Created at Guelph

UNIVERSITY of GUELPH

RESEARCH INNOVATION

2021–22 Annual Report

Contents

Photo: Life Stages
U of G Through the Lens photo contest—2021 Honourable Mention (Undergraduate Students).
Photo: Rory Wills · Photo courtesy of the Office of Research

Cover photo: Beyond the appearance 2
U of G Through the Lens photo contest—2021 Honourable Mention (Graduate Students).
Photo: Guilherme Madureira · Photo courtesy of the Office of Research

Welcome

Jessica Bowes
Assistant vice-president (research innovation and knowledge mobilization)
Photo: Rob O'Flanagan

Supporting innovation and partnership from discovery to impact

The Research Innovation Office (RIO) provides services that enable the conversion of discoveries to impacts through knowledge mobilization and commercialization of research. RIO's work includes innovation management, protection and licensing of inventions, and new venture creation and incubation. RIO also provides support to develop and steward partnerships with a variety of external partners, from private sector industry to not-for-profit organizations.

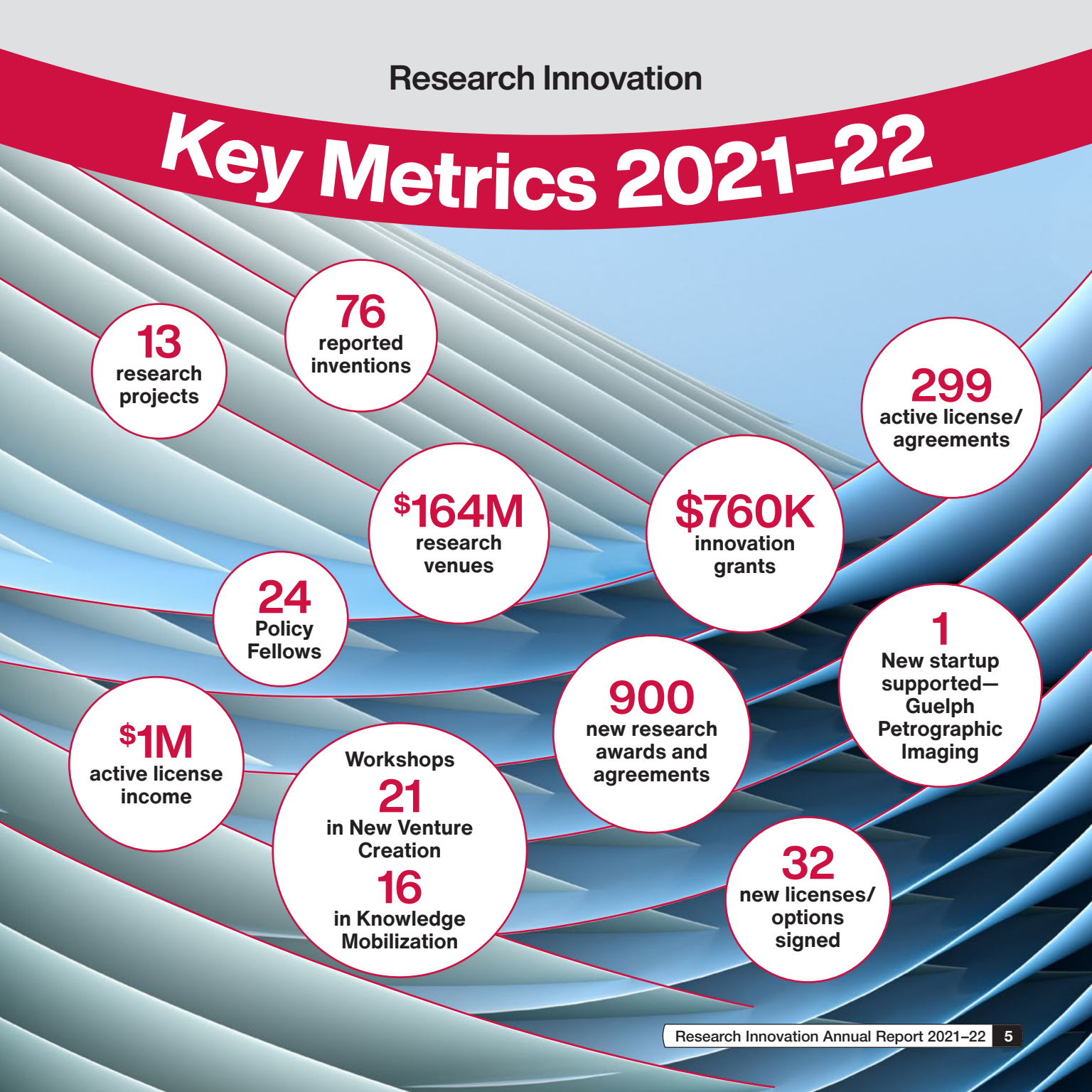
Welcome

Guided by principles of the Strategic Research Plan, RIO made significant contributions to programs and services in 2021–22. Our office reported 76 new inventions and helped execute more than 30 new licences and option agreements. This report contains some of the stories we are most proud of, including stories of start-up companies that experienced significant growth to get innovative solutions into the hands of those who need them most.

This past year, RIO led the development of an institutional commercialization policy and supporting framework through consultation with critical research community members. The University of Guelph has long embraced knowledge and technology transfer as part of its mission and purpose to Improve Life. This new policy articulates the University's commitment to knowledge mobilization and technology transfer and to sharing resources and policies that facilitate the protection, management and commercialization of IP arising from University of Guelph research.

We look forward to building on this momentum as we continue to adapt and optimize services and processes to meet the needs of researchers, students, partners and collaborators to maximize research impact and improve life.

Key Metrics 2021–22



FloNergia research team collecting performance data of FloMov pumps installed in a recirculating fish tank for field trials at the Ontario Aquaculture Research Centre.

Photo courtesy of Rashal Abed

Startups

FloNergia Inc.

