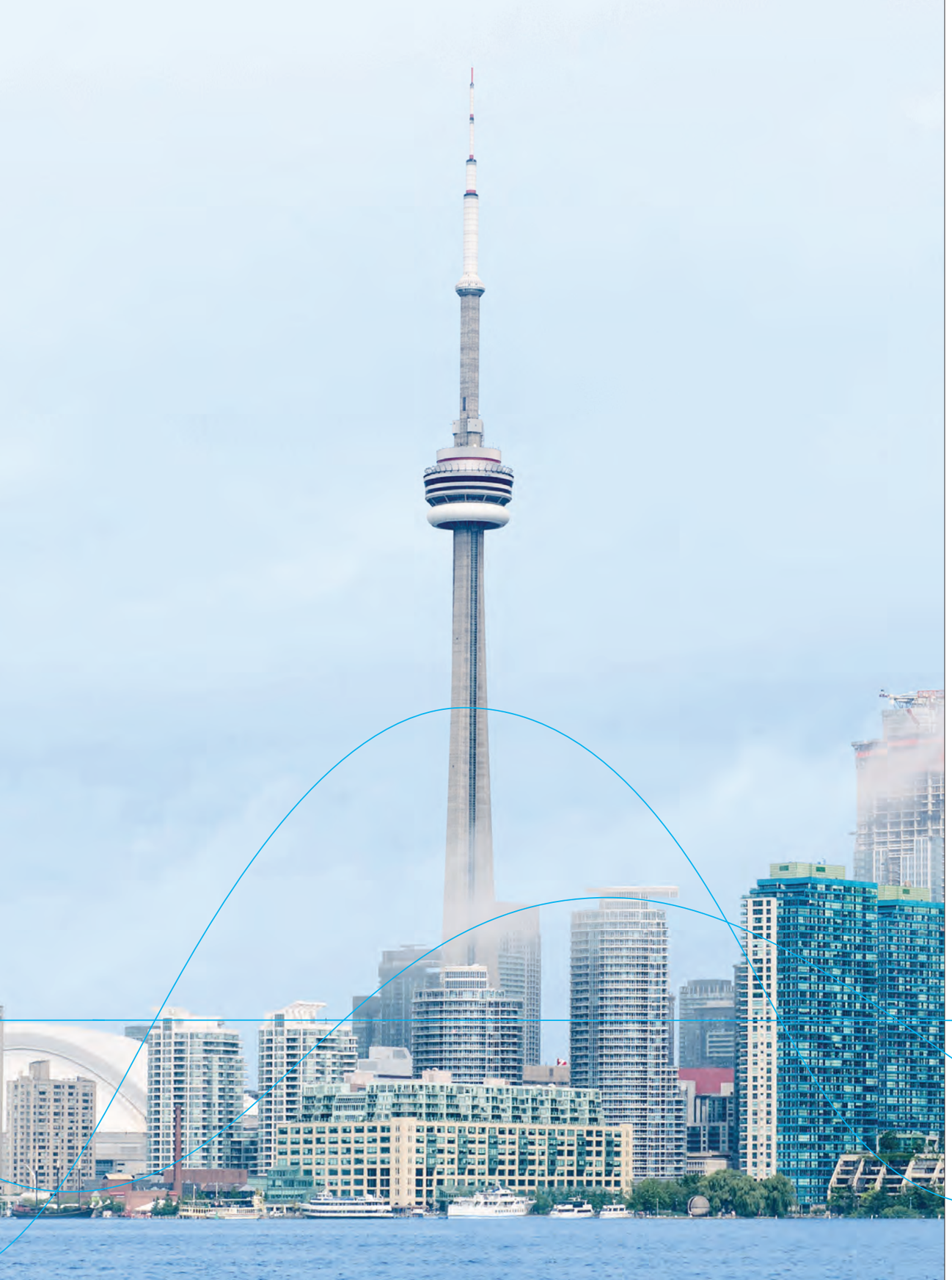
Annual Report 2020— Faculty of Science

Ryerson University

Faculty of Science



2020—
Resilience
Perseverance
Creativity
Evolution

The soundwaves you see in this report are based on the song "Perseverance" by David Cramb. This track is a unique, abstract representation inspired by the sounds that NASA's Perseverance rover emitted through its space journey during the Mars 2020 mission.

Contents

Dean's Message

"Reflecting on the unique year that was 2020, I continue to take deep pride in the way in which we collectively walked through the complicated and challenging path of pandemic life."

Greetings, FOS community members!

REFLECTING ON THE UNIQUE YEAR that was 2020, I continue to take deep pride in the way in which we collectively walked through the complicated and challenging path of pandemic life. At and across every level – faculty, staff and students – we found strength in each other.

None of us could have predicted how the year would unfold. In the strange, almost surreal environment, much of what we knew as 'normal' seemed forever lost. And yet, we forged ahead, with major pivots in scholarly, research and creative activities and teaching approaches. The Faculty of Science led Ryerson in the development of safe practices for essential research.

We also put in long hours to recast our teaching practice for online delivery. In the midst of it all, six new tenure-track professors and four new staff members came on board. Although working remotely, they quickly became part of the FOS family.

As the lines between work and home life blurred into one, each of us grappled with maintaining balance. We juggled multiple balls. We strived to do what was best for our students and to empathize with their situations. We dealt with tragedy. And we grew.

Throughout it all, your agility, fortitude and tenacity are testimony to the caliber of individuals that make up our science community here at Ryerson. In this annual report, we honour some of the accomplishments of 2020. Join me in reliving some of its most encouraging moments and triumphs. As we move forward, let's reflect deeply on what really matters, and treasure the learnings from this year that can inform our future and equip us in the years ahead.

David Cramb

PHOTO: IAN PATTERSON

SERVICE MILESTONES

2

FOS members were recognized for their long service milestones

25 years: **Rajeshwari (Raji) Iyer**, (Chemistry & Biology)

35 years: **David Naranjit**, (Chemistry & Biology)

NEW STAFF

10

new faculty and staff members

AWARDS

17

faculty and staff members received awards for their exceptional contributions at Ryerson

2020—
Resilience

Spotlight on COVID-19 Research: Ultrasensitive Virus Detection

PHOTO: SARAH MCINTYRE

FOR OVER 10 YEARS, John Marshall of the Department of Chemistry and Biology had been developing ELiMSA™, an ultrasensitive technique to detect large biomolecules such as proteins, antibodies, and DNA or RNA in samples of human blood or other biological samples. By combining enzyme-based assay with mass spectrometry analysis, ELiMSA™ can quantify molecules right down to the yoctomole (10–24 moles). That's so tiny that naysayers doubted there'd ever be a practical need for the capability. But then, COVID-19 hit.

