Faculty of Science
2017 Year in Review

17

Ryerson University

Faculty of Science

"

Science and everyday life
cannot and should not
be separated."

Rosalind Franklin
CHEMIST AND X-RAY CRYSTALLOGRAPHER

Dean's Message

PHOTO: MIKE FORD

As we celebrated our five-year anniversary in 2017, we continued to build on our reputation as a national leader in research, teaching, science outreach and public engagement. This year saw us welcome 836 first-year students and five new faculty and staff whose perspectives will energize and enrich the Faculty well into the future. We are planning for the future opening of the Ryerson University Centre for Urban Innovation and the opportunities for expansion into backfill space that will be available as a consequence.

One of the great strengths of the Faculty of Science is that, along with our commitment to excellence in teaching and research, we are proudly diverse and intentionally inclusive. Among our core values and competencies are awareness and action in support of equity, diversity, community engagement, inclusion and respect for Aboriginal perspectives. As such, we are firm in our commitment to evidence-based, data-driven approaches that identify and remove organizational, institutional, structural and systemic barriers to full equity, diversity and inclusion in science. We are moving toward a future where all members of the Faculty of Science can contribute and achieve their full potential.

In addition to our equity and inclusion efforts, we support science outreach. As but one example of these efforts, we were thrilled to award Dr. Bonnie Schmidt an honorary doctorate in recognition of her vision and impact. Dr. Schmidt is Founder and President of Let's Talk Science – a national outreach organization that has enriched the lives of millions of youth across Canada by providing them with STEM-based experiences.

On behalf of all of us at the Faculty of Science, I welcome you to our Year in Review and I hope you enjoy this overview of another successful year of connected science.

Imogen R. Coe

Imogen R. Coe
DEAN, FACULTY OF SCIENCE

Leadership Team

Imogen R. Coe
DEAN

Michael Kolios
ASSOCIATE DEAN, RESEARCH AND
GRADUATE STUDIES

Marcus Santos
ASSOCIATE DEAN, UNDERGRADUATE SCIENCE
PROGRAMS AND STUDENT AFFAIRS

Warren Wakarchuk
CHAIR, DEPARTMENT OF CHEMISTRY AND BIOLOGY

Eric Harley
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CHAIR, DEPARTMENT OF MATHEMATICS

Ana Pejović-Milić
CHAIR, DEPARTMENT OF PHYSICS

Suzana Pinto
COMMUNICATIONS AND WEB MANAGER

Andrei Cojita
MANAGER OF FINANCE AND
ADMINISTRATIVE SERVICES

Sandra Solomon
DIRECTOR OF DEVELOPMENT

Emily Agard
DIRECTOR, SCIXCHANGE

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I want to help people find their way and also promote equity and inclusion in math and science."

Eugenia Khaikhina

BELOW:
Computer science undergraduates Mitchell Mohorovich, Alexander Momschilov, and Olsi Spahiu discuss their co-op experience.

BELOW:
Pursuing graduate work to make a societal impact.

I don't know

EGFR + EGF

c-src
Fyn
Yes
NO

maybe

P13K/ Akt

Fyn

TOMIVU

TOMIVU IF

TOMIVU
thrin

enrichment

B EGF

Section 1:

Undergraduate Studies

The primary focus of our undergraduate programming is to encourage student excellence and connectivity. This priority guided a range of enhancements and growth in 2017. Our Step-Ahead Program has been a huge success, offering optional online and in-class learning modules at no cost to any incoming students from around the world in the two weeks prior to the academic year beginning in September. These modules assist first-year students in brushing up on fundamental concepts and skills to help them make a strong start to their degree.

We have also established a new non-credit course, SCI999: Research Practicum, which provides students with a low-risk opportunity to engage in research with a faculty supervisor. The course is an intermediate step for students considering a thesis project because it offers more structure than volunteering in a lab.

We also continue to celebrate and support student success through our awards programs, including the new Rodney Yip Award in Science. Named after its benefactor, Science Advisory board member and active Computer Science alumnus Rodney Yip, this endowed award will be given out each year to a deserving full-time fourth-year student who excels and demonstrates financial need. Of course, all these enhancements are simply ways to better meet the needs of students, several of whom are highlighted here as a representation of the innovative and interesting things happening with our undergraduates.

For the Love of Science

Kyle Cheung in the Ryerson University Research Facilities at the MaRS Discover District.

After completing a prestigious Ryerson BFA in New Media, Kyle Cheung took a few science courses because he was considering applying to physiotherapy. "I hadn't studied science since high school, and then suddenly, I wanted to get back into it full-time," says Cheung. Currently a fourth-year biomedical science student, a highlight of his studies has been research-based co-op placements. Cheung is a research assistant for his thesis supervisor, Dr. Sarah Sabatinos, at the MaRS Discovery District labs, exploring the impact of environmental stresses on the replication of yeast cells as part of an overall effort to enhance the effectiveness of cancer-fighting drugs. Cheung also spent a summer as a research assistant at Dalhousie University in Halifax doing research with proteins. Wrapping up his studies this spring, Cheung is considering attending medical school or pursuing an MSc with the end goal of working as a healthcare professional.

Select Undergraduate Student Highlights

Start Me Up

Biomedical Science and
Computer Science
had the highest incoming
student averages:

88%
Biomedical Science

85%
Computer Science

"It's been a busy year," says Andrei Betlen, Team Lead for software development at Oxilight, a biotech startup born in the Biomedical Zone and now working out of the Science Discovery Zone. "Oxilight's main focus is the prototype of a mobile phone-operated medical device that assesses the oxygen content in wounds," he explains. "It's essential for patients managing the complications of diabetes." Betlen oversees a team that includes a software intern from the University of Waterloo, a developer in the Ukraine and a designer in China. The Oxilight device is in clinical trials here in Canada and also in China, where the company participated in an six-month accelerator program to develop and market their product to the 130 million Chinese who suffer from diabetes. While managing his near full-time job, Betlen is also completing a thesis in artificial intelligence and computer vision under the supervision of Dr. Kosta Derpanis from the Department of Computer Science.

The Art of Physics

When she began studying fashion design in 2015, Monica Bell Vila missed science so much that she transferred into medical physics. Now in her fourth year and loving her chosen field, Bell Vila actively ensures she has the broad skill set required to excel in this interdisciplinary field. For example, she pursued a paid internship at the Ontario Institute for Cancer Research to get hands-on research experience to enhance her comprehension of biological concepts. "I also keep up with my painting and sketching, which I love doing as art but also to help me to visualize complex physics concepts," says Bell Vila. Bell Vila is also Vice President of Internal Affairs for the Medical Physics Course Union, where she works with her peers to connect the faculty and older students with younger undergraduates who benefit from the mentoring and guidance available.

ABOVE: OxiLight is developing a wound imaging system which assesses and monitors wound healing progression.
BELOW: Monica Bell Vila, medical physics undergraduate student and artist.
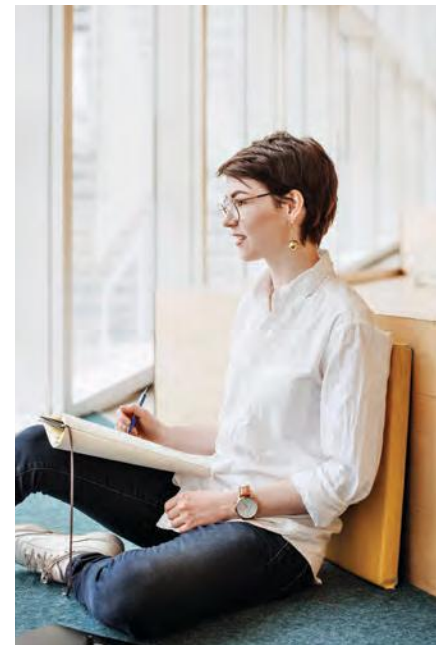
Equity and Inclusion Champion

ABOVE: Eugenia Khaikhina, financial mathematics undergraduate and student leader.

Completing a four-year financial mathematics degree in three years didn't stop Eugenia Khaikhina from making an impact beyond her studies. She is currently co-chair of the second annual Beyond the BSc Conference, an event aimed at assisting students who aren't sure about where their undergraduate science degree can take them. She is also President of Women in Mathematics, a Ryerson equity group aimed at empowering and supporting women and other traditionally marginalized people to overcome obstacles as they complete their degree and pursue a career in the field. Khaikhina is also a Career Boost student at the Office of the Vice President Equity and Community Inclusion and a member of a team competing in the Rotman International Trading Competition at the University of Toronto. "I want to help people find their way and also promote equity and inclusion in math and science," says Khaikhina.

Experiential Learning
____

From my research experience, I got a sense of what kind of work I wanted to do. In a few years, I advanced from my first step inside a lab to ranking in the top 10% of 6,500 submissions to the Undergraduate Awards. I am so grateful for the research opportunities at Ryerson.

Morla Phan '17
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"What we have to learn to do, we learn by doing," says Aristotle, who believed that developing Phronesis (φρόνησις, practical wisdom) is a cyclic process of reflection and experience: as knowledge is gleaned through reflection on a particular experience, more general understanding is developed.

Every undergraduate program at the Faculty of Science offers our students opportunities to immerse themselves in this cycle of learning by doing and reflecting to build knowledge, be it through group projects, conferences and competitions, research opportunities, co-op placements, zone learning, or extra-curricular programming.

As such, science students enjoy a balanced education that mixes thinking and acting, classroom and community, lab and workplace. Embedded in science courses and programs, experiential learning opportunities are in high demand as they allow students to both develop social purpose and acquire subject expertise.

Cancer Researcher Debuts on the World Stage

Pursuing her Bachelor of Science in Biology, Morla Phan '17 initially planned to look for work right after graduation. Then she volunteered in the Michael T. Arts lab in the summer of 2016 and everything changed. In her fourth year, she enrolled in the undergraduate thesis program to pursue her newfound passion for research. She then worked in the John G. Marshall Lab identifying the biomarkers for breast cancer in human blood plasma. "If we can find a biomarker specific only to breast cancer, we can use blood tests for earlier detection," Phan says. As a result of her research, Phan received a 2017 Highly Commended Award in the Life Sciences category of Undergraduate Awards, the world's leading recognition of undergraduate work. Now pursuing her Master of Biomedical Science at the University of Guelph, Phan is researching canine cancer to discover more about what makes cancer cells sensitive to radiation.

PHOTO: ADRIAN BYERS

Full Stack Preparation

Justin Prajza '17 has had extensive work experience ranging from the founding of J's Landscaping Services at age 14 to his 2016 co-op placement at the Inner City Family Health Team in Toronto. In between, Prajza applied his mathematics and computer science knowledge to placements at Rogers and Deloitte. "I spent a lot of time at Ryerson's Co-Op Office," says Prajza. "The coaching and seminars are fantastic, and I got my first interview at Rogers with their help. After graduating, one of my professors then offered to help me find a job. I think I ended up at the DMZ because of the diversity of my co-op experience – large corporations and a small family health unit – and my use of the resources here at Ryerson." As a full-stack developer at the DMZ, Prajza maintains websites and information systems: "It's an amazing job in an incredibly exciting environment."

LEFT: Morla Phan, biology graduate, gained valuable experience through her research placement.
BELOW: Justin Prajza, mathematics and computer science graduate, attributes his success to his co-op placements.

PHOTO: IAN PATTERSON

Amazon
Hat Trick

Before 2017, there had never been an undergraduate student from the Computer Science Department hired as an intern at Amazon. That changed when not one but three students successfully completed the rigorous interview process and joined the company as software development engineers – with full-time job offers for when they finish their degree. Their experiences in co-ops, internships and the competitive programming club made all the difference for the threesome.

After first year, Mitchell Mohorovich was invited by Dr. Eric Harley to work on "The Wizard," the program used to evaluate computer science students. He joined the competitive programming club in second year while developing a weather app on his own time. These experiences helped him become the only Ryerson student – and the only second-year student – selected for a 16-month co-op at Environment Canada on the data dissemination team. In his role at Amazon, Mohorovich worked with the Tax Engine Artisans (TEA) in the Vancouver office developing and revising algorithms that manage the tax parameters and implications of transactions in various regions and cities around the world.

Best friends Alexander Momchilov and Olsi Spahiu lived together in Seattle, Washington and worked at the Amazon head office on the Supply Chain Optimization Team (SCOT). Momchilov worked on implementing an improved algorithm that preempts demand to meet customer needs by avoiding items being out of stock. Prior to the internship, he had completed two co-op terms, one at the University Health Network and another at a software consultancy. Spahiu worked on inbound network optimization, trying to lower the cost between vendors and fulfillment centres through improved strategies for shipping. In particular, he developed a debugging tool currently in use to assess the calculations made by Amazon's shipping optimization product. Before joining Amazon, Spahiu held internships at the Legislative Assembly of Ontario, Spin VFX, and WAVE, an accounting and financial services fintech in Toronto.

> "After my third interview, the engineer from Amazon told me he was surprised by the breadth of my knowledge. The diversity of courses we take at Ryerson and my experience in the competitive programming club prepared me well."

Mitchell Mohorovich

ABOVE: **Mitchell Mohorovich, Alexander Momchilov (virtual), and Olsi Spahiu in the George Vari Engineering and Computing Centre.**

Cracking Codes and Glass Ceilings

Science Agora Serves Up π and Pie

Attended by six Ryerson computer science students, including Deborah Mepaiyeda, co-president of Ryerson's Women in Computer Science, the Grace Hopper Celebration (GHC) 2017 was held in Orlando, Florida in October. Attendees gathered to learn, connect and celebrate women technologists. Keynote speakers included Melinda Gates (co-chair of the Bill and Melinda Gates Foundation), Fei Fei Li (Director of Stanford University's AI Lab) and Diane Greene (founder of VMWare). Workshops were offered on topics ranging from artificial intelligence and software engineering to the lack of diversity in tech companies. In addition, a four-hour hackathon challenged attendees to code an open source project. "We are now sharing our GHC experience with girls and women in computer science to encourage them on their journey," says Mepaiyeda.

