2022

FACULTY OF SCIENCE
ANNUAL REVIEW

Our Community. Our Impact.

science | YORK UNIVERSITÉ UNIVERSITY

contents

A Message from Dean Rui Wang

As I reflect on the past year, I am grateful to our instructors, researchers and staff who work very hard to serve our students and make a positive impact on the Faculty of Science and our community. Our Faculty is committed to fostering scientific discovery and tackling global challenges to create positive change in our world. And we are so lucky to have talented researchers, teachers and staff on our team to help us achieve this. Together, we are building science for the future and making York Science a great place to study, to research, and to be proud community members.

We accomplished so much together in 2022.

We launched our Community 2022 initiative to help our faculty, staff and students reconnect in person and to support the return to a more robust on-campus presence. Our researchers attracted $20.6 million in research funding, including an incredible $7.25 million grant from the International Development Research Centre of Canada to establish the Global South Artificial Intelligence for Pandemic and Epidemic Preparedness and Response Network. We recruited talented new researchers and teachers, and celebrated new and renewed Chair positions and elections to the Royal Society of Canada.

We launched a syllabus template for instructors that includes an Indigenous land acknowledgement and integrates principles of equity, diversity and inclusion (EDI) to welcome students into their courses. We installed automated, remote-controlled domes at the Allan I. Carswell Observatory that have enhanced the opportunities for viewing, research, public engagement and more for our entire community. Our Departments launched new programming, including a Data Science program and revamped offerings in Science, Technology & Society, including new courses focused on EDI. We enhanced opportunities for undergraduate research and success by hosting a successful summer research conference and establishing a new Undergraduate Research Award program, thanks to a generous donation by Earle Nestmann. And we created new international education experience programs and initiatives, such as our 2+2/2+3 Undergraduate International Collaboration Education Program, which allows students studying at partner institutions to complete their degrees at York Science.

I am so proud of these achievements. You can read more about these and many more accomplishments in our 2022 Faculty of Science Annual Review.

Rui Wang
Dean, Faculty of Science
York University

Faculty of Science

By the Numbers

174
Faculty members
(Full-time)

101
Staff members
(Full-time)

20
Undergraduate programs

9
Graduate programs

93
Postdoctoral Fellows & Visitors

4,197
Undergraduate students
63% Canadian
37% International students
(full-time and part-time)

421
Graduate students
63% Canadian
37% International
(full-time and part-time)

5
Departments:
Biology, Chemistry, Physics & Astronomy, Mathematics & Statistics, Science, Technology & Society

1
Division:
Natural Science

25
Bethune-affiliated student clubs

$78.2 million

Total annual budget

$20.6 million

Total research funding revenue

$2.9 million

Total fundraising amount

Annualized results since the time of the 2021 Annual Review report (as of March 31, 2023)

18

Fellows and College members of Royal Society of Canada

(current and emeriti)

23

Canada Research Chairs, York Research Chairs, and Endowed Chairs

4

Organized Research Units based in or led by the Faculty of Science:

Centre for Bee Ecology, Evolution and Conservation

Centre for Research on Biomolecular Interactions

Risk and Insurance Studies Centre

Emergency Mitigation, Engagement, Response, and Governance Institute

4

Research facilities and equipment centres based in the Faculty of Science:

1 YSciCore (NMR Spectroscopy, Microscopy, and Mass Spectrometry)

2 Technical Shops

1 Science Store

Department Chair updates

Biology

In 2022, the Department of Biology had many exceptional scientific and academic achievements and recognitions. We welcomed Professor Kohitij Kar, Canada Research Chair (Tier 2) in Visual Neuroscience. Over 300 Biology undergraduate and graduate students convocated, including 23 MSc and seven PhD students. At the June convocation ceremony, undergraduate students Sophie Eisen, Pablo Gonzalez, and Robert Khatib received the Faculty of Science Gold Medal, and the Silver Medal went to Jacob Fine. Khatib also received the prestigious Governor General's Silver Medal. Other student recognitions included Gurnoor Kaur Brar (MSc candidate) being awarded the Robert J. Tiffin Student Leadership award, and Farwa Sajadi (PhD candidate) receiving the Richard Jarrell Excellence in Teaching at the Graduate Level Award.

ROBERT TSUSHIMA

Professor Bridget Stutchbury was the recipient of two prestigious awards: the 2022 Elliott Coues Award from the American Ornithological Society and the Jamie Smith Memorial Mentoring Award in Ornithology from the Society of Canadian Ornithology. Professors Sandra Rehan and Sapna Sharma were appointed to the Royal Society of Canada College of New Scholars, Artists and Scientists. Sharma was also awarded the Postdoctoral Supervisor Award from the Faculty of Graduate Studies. Professor Christopher Jang received the Faculty of Science Excellence in Teaching Award in the Junior Tenure-Stream Faculty category. Professor Dawn Bazely was recognized by the Ontario Minister of Colleges and Universities' Award in the Future Proofing category.

Professor Elizabeth Clare published a landmark paper in *Current Biology* demonstrating the feasibility and sensitivity to extract and identify the DNA of terrestrial animals in the air.

Professor Robert Tsushima
Chair of the Department of Biology

Physics & Astronomy

The department welcomed new Professors Sarah Rugheimer, Gloria Orchard and Balint Radics. Rugheimer is York's new Carswell Chair for the Public Understanding of Astronomy. She and Professors Chris Bergevin and Cody Storry were NSERC Discovery Grant recipients. Joel Zylberberg received tenure and promotion to associate professor.

Allan I. Carswell Observatory Director Elaina Hyde oversaw the effort to install new telescope domes. The Observatory later hosted a Nuit Blanche event with more than 200 visitors. Professor Hyde also collaborated with Killarney Provincial Park to launch the successful Astronomer in Residence program, serving hundreds of park visitors and online viewers.

PATRICK HALL

Professor Ozzy Mermut co-created a new sensitive and portable delayed fluorescence photon counting device which can be used to help measure the health and sustainability of plants and which is already used in an undergraduate Biophysics class in the department.

Professor Adam Muzzin and YUFA Visitor Cemile Marsan were featured in a press release about discovering evolved galaxies in the young universe. Muzzin and graduate

student Ghassan Sarrouh were also featured in a press release about discovering some of the universe's oldest clusters of stars using James Webb Space Telescope images.