"Everyone thought ELiMSA is way too sensitive," says Marshall. "But when COVID-19 tests began producing so many false negatives, they realized that existing technology is just not sensitive enough."

Working with National Taiwan University, Luxembourg Institute of Health, and YYZ Pharmatech, a Toronto-based life sciences company, Marshall adapted ELiMSA™ to detect SARS-COV-2 virus RNA, proteins or antibodies. The technique is unique in its ability not only to provide a positive or negative test result, but also to measure the severity of the infection. Clinical validation of the technology has begun, in partnership with St. Michael's Hospital, a site of Unity Health in Toronto. Beyond COVID-19, ELiMSA™ may provide healthcare services with a relatively inexpensive, accurate testing method for future diseases, and could be used to measure the interactions of tiny amounts of biomolecules.

> "Everyone thought ELiMSA is way too sensitive ... but when COVID-19 tests began producing so many false negatives, they realized that existing technology is just not sensitive enough."

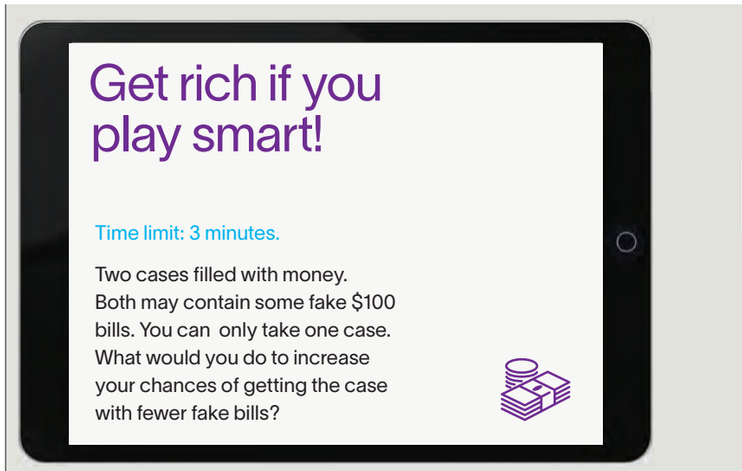
The Move to Distance Learning

Stepping Right into the Virtual Hospital

PROFESSOR JAHANGIR (JAHAN) TAVAKKOLI of the Department of Physics had also been conceiving virtual learning for years - chiefly in response to the rising cost and logistical challenges of accessing hospital visits and training for students in biomedical engineering and medical physics programs.

Tavakkoli had teamed up with a US-based virtual reality (VR) medical equipment company, Arch Virtual Inc., to develop virtual hospital rooms and equipment such as LINAC, MRI, X-ray and Ultrasound. "The project was initiated in 2017 through a joint collaboration between the faculties of science and engineering, and I had planned to implement it for Fall 2020 irrespective of the COVID-19 campus lockdown," says Tavakkoli. "It turned out as a timely initiative amid the challenges we have been facing in providing quality teaching in the current remote learning environment."

As part of the VR app, Tavakkoli now has four virtual hospital rooms running. The set-up includes VR simulations of imaging and treatment scenarios, animated patients, and in-the-room videos and voice narration describing methods and outcomes of each procedure. Once campus reopens, he's looking to set up a dedicated VR lab where the developed VR hospital rooms will be available for students.



Let the Games Begin

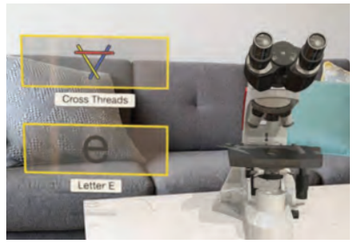
FACED WITH THE STRESSES of learning amid the pandemic environment, mathematician Alexey Rubtsov knew there had to be better ways to get students excited – beyond lecturing from a Zoom screen.

He found it an old classic: games. Splitting his students into breakout rooms, teams compete for points by devising solutions to fun but challenging problems – all based on relatable, day-to-day scenarios. Student response has been very positive.

"Infusing fun into their statistics classes has been really effective," says Rubtsov. "When I visit the breakout rooms, students are very engaged. They sometimes even erupt into lively arguments about their answers."

Rubtsov has been churning up interesting ways to bring course material to life, so that students become wrapped up in the fun of learning.

With academic integrity being a hot topic during the pandemic, Rubtsov sees the benefits of taking a pragmatic approach: "I cannot control academic integrity. But I can at least influence their interest in the subject. I've been doing it with games, and students love it!"



Introducing Holographic Labs

EVEN BEFORE COVID-19, Dean David Cramb had already been exploring the possibilities of augmented reality (AR) with Computer Science alumnus Paul Duffy ('89), now president of NexTechAR Solutions. But when lockdowns shuttered most campus facilities, augmented reality became not just a nice-to-have, but a lifeline for lab-only courses where hands-on experiences are the order of the day.

By the fall semester, the new Ryerson Augmented Learning Experience (RALE) platform had begun beaming up holographic microscopes, pipettes and virtual lab experiences to students in over 80 labs in the Department of Chemistry and Biology, including 125 students in General Chemistry alone. Response has been overwhelmingly positive.

Since the platform uses machine learning to determine which virtual experiences are best, the format and flow of the learning will improve iteratively. Even post-COVID, the virtual labs are projected to stay.

"Modern equipment is very much a black box," says Technical Specialist Shawn McFadden, "so I've used AR to pull the cover off and let students look at how an instrument works. It's really helped them with comprehension."

"We're also hoping to incorporate 'mistakes' into the experience," says Technical Specialist Miriam de Jong. In 'real life', mistakes – such as hooking up the power to a gel electrophoresis unit backward – can be costly and wasteful. But in a virtual lab, it could be a great way to learn."

On the Frontlines

ON THE FRONTLINES OF the COVID-19 pandemic, Biomedical Physics '12 alumna Shermiyah Rienecker is a medical physicist at Biomedical Technology Services in Queensland, Australia. Her ever-adapting work involves creating evidence-based policies and guidelines in response to the pandemic, as it happens. Scientists like Reineker are in high-demand as she works with clinicians to prepare changes to workflows, clinical spaces, and telehealth capabilities amid the pandemic.

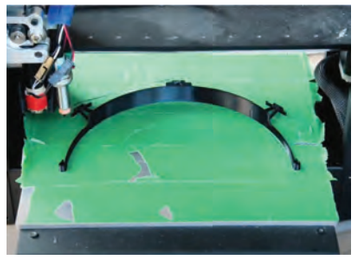
Last year, Rienecker set up an award to support a female undergraduate student in physics. She has committed $10,000 over five years, and the award is being matched by Ryerson University for an additional $10,000 over the same period.