Science Ambassadors were instrumental in the great success of this year's Open House events. The first, in November, was designed to connect with parents, while the March Break "Science Agora" event was geared toward students with admissions offers. Agora is the Greek term for the marketplace where merchants sold their goods and the public gathered to discuss the events of the day. In a similar fashion, Science Agora offered activities and displays. Ambassadors were stationed at various booths to engage with students and showcase their projects and experiments. As it happened, Pi Day coincided with Science Agora this year, so members of the Mathematics Department enthusiastically talked π and served pie to students and the larger community.

ABOVE: Undergraduate students who attended the Grace Hopper Celebration.
RIGHT: Celebrating Pi Day by serving over 2,000 pieces of pie to the Ryerson community.

Ryerson Science Society, Course Unions, and Groups

Outside of the classroom and labs, students enrich their undergraduate experience by participating in over 15 science groups. Sharing their interests and goals with like-minded others, they successfully host events, provide services and resources, and support academic and professional growth.

Science Students Sample the Red Planet

Ryerson Rams Robotics (R3) participated in this year's University Rover Challenge (URC), an international competition at the Mars Desert Research Station, Utah, challenging student teams to design and build the next generation of Mars rovers. R3 science team members Daniel Cresta (medical physics) and Michel Kiflen (biomedical science) were responsible for the design and implementation of an automated science console of the rover, which collects soil samples and tests various physical properties of the sample on board the rover (pH, temperature, moisture, electrical conductivity, nitrates, etc.). The analysis continues in the lab, where they must run biological tests to detect or suggest the presence of extra-terrestrial microbial life in a high pressure and time-sensitive environment. The science team broke new ground by designing robust two-minute DNA and RNA extraction protocols. For their first year competing in the URC, the Ryerson Science team placed 11th out of 86 worldwide finalists. "A competition such as this offers interdisciplinary team experience and an opportunity to stretch our knowledge beyond basic science," says Kiflen.

PHOTO: IAN PATTERSON

Leading the Way

Extracurricular activities provide opportunities to network, develop teams, organize initiatives and gain valuable leadership experience. Students in the Ryerson Science Society (RSS) have been busy this past year:

- Establishing the RSS constitution
- Running a referendum campaign to gain sustainable funding for operations and events
- Helping launch the STEAM Café on Ten Thousand Coffees
- Hosting social and academic events

Partnering with student groups, the RSS also established the Beyond the BSc Conference, which hosted over 100 science students exploring career pathways in STEM. Meanwhile, the science course unions have been actively promoting opportunities for students and connecting them to larger causes. On October 1, the Women in Mathematics and the Medical Physics Course Union participated in CIBC Run for the Cure, raising funds for the Canadian Cancer Society and breast cancer research.

LEFT: Michel Kiflen, biomedical sciences undergraduate, with the Mars rover.
ABOVE: The student groups joined the Run to honour the survivors and show appreciation for the people behind the movement.

Science Discovery Zone

Ryerson's newest learning zone has just passed its first birthday. With its mission of "connecting science to value," the Science Discovery Zone (SDZ) has been busy driving innovation and solving real-world challenges by connecting three segments: students (a diverse group of university and community learners), mentors (leaders and experts) and industry (innovative companies).

Great First Dates

July 27
The SDZ hosted Matteo Vignoli, director of the Food Innovation Program and founder of the Future Food Institute, to discuss food innovation, one of the SDZ's hubs. Future Food is an entire ecosystem that makes food innovation a key tool to tackle the great challenges of the future, connecting with the world while promoting the local territory.

August 31/September 1
Ryerson students Aly Burtch and Alejandro Saettone, co-founders of uBioDiscovery, provided a two-day, hands-on cloning workshop for SDZ members. On day one, participants learned how to "edit" the genome of bacteria, allowing it to grow in an environment it could not grow in before. Results were viewed on day two: if the bacteria grew, the experiment was a success. And it was!

September 29
To mark its one-year anniversary, the SDZ brought together mentors, industry partners, ventures, and general members for an afternoon of networking, presentations, and conversations about prospective next steps.

20+
startups

100+
members
(75% general members, 25% startups)

The Early Bird Gets the Mealworm Bolognese

The 2017 winner of the MAKO Student Innovation Award was C-fu Foods, co-founded by brothers Eli and Lee Cadesky. When the Cadeskys first created cricket tofu ("c-fu"), they knew they were onto something socially useful and economically viable. C-fu's mission is to put insects on all of our plates with its textured insect protein, insect protein concentrate, and other products. Its sister company, One Hop Kitchen, sells cricket and mealworm tomato sauces. Why eat insects? They're healthy (high in protein, iron and calcium), can be raised in almost any climate or environment, and require less land, water, feed, and energy than more traditional protein sources. C-fu leverages food science to provide the next generation of insect protein.

ABOVE: Eli and Lee Cadesky, founders of C-fu Foods.

Ground Control to Major Breakthrough

Undergraduate student Mark Zaidi (Biology) created Entropy Labs to bring rocket science to everyday applications. He's developed a more economical and sustainable method to produce aerogel, the third-lightest material ever made and the world's best insulator. Currently used by NASA to line rockets and capture comet dust, the cost of aerogel (three times that of gold) has been a barrier to more widespread use. With support from the Science Discovery Zone, Entropy Labs has discovered a way to reduce the cost of production of aerogel-fiberglass composites from $30 to $3 per square foot, using minimal energy and reducing the carbon footprint. With this breakthrough, it will be possible to use aerogel in insulation applications with any social, economic or scientific value that innovators can dream up.

Mark Zaidi, biology undergraduate, discovered an alternative way to produce a superinsulating material called aerogel (originally developed by NASA) for a fraction of the price. It resists heat or cold better than traditional fiberglass insulation.

PHOTO: IAN PATTERSON

RySciMatch

RySciMatch is a non-credit course offered through The Chang School that connects senior students, staff, faculty, and community mentors to current undergraduate students at Ryerson. During a semester, students attend weekly sessions to engage with mentors on topics such as research, health and wellness, career planning, and extracurricular opportunities.

In the Zone

RySciMatch has become integrated with zone programming, and its members are now enrolled in the Science Discovery Zone, giving them access to all the resources the zone offers. This membership provides an even more direct path to applying what students learn through the RySciMatch sessions and to interacting with professionals and startups in a field of interest.

Magnetic Attraction

As RySciMatch expands, the program is attracting students from many different disciplines. Initially of interest mainly to chemistry and biology students, it now has members from computer science and engineering, highlighting the applicability of the mentorship program.

"

Participating in the RySciMatch and SDZ has provided me with the opportunity to network with professionals and academics I would not usually have access to. As an engineering student, I particularly appreciate the collaborative and relaxed method of learning adopted by the zone."

Ibukunoluwa Oluwayomi '17
BIOMEDICAL ENGINEERING

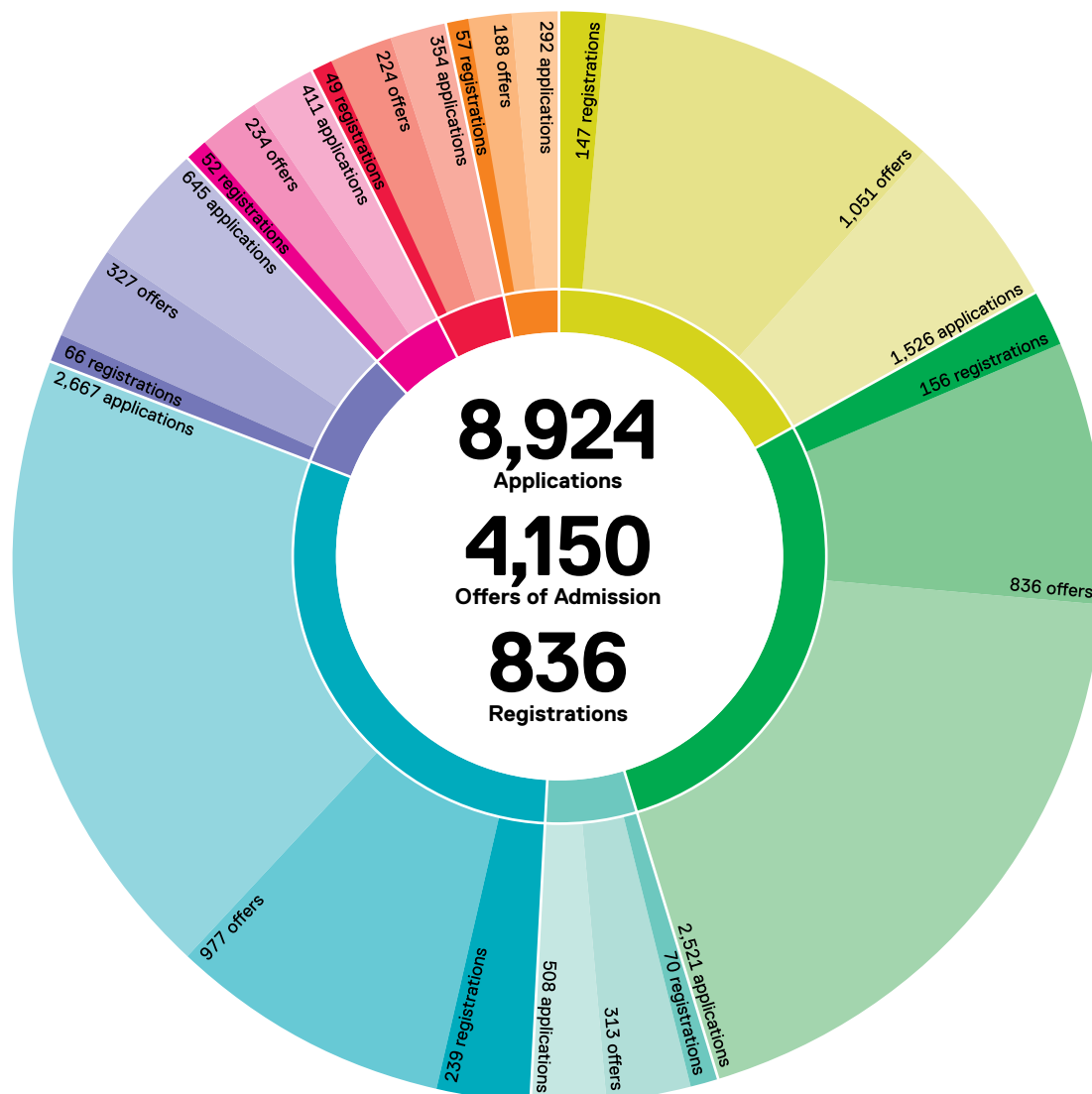ABOVE: Students learn from experts and are mentored by community members.

Undergraduate Studies By the Numbers

Undergraduate Programs
- Biology
- Biomedical Science
- Chemistry
- Computer Science
- Undeclared
- Financial Mathematics
- Mathematics
- Medical Physics

Applications, Offers and Registration of First-Year Domestic Undergraduates, Fall 2017

8,924 Applications

4,150 Offers of Admission

836 Registrations

Biology: 1,526 applications, 1,051 offers, 147 registrations
Biomedical Science: 2,521 applications, 836 offers, 156 registrations
Chemistry: 508 applications, 313 offers, 70 registrations
Computer Science: 2,667 applications, 977 offers, 239 registrations
Undeclared: 645 applications, 327 offers, 66 registrations
Financial Mathematics: 411 applications, 234 offers, 52 registrations
Mathematics: 224 offers, 49 registrations
Medical Physics: 292 applications, 188 offers, 57 registrations, 354 applications

71%▲

increase in domestic applicants since 2012 so that in 2017, applications (8,924) were tenfold the number of available spaces (836)

78%▲

of students admitted directly from an Ontario secondary school had an entering average of 80% or higher, up from 68% in 2015 and 73% in 2016