FloNergia continues to expand its sales around the globe, thanks in part to its ongoing collaboration with the University of Guelph. The company now has 14 distributors and three sales agents across five continents with customers engaged in agriculture, aquaculture, wastewater and food production. Currently, the team is working closely with the Ontario Aquaculture Research Centre* (see photo at left) to validate the positive impact of using FloMov airlift pumps to improve overall fish health and yield. Most recently, Dr. Wael Ahmed and Josh Rosettani, both in the School of Engineering within the College of Engineering and Physical Sciences, participated in the RIO booth at the Ontario Innovation Expo.

Dr. Wael Ahmed (right) and Josh Rosettani participated at the RIO booth at the Ontario Innovation Expo in October 2022.

Photo: Paul Subject

"In 2023, we expect to add additional human resources as we continue our global expansion with expanded distribution capability in Europe."

—Dr. Paul Subject

*The Ontario Aquaculture Research Centre is owned by the Agricultural Research Institute of Ontario and managed by the University of Guelph through the Ontario Agri-Food Innovation Alliance, a collaboration between the Ontario Ministry of Agriculture, Food and Rural Affairs and U of G.

Rémi Maglione, vice president and co-founder of Harvest Genomics.

Photo courtesy of Harvest Genomics

Harvest Genomics

Since its Gryphon's LAAIR* pitch competition win back in 2020, Harvest Genomics has made a significant impact in Ontario's greenhouse industry. In partnership with the Ontario Ministry of Agriculture, Food and Rural Affairs and Agriculture and Agriculture Food Canada, the company has developed a new test for early detection of the tomato brown rugose fruit virus (ToBRFV), which infects tomato and pepper crops.

This swab test proved to be a vital component of provincial and industry response to the virus. Harvest Genomics also received additional grant funding from SmartGrowth, a FedDev Ontario-funded program administered by Bioenterprise Corp. News of this and the company's other successes was featured on the cover of *Greenhouse Canada* magazine in September 2021 and in *Farmtario* in May 2022.

*Gryphon's LAAIR is a program funded by U of G and the Ontario Agri-Food Innovation Alliance that is designed to support the commercialization of research findings.

SP Nutraceuticals

SP Nutraceuticals, which competed in the Gryphon's LAAIR Pitch Competition in 2020, has since welcomed Trevor Clarke (CEO), James Le Duc (CRO), and Darren Contardo (president and chief marketing officer) to the team in 2022! Working with founder Paul Spagnuolo (Food Science, OAC), they have accelerated the company's omni-channel go-to-market strategy and focus on scalable growth. In recent news Metavo, the first avocado-based supplement on the market with AvoB™, is now being sold on the shelves of major retailers like CVS and Shoppers Drug Mart across the U.S. and Canada and plans to be distributed in select international markets in 2023.