The Stroke/COVID-19 Connection

SHORTLY AFTER COVID-19 began spreading, Ryerson Biology '09 alumnus and Clinical Neuroradiologist Dr. Adam Dmytriw founded the North American Neurovascular COVID-19 Consortium to investigate a suspicious increase in strokes among patients who had no known risk factors but one commonality: a COVID infection.

Since then, the research has provided critical revelations on strokes in COVID patients. Findings have been published in notable medical journals and also presented at the Society of NeuroInterventional Surgery and International Stroke Conference. Having undergone two mergers to include data from the next-largest consortia, the research is now the largest and most comprehensive report of first-wave COVID-19 in North America and its effect on rates and the nature of ischaemic stroke.

3D Printer to the Rescue



AS CALLS WENT OUT for personal protective equipment (PPE) donations amid the pandemic, the Department of Physics was determined to help. With no large stockpiles of PPE to draw from, the department turned to 3D printing to help contribute to the community. With a few tweaks to an old department 3D printer, Kevin Liu, the department technologist, began producing visor frames for frontline workers from his home. Each visor took 10 minutes to print and though not the quietest operation, was well worth it. After the first round of production, the Department of Physics donated 200 visor frames to the Michael Garron Hospital PPE drive.

Paying it Forward, One Glove at a Time

AFTER HEARING ABOUT personal protective equipment (PPE) shortages on the news, chemistry professor Dan Foucher thought, "We have to do something." As the pandemic sent Ryerson students home for virtual classes, the department's labs sat idle and stocked with unused supplies. Alongside chemistry professor Rob Gossage and Department of Chemistry and Biology Chair Andrew McWilliams, Foucher reached out to the department to contribute their unused supplies to a glove drive. The collective response was overwhelming – the Department of Chemistry and Biology rounded up 79,000 nitrile gloves, along with goggles and gowns, and donated them to local Toronto hospitals (Sunnybrook Hospital, Women's College Hospital, and St. Michael's Hospital, a site of Unity Health Toronto).

2020—
Perseverance

Cracking the Code

"THE WORLD IS ENDLESS with computer science."

So says computer science PhD student Noama Samreen, who views her field as an open door to so many areas: blockchain technology, artificial intelligence, robotics, data storage and "smart everything." In her view, even a very narrow focus within computer science branches out to much bigger things.

For example, in a paper she recently co-authored with her supervisor professor Manar Alalfi, Samreen examined vulnerabilities to Ethereum smart contracts at the programming level. Her research aims to provide a supporting tool that enables users of blockchain technology to verify their smart contracts for the existence of security vulnerabilities before they deploy the contract. This way, they can protect it from attack by hackers.

"We still don't know the full strength of blockchain or how to safeguard smart contracts before we deploy them on a blockchain network," she says. "It's a complex problem for computer scientists that potentially opens up a vast world of peer-to-peer transactions on the Internet without any central controlling authority."

Samreen loves that there are new innovations every day in her field – and real-world pressure to stay up to date. "The challenge to stay ahead of hackers and keep people's data secure is precisely what drives me today and, I hope, in my future doctoral studies."

A Leader in the Field

THE CANNABIS INDUSTRY has taken off in recent years, and molecular science PhD student Sydney Jordan is emerging as a leader in this rapidly growing field. Most of her doctoral research has been focused on developing practices for breeding and growing cannabis. Given how long cultivation of this crop has been strictly regulated, researchers know less about it than established products like corn or soy.

"This is an economically valuable crop," says Jordan. "And there's competition among cannabis researchers to advance our knowledge and our ability to increase crop yield. The industry will still be developing when I finish my degree, so I'll be ready to join it and make significant contributions."

That timing is by design. Jordan specifically applied to Ryerson for the chance to study under Lesley Campbell, a professor in applied plant evolution and ecology. With the help of her supervisor, Jordan is quickly becoming an expert in her field, as indicated in a 2020 paper she published on cannabis pollination.

"It's my first publication, and that was a highlight of my year," she says. "I'm now looking at how ultraviolet light exposure influences yield, with the aim of increasing the value of cannabis crop cultivation. I love working in a field where so much is unknown. There's always more to discover."

> "I love working in a field where so much is unknown. There's always more to discover."

Eye on Innovation

FIFTH-YEAR BIOLOGY STUDENT Vahid Safar had always been interested in start-up incubators, but figured they were the exclusive playing ground of seasoned, business savvy innovators.

When a pitch competition by the Science Discovery Zone came up during the pandemic, Safar whipped up a proposal one week before the entry deadline – and ended up winning the Steve Naraine Early Innovation Prize for his idea: an autonomous, solar-powered camera system based on computer vision.

Safar's "Aha!" moment came after he drove through an intersection and was caught by a red-light camera. After browsing the police website, Safar discovered that the system costs the city $300,000 apiece. "To take photos at the right time, cameras need a power source and information from the traffic control signal system. That requires digging trenches," Safar explains. "Why not use solar energy instead, and computer vision to detect traffic light status? It could drastically cut costs and simplify set-up." The system could also be useful in other applications, such as mining and crop maintenance.

Since the prize win, Safar has been pivoting into autonomous sound detection. Looking back on his journey, Safar is appreciative. "Ryerson's innovation culture is very inclusive. There are countless opportunities, so stay active in events outside your curriculum and get involved in what you find interesting." Safar has plans to pursue graduate studies and to continue working with the SDZ on his start-up venture.

Ready to Launch

BEFORE ARRIVING ON CAMPUS three years ago, Felicia Levina knew nothing about computers. Though a top math and science student, her high school did not offer instruction in programming, operating systems or emerging technologies. Yet she travelled some 15,000 km from her home in Indonesia to study computer science at Ryerson.

"It looked like an exciting field to enter," she says. "Something about it intrigued me, and I wanted to immerse myself in it."

Now wrapping up her fourth year, Levina is beginning to look for work in her field. She says that great teaching, hard work, and participating in competitions like Elle Hacks – a hackathon for women and non-binary individuals – can take any motivated and curious student in computer science to an Honours degree and the workplace.

"The best part for me is creating programs and applications," she says. "There's a lot of work involved, but there's a great sense of accomplishment in solving problems and making things that work. I've learned that I thrive on the challenge."

Currently finishing her studies from Indonesia amid the global pandemic, Levina hopes to start a career in Canada once travel restrictions are lifted. "I'm excited and ready to launch as a software engineer or web engineer."