90%▲

of Computer Science students entered with an 80% or higher average, up from 83% in 2016
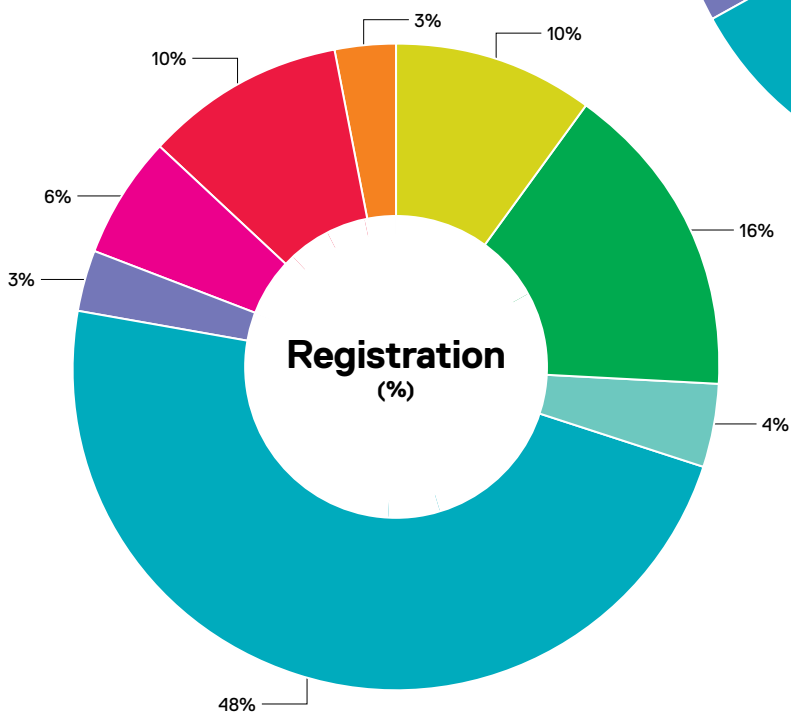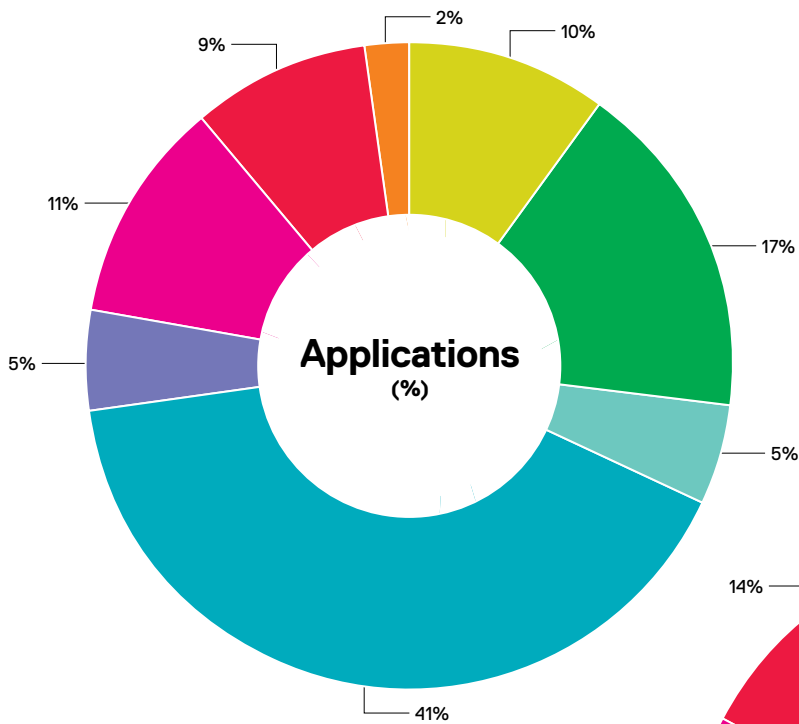
84%▲

is now the overall incoming average to the Faculty of Science for Ontario secondary students, having risen steadily from 81% in 2014

Applications, Offers and Registration of First-Year International Undergraduates, Fall 2017

Undergraduate Programs

- Biology
- Biomedical Science
- Chemistry
- Computer Science
- Undeclared
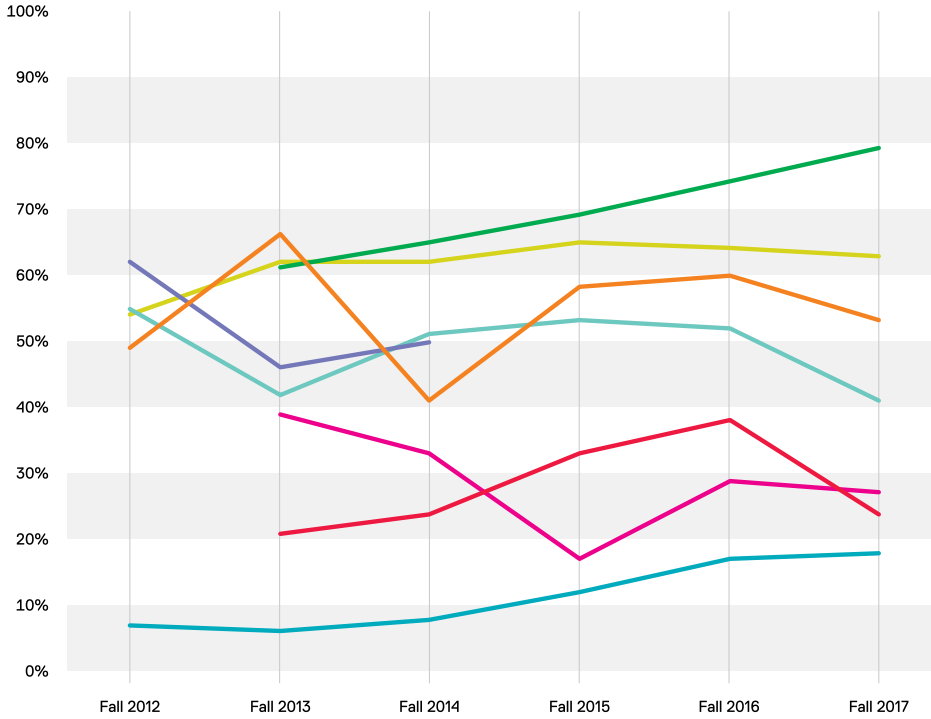- Financial Mathematics
- Mathematics
- Medical Physics

Applications (%)

- 2%
- 10%
- 17%
- 5%
- 41%
- 5%
- 11%
- 9%

Offers (%)

- 3%
- 10%
- 15%
- 6%
- 36%
- 5%
- 11%
- 14%

Registration (%)

- 3%
- 10%
- 16%
- 4%
- 48%
- 3%
- 6%
- 10%

33%▲

increase of international student applications from 2016

Percentage of First-Year Female Undergraduates by Program, 2012–2017

Undergraduate Programs

- Biology
- Biomedical Science
- Chemistry
- Computer Science
- Undeclared
- Financial Mathematics
- Mathematics
- Medical Physics

58% ▲

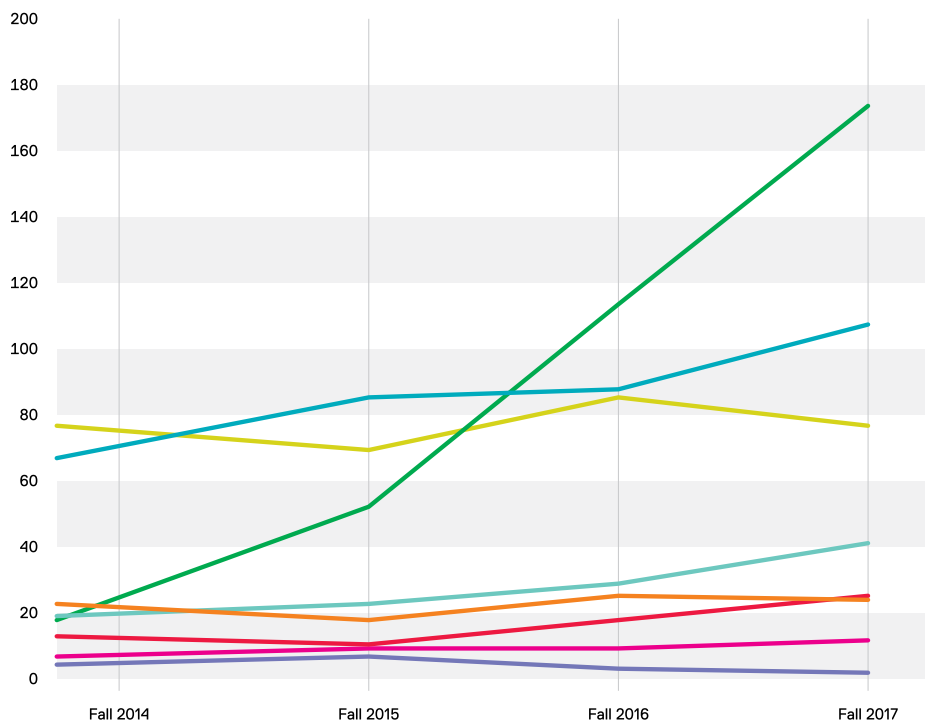Increased overall percentage of female registrants in Financial Mathematics since 2015

First-Year Undergraduates by Location, 2012–2017
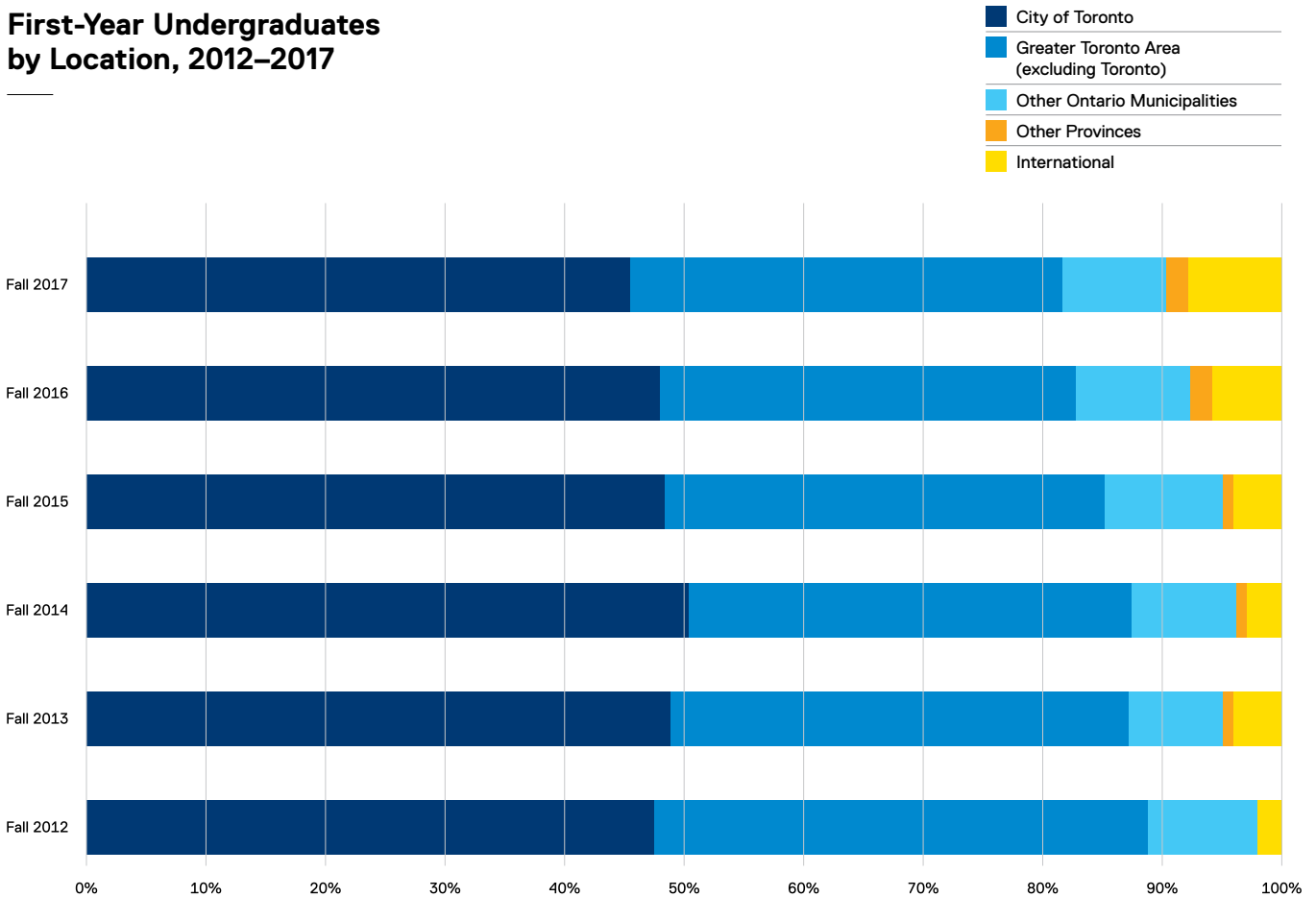
- City of Toronto
- Greater Toronto Area (excluding Toronto)
- Other Ontario Municipalities
- Other Provinces
- International

Dean's Honour List
by Program, 2014–2017

Undergraduate Programs

- Biology
- Biomedical Science
- Chemistry
- Computer Science
- Undeclared
- Financial Mathematics
- Mathematics
- Medical Physics

58%▲

increase of students on the Dean's Honour List from 2016. Specifically, a 47% increase of Financial Mathematics students.