And Biophysics alumna Tarnem Afify was named one of York's Top 30 Alumni Under 30. Congratulations Tarnem!

Professor Patrick Hall
of Physics & Astronomy

Science, Technology & Society

2022 has been a transformative year for our Department. In January, our new major and minor programs were approved by Senate, and in May, we officially changed our name to the Department of Science, Technology & Society, providing a clearly recognizable home for both our STS and NATS offerings.

VERA PAVRI

ROBIN METCALFE

Our STS research colleagues also continued to excel in their respective fields. Professor Hélène Mialet received a large SSHRC Insight Grant, Professor Conor Douglas was lead author on a position paper in the *Orphanet Journal of Rare Diseases* based on findings from his Social Pharmaceutical Innovation Project (SPIN), and Professor James Elwick's book 'Making a Grade: Victorian Examinations and the Rise of Standardized Testing' was featured in an 'author meets critics' session in the journal *Metascience*.

In our Division of Natural Science, we increased the breadth of our environmental science and math offerings, adding courses on Atmospheric Pollution and Water Pollution developed by Professor Stephanie Domenikos and the Mathematics of Biology developed by Professor Carly Rozins. Professor Jesse Rogerson became an FSc liaison for York's Cross-Campus Capstone Classroom and continues his frequent media appearances on recent events in space. We also have some exciting initiatives planned for 2023, including the first NATS field course, Plants in the City, developed by Robin Marushia.

Professor Vera Pavri
Chair of the Department of Science, Technology & Society

Professor Robin Metcalfe
Director of the Division of Natural Science

Mathematics & Statistics

Our Department welcomed two new faculty members: Kelly Ramsay and Allysa Lumley. The Department now has 52 full-time professors, 26 part-time faculty, 17 post-doctoral fellows, eight adjunct professors, and many visiting graduate students and professors. It is the fifth largest department at York University. Last year, our faculty members contributed to internationally recognized and NSERC-funded research in industrial mathematics, mathematical finance, scientific computing, mathematical biology, disease modeling, vaccine mathematics, actuarial science, data science, biostatistics, statistical machine learning, statistical methodology and theory, algebraic combinatorics, analysis, number theory, probability theory, set theory, and the scholarship of teaching and learning. Many faculty members collaborated with industry and government.

STEPHEN WATSON

In 2022, the department taught 254 undergraduate courses to 8,186

undergraduate students across the University. Some new undergraduate courses were launched, including Introduction to Data Science. 800 undergraduate students majored in our programs (about 40% were international students). The department taught 35 graduate courses to 126 graduate students working towards their MA, MSc, or PhD degree in Mathematics, Statistics, or Industrial and Applied Mathematics.

In 2022, we welcomed a new staff member: Wenrui Julie Cui. The department now has three full-time staff members, one part-time staff member, and one temporary staff member.

Professor Stephen Watson
Chair of the Department of Mathematics & Statistics

Chemistry

As a new Chair recruited in July 2022, I am thrilled to join an energetic group of faculty, staff and students in Chemistry and highlight their tremendous accomplishments of 2022.

Professor Chris Caputo was re-appointed as a Canada Research Chair and his group's research contributed to the $65 million acquisition of local company Inkbox by BIC. Professor Bill Pietro joined a multi-institutional team in receiving a $1.35 million NSERC Alliance Grant to create AI for chemical synthesis and drug discovery. Professor Sergey Krylov was awarded the largest NSERC Discovery Grant in the university's history and led a successful CIRC proposal with Professors Jennifer Chen and Derek Wilson to develop point-of-care detection to inform effective policy-making for infectious diseases. Mike Hempstead was promoted to full professor while both Caputo and Tao Zeng earned tenure and promotion to associate professor. Professor Thomas Baumgartner received a visiting professorship in Nagoya, Japan and invited lectureship tour.


JENNIFER VAN WIJNGAARDEN

Professor Cora Young's work on a persistent pollutant was recognized with a Best Paper of 2021 award by RSC *Environmental Science*, and Professor Tao Zeng reported a breakthrough in *Journal of Physical Chemistry Letters* in the design of chromophores for fast singlet fission in support of improved photovoltaic devices. Professor Christine Le's *Journal of Organic Chemistry* article on novel synthetic routes with applications in pharmaceutical chemistry was highlighted as one of the most-read papers of 2022.

Professor Jennifer van Wijngaarden
Chair of the Department of Chemistry

Supporting and reconnecting our people

Created in consultation with our members, we launched our Community 2022 initiative to help faculty, staff and students reconnect in person and to support the return to a more robust on-campus presence.

"We conducted a survey of our community and many expressed a sense of disconnection stemming from the COVID-19 pandemic," said Dean Rui Wang.

Survey respondents overwhelmingly asked for more opportunities to connect in person within the Faculty, according to Melissa Hughes, senior advisor, Strategic Engagement & Policy. "Our community also wanted more streamlined access to information on health and well-being and University policies related to COVID-19, seminars on research office policies and procedures and hybrid remote work, and improved technological supports for teaching."

Community 2022 was composed of 24 events, covering five areas of community engagement:

- In-person events to connect with your Science community in meaningful ways
- Seminars for faculty, staff, and researchers
- Improvements to physical spaces within our Faculty to function, look, and feel better
- Resources for instructors and improved channels for technology support
- Increased accessibility of information on health and well-being supports

Internationalizing our programs and learning opportunities

Our Office of International Collaborations & Partnerships, led by Hugo Chen, director of International Collaborations & Partnerships, spearheaded several new international education experience programs and initiatives.

Among them was our 2+2/2+3 Undergraduate International Collaboration Education Programs, which allow students from participating institutions to complete their first two years of study at their home university and their last two or three years at York. Students graduate from York with a BA or a BSc degree. In 2022, our office negotiated five agreements with international partners for this program, with more to follow in the coming year.

"The program allows students from abroad to internationalize their degrees in a more affordable way, since they only spend two or three years studying in Canada, rather than their entire undergraduate career," said Chen.

The office also created the York Science Hainan Learning Centre to support some of our international students studying online due to COVID-19.