Partnering for the Win

PHOTO: SARAH MCINTYRE

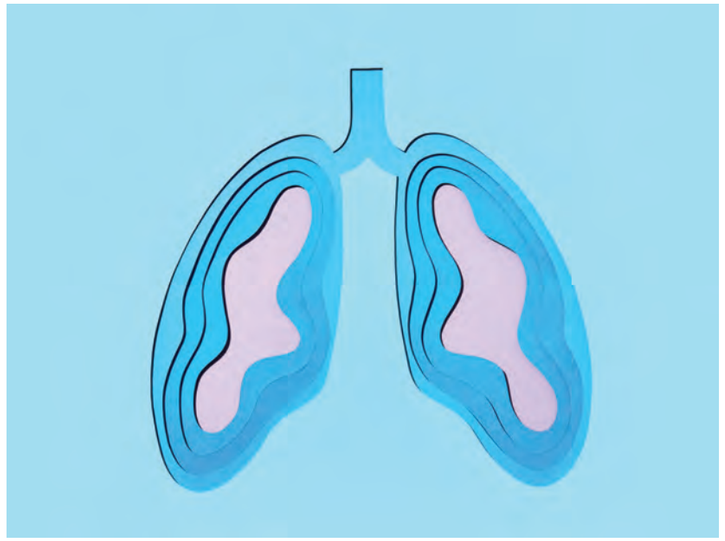
"We're all working to help people enjoy longer, healthier lives."

IF IT'S TRUE THAT talent wins games but teamwork secures championships, then Miranda Kirby is playing for the cup. In 2020, the Department of Physics Canada Research Chair established three ambitious collaborations, with her specialities in quantitative lung imaging and machine learning as the thread that connects them all. Combining image processing with machine learning makes it possible to detect and treat lung conditions and detect disease earlier.

There's the work with a transplant respirologist that uses imaging to identify organ rejection well before conventional tests can. There's the study to examine the impact of vaping and cannabis use on lung health. And there's the research tracking the underlying structural impact on the lungs of contracting COVID-19. In each case, Kirby has partnered with specialists in diverse fields to find answers.

"Most of my work occurs within the context of local, national or international collaborations," says Kirby. "That includes students as well. On my team are ten graduate and several undergraduate students, all of whom can perform data and image analysis remotely. Our research team has adapted to pandemic restrictions to keep the work moving forward."

Despite the range of specializations within Kirby's various projects, there is a unified purpose: "We're all working to help people enjoy longer, healthier lives."



Coming Down the Pipes

PHOTO: IAN PATTERSON

FEW PEOPLE CONTEMPLATE what they flush down the toilet. But for microbiologist and urban water expert Kimberly Gilbride of the Department of Chemistry and Biology, wastewater is a wellspring of data – literally.

"Anything you put in your body is coming out the other end," she says. "Wastewater is an amazing source of what's going on in human populations."

During COVID-19, Gilbride began monitoring virus levels in Toronto wastewater. "Patients shed the RNA of the virus through their stools, so we can detect it in wastewater from specific communities – even if people don't get officially tested."

Ryerson's initiative is now part of Ontario's $12 million wastewater surveillance project to test wastewater across Ontario. Along with other academic and research institutions, Ryerson is hoping to contribute to valuable data that can be used to track and monitor COVID-19 in wastewater and act as another tool to limit the spread of the virus.

Gilbride then began a sister project monitoring wastewater in the pandemic's hardest-hit locales – shelters and long-term care homes. The project is part of Canada's COVID-19 Immunity Task Force (CITF), with funding from St. Michael's Hospital, a site of Unity Health Toronto.

In 2020, Gilbride also received a Knowledge Synthesis Grant to conduct multidisciplinary research with Ryerson water policy expert Patricia Hanna and civil engineering professor Rania Hamza. They're making a comprehensive review of existing research about contaminants of emerging concern (CECs) in water, such as microplastics, fire retardants and pharmaceuticals.

Their findings will help identify knowledge gaps and inform water policy and public works engineering.

PHOTO: IAN PATTERSON

Community Builder

WHILE QUIETLY DISSECTING FROGS in high school biology class, Samantha Sanayhie got the first inkling that her path would lead into STEM. Now in her fourth year of the biomedical sciences program, she's blazing a trail as a Dean's List scholar, prospective cancer researcher, and student leader.

Sanayhie's taste for campus engagement began in second year, when she wanted to help provide more academic and social opportunities to fellow students. Since then, she's held a smorgasbord of positions with student groups, the Biomedical Sciences Course Union and Department of Chemistry and Biology Council, the Science Orientation Committee, and the Ryerson branch of STEM Fellowship – a national organization that promotes student mentorship and experiential learning. In recognition of her contributions, she received Ryerson's SLC Student Engagement and Leadership Award (2020/2021).

"I strongly believe that my university experience would not have been as fun, stress-relieving or amazing without my involvement in groups and events," says Sanayhie. "It allowed me to step forward and grow into the person I am today."

Working in the lab of Sarah Sabatinos, Sanayhie is also developing an interest in cancer research. She's investigating the effects of DNA folding on a cell's ability to divide, or to divide too much, such as in cancer. Straddling dreams of becoming a cardiac surgeon, the lab is opening up new horizons. "They're very different pathways," Sanayhie reflects, "but I feel that with either option, I'd be in a great place."

> "My involvement in groups and events ... allowed me to step forward and grow into the person I am today."

PHOTO: IAN PATTERSON

Family Act

FOR FIFTH YEAR STUDENT Paige Allison, mathematics just runs in the family. With both parents as high school math teachers, she took to the subject like a duck to water. Now in her final year in the Math and Its Applications program, Allison is president of the Women in Mathematics group, and recipient of the Math Guru Award for Women in Mathematics for outstanding contributions in leadership.

Through co-op, Allison picked up work experience at Scotiabank and the Toronto Transit Commission. "Co-op was the best decision I ever made," she says. "I got a taste of statistics, business and data analysis, and discovered which kinds of work and organization I now want to head in."

Allison has also kept grounded with broader interests. She's been learning various programming languages on the side, worked as a Research Assistant in a Department of Psychology research study, and chose electives in music and contemporary dance.

Asked if she plans on following her parents' footsteps into teaching, Allison reflects: "I've definitely thought about it, and I think how kids learn math can be a real deal maker or breaker. But it's so interesting applying math to business, so, I now have my sights set on a career in data analysis."

> "Co-op was the best decision I ever made."

PHOTO: JOHNNY C.Y. LAM

Solving Tomorrow's Problems Today

OPERATING MILLIONS OF TIMES FASTER than today's machines, quantum computers will eventually exceed the capacity of today's machines for a small subset of algorithms – and it just so happens that one of these algorithms can break modern encryption schemes and decrypt data currently considered secure. In 2020, Andriy Miranskyy of the Department of Computer Science partnered with IBM to mitigate that risk.

"Today, hackers can steal and save encrypted data for the future, when quantum computing is able to break those algorithms," he says. "Our team came up with a process to replace current algorithms with new, quantum-resistant ones to meet that challenge."