Dean's Honour List GPA Average
Distribution, 2014–2017
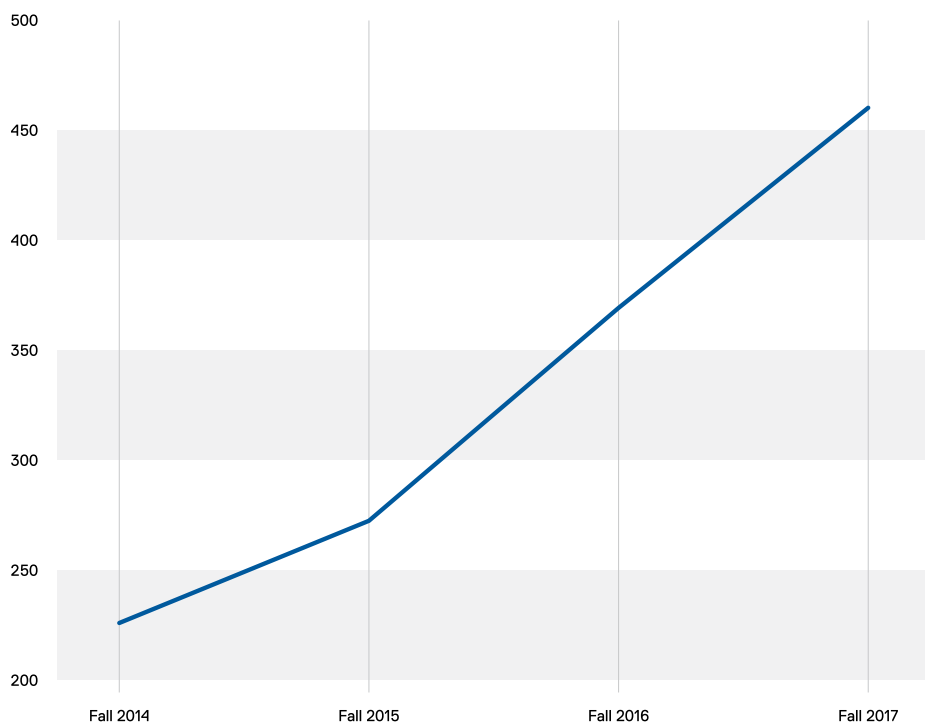
Increased percentage of A+ (13%), A (34%), and A- (20%) students on the Dean's Honour List from 2016.
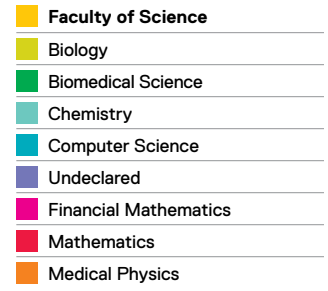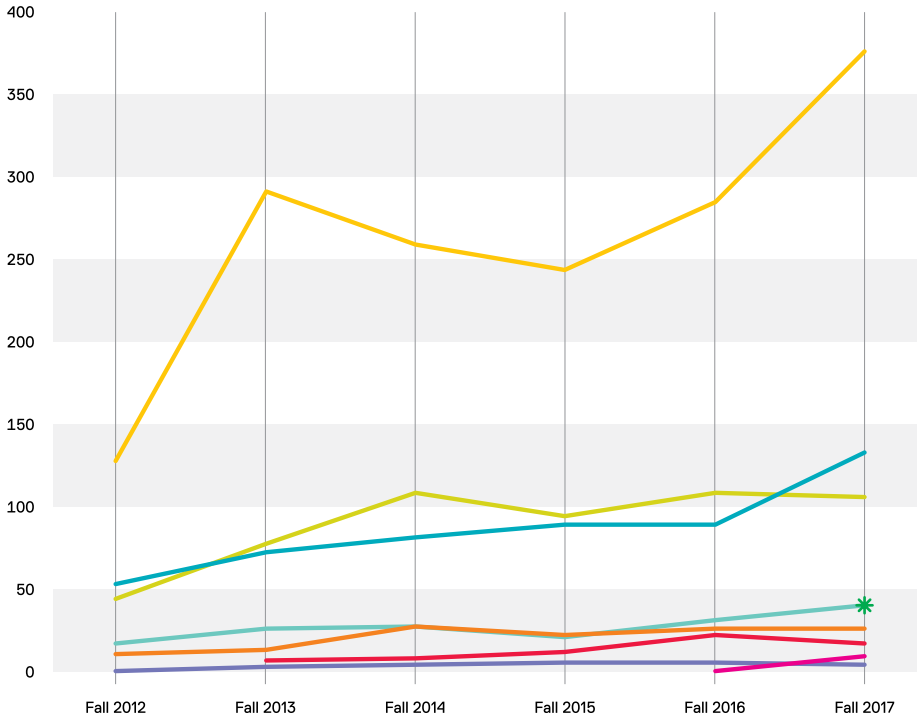

A+
13%▲

A
34%▲

A-
20%▲

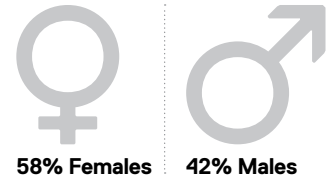# Undergraduate Degrees Awarded by Program, 2012–2017

Legend:
- Faculty of Science
- Biology
- Biomedical Science
- Chemistry
- Computer Science
- Undeclared
- Financial Mathematics
- Mathematics
- Medical Physics

First cohort of Biomedical Science students graduated:

58% Females   **42% Males**

32% ▲

increase in the Faculty of Science output from 2016

*First cohort of Biomedical Science students graduated in 2017

Undergraduate Degrees Awarded by Program and Gender, 2017

Legend:
- Female
- Male

Biology
39% / 61%

Biomedical Science
42.5% / 57.5%

Chemistry
52.5% / 47.5%

Computer Science
8% / 92%

Contemporary Science
25% / 75%

Financial Mathematics
50% / 50%

Mathematics
29% / 71%

Medical Physics
58% / 42%
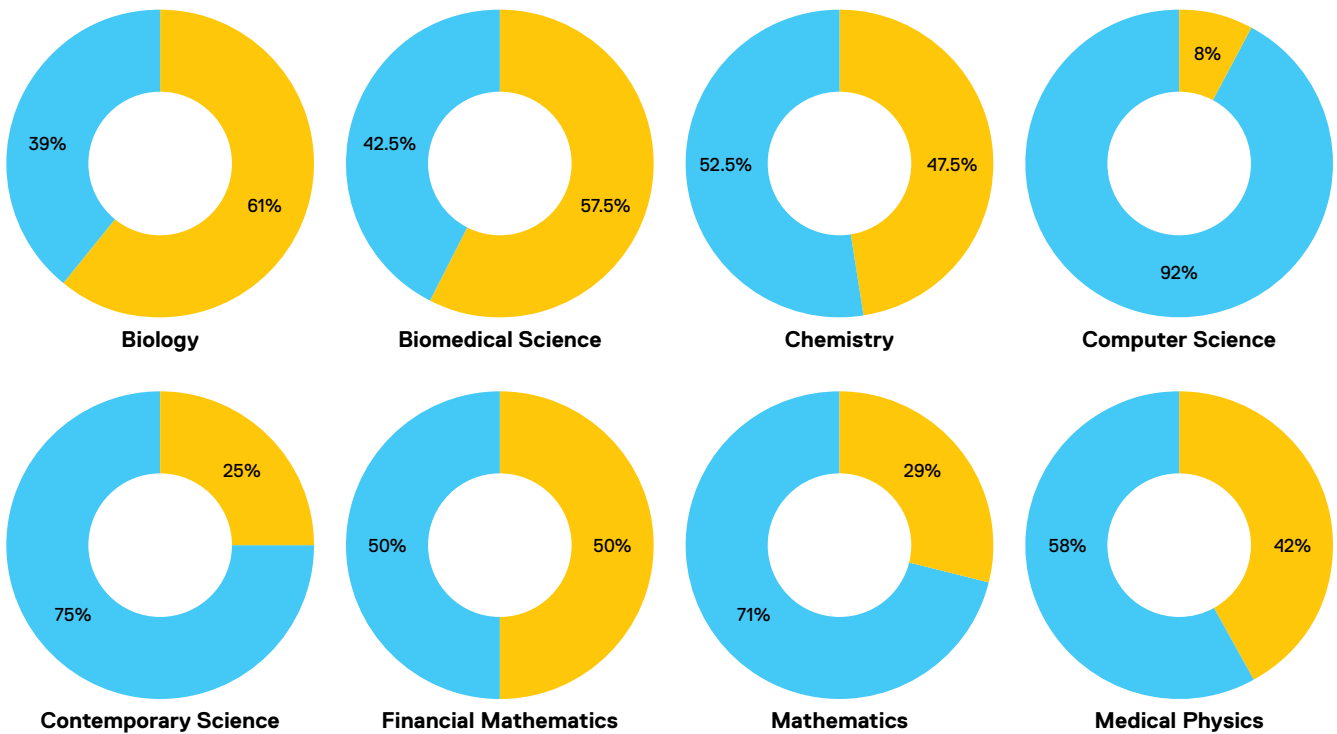
Section 2:

Graduate Studies

It is an incredible time to be a part of graduate studies at the Faculty of Science at this stage of its development. Working together, we are building programs that enable us to achieve our shared scientific, research, and educational objectives.

We are proud of the active role we play in advancing the state of equity, diversity and inclusion in STEM, as evidenced by the diversity of students and graduates, half of whom are women. As the only fully comprehensive faculty at Ryerson with PhD programs in each department, our commitment to connected science fuels our efforts to provide graduate students with opportunities to advance the state of knowledge in their field while also having a tangible impact.

We are also committed to exploring new forms of cross-disciplinary projects that will assist our students in generating novel solutions. We regularly celebrate the achievements of our graduate students, such as our Paper of the Month program which publishes short synopses of recent publications in Canadian and international journals by master's and doctoral candidates in science. We also continue to connect our students to industry through an immersive career education program, Industry Insights and Navigating Networks (IINN), which is now in its second year. In addition, our faculty are always generating engaging opportunities for students through internships, industry projects, research assistantships, and collaborations.

Immune Cell Insights

Victoria Hipolito, Molecular Science PhD student, is studying how immune cells fight infection.

Victoria Hipolito's overall research goal is to understand how the processes that regulate immune cell signaling may impact inflammatory diseases and vaccine efficacy. As part of the Roberto Botelho lab, "I'm focused on how immune cells adapt their 'organs' to fight infection, especially lysosomes, which are the 'stomach' of immune cells and expand in size and shape to hold more foreign material during a period of infection," she explains. Through a collaboration with the Terebiznik Lab at University of Toronto Scarborough, Hipolito is first co-author on a 2018 article in the *Journal of Cell Biology*. Other recent achievements include being Invited Guest Speaker and member of the trainee organizing committee at the Canadian Society of Molecular Biosciences (CSMB) Conference in Ottawa 2017; placing first in research poster competitions at the 2017 Ryerson Science at the Interface Symposium and at the 2017 U of T Microbiology & Infectious Diseases Research Day; and achieving high honours at graduate student seminar presentations (second place for her PhD and first place for her master's). She has also been an active member of the Molecular Science Course Union for the past three years and is funded by a Ryerson Graduate Fellowship.

Select Graduate Student Highlights

PHOTO: IAN PATTERSON

Financial Mathematics Phenomenon

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After completing his undergraduate degree in mathematics at Ryerson in the spring, Harjas Singh began a master's degree in Financial Mathematics with a focus on Quantitative Risk Management (QRM) with Drs. Niushan Gao and Foivos Xanthos. In particular, he is looking at risk measurement under model uncertainty and developing algorithms for computing sharp bounds in risk aggregation. During his undergraduate work, Singh established himself as a top math student by winning several awards, such as the Scotiabank International Scholarship for Excellence in Academics and all three undergraduate GPA-based awards given out by the Mathematics Department (his GPA was 4.18 out of 4.33 and he received an A+ in all the math courses). Singh also placed in the top ten at the competitive Rotman International Trading Competition at the University of Toronto. "Financial Mathematics is a relatively new program," says Singh, "but it is both incredibly challenging and supportive."

> "
>
> Harjas' tenacity and continued success at Ryerson truly makes him a role model for both our undergraduate and graduate students."
>
> **Lawrence Kolasa**
> UNDERGRADUATE PROGRAM DIRECTOR

What's New in Networking

———

A graduate of Ryerson's MSc program in Electrical and Computer Engineering, Zulfiker Ali is a fourth-year doctoral computer science student engaged in research related to machine to machine (M2M) communications over LTE/LTE-A networks, specifically Medium Access Control (MAC) in wireless networks and vehicular ad-hoc networks. In 2017, the research team Ali works with generated several novel discoveries and recognitions. These include the IEEE Communications Society Best Paper Award at the IEEE Wireless Communications and Networking Conference in March in San Francisco, California, presenting at the 2017 IEEE 86th Vehicular Technology Conference in September in Toronto, and submitting a paper regarding a new MAC protocol to *IEEE Network* magazine, which is accepted for publication. Ali, supervised by Dr. Jelena Misic, and the team also presented at the 2017 IEEE GLOBECOM in Singapore in December 2017. "It's an understatement to say there has been a lot going on," says Ali. "But the work is fascinating and worth every effort."

BELOW: Zulfiker Ali, Computer Science PhD, is generating a number of novel discoveries in the area of wireless networks.

Virophysics Modelling Scholar

—

BELOW: Laura Liao, Biomedical Physics PhD graduate, at the Los Alamos National Laboratory.

2017 was a busy year for Dr. Laura Liao, who completed her doctorate in Biomedical Physics under the supervision of Dr. Catherine Beauchemin and secured a postdoctoral fellowship with Dr. Alan Perelson, a Senior Fellow in the Theoretical Biology and Biophysics Group of the prestigious Los Alamos National Laboratory. Perelson has trained postdocs over the last 40 years and is a pioneer in the study of theoretical immunology most famous for his work with HIV. While at Ryerson, Liao worked on mathematical models of influenza A virus infections in vitro to study both defective interfering particles (DIPs) and virus release. Liao's work revises the methodology for counting DIPs, which had been in use unchanged since 1959. "This innovation has significant potential," explains Liao. "It could lead to improved vaccine production and have positive applications as an antiviral measure to suppress infection, because the presence of DIPs can change the course of an infection."

20+

partnerships & collaborations

25

maximum student enrolment
per IINN cohort

———

**Available to all graduate students
within the Faculty of Science**

Enriching
the Graduate
Experience

———

Industry Insights and Navigating Networks (IINN) is an immersive and experiential learning career education program. It educates graduate students about career options and opportunities to leverage their professional expertise in academic and non-academic environments. Students learn about best practices in labour market research, industry value propositions, and building and sustaining a professional network.

   After a successful pilot in 2016, IINN evolved into a four-part workshop series, field project (industry job shadow) and networking breakfast with industry representatives. This year, the program was open to all Faculty of Science PhD candidates and a pilot cohort of six master's students.

