innovations for Information and Communication Dr. Younès Messaddeq, Canada now possesses advanced research capabilities in glass and optical fibres that will consolidate its position among world leaders in optics and photonics technology. Progress on fibre optic materials has already improved how we communicate, how we gather and store information, and how medical instruments are made. Future innovations are certain to enhance and accelerate the transfer of information.



D. Graham Pearson
Canada Excellence Research Chair in Arctic Resources, University of Alberta

In the past decade, Canadian diamond exploration and mine development has generated more than \$2 billion in annual economic activity. To help sustain this activity, Dr. Pearson will develop the first detailed picture of rock formations hidden deep under the Earth's crust in Canada's Arctic region, revealing new data on landmasses where diamonds are formed. Dr. Pearson's work will revolutionize current and potential diamond mine understanding and help the Canadian government forge a geo-mapping program useful to Arctic mineral exploration.



Bertrand Reulet
Canada Excellence Research Chair in Quantum Signal Processing, Université de Sherbrooke

Combining physics, computer science and engineering, researchers aim to harness the laws of quantum mechanics to build the first generation of quantum computers – machines able to work exponentially faster than current processors, handling information in a completely new way. Dr. Reulet's work will advance the first generation of quantum information processors by tackling the biggest obstacle currently facing quantum computing pioneers – electronic noise. This groundbreaking research is expected to have wide-reaching applications for advancing information technology, especially microelectronics.



Patrik Rorsman
Canada Excellence Research Chair in Diabetes, University of Alberta

Close to three million Canadians have diabetes. More than 15,000 people die each year of the disease, and treatment is estimated to cost in excess of \$15 billion annually. With those numbers expected to grow by 20 per cent over the two decades, scientists need to better understand the function of insulin-producing pancreatic islets. A world leader in diabetes research, Dr. Rorsman will develop new treatments that preserve, regenerate and transplant these insulin-producing cells back to healthy conditions, thereby restoring the pancreas' functions.



Frederick Roth
Canada Excellence Research Chair in Integrative Biology, University of Toronto

Increasingly, the ability to reveal DNA sequences is outpaced by a capacity to understand them. Today, a minority of genes are thoroughly understood, and nearly half remain a compete mystery. Dr. Roth will lead research to develop new technology for discovering gene functions, the pathways they encode, and how these genes and pathways relate to human disease. This work will be highly synergistic with efforts currently underway at the University of Toronto's Samuel Lunenfeld Research Institute.



Søren Rysgaard
Canada Excellence Research Chair in Arctic Geomicrobiology and Climate Change, University of Manitoba

A persistent loss of ice in Canada's Arctic north due to climate change has massive implications for the planet. Dr. Rysgaard's research team studying the effects of melting sea ice on coastal Arctic ecosystems will join the Centre for Earth Observation Sciences at the University of Manitoba's Clayton H. Riddell Faculty of Environment, Earth and Resources. In co-operation with ArcticNet, Canada's umbrella organization of Arctic study groups, Dr. Rysgaard's research promises to position Canada as the global leader in understanding changing Arctic ecosystems.



Philippe Van Cappellen
Canada Excellence Research Chair in Ecohydrology, University of Waterloo

The availability and quality of fresh water is threatened by overuse and other environmental stresses. Dr. Van Cappellen will advance understanding of how groundwater and surface waters interact, and how these interactions affect human and aquatic ecosystem health. Combining lab and field experiments with mathematical modelling, Dr. Van Cappellen will seek to define the biogeochemical changes involved in the movement of nutrient elements and toxic metals between groundwater and surface water and their impacts on water quality and ecosystem health.



Douglas Wallace
Canada Excellence Research Chair in Ocean Science and Technology, Dalhousie University

Unprecedented changes in the world's ocean systems – from rising sea levels and overfishing to habitat destruction and ever-increasing ocean water acidity – have been well documented. Dr. Wallace's research team will advance understanding of ocean changes, in part, by developing and deploying new observation instruments that are more sensitive than current methods of detecting biogeochemical oceanic change. These tools and platforms will help Dr. Wallace and his researchers measure, for example, how ocean uptake of fossil-fuel-derived carbon dioxide is changing.



Howard Wheeler
Canada Excellence Research Chair in Water Security, University of Saskatchewan

The world's water security is increasingly threatened by climate change, pollution and overuse of water resources. Combining ecology, toxicology and hydrology, Dr. Wheeler will develop new science and risk assessment tools to better understand and manage the complex interactions between water, land use and climate change. Ushering in a new field – ecotoxicohydrology – Dr. Wheeler's new state-of-the-art science and technologies will help policy-makers forge better water resource management plans and address complex industrial and social needs.



Thomas Thundat
Canada Excellence Research Chair in Oil Sands Molecular Engineering, University of Alberta

The massive landscapes of Alberta's oilsands represent a multibillion-dollar economic operation, but it is the underlying micro-scale chemical processes, such as the complex interaction of water and bitumen, that enable successful extraction. Dr. Thundat will develop new detection and extraction technologies to improve the overall efficiency of how Canada's oilsands are processed. The tools he develops will eventually lead to extraction processes that are more energy efficient, use less water and reduce greenhouse gas emissions.