Miranskyy and his team spent months on the IBM Enterprise Project, arriving at a best practice for keeping existing software (running on modern computers) secure – by replacing old code with new quantum-resistant one. The process involves making minute changes, tracking what breaks, and then addressing each error generated. It's painstaking work that Miranskyy compares to swapping out a single word throughout all of Wikipedia without changing the meaning within any entry. Altering just one line of code has a cascading effect on countless others.

In parallel, Miranskyy co-authored a complementary paper with his postdoctoral researcher Lei Zhang and fellow Ryerson computer science professor Javad Doliskani – work that won the International Conference of Software Engineering (ICSE) New Ideas and Emerging Results Distinguished Paper Award. Their results set the foundation for writing high-quality software for quantum computers, with numerous possible applications, such as health, climate, or traffic flow problems.

Rising Stars

Yeganeh Bahoo
Computer Science

YEGANEH BAHOO'S specialization in computational geometry brings a fresh perspective to the Department of Computer Science. The field of computational geometry focuses on developing algorithms that can be explained in the language of geometry. Though her research primarily involves mathematics and proofs, it has diverse applications in robotics, 3D printing, search-and-rescue, and wireless networking. She brings industry experience from working as a postdoctoral fellow for CAMufacturing Solutions, where she focused on optimizing tool-paths of industrial additive manufacturing machines like 3D printers. Her teaching philosophy involves providing her students with a deep understanding of the material, as well as fostering opportunities for teamwork and collaboration.

Nariman Farsad
Computer Science

FOLLOWING HIS NSERC postdoctoral fellowship at Stanford University and work as a Senior Machine Learning Researcher at Apple Inc., Nariman Farsad now joins Ryerson's Department of Computer Science, bringing experience in the general areas of machine learning, AI and signal processing. His new lab, the Learning and Inference Algorithms (LIA) Lab, aims to understand the fundamentals of learning and inference in modern machine learning approaches such as deep learning, from both theoretical and practical perspectives. His work on applications in the biomedical domain, VR/AR, communication networks, and space robotics. He has been a member of the technical program committees of various conferences, and is also the editor for a number of special issue journals in his field.

Guanghui (Richard) Wang
Computer Science

JOINING THE DEPARTMENT OF Computer Science as Associate Professor, Richard Wang brings industry experience and over 130 published peer-reviewed papers to the table. His specialty in computer vision is a hot topic in both academia and industry, with applications in visual surveillance and self-driving and autonomous systems. His experience involves working with Baidu Research on 3D mapping for self-driving vehicles and a collaboration with Honda R&D Americas to develop a vision-aided system for automotive positioning and scene reconstruction. At Ryerson, Wang's goal is to establish a successful research program in computer vision and artificial intelligence, and attract more talented students and researchers to the program.

Dustin Little
Chemistry and Biology

AS ONE OF THE newest faculty members in the Department of Chemistry and Biology, Dustin Little brings an expertise in pathogenic strains of E. coli. His research group, the Little Lab, specializes in understanding how pathogenic bacteria interact with the host, and in finding new ways to disrupt the process and prevent disease. Little has received numerous awards and accolades throughout his training. Among other highlights, he represented Canada at the Nobel Laureates Meeting in Germany and won the top overall award for best research poster presentation. Not only does Little love research, but his passion also lies in teaching and mentoring. His teaching philosophy focuses on taking a hands-on approach and developing invaluable connections with his students.

Roxana Sühring
Chemistry and Biology

ROXANA SÜHRING'S expertise in environmental chemistry research and risk assessment is in high demand. After working for governments across Europe as a policy advisor, Sühring shares her research with the Department of Chemistry and Biology. Sühring's work involves analyzing chemicals that leach out of everyday products and their fate and potential risk for people and the environment. These environmental issues have ethical and political implications, and her goal is to find innovative pathways towards addressing them. At Ryerson, she looks forward to building a lab and bouncing ideas off each other with her colleagues.

Aidan Brown
Physics

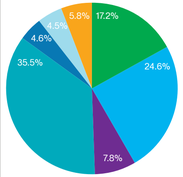
AFTER SPENDING FIVE YEARS in San Diego and Vancouver as a postdoctoral fellow, Aidan Brown is glad to be back in Ontario to share his expertise in theoretical biological physics with the Faculty of Science. For Brown, there is no border between physics and biology — his research involves studying the physical principles that govern cell biology, and understanding the rules and implications under which cells operate. Since cells are great examples of complex systems, Brown's research is a perfect fit for Ryerson's new Complex Systems field. As one of four researchers at the heart of the Complex Systems initiative, Brown looks forward to working alongside his colleagues to solve problems that would be intractable if remained siloed to their respective departments.

Faculty of Science by the Numbers

560
New alumni
(518 undergraduates, 42 graduates)

Undergraduate Degrees Awarded by Program in 2020

- Biology
- Biomedical Sciences
- Chemistry
- Computer Science
- Financial Mathematics
- Mathematics and Its Applications
- Medical Physics



18%
Increase of new international students in Faculty of Science undergraduate programs, compared to last year

2x
More students in the financial math program are on the Dean's List than last year

42%
Increase of new students in the computer science undergraduate program, compared to last year

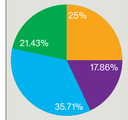
$100K+
Benefited over 300 students in need, through the COVID-19 FOS Student Emergency Fund

360+
Total number of research publications

10k+
Total number of research citations

Total Master's Degrees Awarded in 2020, by Program

- Molecular Science
- Computer Science
- Applied Mathematics
- Physics



69%

↑69%
Increase of new chemistry undergraduate students with an entering average of 80%+

51%

↑51%
Increase of new math undergraduate students with an entering average of 80%+

72%

72%
Of new biomedical sciences students in Fall 2020, identified as female

67%

67%
Of new molecular science PhD students in Fall 2020, identified as female

26%

↑26%
Increase of new students in Faculty of Science master's programs in Fall 2020

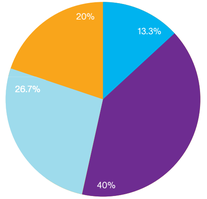
$7.7m+
In overall external researching funding

$6.5m+
In total funding for graduate students

59%
Of new medical physics students in Fall 2020, identified as female

Total PhD Degrees Awarded in 2020, by Program

- Mathematical Modelling and Methods
- Physics
- Computer Science
- Molecular Science



1,094
New Faculty of Science undergraduate students in Fall 2020

89%
Entering average to FOS undergraduate program (up 9.88% from last year)

Facebook

336k+
Impressions in 2020

10x
More video views than 2019

52
New fans

Twitter

400+
Twitter mentions

26%
More followers than in 2019

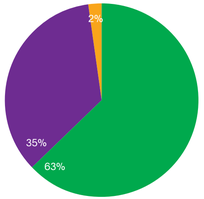
#WomenInScience
Top performing hashtag

Instagram

↑57%
More user engagement

↑25%
More followers than in 2019

Instagram Audience by Gender



- Female
- Male
- Nonbinary/Unspecified

LinkedIn

362
New followers

3.5x
Higher engagement rate

Math Rocks

"After the award win, there's no better affirmation that I'm on the right path."