Graduate Studies By the Numbers

Greater Toronto Area
Other Ontario Municipalities
Other Provinces
International

Applications & Enrolment Total Headcount by Location, Fall 2017

Master's (%)

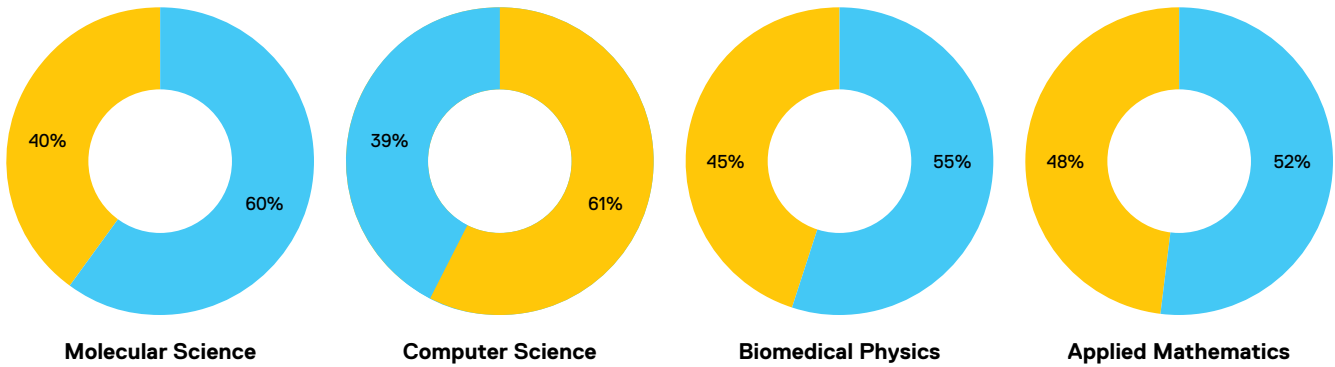78%
10%
3%
9%

PhD (%)

74%
15%
3%
7%
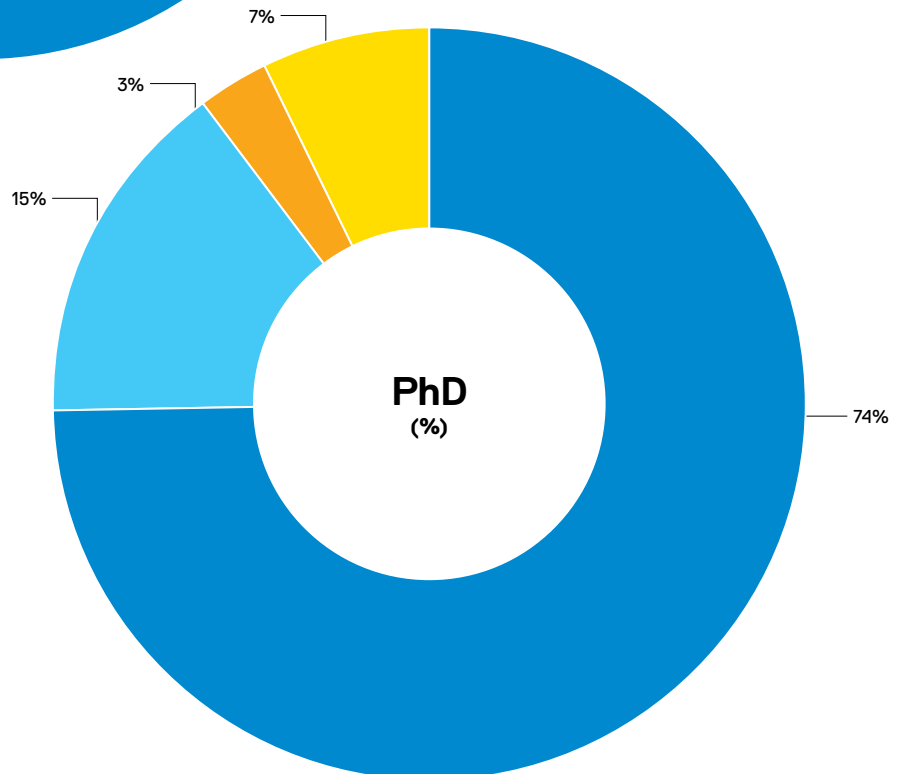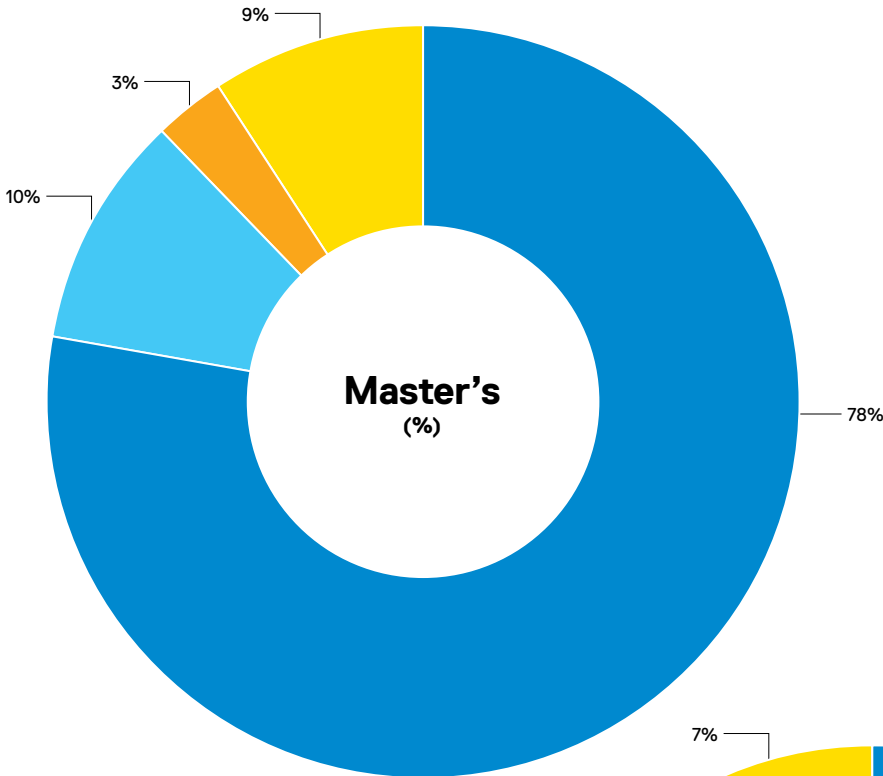
223

Fall 2017 Master's & PhD Total Enrolment Headcount

Total Headcount by Master's Program and Gender, Fall 2017

Female
Male

Molecular Science
40% / 60%

Computer Science
39% / 61%

Biomedical Physics
45% / 55%

Applied Mathematics
48% / 52%

Total Headcount by PhD Program and Gender, Fall 2017

Female
Male

Molecular Science
48% / 52%

Computer Science
32% / 68%

Biomedical Physics
35% / 65%

Mathematical Modelling & Methods
33% / 67%
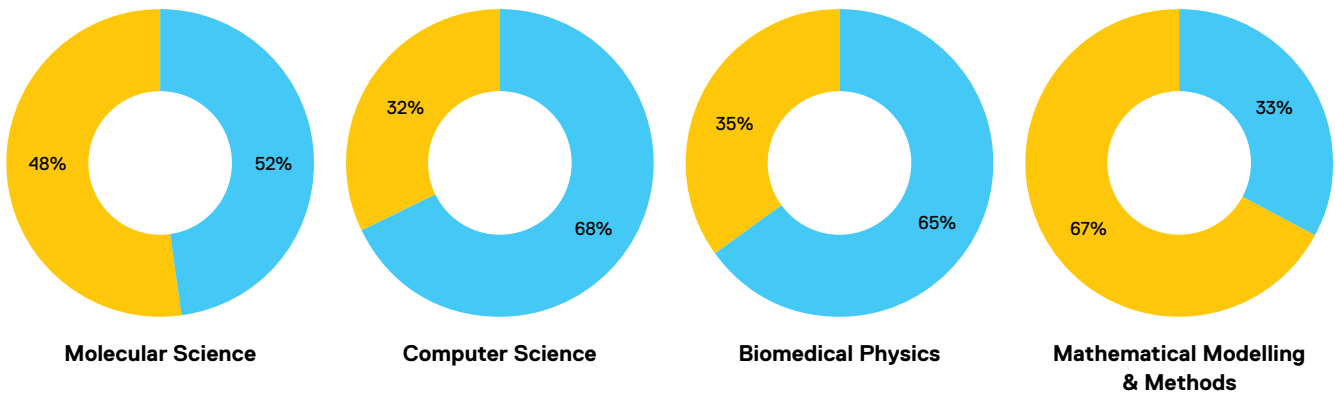
100%

master's program retention rate in Applied Mathematics for the last two years and Molecular Science for the last four years

100%

retention rate for all PhD programs after one year of study, for the last three years – compared to the Ryerson retention rate of 95% in 2016–17, 95% in 2015–16, 94% in 2014–15
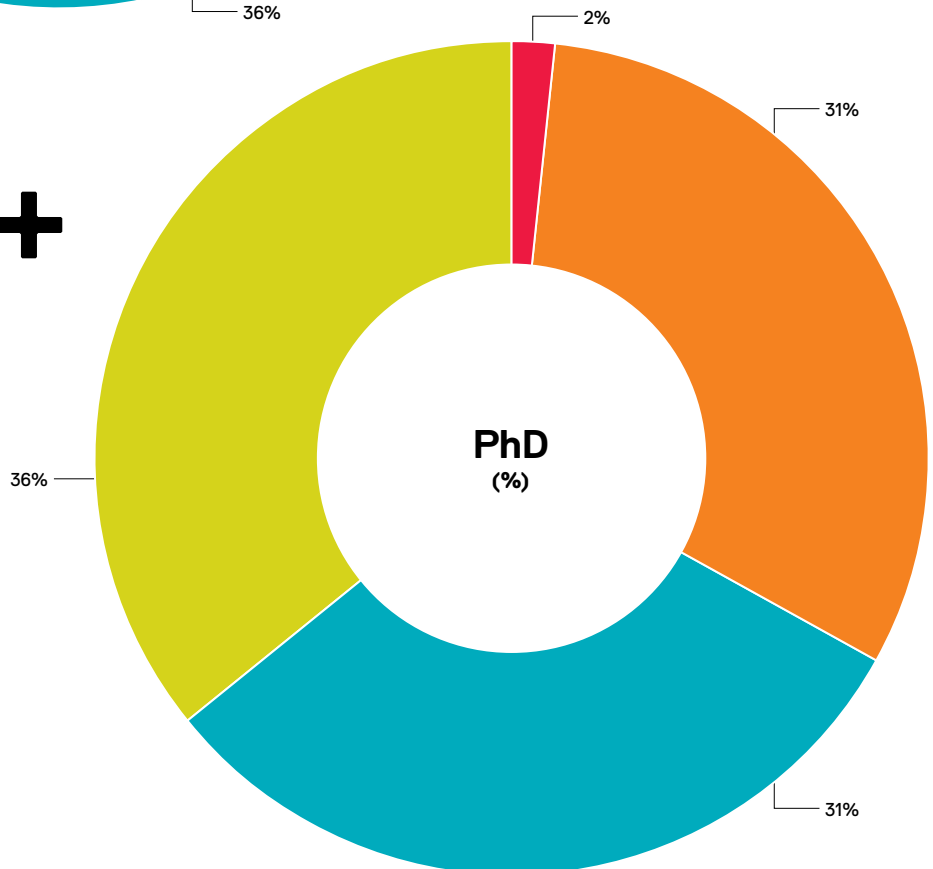
Total Funding Distribution by Program, 2016–2017*

Graduate Programs

- Applied Mathematics
- Mathematical Modelling & Methods
- Biomedical Physics
- Computer Science
- Molecular Science

Master's (%)

10%

78%

36%

42%
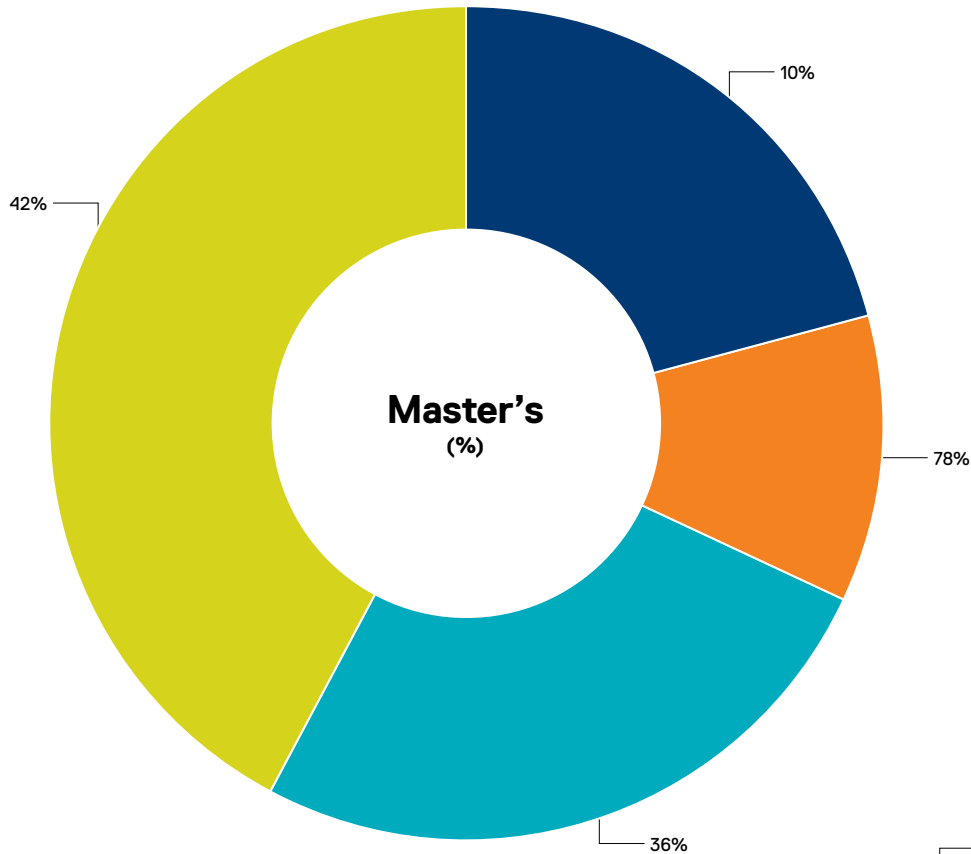
$5 million+

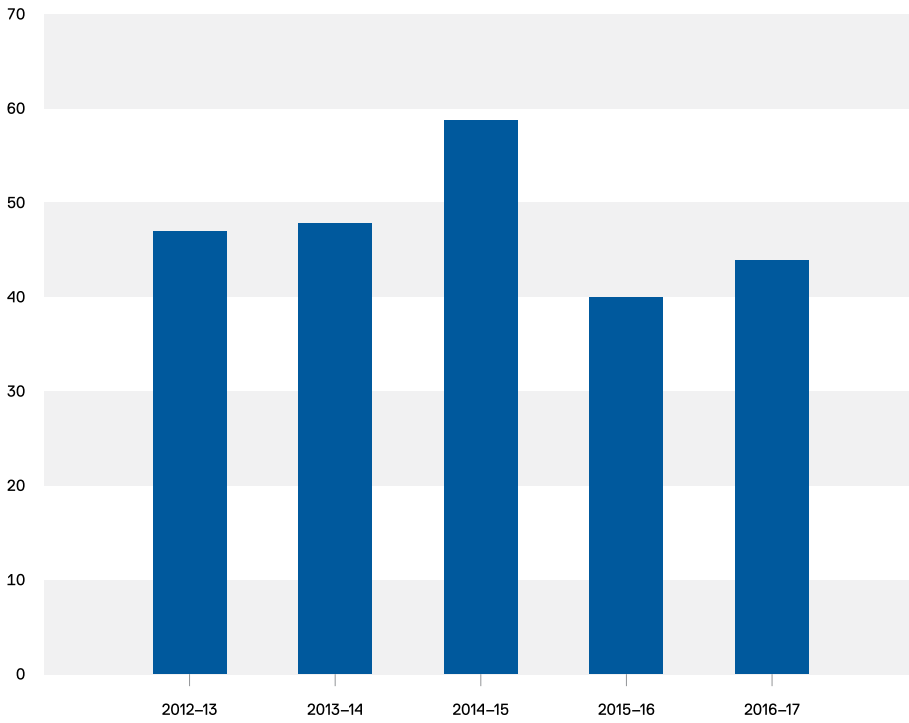in funding
graduate students

PhD (%)