"We are on a mission to reverse metabolic dysfunction. We believe Metavo, powered by AvoB is the best solutions out there for the 88 per cent of North American's impacted by metabolic inflexibility... Our partnership with the University of Guelph has enabled us to bring this breakthrough innovation into the hands of the people who need it most."

—James Le Duc, Chief Revenue Officer, SP Nutraceuticals Inc.

Photo courtesy of NP Nutraceuticals Inc.

"All of us at Mirexus are thrilled to find the ideal home for our technology at Mibelle Biochemistry. The deep knowledge and capabilities of Mibelle will enable the growth of this technology beyond what Mirexus could do on its own. We look forward to seeing the continued expansion of our technology under Mibelle's experienced leadership."

—Phil Whiting, President and CEO, Mirexus Biotechnologies Inc.

"It's very exciting to see the PhytoSpherix technology continue to move forward in personal care applications with Mibelle Biochemistry."

—Dr. John Dutcher

Mirexus

On October 3, 2022, Mibelle Biochemistry announced the purchase of key assets of Mirexus Biotechnologies Inc., a Canadian company that offers a sustainable plant-derived glycogen (phytoglycogen) called PhytoSpherix™ for use in personal care products. The transition became effective October 1st, 2022 and under the terms of the agreement, both parties accepted to not disclose further details. The branded products PhytoSpherix™, EnerZea™, Adveen™ and Susttain™ are fully integrated in the portfolio of Mibelle Biochemistry and are available for purchase immediately at Mibelle Biochemistry.

PhytoSpherix™ was developed and commercialized with funding in part from the Ontario Agri-Food Innovation Alliance.

Photo: Timing is Everything!
U of G Through the Lens photo contest—2018 Best in Show.
Photo: Amira Rghei · Photo courtesy of the Office of Research

2022 Innovation of the Year

2022 saw two impactful University of Guelph technologies recognized with Innovation of the Year Awards: a mental health literacy program for farmers and a biomonitoring method and tool to help protect biodiversity.

Dr. Andria-Jones Bitton and Dr. Briana Hagen
Photo: Nakita Byrne-Mamahit

In the Know

Developed by Dr. Andria Jones-Bitton and Dr. Briana Hagen (Department of Population Medicine, OVC)

In the Know is a trilingual mental health literacy program for farmers and other workers in the agricultural sector, designed to help them identify and understand mental health challenges and connect people with the appropriate support. A four-hour live session delivered in-person or virtually, the program has grown since 2019 to serve across Canada from Ontario, Manitoba, Nova Scotia, Alberta and British Columbia, with multiple languages now available as well.

In the Know was developed with funding in part from the Ontario Agri-Food Innovation Alliance.

Learn more about these amazing innovations!

Andria Jones-Bitton and Briana Hagen
uoguel.ph/ioty-intheknow

Robert Hanner
uoguel.ph/ioty-ednabiomonitoring

Environmental DNA for Biomonitoring

Developed by Dr. Robert Hanner (Department of Integrative Biology) and his team

Environmental DNA for Biomonitoring is a laboratory test known as a PCR assay that monitors endangered species by detecting and measuring the environmental DNA they shed. Involving two reported inventions, these were used as the foundation for Precision Biomonitoring Inc. in 2017, which provides eDNA biomonitoring services.

Dr. Robert Hanner
Photo: Nakita Byrne-Mamahit

“Candidate line OAC20-SRW-03, a soft red winter wheat was supported for registration in 2022. OAC20-SRW-03 was evaluated in orthogonal pastry trials in 2020 and again in 2021 where yield was 107 per cent across Ontario compared to the agronomic checks. Additionally, the line exhibited low levels of leaf disease infection. Breeder seed was distributed to SeCan, the licensee of this new line, which will be named OAC Gemini.”