MICHAEL FECENKO STILL REMEMBERS the moment he knew math would be his future. He'd already completed a life sciences degree, and was working as an Assistant Store Manager while trying to decide where life would take him. When tasked with deciphering a bunch of metrics, figures and data, Fecenko found himself drawing on his math intuition to interpret the numbers and explain how he'd arrived at his conclusions.

Two years later, Fecenko enrolled in the financial mathematics program at Ryerson. In 2020, he finished his first year with the highest CGPA and one of the department's Mathematics Faculty Scholarships. "I absolutely did not enter this program expecting to do so well," he says, "but I believe my genuine interest in the course material fueled my success."

Shattering math stereotypes, Fecenko is also an avid athlete and rock climber – specifically bouldering, a style of free climbing without ropes of harness. "I have such a passion for it, I can't even describe it. It's a form of stress relief." During the pandemic, Fecenko hit two other milestones – running his first 42.2km marathon with his dad and then completing an imperial century (100-mile) cycling ride with his brother.

Reflecting on his newfound direction, Fecenko is optimistic: "People around me tell me how passionate I get when I use math. After the award win, there's no better affirmation that I'm on the right path."

2020—
Creativity

Pushing the Envelope

PHOTO: SARAH MCINTYRE

MATHEMATICIAN MICHELLE DELCOURT joined as Ryerson faculty in 2019, bringing expertise at the junction of math and theoretical computer science. By 2020, she had made a breakthrough on one of the most famous, unsolved questions in design theory: the Nash-Williams Conjecture on Triangle Decompositions.

Going against the grain of widespread practice, Delcourt took an unconventional route by using nonlinear – rather than linear – optimization to examine the problem. The results broke a theoretical barrier, and the paper was accepted and published by the Journal of Combinatorial Theory, Series B.

In another specialty area, Delcourt also formulated tools inspired by the powerful method of hypergraph containers to stretch classic results in graph theory, number theory and algebraic geometry – namely whether problems known only in well-behaved environments still hold in sparse, random settings. The results not only provide more accessible tools to researchers outside of graph theory, but are also more suited to important future applications. Her findings were accepted by the high-impact Journal of the European Mathematical Society.

In 2020, Delcourt was also awarded a multi-year Structured Quartet Research Ensembles (SQuaREs) Grant from the American Institute of Mathematics (AIM). She will work with a team of six mathematicians on interdisciplinary research in pure mathematics.

Shooting Star

RYERSON COACHES FIRST discovered Katie Joyce at an event showcasing elite high-school soccer players to recruiters from American college and Canadian university programs. From that moment, it was clear she was going to be a star. After accepting a scholarship to join Ryerson's women's varsity program, Joyce dazzled as a midfielder, captain, and leader who helped the team generate more than double the volunteer hours required by the Athletics program.

As Joyce moved through her undergraduate program in medical physics, her academic performance also began to shine. Now in her fourth year, Joyce has a 4.15 GPA and has earned many accolades, including the Physics Faculty Scholarship Award, the Fred Hainsworth Award, and the Connections in Science Award. She has also conducted research in Dean David Cramb's lab at iBest, held an NSERC-funded summer internship, and is now completing a thesis focused on algorithm development for the non-invasive measurement of cerebral blood flow in the human brain.

What drives her success on and off the field? Gratitude and a strong work ethic top the list. "Ryerson gave me this opportunity. I want to take full advantage of it and perform at my best – on and off the field."

Next year, Joyce plans to continue studying physics in graduate school, and, of course, continue to shine on the soccer field.

PHOTO: IAN PATTERSON

RU's First Math PhD

RYERSON ALUMNA ERIN MEGER was just five years old when she first learned about a classic in mathematics, the Four Colour Theorem. Her fascination with math continued, and by 2020, Meger became Ryerson's first ever PhD graduate in Mathematical Modelling and Methods.

Meger began her master's studies here under the supervision of mathematics professor Anthony Bonato, and eventually stayed on for her doctorate. She's a structural graph theorist and also specializes in network modelling – the theoretical underbelly of complex networks such as the internet, social media or urban infrastructure.

While at Ryerson, Meger presented her research at notable events – the Yale Combinatorics Seminar at Yale University, the Prague Midsummer Combinatorial Workshop (where she was the only female speaker at the Gena and Robert Day event), and the Joint Math Meeting in Denver just three days after defending her PhD.

Since graduating, Meger has organized a mini-symposium at the SIAM Discrete Math Meeting, and from one of her talks in April 2020, was invited to work with the Lincoln Laboratory at MIT where she was the theoretical expert in a team of computer scientists. She's currently a postdoctoral researcher at Université du Québec à Montréal.

"Ryerson has been a wonderful place for me," says Meger. "The school will have more PhD graduates to come, but knowing that I was the first – that will always be extra special."

> "Ryerson has been a wonderful place for me."

Good Chemistry

WHEN KELVIN URBINA (CHEMISTRY '20) looks back on his undergraduate years, it's with the perspective of an ultra-high achiever. After attaining an A+ in all of his courses, he won the 2020 Governor General's Silver Medal as the top graduating student across Ryerson. His list of additional awards goes on for pages. As a result of his impressive achievements, he's currently enrolled in a fully-funded direct-entry doctoral program in organic chemistry at Rutgers University in New Jersey.

When he reflects on his time at Ryerson, one feature stands out as a driver of his success, even beyond the valuable co-op experiences that helped shape his career interests: the quality of his relationships within the Faculty of Science. "That was the foundation for me," he says. "It was a very friendly, welcoming and supportive place, and I could be myself. I think that's why I thrived. In another setting, the pressure I put on myself could have been much more amplified."

In particular, Urbina points to the personal approach taken by faculty. "Being able to talk to the professors as people really mattered," he recalls. "And they all knew who I was and greeted me by my first name. Those close connections made all the difference in my progress."

Life in the Fast Lane

BIOMEDICAL PHYSICS PHD Kurt Van Delinder's life changed dramatically in 2020. He published three high-impact research studies. He successfully defended his doctoral dissertation on Particle Neutron Gamma-X Detection (PNGXD), a newly proposed imaging concept developed for the application of particle therapy. He secured a postdoctoral fellowship. He then landed a position at the Juravinski Cancer Centre in the Hamilton Health Sciences system as a medical physics resident. And all of this during the pandemic.

He admits it has been a bit head-spinning.