2%

31%

31%

36%

*September 2016 – August 2017

Note: Mathematical Modelling
& Methods is a new PhD program
that started September 2016

Total Master's Degrees Awarded, 2012–2017
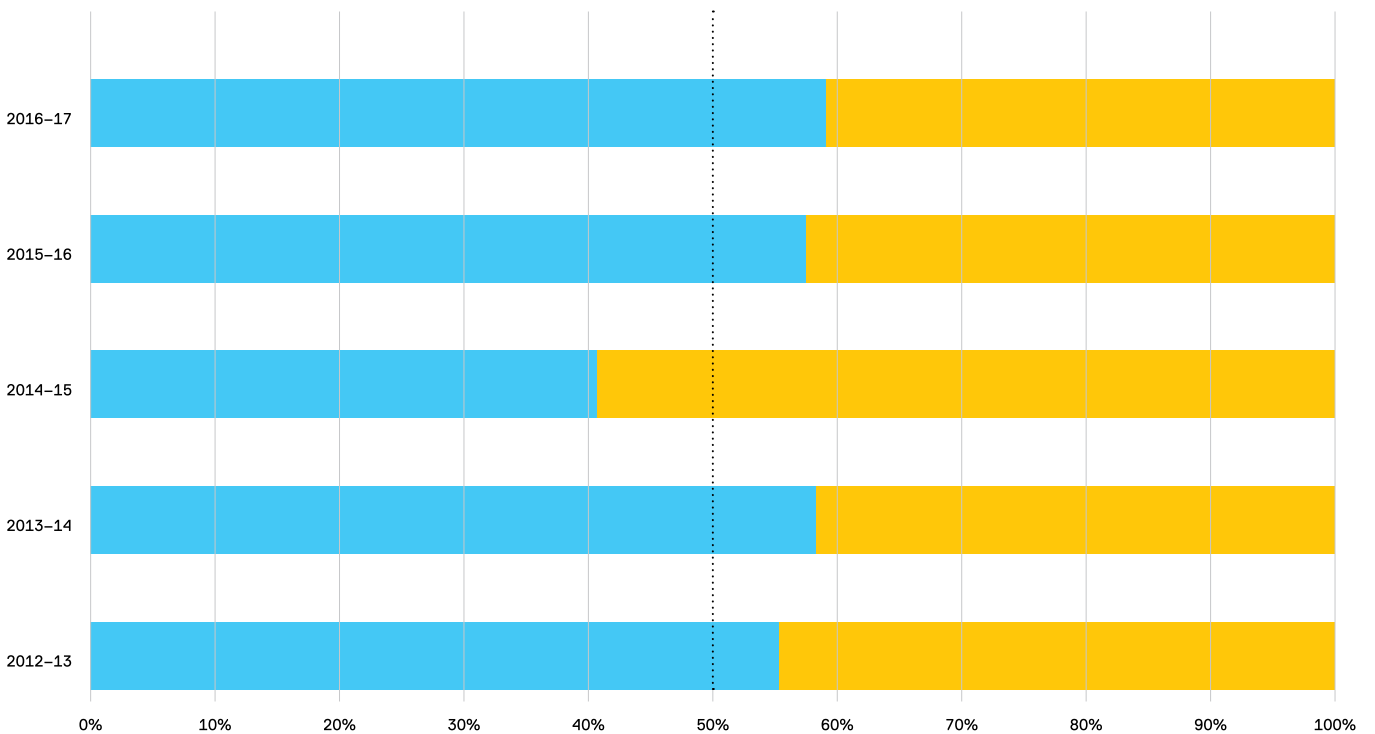
—

Year	Degrees
2012–13	47
2013–14	48
2014–15	59
2015–16	40
2016–17	44

- Biomedical Physics and Molecular Science master's increased their output of degrees from 2015–2016 by 42% and 50%, respectively

- Master's and PhD completion rates are on average 2 and 4.5 years, respectively
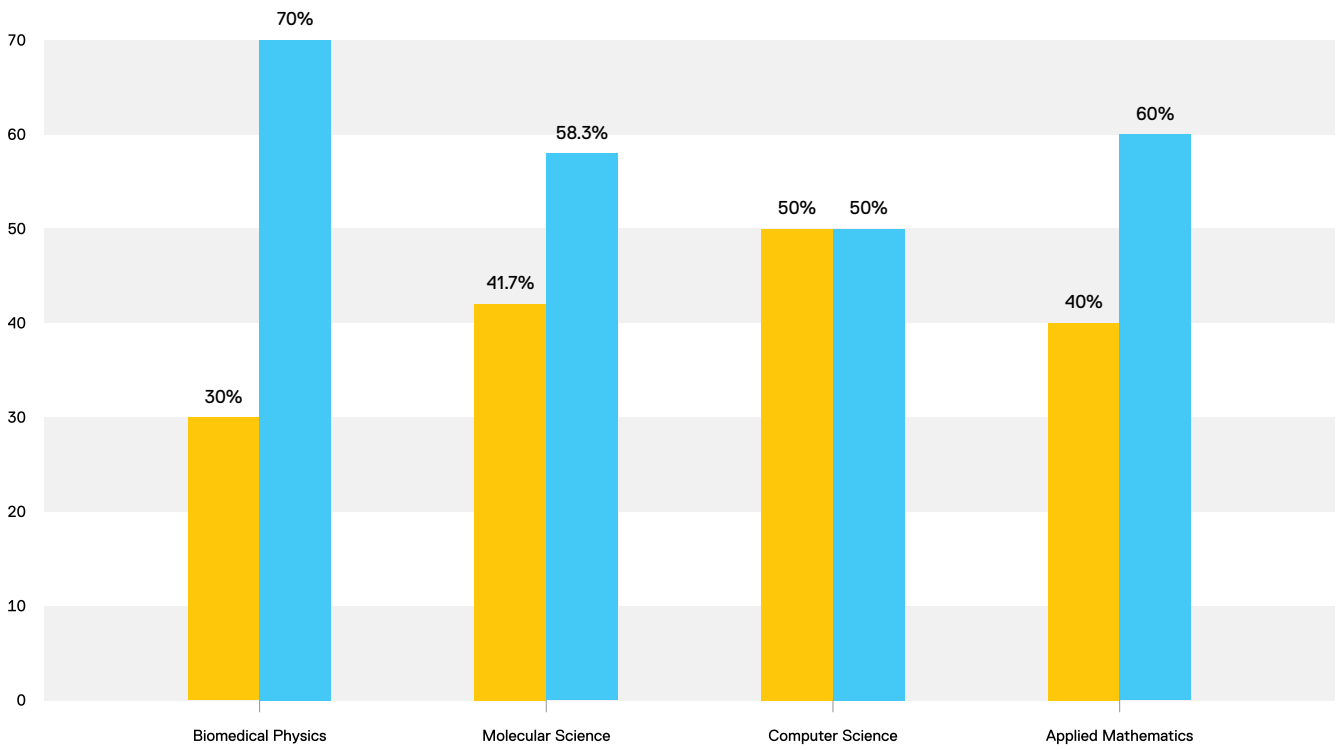

Master's Degrees Awarded by Gender, 2012–2017

—

Female
Male

Year	Male	Female
2016–17		
2015–16		
2014–15		
2013–14		
2012–13		

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Master's Degrees Awarded by Program and Gender, 2017

Female
Male

70%

58.3%

60%

50% 50%

41.7%

40%

30%

70
60
50
40
30
20
10
0

Biomedical Physics
Molecular Science
Computer Science
Applied Mathematics

Total PhD Degrees Awarded, 2012–2017

10

8

6

4

2

0

2012–13
2013–14
2014–15
2015–16
2016–17
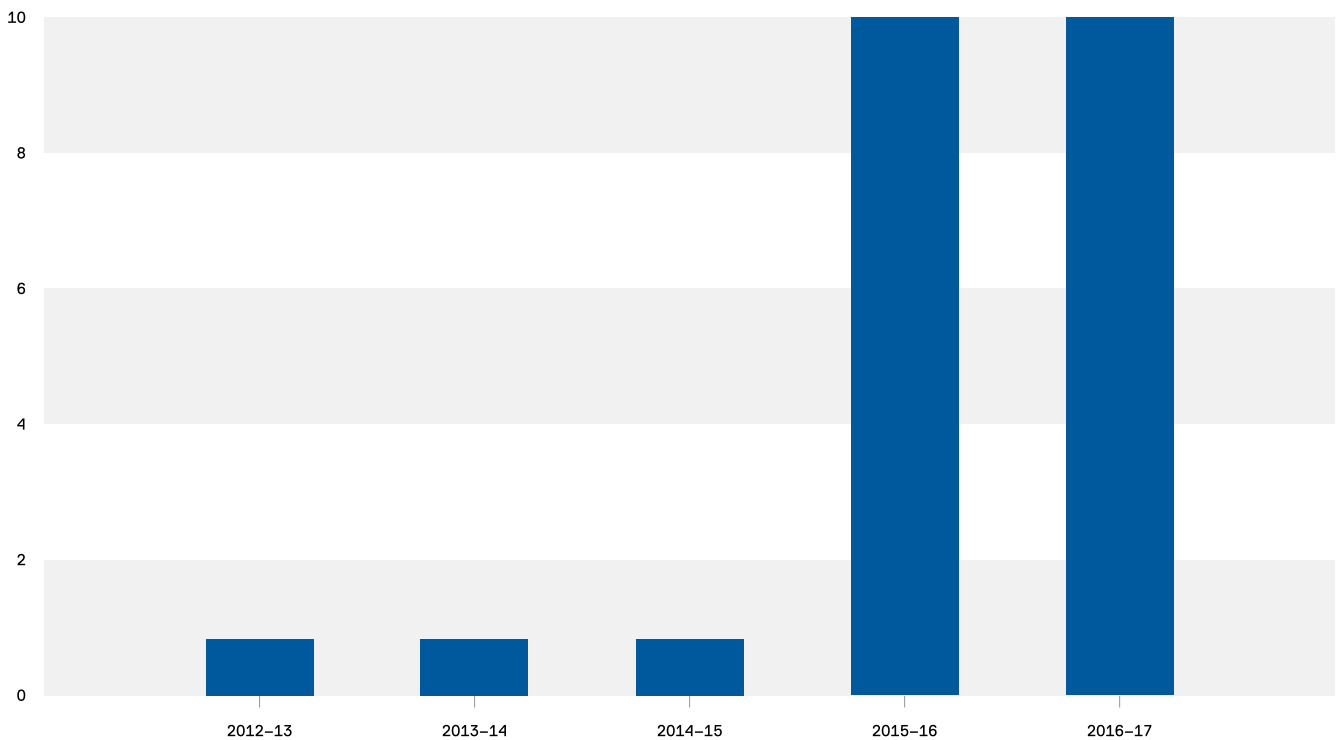
Section 3:

Research

As our fifth year comes to a close, the Faculty of Science continues to deepen its reputation as a leader in research and industry partnerships. In a research climate shaped by technological transformation and pressure to generate societal impact, our commitment to connected science is fueling the ongoing success of our researchers.

In the fall, Dr. Catherine Beauchemin was named a member of the Royal Society of Canada's College of New Scholars, Artists and Scientists; mathematics professor Dr. Anthony Bonato was appointed a Massey Fellow at the University of Toronto; and nine of our researchers received a Natural Sciences and Engineering Research Council of Canada (NSERC) Discovery Grant.

The fall also saw Dr. Dérick Rousseau, in collaboration with Dr. Nick Bellissimo of the School of Nutrition, secure a $5.2M Canadian Foundation for Innovation (CFI) grant and matching funds. This is the largest CFI Research Infrastructure project funding for the Faculty of Science and one of the largest single-project grants in the history of Ryerson University. The funding consists of $1.89M from CFI and $1.89M from the Ontario Ministry of Research, Innovation and Science, with the additional $1.42M provided through industry funding and in-kind contributions. The research from these grants will get underway in late 2018 when the Centre for Urban Innovation opens, and will involve collaborators from George Brown College, University of Guelph, University of Toronto, and Agriculture and AgriFood Canada.