New Associate Dean position leads curriculum and pedagogical innovation

HOVIG KOUYOUMDJIAN

In an effort to further enhance our excellence in teaching and learning in the Faculty of Science, the Dean's Office created a new Associate Dean role to provide leadership and direction for academic programming and pedagogical innovation in Science at the Keele Campus and upcoming Markham Campus.

The inaugural Associate Dean, Curriculum & Pedagogy position, filled by Professor **Hovig Kouyoumdjian** (Chemistry), was created to provide leadership on teaching and learning initiatives in the Faculty, such as improving undergraduate pedagogy; enhancing experiential education experience and opportunities; guiding curricular and program development and innovation; steering the inclusion of equity, diversity and inclusion principles, as well as Indigenous knowledge in science education; and much more.

New programming expands career pathways

Data Science

The Department of Mathematics & Statistics launched a new Data Science program (starting fall 2023), which was designed with input from industry. Data Science is a booming field that uses computing and statistical reasoning to generate valuable insights from data. Unique aspects of the new program include students selecting streams in areas of practice such as business or health, and taking a capstone course in fourth-year to work on real-world problems for clients.

The program offers students a middle ground between computer science and statistics to ensure they are well prepared to obtain meaningful employment in a wide range of industries.

STS courses focused on equity, diversity and inclusion (EDI)

The Department of Science, Technology & Society (STS) revamped its roster of courses and major and minor options. Included in the refresh were two new EDI-focused courses: Exploring Gender in Science, Technology, Engineering and Mathematics; and Science, Technology and Racial Social Justice. Both courses offer students the opportunity to examine EDI in a unique way through explorations of past and present issues and controversies in science and technology.

The Division of Natural Science also created its first field course, Plants in the City, to provide students with an experiential education opportunity as they discover urban ecosystems at York.

Integrating Equity, Diversity and Inclusion (EDI) in all that we do

The Faculty of Science is working hard to embed principles of EDI into how we lead, research, and teach. At our Leadership Retreat, we explored how we can Indigenize our curriculum with a discussion led by Professor Nicole Redvers, director of Indigenous Planetary Health, University of Western Ontario, who co-developed the first Indigenous Health PhD degree program in North America. In partnership with York University Libraries, we also created Indigenous knowledge reading lists relevant to our areas of research and study and distributed them to the Departments for further sharing amongst faculty and graduate students.

The Faculty's Committee on Teaching and Learning and Committee on EDI launched and hosted three EDI Book Club meetings for instructors to discuss the book "Inclusive Teaching-Strategies for Promoting Equity in the College Classroom," and three EDI Science Reading Group meetings for instructors to review academic articles on topics of EDI and science. A syllabus/course outline template for instructors that centres on EDI and welcomes students into their courses was developed and distributed (*see page 24* for more). And, the Department of STS introduced two new courses for students to examine EDI through explorations of past and present issues and controversies in science and technology (*see page 10* for more).

New Observatory domes improve night sky viewing, collaboration

Two new state-of-the-art domes replaced the original 1960s domes at the Allan I. Carswell Astronomical Observatory, opening the night sky for better viewing of planets, stars, nebulae and more.

"Unlike the old domes, the new domes have an automatic control system that goes to a computer where you can tell the dome to follow the telescope. Not only is this a huge timesaver, it means we can collaborate with other astronomers and teachers anywhere in the world for research and outreach," said Observatory Director **Elaina Hyde** (Physics & Astronomy).

"These new domes will give us a massive upgrade in terms of our technology. We can come at the beginning of the night, set up the telescope, and then operate them from home," said graduate student **Sunna Withers**.

The design of the new domes also allows for a larger viewing area as the top part of the shutter opens up and the bottom part flips down, exposing more of the sky.

AERIAL VIEW OF CRANE INSTALLING NEW DOMES AT THE ALLAN I. CARSWELL OBSERVATORY

External Highlights

The **Royal Society of Canada** (RSC) elected Professor **Jianhong Wu** (Mathematics & Statistics) to the rank of Fellow, Academy of Science, and Professors **Sandra Rehan** (Biology) and **Sapna Sharma** (Biology) to the College of New Scholars, Artists and Scientists. Recognition by the RSC for career achievement is the highest honour an individual can achieve in the arts, social sciences and sciences.

JIANHONG WU

Wu, a renowned mathematician, has made foundational contributions to the global dynamics and bifurcation theory. His novel mathematical models have pioneered several research fields. His disease modelling research provides critical insights of mechanisms behind complex patterns and accurately forecasts disease trends. His leadership has profoundly contributed to the paradigm shift toward using interdisciplinary modelling extensively in health planning and firmly establishing Canada as a global leader in mathematical epidemiology. In 2022, he was also elected as a Fellow of the Canadian Academy of Health Sciences.

SANDRA REHAN

Rehan is an international leader in the molecular ecology and behavioural genetics of bees. Rehan's research combines comparative genomics and socio-demography to provide critical insights into the diversity, decline and sustainability of wild bees. Rehan is advancing our understanding of the causes of wild bee declines by developing comprehensive wild bee population genomic and disease ecology models. These results will ultimately be used to implement critical conservation strategies.

Sharma has transformed the understanding and study of how lakes worldwide respond to climate change, including rapid ice loss, warming water temperatures, degrading water quality, and changing fish distributions. She reinvigorated the field of winter limnology using big data and cutting-edge statistical analysis. She is a remarkable science communicator, generating millions of media impressions by clearly conveying complex research and as founder of SEEDS, an outreach program for refugees.

SAPNA SHARMA

RUI WANG

Dean **Rui Wang** received a Top 25 Canadian Immigrant Award from *Canadian Immigrant*. The award program recognizes inspirational immigrants who have made a positive impact on their communities since arriving in Canada.

"Immigrants are an integral part of our success story – across Canada and here in our Faculty," said Wang. "We take so much pride in the diversity within our community and our strong international student component. I was so incredibly pleased to see, in our most recent graduating class, students walk across our convocation stage from 32 countries spanning five continents. We have international partnerships and research taking place around the globe as we speak. This is truly science for the future – connected, collaborative, cross cultural, and inclusive, and I could not be prouder of our collective success."

Distinguished Research Professor **Bridget Stutchbury** (Biology) received the **Elliott Coues Award from American Ornithological Society** for her contributions to the understanding of the ecology and conservation of migratory and neotropical songbirds.