"I came to Ryerson to study under James Gräfe," he says. "By the time I graduated, I had gained so much knowledge and research experience that I was offered a position in a residency program much sooner than I had anticipated. But working with James elevated and accelerated everything I was doing, which includes the novel imaging concept we developed. The fact that I was hired right away says a lot about him and the Department of Physics."

Today, Van Delinder oversees radiation oncology treatments from a technical and quality assurance standpoint. He partners with oncologists to ensure that the complex treatments are delivered exactly as planned.

While career trajectory has been moving fast, that's how Van Delinder likes it. "It's rare to jump right into a residency program, but I'm in a great place and I love what I'm doing."

Empowering the Leaders of Tomorrow

"I will be a mentor one day. I would like to do for others what [my mentor] is doing for me."

LEFIKA BALOYI COULD NOT BE HAPPIER about living in Toronto and attending Ryerson University. The third-year international student from Botswana is excited about the many possibilities that Canada's largest city offers, especially once his degree in financial mathematics is in hand. But at the same time, he's not sure exactly what he wants to do after graduation.

"I'm a city boy," he says. "I love being downtown and hope to live here long term. But I have a lot of questions about where my degree can take me and also about some things you can't learn in a classroom, like a really effective job search or what employers value most these days. There are so many areas where additional guidance is important."

Baloyi is receiving that guidance from Christian Grunt, the mentor he was matched with through the new Faculty of Science Mentoring Program. Grunt is a graduate of the Ted Rogers School of Management, a principal at the venture capital firm ScaleUp, and a part-time business instructor at The Chang School. He brings a wealth of academic training and industry knowledge to his advisory role with Baloyi.

Perhaps even more important, he brings a willingness to share his time and an enthusiasm for helping young people.

"I wish a program like this existed when I was a student," says Grunt. "My approach then was just to harass people with all the questions I had. I did get support, and I'm grateful for it, but mainly in an ad hoc way. A mentoring program provides much needed structure when it comes to helping students access resources and develop their careers."

Grunt and Baloyi embraced that structure early on, establishing goals and guidelines for how they would proceed together. They view their relationship as a two-way street: each gets out of it what they put in.

"We both care about this program and about each other," says Grunt. "Lefika relocated his life to study at Ryerson. That ambition should be rewarded. And I am learning a lot about his unique perspective and experiences while helping him clarify where he's headed professionally. So, I don't really ask myself why I signed up to be a mentor. It's just the right thing to do."

Baloyi is grateful for the support. Though he is planning to complete a master's degree before entering the workplace full time, he wants to fill some career-related gaps: "I really need professionalization. By that, I partly mean skills like how to interview well and present myself with confidence. I also mean better knowledge of career options in my field. Christian has been offering a primer of what's out there, including lesser known paths."

Grunt admires the Faculty of Science for creating a structured program that brings experienced leaders and exceptional students together, and he believes it should be "used as a playbook across the university."

The program was developed by Edward Wickham, Ryerson's Associate Director of Development, and is co-chaired by Janice Fukakusa, Ryerson's Chancellor, and Meaghan Stovel McKnight, the Chief Operating Officer of the Princess Margaret Cancer Foundation. Currently in its first year, it has 20 high-achieving students and 20 mentors enrolled, with plans to double in size next year.

"We know that career development and job searching can be a daunting process," says Wickham. "This program provides mentors who can guide students, offering both practical and emotional support, during a critical part of their educational journey. Students gain access to invaluable insights and experience, and mentors gather new perspectives and connect with future talent. Everyone wins."

Baloyi is making the most of his time in the program as he continues to explore the financial mathematics landscape. He doesn't know what direction he will take but is certain of one thing: "I will be a mentor to someone else one day. I would like to do for others what Christian is doing for me."

2020—
Evolution

Science, Ahoy!

Despite the challenges of pandemic conditions, scientific outreach continued unabated in 2020. In fact, workarounds helped diffuse science even further. All SciXchange programs moved online or were recorded STEM-at-home activities uploaded onto our YouTube channel. Several new initiatives also made successful debuts.

Technovation Girls Toronto

TECHNOVATION GIRLS is a global competition where girls work in teams to identify a problem in their community, create an app to address the problem, pitch their ideas and develop a business plan. In 2020, SciXchange became the host for the Toronto chapter and director Emily Agard was the chapter ambassador. We had a 100% completion rate for the girls who participated. One of our teams made it all the way to the Technovation Girls global summit in August as 1 of the top 5 junior teams selected in the world, winning the technology award.

1159
participants engaged

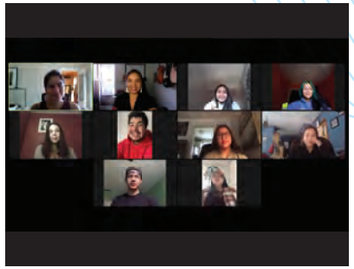
741
volunteer hours

70
hosted events and visits

825
outreach hours

Science Chats

OVER A SPAN OF 11 weeks, over 500 students and parents tuned in to meet and chat with 11 different guest scientists from various STEM fields. Partnering with national outreach organization Let's Talk Science, and matching each chat theme with their weekly Online Challenge quiz show, Scientist Chats engaged students from British Columbia all the way to Newfoundland.



Stoodis Future Scientists

CONTINUING SCIENTIFIC engagement with First Nations, this new day camp program engaged Indigenous high school students to help them envision a career path into STEM. Students mingled with Indigenous professionals in STEM, and even tried their hand at scientific communication by creating social media posts for SciXchange's Instagram account.

What the Science?!

DEPARTMENTAL ASSISTANT Stephanie Sim spearheaded a new social media series on the Scixchange Instagram channel (@SciXchangeRU) in July 2020. With bite-sized content, visual presentations and upbeat style, What the Science?! opens users' eyes to science all around us from a non-scientist perspective. Topics run the gamut, from how sunscreen works, to whether our bodies can tell time, to video tours of flora and fauna found in nearby Toronto parks. Audiences have been 79% female, and reaction has been 100% positive.

SciCommTO

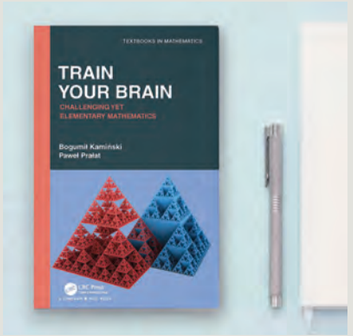
ON FEBRUARY 21 AND 22, Ryerson campus was the place to be for scientific communication. Along with Royal Canadian Institute for Science (RCI), SciXchange co-hosted the first-ever SciCommTO conference. Over 120 delegates picked up tips and tools of the trade through panel discussions, interactive workshops, show-and-tells, and lively speed networking round robin. This was our last big, in-person event before the pandemic moved all programs online.