—Dr. Helen Booker, plant breeder and GFO wheat breeder, OAC

Innovation Highlights

U of G Wheat Program's First Canadian Eastern Soft Red Winter Wheat — *OAC Constellation*

After three years of Ontario Cereal Crop Committee performance trials, OAC Constellation is the first release of a Canadian eastern soft red winter wheat by the U of G Wheat Breeding Program. With short, strong straw and high-test weight, this wheat variety has good resistance to stripe rust. The first cultivar released by the new wheat breeding program, it was reintroduced in 2013 by the University of Guelph's Ontario Agricultural College (OAC), SeCan and the Grain Farmers of Ontario (GFO). In an ongoing partnership with SeCan, OAC Constellation is licensed and available to Ontario and Maritime growers as of 2022.

Since July 2020, the Wheat Breeding Program has been run by Dr. Helen Booker (Department of Plant Agriculture, OAC), the GFO wheat breeder and successor to the late Dr. Alireza Navabi (Plant Agriculture, OAC).

The program has received support for registration for three soft red candidate winter wheat lines. These lines are supplied through multi-party agreements with the University and tested in Ontario.

An important part of this research is its focus on wheat disease pathology. Through connections to the University of Saskatchewan, Dr. Booker runs testing of spring wheat lines from Canada's seed bank, Plant Gene Resources Canada (PGRC), by Dr. Randy Kutcher at the Crop Development Centre in Saskatoon.

This work used the University of Guelph program's inoculated Fusarium nursery at the Ontario Crops Research Centre in Elora, which is owned by the Agricultural Research Institute of Ontario and managed by U of G through the Ontario Agri-Food Innovation Alliance.

Winter wheat plots at the Ontario Crops Research Centre in Elora.
Photo courtesy of Dr. Helen Booker

“Our *C. jejuni* vaccine journey during the past 20 years at Guelph exemplifies well what our Guelph students can accomplish when exposed to curiosity- and application-driven research.”

—Prof. Mario Monteiro (Chemistry, CEPS)

Vaccine for Traveller's Diarrhea

Since 2004, Prof. Mario Monteiro (Chemistry, CEPS) has worked in collaboration with researchers at the U.S. Naval Medical Research Centre to create the first human glycoconjugate vaccine to prevent food poisoning in humans caused by *Campylobacter jejuni*. This bacterium causes an estimated 1.5 million illnesses per year in the USA alone and many more people in the developing world where sanitation levels are lower. Most often symptoms are mild with GI pain and disabling diarrhea but if left untreated, in extreme cases may cause death. In some cases, *C. jejuni* infection leads to Guillain-Barré syndrome, an autoimmune disease.

Unlike protein-based or mRNA gene-based vaccines used against COVID-19 which recognize proteins, Dr. Monteiro's vaccine works by teaching the body's immune system to recognize specific carbohydrates (sugars) on the bacteria's surface to prompt an immune response. Sugars alone elicit short-lived antibodies, so the carbohydrates are joined (conjugated) to a highly immunogenic helper protein, which enables the production of long-lasting antibodies against the *C. jejuni* surface sugars.

This vaccine is one of very few sugar-based vaccines that currently exist. The vaccine just started a second human trial (Phase 1b) at the Cincinnati Children's Hospital Medical Centre which is funded by the National Institutes of Health in the United States.

Dr. Monteiro is one of the few researchers in the world working on sugar-based vaccines. He has also created a glycoconjugate vaccine for preventing *Clostridiodes difficile* which is being commercialized by Matrivax, a Boston based biotech company. As well, the WHO has identified Dr. Monteiro and the US Navy's next bold project as a preferred product for the developing world: a multivalent vaccine for *C. jejuni*, *E. coli* and *Shigella*.

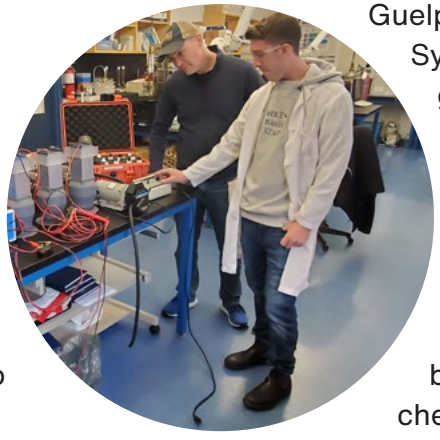
Scanning electron microscope image showing the characteristic spiral shape of C. jejuni cells and related structures.