BRIDGET STUTCHBURY

Stutchbury's research career has focused on the ecology and conservation of migratory songbirds. Her pioneering research uses geolocators to track the migratory behaviour and patterns of tree swallows, purple martins, and hooded warblers between eastern North America and Central and South America.

York University Professor **Dawn Bazely** (Biology) joined the ranks of illustrious Canadians as the recipient of the 2022 **Sandford Fleming Medal** for excellence in science communication from the Royal Canadian Institute for Science. The selection committee was unanimous in its decision, noting Bazely's impressive, diverse range of activities as a science communicator and activist for more than 30 years.

Bazely also received the **Minister of Colleges and Universities' Award of Excellence** in the Future Proofing category, in honour of her work in supporting student learning during the pandemic. For instance, she incorporated media coverage of SARS-CoV2 and other zoonotic diseases into her teaching in relation to biodiversity loss. She also designed the online field course Biodiversity & Watershed Management, which was one of only two to run early in the pandemic, and later expanded the course to five Ontario universities to ensure that students could meet their field course requirements.

DAWN BAZELY

Internal Highlights

STEPHEN WATSON

Dean's Special Recognition Award

Department Chair **Stephen Watson** (Mathematics & Statistics) was recognized for coordinating many professors across York University, especially those in Statistics, in their creation of the new Data Science program. He was also acknowledged for his efforts in recognizing the importance of teaching and learning and in helping the Department better listen to, learn from, and satisfy its students.

HUGO CHEN

Hugo Chen, director of International Collaborations & Partnerships, was recognized for his leadership in advancing new internationalization initiatives and education experiences for the Faculty. Since joining York Science in 2021, he launched the 2+2/2+3 Undergraduate International Collaboration Education Programs, the York Science Hainan Learning Centre, the inaugural Science International Education Month, and the Global Leaders of York Science.

JUDE KONG

Faculty of Science Excellence in Research Awards

Professor **Jude Kong** (Mathematics & Statistics) received the **Early Career Researcher Award**. Since joining York in 2020, he has become a superstar in the global community of mathematical modeling and artificial intelligence technologies for global public health of pandemics. In addition to a large number of publications in high-profile journals, he has secured an incredible amount of research funding and established a large network of international collaborators.

NEAL MADRAS

Professor **Neal Madras** (Mathematics & Statistics) received the **Excellence in Graduate Mentorship Award**. Madras has been a major contributor to the graduate study and postdoctoral research of many trainees through his dedicated supervision, his graduate courses in applied probability and mathematical modelling, and his contributions to thesis/dissertation examination committees.

Faculty of Science Excellence in Teaching Awards

Professor **Christopher Jang** (Biology) received the Teaching Award in the **Junior Tenure-Stream Faculty** category. He was recognized for transforming second-year biology labs using advanced, integrated pedagogical approaches. He collaborated with faculty to create a Course-Based Undergraduate Research Experience that provides experiential learning for 300 students per term, and introduced creative new forms of assessment.

CHRISTOPHER JANG

ALIREZA RAFIEE

Professor **Alireza Rafiee** (Natural Sciences) received the Teaching Award in the **Contract Faculty** category. Rafiee created a relaxing, yet engaging and effective online learning environment for students in response to the pandemic. in response to the pandemic. Many students commented on how he made potentially difficult subject matter accessible by using a diversity of creative resources and teaching approaches.

FARWA SAJADI

PhD student **Farwa Sajadi** (Biology) received the **Richard Jarrell Excellence in Teaching at the Graduate Level Award**. Sajadi created an organized, warm, and productive lab atmosphere when she coordinated and led both online and in-person labs during the height of COVID-19 restrictions. Her personal attention and constructive feedback provided critical support, but it was her dedication to students' future success that students appreciated and respected the most.

PhD student **Evangelia Tzamali** (Lassonde) received the **Richard Jarrell Excellence in Teaching at the Graduate Level Award**. Tzamali made first-year physics courses a rich and enjoyable learning experience. Students appreciated her consistent and in-depth feedback, hands-on mentorship, and extra instructional aids. Professors noted her commitment to innovative teaching strategies, and that she worked to engage and challenge students, earning their trust and respect.

EVANGELIA TZAMALI

President's Research Impact Award

Professor **Seyed Moghadas** (Mathematics & Statistics) received the President's Research Impact Award in recognition of his global leadership in using mathematical and computational models of disease epidemics and vaccination. During the COVID-19 pandemic, his expertise has been in high demand and instrumental in setting and improving health policies both in Canada and the U.S. Moghadas served in an advisory role to the Public Health Agency of Canada and to the Science Advisor of Canada as part of the COVID-19 Modelling Expert Group. He is also a member of a research team established by The Commonwealth Fund, which provides regular updates on the impact of COVID-19 interventions to the U.S. federal government and the Centre for Disease Control and Prevention.

SEYED MOGHADAS

Research Funding

By the Numbers

$20.6 million
Total funding awarded in 2022

$1.6 million
Canada Research Chairs

$8.0 million
Provincial, national and international agencies

$1.3 million
Foundations, societies, and not-for-profits

$4.8 million
Natural Sciences and Engineering Research Council of Canada

$1.1 million
Canadian Institutes of Health Research

$1.2 million
Social Sciences and Humanities Research Council

$877 thousand
Mitacs and other fellowships

$1.0 million
Contracts and industry

$213 thousand
Fields Institute

$441 thousand
Canada Foundation for Innovation and Ontario Research Fund

$56 thousand
Donations

Highlights

$7.25M to use AI and big data in fight against infectious diseases

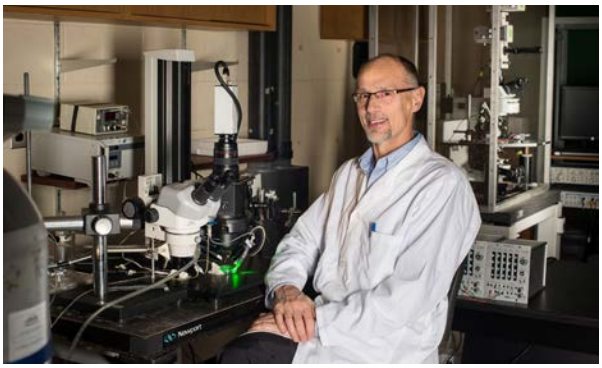
At a time when the risk of emerging or re-emerging infectious diseases is increasing, an international team led by Professor **Jude Kong** (Mathematics & Statistics) received a **$7.25 million grant from the International Development Research Centre of Canada** to help tackle the issue.