Notable Events and Milestones

Introducing: Complex Systems

AS THE WORLD BECOMES increasingly interconnected, the need for individuals trained in complex systems thinking is more urgent than ever. Amid this growing demand, the Department of Physics spotted the opportunity to rethink and evolve its graduate program.

In Fall 2020, it launched a new graduate field in complex systems (MSc and PhD), placing Ryerson University now among only a handful of North American universities, and the only one in Canada, to offer specialized training in this field. This fresh offering comes alongside the department's updated, broadened degree in Physics, with three graduate fields: Biomedical Physics, CAMPEP Medical Physics and Complex Systems.



Brain Booster

MATH BIBLIOPHILES became one volume richer this year with the release of a new book. Train Your Brain – Challenging Yet Elementary Mathematics is the second book written by the Department of Mathematics' Pawel Pralat, co-authored by Bogumil Kaminski of SGH Warsaw School of Economics.

The all-in-one brain booster helps readers supercharge their logic and problem solving prowess, using no more than high school math. Readers gain access to a collage of competition-level math problems rarely seen outside of Poland, along with all necessary definitions, theorems, thought processes and detailed solutions. The new publication supplies students, quantitative professionals and math hobbyists with hours of challenging, contemplative enjoyment.

The Debug Room

STARTING FALL 2020, the Department of Computer Science debuted a new resource aimed at first-and second-year students: The Debug Room.

Alumna Maria Poveda (Computer Science Co-op '20) heads the room as its Student Skills Facilitator. Run via Zoom at the moment, the Debug Room offers generous availability and free-form appointments where students can get help with course material, get 1:1 training on debugging their own code, explore co-op, or just chat with a peer-aged alumna who's already been through the computer science program.

"I know what it's like to feel lost during first year," says Poveda. "But seeing students who are struggling, helping them, and then seeing their code actually work – it's just fantastic."

Students Helping Students

2020 WAS THE FIRST year in history that entire cohorts began their undergraduate lives online. Shortly before the pandemic, our First Year Science office had launched a Peer Mentor program. The timing was fortunate – up and running before widespread pandemic restrictions forced incoming students to get acclimatized for the fall term amid.

Administrative Assistant Alina Velieva led the initiative and a team of 18 upper-year mentors. The volunteers spanned all programs and demographics, including international and mature students. Promoted on Instagram and held on Zoom, first-year students connected with mentors through information sessions, virtual drop-ins and chats. The program was a hit with both mentees and mentors, and will continue as an ongoing resource for students.

Anchors Aweigh

IN DECEMBER 2020, the Faculty of Science offered a bittersweet salute to biologist Michael Arts, as he retired from the Department of Chemistry and Biology, and was then appointed Professor Emeritus.

For 24 years, Arts was a government scientist with Environment Canada. After federal downsizing, he joined Ryerson as a Full Professor in 2014, and continued his research in essential fatty acids, their critical role in invertebrate and vertebrate functioning, and ongoing environmental threats to their availability.

Arts reminisces: "Early on, I had expressed some wild research ideas to colleagues at Ryerson, and, much to my delight, they were met with enthusiasm. I felt my intellectual freedom had been restored, and this allowed my productivity to soar. It was very liberating."

Over his career, Arts produced a plethora of research, totalling 137 papers and two books. Now, as Professor Emeritus, he is still involved in research, including a study on the effects of microplastic contamination of fish physiology in Toronto and another in Norway that deals with using biochemical tracers to quantify habitat choice of critically-endangered European eels. He also has four new papers on the go with his postdoctoral fellow and with several colleagues in Canada and abroad.

Ryerson Hosts 2020 Gairdner Laureate

IN OCTOBER 2020, the Faculty of Science hosted pre-eminent developmental biologist and Canada Gairdner Award recipient, Roel Nusse of Stanford University. The visit was part of the Gairdner Laureate Lecture series, featuring the world's best biomedical and global health researchers.

Dean David Cramb hosted the two-part virtual event. Nusse first delivered a lecture tracing his discovery of the Wnt signalling pathway – a transformative breakthrough that has helped establish the link between faulty signaling and cancer. Nusse then fielded questions from graduate students during a round table discussion, covering issues such as finding the right research topic and when to pull the plug on dead ends. Amid the pandemic, the visit gave the audience a much-appreciated intellectual boost.

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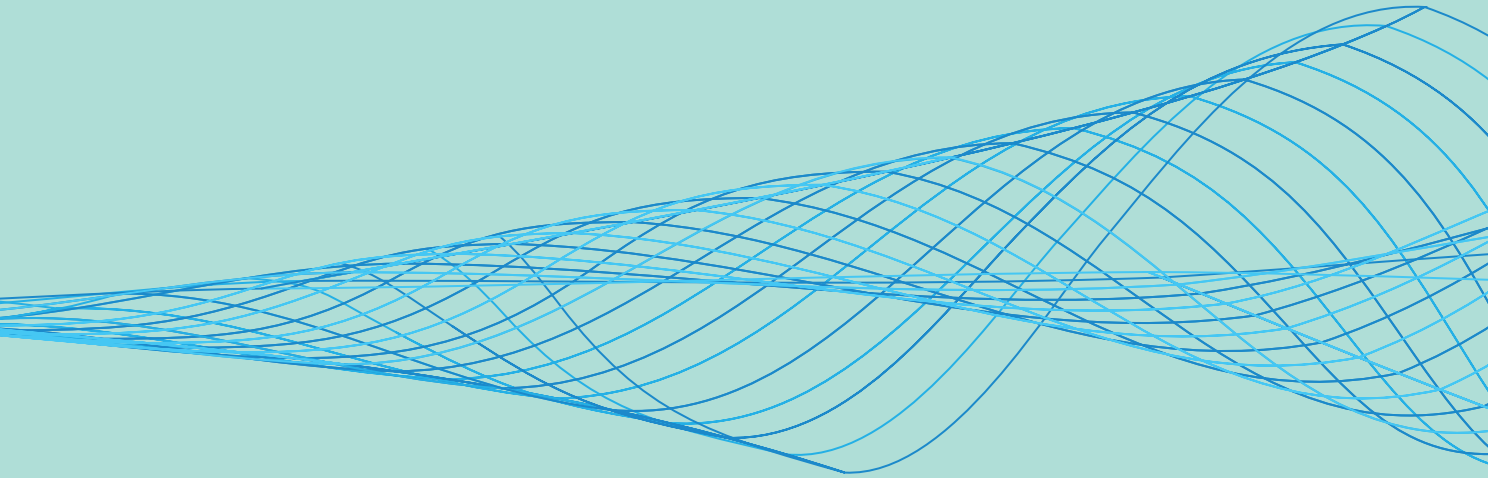

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