Photo: U.S. Department of Agriculture, Agricultural Research Service (ARS)/De Wood


WOLVES
HAWKS
STAFF

Controlled Environment Agriculture Water Remediation: Closed-loop water circulation in climate-controlled farming

As producers look for solutions to allow for closed-loop water circulation in controlled environment agriculture (CEA), Dr. Thomas Graham (School of Environmental Sciences, Ontario Agricultural College) and his team have developed a novel water purification technology to address this need.



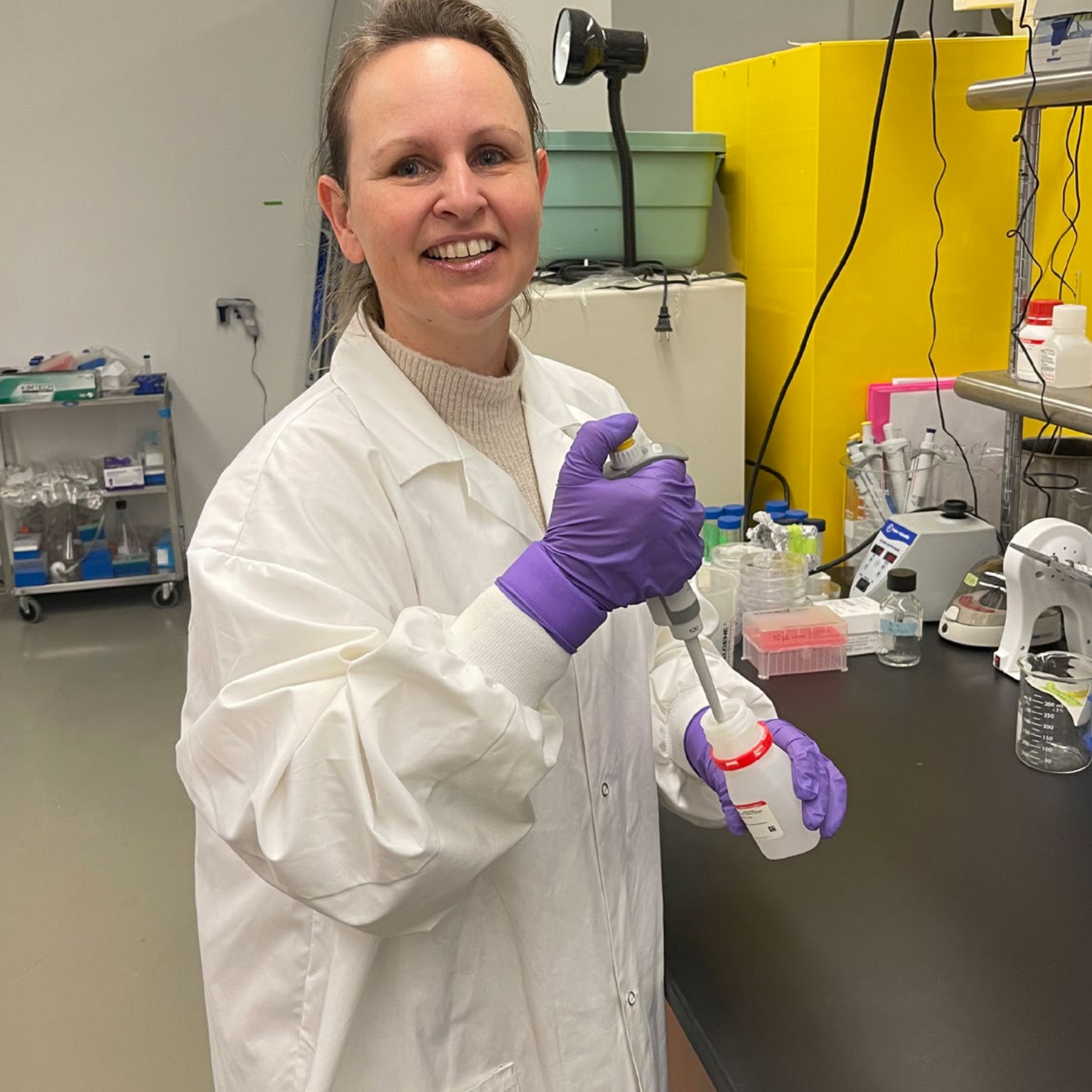
Currently, UV light-based systems are often used to disinfect water on farms. This water, which can contain residual fertilizer, chemical contaminants and a range of microorganisms including potential pathogens, requires treatment before it can be reused. Although UV light disinfects the water, it does not effectively control chemical contaminants and requires a significant amount of energy to run.