The five-year project, **Global South Artificial Intelligence for Pandemic and Epidemic Preparedness and Response (AI4PEP) Network**, will enable Kong and his research team to work alongside countries in the Global South to develop equitable and AI solutions and big data approaches to improve public health outcomes. The project will support prevention, early detection, preparedness, mitigation and control of emerging or re-emerging infectious disease.

Project funded by CIHR explores causes of atrial fibrillation

Canada Research Chair **Peter Backx** (Biology) received nearly **$750,000 from the Canadian Institutes of Health Research (CIHR)** to explore how atrial stretch is involved in promoting atrial fibrillation, the most common cardiac arrhythmia.

Regardless of cause, the atria of patients with this arrhythmia show fibrosis, hypertrophy and inflammation, which Backx and his team have linked to a critical inflammatory factor called tumour necrosis factor (TNF). Because the activation of TNF is driven by stretch, the team will examine the mechanisms whereby stretch activates TNF and the effect of TNF inhibitors.



PETER BACKX

Largest NSERC Discovery Grant in York history

Our faculty members were awarded a total of more than **$1.9 million from the NSERC Discovery Grants program**, including Professors **Chris Bergevin** (Physics & Astronomy), **Michael Chen** (Mathematics & Statistics), **Jairo Diaz Rodriguez** (Mathematics & Statistics), **Peter Gibson** (Mathematics & Statistics), **Jude Kong** (Mathematics & Statistics), **Sergey Krylov** (Chemistry), **Dong Liang** (Mathematics & Statistics), **Kim Maltman** (Mathematics & Statistics), **Sarah Rugheimer** (Physics & Astronomy), **Jeffrey Schall** (Biology), and **Cody Storry** (Physics & Astronomy).

Receiving the largest amount ever in York University history from the NSERC Discovery Grant program, Krylov was awarded $605,000 for his project "Disruptive Analytical Technologies for Biomedical Sciences."

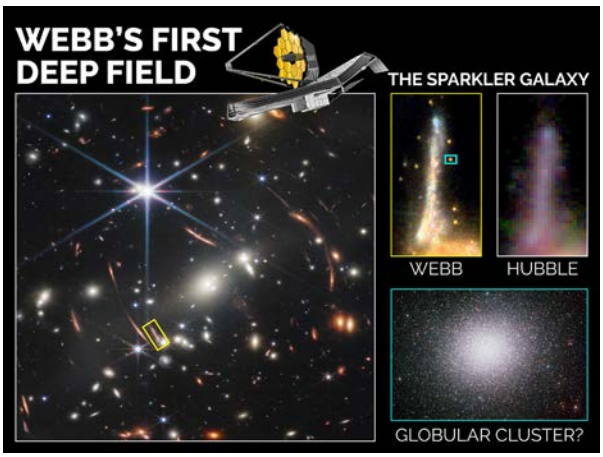
Webb reveals a galaxy sparkling with the universe's oldest star clusters

Using the James Webb Space Telescope, a team of researchers including Professor **Adam Muzzin** (Physics & Astronomy) and PhD student **Ghassan Sarrouh** identified the most distant globular clusters ever discovered. Globular clusters are ancient collections of stars from a galaxy's infancy and contain clues about its earliest phases of formation and growth.

"Globular clusters are quite mysterious. They orbit the Milky Way and other galaxies, however, we have little idea where they come from," said Muzzin.

In the finely detailed Webb's First Deep Field image, the researchers zeroed in on "the Sparkler galaxy," named for the small yellow-red objects surrounding it. The team posited that these sparkles could either be young clusters actively forming stars, or old globular clusters. From their initial analysis of 12 of these compact objects, the researchers determined that five of them are not only globular clusters but among the oldest ones known.

The team published their findings in *The Astrophysical Journal Letters*.



Credit: Canadian Space Agency from NASA, ESA, CSA, STScI; Mowla, Iyer et al. 2022

Climate change creating a cauldron of issues for lakes

Professor **Sapna Sharma** (Biology) and her colleagues reviewed and synthesized available studies on freshwater lakes from across the globe to get a cohesive picture of how climate change is threatening lakes.

They found that the effects of climate change on lakes are often cumulative. For instance, warmer air temperatures can lead to ice loss on northern lakes, increasing winter evaporation rates and water temperatures and leading to a multitude of physical and chemical effects, including greater salinity. Events like an earlier summer season can also cause mismatches in fish spawning and foraging, often with widespread ramifications across the food web. And some of the effects of climate change are creating conditions where lakes are losing oxygen needed for fish and other aquatic species. This deoxygenation can be made worse by cyanobacterial blooms.

LAKE SUPERIOR

"Climate change has far-reaching social and ecological repercussions, but the impacts of climate change, combined with other environmental pressures, are often little understood and the significance of them has not been appreciated at a global level," said Sharma. "There is still much work to be done."

The team's research was published in the journal *BioScience*.

Vacuuming DNA from air could help monitor biodiversity

Research by **Elizabeth Clare** (Biology) showed that environmental DNA (eDNA) collected from air can be used to detect a wide range of animal species and offers a novel, non-invasive approach to monitoring biodiversity.

Her team used sensitive filters attached to vacuum pumps to collect air samples from Hamerton Zoo Park, UK, and succeeded in detecting the presence of numerous animal species within and beyond the confines of the zoo.

"The non-invasive nature of this approach makes it particularly valuable for observing vulnerable or endangered species as well as those in hard-to-reach environments, such as caves and burrows," said Clare. "Air sampling could revolutionize terrestrial biomonitoring and provide new opportunities to track the composition of animal communities as well as detect invasion of non-native species."

Serendipitously, a separate research team in Denmark also made a similar discovery (using a different filtering method). Their research papers were published together in the same issue of *Current Biology*.

ELIZABETH CLARE SAMPLES AIR TO COLLECT ENVIRONMENTAL DNA

New, portable device detects glow emitted by plants to measure their health

Healthy plants emit red light that is nearly impossible to see with the naked eye; but with a new, highly sensitive, portable biosensor instrument developed by Professors **Ozzy Mermut** (Physics & Astronomy) and **William Pietro** (Chemistry), it's now possible to measure that light out in the field.