In terms of ongoing projects, the 20,000-square-foot state-of-the-art collaborative space in the MaRS Discovery District has now been in use for over a year and has been a huge success. The Faculty of Science has also enhanced its reputation by hosting important gatherings, such as the #SciRevYYZ summit in May during which health researchers discussed the 2017 report, Canada's Fundamental Science Review, and the annual iBEST symposium in June, which brought together the brightest minds in biomedical research at St. Michael's Hospital's Li Ka Shing Knowledge Institute. Meanwhile, our innovative and ambitious researchers, several of whom have their work highlighted here, continued their transformative work.

Enzyme Examiner

Dr. Warren Wakarchuk, biochemist and Chair of the Department of Chemistry and Biology.

Dr. Warren Wakarchuk's current research includes understanding the structure of enzymes in order to repurpose them for the creation of new therapeutics. Wakarchuk is part of a team that published in Nature's *Scientific Reports* on their success in solving the first structure of a bacterial polysialyltransferase, which they are using to improve the efficacy of protein-based drugs by preventing them from being cleared rapidly from the blood. Wakarchuk is also part of a national network,

GlycoNet, where he is working with colleagues to study enzymes from bacterial pathogens that use a particular carbohydrate to recognize essential proteins for destruction. "We are hoping that this research will lead to the creation of a new type of anti-bacterial drug to treat serious infections," says Wakarchuk. This work was published in the *Proceedings of the National Academy of Sciences of the United States of America* (PNAS) journal.

Select Research Highlights

Vision of the Future

Dr. Kosta Derpanis is a leading researcher in the cutting-edge field of computer vision. His work seeks to enable machines to perceive useful properties from visual information, such as the geometric layout or location of objects in a surrounding scene. Combining expertise in machine learning, mathematics and image processing, Derpanis' research spans a host of challenges, including 3D human pose estimation, semantic segmentation and video texture synthesis. It has been a busy year for Derpanis. He and his team generated state-of-the-art results on standard benchmarks for 3D pose estimation. He became a Faculty Affiliate of the Vector Institute. He recruited Dr. Neil Bruce to become co-director of the Ryerson Vision Lab, which Derpanis founded. He also co-authored three papers that appeared in the two top-ranked conferences in computer vision, IEEE International Conference on Computer Vision (ICCV) and IEEE Conference on Computer Vision and Pattern Recognition (CVPR). Additionally, Derpanis has ongoing international collaborations in USA, Europe and China and is working with several industrial partners to address their challenges by transferring state-of-the-art computer vision research into applications.
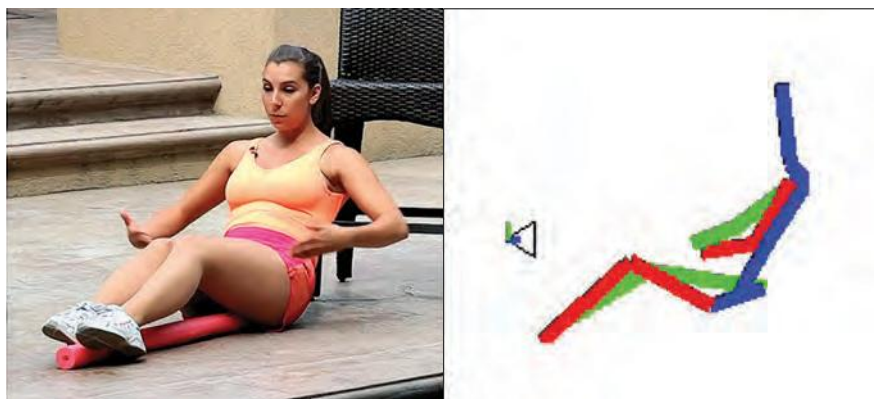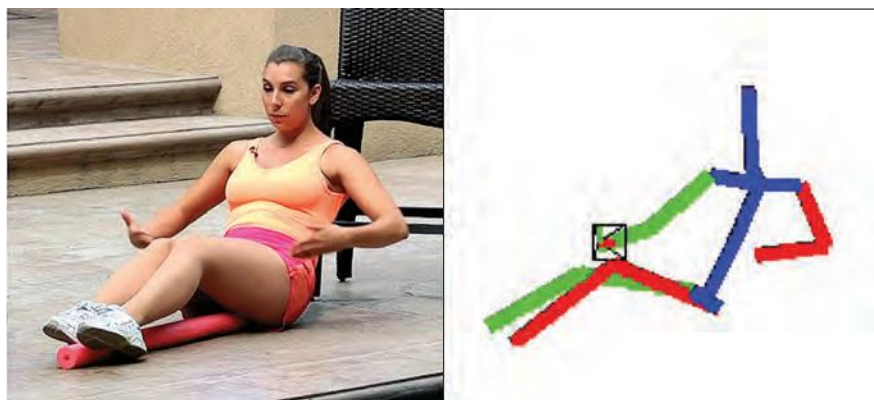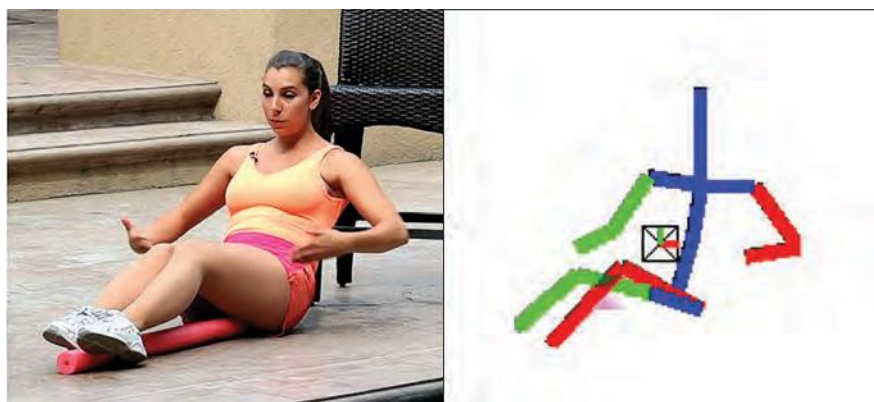

Drug Tracker

For a decade now, Dr. Russ Viirre, a synthetic organic chemist, and Dr. Christine Bear, a protein biochemist from SickKids, have been engaged in an ongoing collaboration funded by a prestigious Canadian Institutes of Health Research (CIHR) operating grant. Their goal is to understand how cystic fibrosis (CF) drugs work at the molecular level en route to enabling the development of the next generation of CF drugs, which could be more potent and effective with fewer side effects. "My team replicates the molecular structure of the two primary drugs used to treat CF, but with a twist – we add a 'probe' to each drug molecule," explains Viirre. These probes allow Bear's team to conduct in vitro studies that reveal how the synthetic drug interacts with the protein which exhibits the mutations that cause CF – Cystic Fibrosis Transmembrane Regulator (CFTR). For example, if the probe is a fluorescent dye, it can be tracked using fluorescence spectroscopy to determine where the drug attaches to the surface of the protein.

LEFT: 3D human pose estimation from a single image. Given a single 2D image of a human in some pose, the goal is to accurately predict the 3D locations of each body joint. A convolutional network is used to achieve the results.
BELOW: Dr. Russ Viirre and PhD student Phillip Junor.

PHOTO: MATTHEW TESFALDET

PHOTO: IAN PATTERSON

The Mathematics of Chemical Reactions

Dr. Katrin Rohlf's expertise is in bio-mathematics. Using computer simulations and theoretical analysis, she employs particle-based methods to understand chemical reactions in biochemical networks such as blood flow applications. In 2017, her NSERC Discovery Grant was renewed through to 2022, and she received a two-year Faculty of Science Accelerator award. 2017 also marked the 10th anniversary of the Ryerson Applied Mathematics Laboratory (RAMLab), which Rohlf co-founded, and she was recently a co-applicant in securing $60,000 in funding from the Faculty of Science Dean's Funds to upgrade the RAMLab to state-of-the-art status. Rohlf recently published in the *Dynamics of Continuous, Discrete and Impulsive Systems; International Journal of Applied Nonlinear Science;* and *Physical Biology*. She also serves on the Editorial Board of *Cogent Mathematics OA* and the *International Journal of Applied Nonlinear Science*.

> "Dr. Beauchemin is a young and dynamic scientist who keeps moving knowledge frontiers. Her seminal work on modelling viruses like the flu has the potential to help us better understand this infectious disease. We are honoured to have a colleague who has defined a new discipline and look forward to future innovations."

Ana Pejović-Milić
CHAIR AND PROFESSOR
OF THE DEPARTMENT OF PHYSICS

Royal Recognition

Dr. Catherine Beauchemin recently added a prestigious recognition to the long list of awards and accolades she has garnered in her career. This fall, The Royal Society of Canada inducted her into its College of New Scholars, Artists and Scientists, solidifying her status as one of the next generation of great scholarly achievers. Beauchemin is the founder of the field of virophysics, which uses the tools and methods of physics to describe and understand how viruses spread from one cell to another. In particular, she is renowned for applying her innovative, interdisciplinary approach to answering questions about the influenza virus. In her ongoing effort to change the way knowledge is advanced in virology, Beauchemin oversees the virophysics group here at Ryerson and as a Senior Visiting Scientist in the Interdisciplinary Theoretical and Mathematical Sciences (iTHEMS) research group at the Wakō-shi campus of RIKEN, Japan's largest research institute. "At heart, my group's research is diverse by nature: from physics to virology, from Toronto to Tokyo. It offers new opportunities for students, postdoctoral fellows, and faculty members by building a bridge across these divides," says Beauchemin.

ABOVE: Dr. Katrin Rohlf's research area is biomathematics and developing particle-based numerical methods to properly simulate blood flow in biologically meaningful geometries.

Select Partnership Highlights

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"

Through his work, Dr. Rousseau is advancing discoveries towards improving food and nutritional health. The creation of a cross-disciplinary research facility through this CFI funding will accelerate research, provide opportunities for students and access to world-class facilities, and enhance Ryerson's collaborations and partnerships – a key ingredient in our approach to research and innovation.

Steven N. Liss
VICE-PRESIDENT, RESEARCH AND INNOVATION

BELOW: Dr. Dérick Rousseau's collaboration with Mondelēz Canada Inc. is raising the health profile of common snack foods.

Research with Bite

———

Dr. Dérick Rousseau is one of Canada's premier scientists in the area of food science. Through his expertise in food structuring, he has generated substantial recognition, publication and funding. This year saw him receive Ryerson's Sarwan Sahota Distinguished Scholar Award and secure a $5.2M Canadian Foundation for Innovation (CFI) grant and matching funds, the largest of its kind in the history of Ryerson University. Rousseau's expertise has made him a sought-after collaborator for food industry partners, and he has been in a five-year partnership with Mondelēz Canada Inc., the company known for brands such as Mr. Christie and Cadbury. This collaboration has covered a range of research projects related to chocolate and cookies and has attracted $395,700 in NSERC Funding and $489,000 in matching funds from Mondelēz (cash plus in-kind). "Part of my work with Mondelēz is to help lower the saturated fat content of their snacks, without negatively impacting product performance, texture or taste, in order to help the company produce healthier snack foods," says Rousseau.

PHOTO: IAN PATTERSON

Unlocking the Secrets of Cannabis

2017 was an active year in Dr. Lesley Campbell's NSERC-sponsored collaboration with Beleave Inc., an innovative biotech company striving to become a leading provider of medical cannabis products in Canada. Working together, they are advancing the state of knowledge about the production of cannabinoids, the diverse chemical compounds in cannabis that act to alter neurotransmitter release in the brain. Specifically, Campbell and her team are developing mathematical models and testing them in hemp in order to understand how plant DNA influences the transmission of canabadial (CBD), one of the main ingredients responsible for the benefits of medical marijuana. Beleave, which has already secured over $200M in investment, hopes to use Campbell's research to transform existing knowledge about growing methods. "This is a remarkable collaboration," says Campbell. "My team and I work very closely with the team at Beleave. It is extraordinary to work with industry collaborators who understand the value of a university."

> "
> Along with the benefit to our industry partner, this collaboration enables us to do research on a scale that would never be possible to create in an experimental or theoretical context."
>
> Dr. Andriy Miranskyy

Diagnosing What Ails the IBM Cloud

Dr. Andriy Miranskyy is a software engineering researcher with expertise in mitigating risk, a skill set he applies across a diverse range of industry collaborations. Beginning in May, Miranskyy teamed up with the IBM cloud computing group to develop novel methods for analyzing the log data generated by hardware and software across the company's global cloud network. The scale of the project is significant given that the IBM cloud has tens of thousands of computers, seven data centres and, as of October 2017, has generated annual revenue of $15.8B.

The project's goal is to enable IBM to mine terabytes of information in real time and provide insights about customer satisfaction. Using software engineering tools, Miranskyy is able to detect problems with IBM cloud offerings by mapping data from hardware and software logs onto user actions, enabling IBM to address problems in real time. The project is currently sponsored by the IBM Centre for Advanced Studies, and there are applications underway to secure matching grants from government agencies.

Hey, It Knows Me!

Dr. Pawel Pralat is an expert in graphs and hypergraphs, cutting-edge techniques for analyzing large data sets. In particular, he develops advanced methods for clustering, organizing data into networks, and the more complex process of data fusion, integrating two or more data networks to produce deep insights. With over 100 collaborators around the world, Pralat recently added a new industrial partner: Scaled Insights. Using neuro-linguistic pattern matching to digitize people's personalities based on their speech, Scaled Insights has developed a solution called Behavioural AI, which has two assessment components: Personality and Thinking Style. Their AI is being used by banks, insurance companies, military organizations and human resources businesses around the world. Scaled Insights reached out to Pralat because his expertise will enable them to integrate new aspects of their AI, so as it digitizes personality it can simulate human intuition and therefore create "scorable" insights about people. "Dr. Pralat is unique because he has the capacity to manage both the theoretical and applied elements of this project," says Stuart Sherman, CEO and Founder of Scaled Insights.