New electrochemical water treatment technologies developed at the University of Guelph's Controlled Environment Systems Research Facility generate short-lived reactive chemicals directly in and from the water using specialized electrodes and custom reaction chambers. These reactive chemicals, also known as free radicals, kill or break down the biological and chemical contaminants in the water, and in doing so, are consumed themselves. This process leaves no lasting residual chemicals in the water. After passing through these reaction cells, the water is once again safe to apply to the crop.

This system provides environmental and workplace safety benefits. With no moving parts in the reaction cell, the technology requires little power. With no added reagents beyond those derived from the irrigation solution, the system requires no hazardous chemical handling.

Dr. John Phillips and PhD student Serge Levesque (Molecular and Cellular Biology, College of Biological Science).

Photos: Thomas Graham



Industry Liaison

Isolating Extracellular Vesicles for Health

Extracellular vesicles (EVs) play a role in intercellular communication, making them a promising tool for disease diagnosis, treatment monitoring and, potentially, treatment of complex disease. However, current technologies to isolate EVs have poor yield and purity, making them unreliable for testing. Dr. Huiyan Li (BioMed Innovation Laboratory, School of Engineering, College of Engineering and Physical Sciences has partnered with Galenvs Sciences, a Montreal-based biotech making magnetic nano-particles and oligonucleotides, to develop a high-yield and high-purity isolation kit for extracting EVs from complex biological fluids such as blood and urine. Dr. Li reached out to RIO on her first day at U of G to help navigate this potential project partnership. The Industry Liaison team helped Dr. Li and Galenvs Sciences secure an NSERC Alliance grant to develop the isolation kit. Successful completion of this project will be a valuable step toward the broader applications of EVs in health and life sciences while enhancing the competitiveness of the Canadian biotechnology market.

Graduate student Gisela Strohle in the lab.
Photo: Dr. Huiyan Li

Dr. Ali Dehghantanha presenting to graduate students in the Cyber Science Lab.
Photo: Kaleigh Rajna

A Cyber Threat Hunting and Intelligence System for the Energy Sector

Cybersecurity is a primary concernin critical infrastructure to safeguard all types of data against theft and loss. One way to actively mitigate and prevent threats to cybersecurity is to develop active threat-hunting models able to identify malicious activities at onset. Dr. Ali Dehghantanha (Cyber Science Lab, School of Computer Science, College of Engineering and Physical Sciences) has partnered with iS5 Communications Inc (iS5Com) to leverage the capacities of the company's next-generation hardware platform, the RAPTOR™, to build a machine learning-based threat intelligence prediction system for the energy sector. The Industry Liaison team worked alongside Dr. Dehghantanha and iS5Com to navigate the funding guidelines and contract discussions for the OCI VIP grant. Through this funding, the developed technologies have become among the most advanced cybersecurity products available. This will ensure Canadian utilities and energy sector have the latest security and protection technologies at their disposal.

Left: Graduate student Victoria Loor collecting a field sample. Above: A field turnover sample.

Photos courtesy of M. Victoria Loor

Long-term Ecological Effects of Diesel Oil on Marine Populations

Studying the impacts of diesel oil on marine species can help inform future restoration and protection efforts. Multiple bivalve species are of cultural, ecological and economic importance to the Haíɬzaqv (Heiltsuk) First Nation. The Heiltsuk Integrated Resource Management Department (HIRMD) is conducting assessment and restoration work on clam populations in an area of their Territory impacted by an oil spill. HIRMD has partnered with Dr. Ryan Prosser (School of Environmental Sciences, Ontario Agricultural College) and his lab to examine the effects of marine diesel exposure on larval and juvenile viability and on the reproductive capacity of adult clams. The Industry Liaison team helped Prosser and HIRMD secure NSERC Alliance funding to inform restoration approaches and regional risk protection strategies, and advance the understanding of persistent, long-term ecological effects of marine diesel pollution on near-shore environments.