"The weaker the light gets, the less healthy the plant is," said Mermut. "You can't always tell the health of the plant just by looking at it. Often, it will look green and healthy until you test it."

"We developed a device that can capture low intensity light emission from plants," said Pietro.

The tool – the size of a briefcase – can easily be deployed remotely to help measure the health and sustainability of plants, especially those stressed by CO_2 emissions, greenhouse gases and extreme weather events, and asses impacts of industrialization. In the future, Mermut and Pietro hope that the equipment can be mounted on a drone to fly over rainforests, conservation areas or agricultural fields to gauge plant health.

PORTABLE BIOSENSOR DEVELOPED BY OZZY MERMUT AND WILLIAM PIETRO

They published their proof-of-concept study in a special issue of *Biosensors*.

Chemists create more sensitive rapid antigen test

Rapid antigen tests use a technology called lateral flow immunoassay (LFIA), which is simple to use and inexpensive. But a major limitation of LFIA is its low sensitivity.

A team led by Distinguished Research Professor **Sergey Krylov** (Chemistry) invented an enhancement step for LFIA whereby the sensitivity is increased by 25 to near 100 percent. The team, including York postdoctoral fellows **Vasily Panferov** and **Nikita Ivanov**, developed their enhanced test and proof of concept for the hepatitis B virus, increasing the diagnostic sensitivity of LFIA from 73 to 98 percent while not affecting its 95 percent specificity. The test requires a tiny drop of finger-prick capillary blood, making it practical for use on babies born from infectious mothers, for example. And it involves a simple procedure with low-cost accessory equipment that could be done in a primary care setting or lab to generate quick and reliable results.

RAPID ANTIGEN TESTS FOR COVID-19 ARE AN EXAMPLE OF LATERAL FLOW IMMUNOASSAY TECHNOLOGY

"This could significantly reduce the workload of hospital testing facilities and facilitate more affordable diagnostics in resource-limited settings," said Krylov.

The research was published in *Angewandte Chemie International Edition*.

Monkeypox in urban wildlife could lead to repeated outbreaks

Mathematical modelling led by Professor **Huaiping Zhu** (Mathematics & Statistics) showed that it would become difficult to control monkeypox (MPX) outbreaks in a metropolitan area if the virus were to spill over into wild animal hosts, such as rodents.

The team's simulations suggested that the risk of an MPX outbreak remains high, but can be greatly reduced if at least 65 per cent of symptomatic cases are isolated and their contacts traced and quarantined. Nevertheless, when factoring in the existence of an animal reservoir and potential virus evolution, the team observed the possible higher risk of outbreaks with much earlier peaks and multiple waves driven by animal transmission.

RODENTS, SUCH AS SQUIRRELS, WERE CONSIDERED POTENTIAL ANIMAL HOSTS IN THE MONKEYPOX MODELLING STUDY.

"It is vital that we monitor the incidence of MPX in animals to serve as an extra indicator for assessing the risk of MPX epidemics," said Zhu, who directs the Centre for Disease Modelling.

The research team included York postdoctoral fellow **Pei Yuan** and PhD students **Yi Tan** and **Liu Yang**, and Professor **Jane Heffernan** (Mathematics & Statistics). The research was published in the *Journal of Medical Virology* and conducted as part of the One Health Modelling Network for Emerging Infections, supported by NSERC and the Public Health Agency of Canada.

Celebrating new and renewed Chair positions

Canada Research Chairs (CRC)

In 2022, three professors in the Faculty of Science received new or renewed CRCs, bringing the total number in the Faculty to 10.

Professor Chris Caputo (Chemistry)
Tier 2 CRC in Main-Group Catalysis and Sustainable Chemistry (renewed)

Caputo's CRC program is focused on developing greener catalysts to create chemicals. These catalysts are produced using less energy and without the need for precious metals, which are rare, expensive and unsustainable. His team is also working on an innovative platform technology from renewable feedstocks with the goal of revolutionizing personal care by producing ultra-long lasting sun protection.

Professor Kohitij Kar (Biology)
Tier 2 CRC in Visual Neuroscience (new)

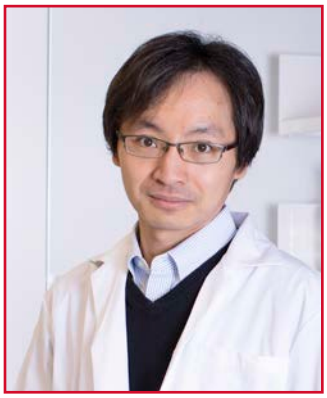
As CRC in Visual Neuroscience, Kar aims to uncover the inner workings of the primate visual system. He and his research team are performing detailed circuit-level neural measurements in non-human primates and relating them to specific visual behaviours. They are using their findings to develop artificial intelligence systems that mimic the primate brain in hopes of coming up with treatment strategies for mental health disorders that could improve cognitive behavioral therapies.

Professor Raymond Kwong (Biology)
Tier 2 CRC in Environmental Toxicology (renewed)

As CRC in Environmental Toxicology, Kwong strives to advance our understanding of how environmental stressors affect the function of aquatic animals' nervous systems. Kwong and his research team are using molecular neurophysiology and functional genetics tools to study the toxicity of metals and bisphenol compounds in the early stages of aquatic animals' lives. Their aim is to identify the mechanisms behind their toxic response or tolerance and to shed light on the relationship between environmental toxins and geno- and phenotypes.


CHRIS CAPUTO


KOHITIJ KAR


RAYMOND KWONG

York Research Chairs (YRC)

The YRC program is York University's internal counterpart for the national CRC program. In 2022, two professors in the Faculty of Science were appointed as YRCs, bringing the total number in the Faculty to 10.

Professor Jianhong Wu (Mathematics & Statistics)
Tier 1 YRC in Industrial and Applied Mathematics

Wu is an expert in dynamical systems, disease modelling and vaccine evaluation. His YRC program aims, in part, to understand biological and physical systems wherein predation occurs. The research will contribute to the University's growing capacities in disaster and emergency management and in AI research.