Knowledge Mobilization

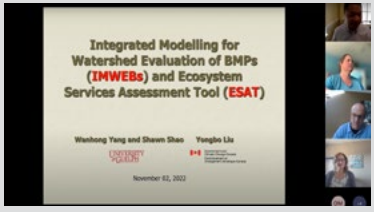
"It wasn't just the networking. A lot of it was the free exchange of ideas as encouraged by the program. There were times where I really enjoyed the fact that it was a one-on-one conversation, but then there were other times where I felt like I gained just as much listening to the other Fellows. Hearing them describe their questions and their point of view was really interesting."

From the Good Roots Fellowship Evaluation

Policy Fellowship

Since 2019, the University of Guelph Policy Fellowship has supported knowledge exchange among science, policy and practice. With funding from Food from Thought, the Canada First Research Excellence Fund initiative at the University of Guelph, the program matches decision-makers from government, industry and non-governmental organizations with faculty experts for conversations about issues in agriculture, food and biodiversity.

In 2021–22, three new virtual cohorts entered the program and the first follow-up evaluation was done with 18 fellowship alumni. The evaluation revealed that 94 per cent of fellowship alumni had used the information they gained during the program to inform their own work and/or the



"I was really pleased to participate. I think a lot of our cohort expressed that they were new to the position, and a policy advocacy job is something you kind of fall into, you're not really trained for it. So just being aware of how we can gain access to the researcher to ask questions, and having discussions about viable policy options, was helpful."

From the Good Roots Fellowship Evaluation

broader work of their organization. Sixty-one per cent also made contact or have been contacted by someone from the program since the program ended to collaborate with or offer support on their initiatives. The fellows also offered positive feedback!

Advancing Research Impact Fund Project

In collaboration with Food from Thought, the Advancing Research Impact Fund program was developed in 2021 to prepare for its 2022 launch. This program offers funding for knowledge mobilization and commercialization activities that help move research in these priority areas outside of the University.

The program aims to increase the uptake and adoption of research results to create environmental, societal and/or economic impact for Canada. The funding will enable activities that support researchers in their efforts to share Food from Thought-funded research.

The first round of funding applications for faculty has been accepted and the first round for student applications will open in 2023.

Education

Knowledge Management and Communication

The Knowledge Management and Communication course offered by RIO is a collection of modules created by collaborators from the University of Guelph, Trent University, York University, Ontario Tech University, Brock University, Queen's University and Wilfrid Laurier University. Also available free online, this text showcases a collaborative effort to generate a series of learning modules on knowledge management, which is the strategic sharing of knowledge with the right partners at the right time to reduce overlap, inform policy and decision-making, and accelerate innovations.

Skills for Research Impact

Skills for Research Impact is a workshop series for University of Guelph faculty, research staff and graduate students interested in enhancing the impact of their research. Hosted by the Ontario Agri-Food Innovation Alliance, the Arrell Food Institute and RIO, six sessions are facilitated during the academic year by impact experts. Participants learn how to successfully plan, execute and evaluate knowledge mobilization activities. During 2021-22, 576 virtual participants in the program explored topics including planning for research impact, infographic design and development, clear language writing, digital storytelling and science policy engagement.

Intellectual Property Education Program—*IP Foundations*

In August 2021, the Intellectual Property Education Program – Foundations course was officially launched on CourseLink. Derived with permission from a similar module at the University of Toronto and the Canadian Intellectual Property Office, the course is a self-directed module created by RIO.

The program is designed to equip individuals with a broad foundation in intellectual property (IP) and its general application in today's knowledge economy. It introduces the basics of IP and related topics including patents, trademarks, copyright and trade secrets, and discusses how to recognize the value of IP and the steps to protect it.

Since its launch last year, the program has seen 123 enrolments from undergraduate and graduate students and from our external partners including the Ontario Ministry of Agriculture, Food and Rural Affairs.

Advantage Workshops

Hosted throughout 2021 and 2022, the Advantage Workshops taught research teams new skills to help them envision and communicate solutions to develop fruitful, long-term relationships with industry. Topics for 12 workshops included creating persuasive value propositions, intellectual property essentials, techniques for advancing collaboration, and the artful science around pitching, all with experts in these fields.

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