Professor Jane Heffernan (Mathematics & Statistics)
Tier 2 YRC in Mathematics of Immunity and Infectious Disease

In her YRC research program, Heffernan will develop models of immunity against infection that can be used to quantify distributions of immunity and its protective effects. The results of the work will serve to inform public health decision-making for mitigation and vaccination policies to combat infectious diseases, with particular emphasis on COVID-19 and influenza.

Endowed Chairs

Professor Sarah Rugheimer (Physics & Astronomy)
Allan I. Carswell Chair for the Public Understanding of Astronomy (new)

The Allan I. Carswell Chair for the Public Understanding of Astronomy, dedicated to science engagement and outreach, is funded by an investment made in partnership with the Carswell Family Foundation. Rugheimer's research interests are in modelling the atmosphere and climate of extrasolar planets with a particular focus on atmospheric biosignatures in Earth-like planets, as well as modelling early Earth conditions. Her interests include many topics in the field of astrobiology, such as the origin of life on Earth and detecting life on other planets and moons in the universe.


SARAH RUGHEIMER

Professor Cora Young (Chemistry)
Guy Warwick Rogers Chair in Chemistry (renewed)

The Rogers Chair is funded by a donation from Mrs. Mary Rogers in 1988, in memory of her late husband, Guy Warwick Rogers, to support faculty research in the Department of Chemistry. Young conducts research on environmental chemistry, using state-of-the-science analytical techniques to characterize chemicals, their sources, and their fates in the environment.

Professor John McDermott (Biology)
McLaughlin Research Chair (renewed)

The McLaughlin Research Chair is funded by the McLaughlin Foundation to support world-class life sciences research in the Faculty of Science. McDermott focuses on the mechanisms that cause a simple cell to become more specialized. He is particularly interested in studying the basic regulatory mechanisms involved in muscle cellular differentiation.

New resources and development opportunities for instructors

In the past year, we expanded, innovated, and progressed teaching and learning in the Faculty of Science. A number of initiatives were spearheaded and coordinated by our teaching and learning experts, including Pedagogical Innovation Chair in Science Education **Tamara Kelly**, Educational Development Specialist **Ashley Nahornick**, and the Faculty's Committee of Teaching and Learning (chaired by Professor **Robin Marushia**).

To make students feel welcome in their courses, Kelly and Nahornick developed and piloted an EDI syllabus/course outline template for instructors to use in their courses. Designed with accessibility in mind, the template features a land acknowledgement, an inclusive teaching statement, clear community guidelines, assistance available to students on academics and well-being, a course overview, and more.

We put a spotlight on teaching in the Faculty through a new teaching and learning website with resources for instructors, including a curriculum change toolkit that provides information for faculty or departments proposing undergraduate and graduate curricula in the Faculty of Science. In addition, we created a Faculty of Science Teaching Network webpage – a go-to list of colleagues interested in connecting about topics in teaching and learning – and highlighted opportunities related to the Scholarship of Teaching and Learning.

We also rolled out more than 25 events focused on current topics in teaching and learning that featured expert speakers from York and beyond, including a presentation by Professor Kim Tanner (San Francisco State University) on non-content classroom language. Some of the sessions were geared toward graduate students, including informal discussions with graduate students to unpack teaching questions. We began an EDI book club and reading group this year in addition to continuing informal faculty chats. We also invited instructors to share transformational changes made in their courses and produced a booklet detailing their efforts to revamp course content and introduce research-based teaching strategies or new course design methods.

Another highlight of the year was our second annual Academic Integrity Week focused on increasing awareness of different strategies to promote academic integrity in our science courses. It included a keynote talk by Professor Laurie McNeill (University of British Columbia) on making academic integrity meaningful and accessible.

Highlights

Immersive, interactive learning with VR technology

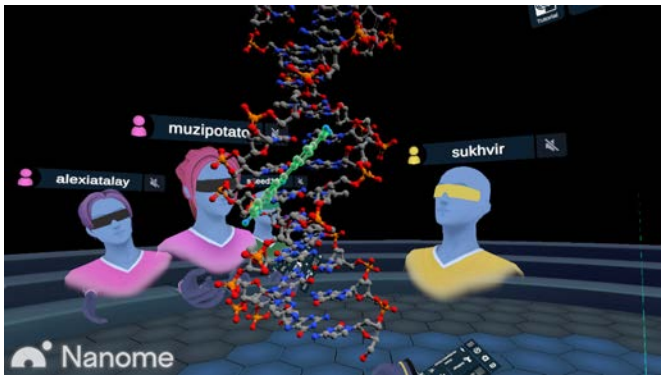
Professors **Kyle Belozerov** and **Derek Jackson** (Chemistry) have been expanding the use of virtual reality (VR) technology in York chemistry courses in an effort to help students understand the structure and function of biological molecules at a deeper level.

"Research shows that students face numerous challenges as they learn complex and dynamic molecular structures using minimally interactive 2D tools like textbook illustrations, videos or computer programs," said Belozerov. "VR provides a unique opportunity to overcome these limitations."

They first piloted a VR learning component in a third-year biochemistry course.

"We received overwhelming positive feedback from the students, who were enthusiastic and excited to use the technology," said Jackson. "We discovered that the VR exercises really enhanced the student learning experience."

With new funding from eCampus Ontario and York's Academic Innovation Fund, they were able to purchase more headsets and work on creating more VR learning activities and interactive modules that could be implemented more widely across the Department and Faculty, and beyond.



A SCREENSHOT OF STUDENT AVATARS WORKING WITH A DNA MOLECULE DURING THE PILOT PROJECT

Transforming courses for better engagement and learning

Our instructors are continuously updating and revamping courses to enhance the learning experience for students. For instance, Professor **Stephanie Domenikos** (Science, Technology & Society) transformed the course Mysteries of Everyday Materials from a lecture-based format to one that now includes lab experiments. The course is for non-science majors and is focused on understanding how everyday materials work, such as sunscreen and non-stick coatings.

STEPHANIE DOMENIKOS

"At first, students were intimidated by the word 'lab,'" Domenikos noted. "Many of them actively avoided science in high school and found it daunting to have labs, but they realized that it isn't complicated; it's just an opportunity to apply what they've learned in lecture and to use their hands. They began to enjoy it."

The experiments they conduct complement the lectures Domenikos delivers in class. The battery lecture, for example, is followed by a lab where students create their own batteries from wire and various solutions and test the conductivity of various foods.

Highlights

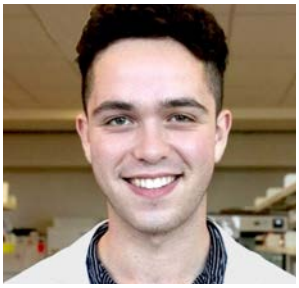
Faculty of Science medals for high achievement of students

The Faculty of Science presents Gold and Silver Medals to undergraduate students graduating with outstanding achievements. The Faculty's Gold Medal goes to the student(s) with the highest GPA, and the Faculty's Silver Medal goes to a student who has combined the highest degree of academic achievement with the greatest contribution to undergraduate student life at York.

SOPHIE EISEN, PABLO GONZALEZ, AND ROBERT KHATIB

In spring 2022, the Faculty presented its Gold Medal to **Sophie Eisen**, **Pablo Gonzalez**, and **Robert Khatib**. Khatib was also a recipient of the Governor General's Silver Medal.

The Faculty's Silver Medal was presented to **Jacob Fine**, who was commended for his exceptional academic record, research contributions in RNA biology, and leadership in science outreach and literacy activities.



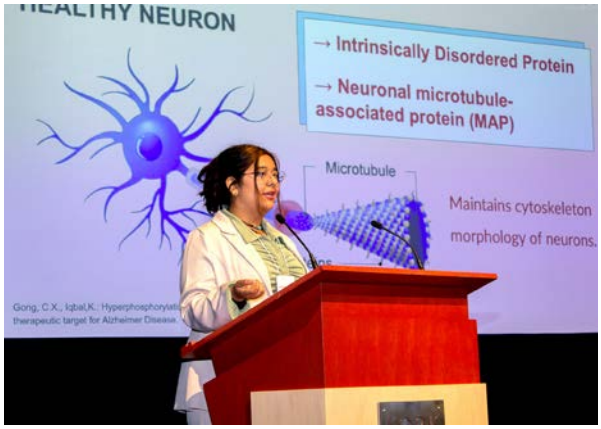
JACOB FINE

Enhanced opportunities for undergraduate research and success

Fifty-five students from Science and across the University attended our annual Summer Undergraduate Research Conference to present their summer research projects and network with their peers. The event included recipients of NSERC Undergraduate Summer Research Awards, Dean's Undergraduate Research Awards, and York Science Scholars Awards (YSSA).

At the conference, Minoosh Fathi (first-tied), Mahya Rezaeifarimani (first-tied) and Selin Tahir (third) received awards for their poster presentations, and Aleeza Qayyum (first), Areeba Chaudhury (second) and Claire Del Zotto (third) received awards for their talks.

In 2022, we also received a generous donation from alumnus Earle Nestmann to create more opportunities for students to participate in paid summer research positions. His gift of $200,000, matched by the Faculty for a total of $400,000, created the Earle Nestmann Undergraduate Research Award program, which will begin in 2023.



ALEEZA QAYYUM PRESENTING A TALK AT THE CONFERENCE; SHE RECEIVED THE FIRST PLACE AWARD IN THE ORAL PRESENTATION CATEGORY

Highlights

Bringing science to the community and world

Our Science Engagement Programs (SEP) team offers innovative and engaging programs designed to inspire youth to discover exciting topics in science, technology, engineering, and mathematics. In 2022, more than 4,600 children and youth from across Canada and the world took part in our in-person and online programming:

- >> **750+** students engaged on campus in summer programs, Saturday and PA Day workshops, and more.
- >> **700+** students engaged off campus, including in school and library workshops, and Community Science Fun Days.
- >> **1,100+** students engaged through virtual programming.
- >> **450** students engaged in fully-subsidized programs, including the Jane and Finch Science Club and in-school CanCode workshops.
- >> **1,600+** participants at York University's Science Rendezvous.

"My child was excitedly going through the kits before the program, and each day, concentrated on the experiment at hand with a focus I hardly see during the summer, all the while having fun! She has developed an enthusiasm for science experiments and plans to continue using the kits on her own."

—PARENT OF CAMPER IN ONLINE BODY SYSTEMS CAMP

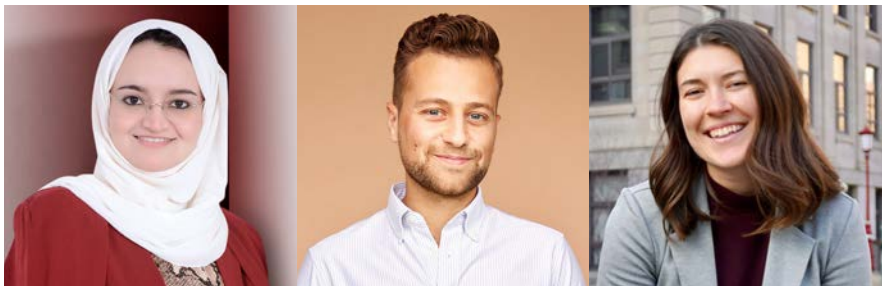
Science graduates among York's Top 30 Alumni Under 30

York University's Top 30 Alumni Under 30 list recognizes inspiring young alumni who are working to right the future in a variety of fields. Three Science alumni were on the 2022 list.

Tarnem Afify (BSc '21) is a scientist, leader, and advocate. She was a representative of the Canadian Association of Physicists in the International Association of Physics Students. She also founded Future Women in Physics. She aims to inspire female scientists to break barriers. She is now pursuing a master's at the Schulich School of Business.

Yaakov Green (BSc '17) is dedicated to solving structural issues in healthcare. He is currently completing an MD/MBA at Yale University, during which he has consulted on health equity strategy for the private sector, conducted research on social determinants of health, and more. He also served as an intern for the U.S. Federal COVID-19 Health Equity Task Force.

Sarah Laframboise (BSc '18) is a scientist, science communicator and advocate for women in science. She is currently completing her PhD in biochemistry at the University of Ottawa; during this time, she has co-founded Next Generation Women and founded the Ottawa Science Policy Network. She also Chairs the Editorial Committee at the Canadian Science Policy Centre.



TARNEM AFIFY, YAAKOV GREEN, AND SARAH LAFRAMBOISE

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