ABOVE RIGHT: Dr. Carl Kumaradas, physicist and Biomedical Physics graduate program director.

Imaging Insights

Dr. Carl Kumaradas is an expert in optics, acoustics and heat transfer in tissue and nanostructures. In 2017, he joined forces with VisualSonics, a world leader in high frequency ultrasound imaging, to assist with developing quantitative photoacoustic imaging, a new imaging technology which combines the best aspects of optical imaging and high frequency ultrasound. "Quantitative photoacoustic imaging has the ability to quantify the concentration of absorbers in a particular region of the body," says Kumaradas. "For example, hemoglobin is an absorber in blood, and oxygenated hemoglobin has slightly different absorption properties than deoxygenated hemoglobin. By measuring the concentration, the oxygen level of blood in that area can be determined, which is a common clinical need." In malignant tumours, blood vessels are more visible in photoacoustic images than with other modalities. Photoacoustic imaging is also highly effective in detecting gold nanoparticles, which have been shown to accumulate in tumours when injected intravenously. Following a successful NSERC Engage Grant, the collaborators have now applied for an Ontario Centres of Excellence (OCE) Voucher for Innovation and Productivity (VIP) grant.

Research
By the Numbers

$5.2 Million+[*]

secured by Dr. Dérick Rousseau for a new research centre dedicated to improving the satiety of foods in order to counter Canada's growing obesity epidemic
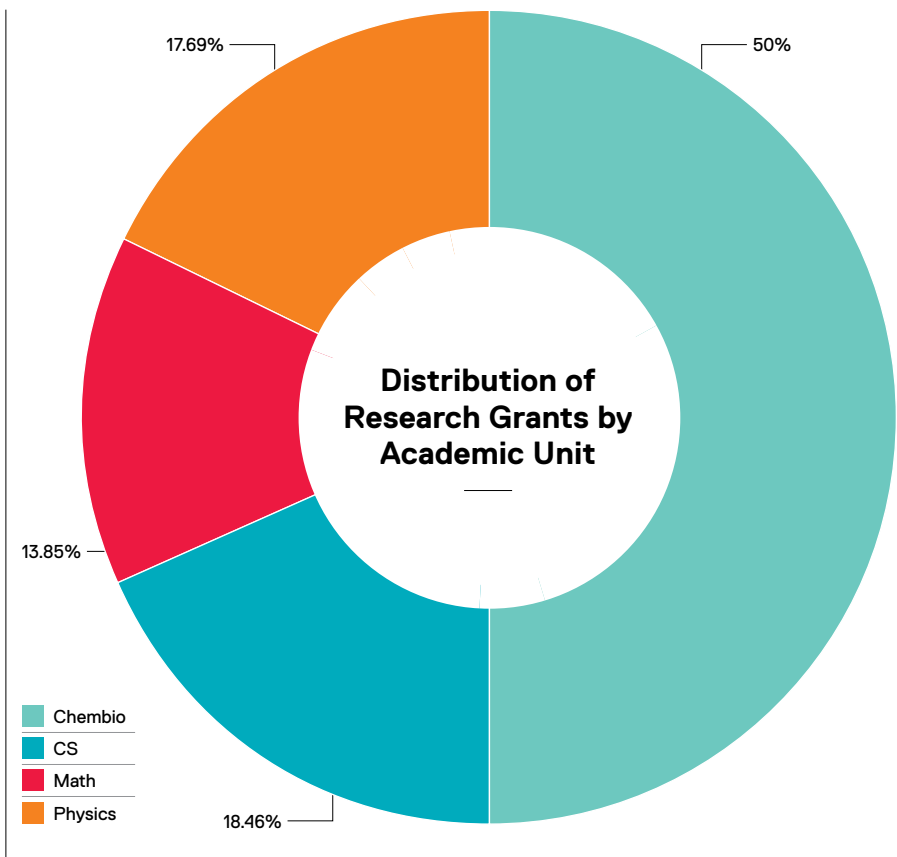
*$1.89M from CFI's Innovation Fund

$300k+

received by Dr. Costin Antonescu from a CIHR New Investigator Award to study cell surface signaling micro-domains in health and disease

$300k+

received by the Department of Physics from sponsored research contracts

$247k+

received by Drs. Jelena and Vojislav Mišić from a CFI JELF to study Smart Things at Ryerson – ST@Rlab

Distribution of Research Grants by Academic Unit

17.69%
50%
13.85%
18.46%

Chembio
CS
Math
Physics

13%▲

increase in partnership-related grants

2x

the number of NSERC Engage grants (overall) for the Department of Mathematics

7477[*]

citations

*January 2017 – December 2017

Section 4:

International Initiatives

———

In striving to deliver a distinctive world-class education, the Faculty of Science seeks opportunities for students to develop qualities valuable to them as people and as future leaders in academia, research and industry. These include a global perspective, an appreciation of diverse cultures and an understanding of the international science community.

A range of international experiences in countries such as the United Kingdom, Netherlands, China, Germany, France and India, where we have partnerships with institutions such as University College London and Wageningen University in the Netherlands, provide this opportunity. We also offer our undergraduate and graduate students access to international research collaborations, conferences and symposiums.

Through research in a lab or courses in another country – or by hosting their peers from other nations here on campus – our students extend their learning and immerse themselves in environments often cited among their cherished memories when they graduate. Of course, representing Ryerson and Canada on the world stage is also a wonderful growth experience that builds confidence as our students join the global network of scientists.
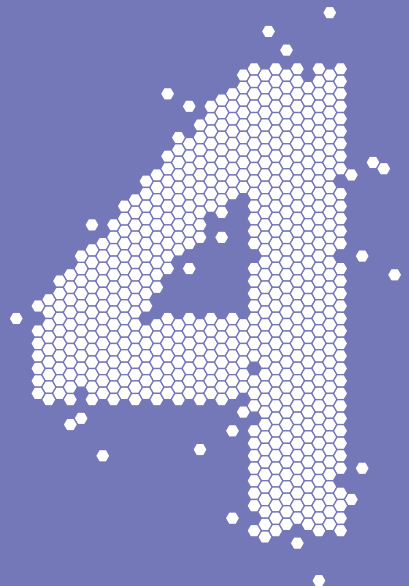
Select International Highlights

London Calling

During the summer of 2017, co-op chemistry student Kelvin Urbina participated in the Global Science Citizen Program as an Undergraduate Researcher at University College London School of Pharmacy. While there, he worked on the pharmaceutics team and was jointly supervised by Professor Duncan Craig, Director of the School of Pharmacy, and Dr. Susan Barker. Urbina worked on dosage design form and nanofabrication of particles to treat bovine mastitis. Once his research objectives were established, it was up to him to decide which drug he would study, the polymer he would use, the experiments he would attempt and the knowledge he needed from various journals and other researchers. He also had to figure out how to write a journal-style summary report at the end of his project. "I learned so much about experimentation and research," says Urbina. "It was eye-opening to be engaged in real problem solving."
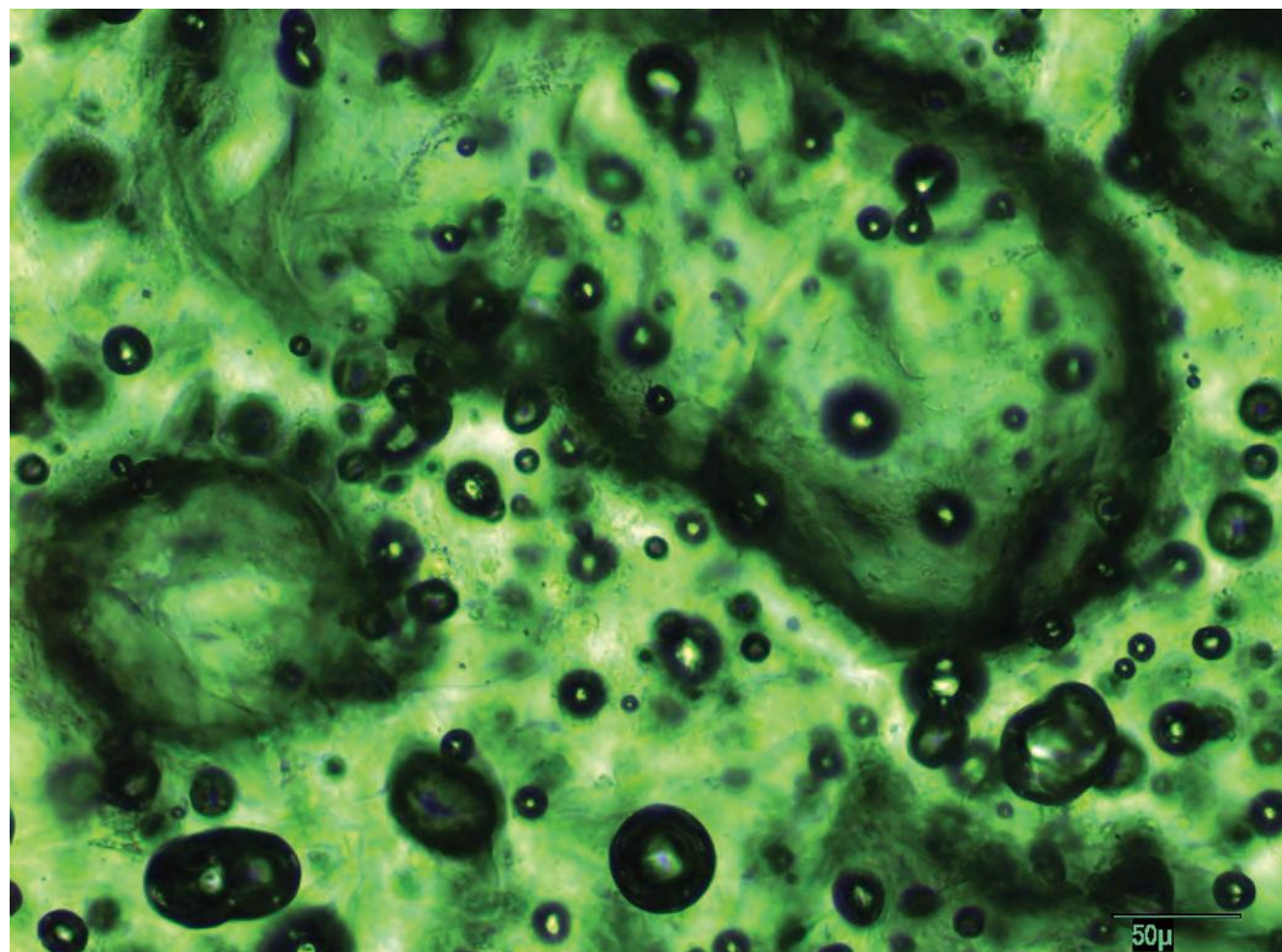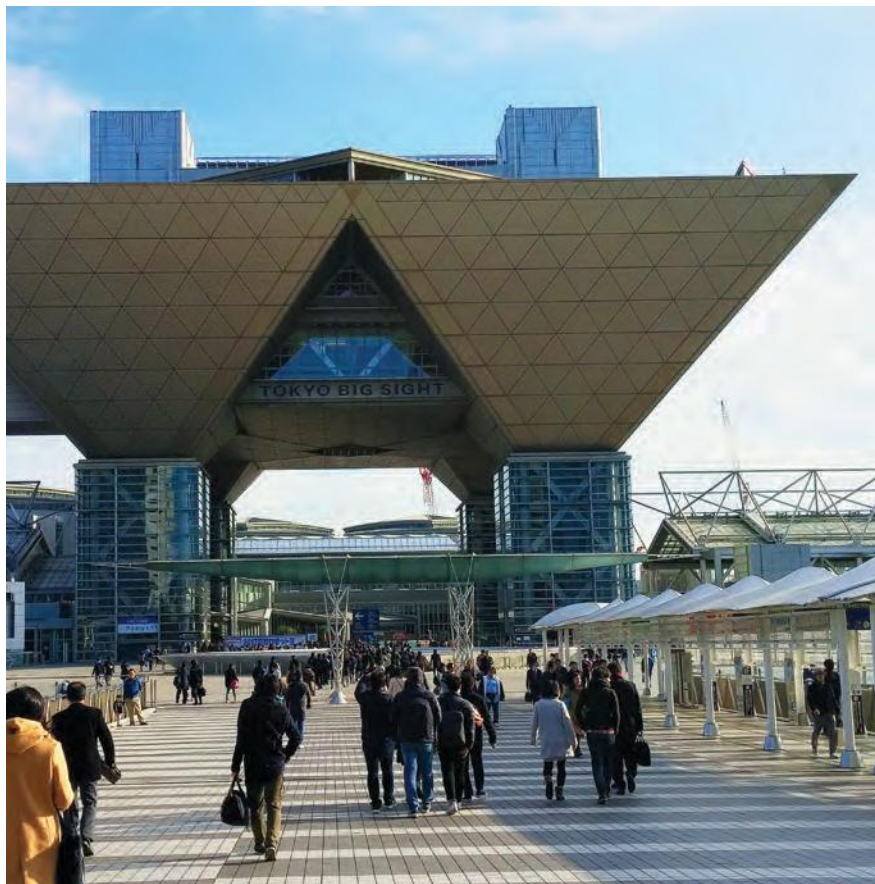
"

It was the greatest experience of my life, and I will never forget it. I learned so much, was the happiest I have ever been, and gained so much confidence. I tell everyone I talk to that they should do an exchange."

Kelvin Urbina
CHEMISTRY UNDERGRADUATE STUDENT

50μ

Discovery in the Land of the Rising Sun

Computer science student Adam Adair is spending a year in the Canada-Japan Co-op Program as a software development intern at the vision labs of the Honda Research Institute in Wakō, Japan. Under the supervision of Senior Scientist Dr. Shigeaki Nishina, Adair chose to conduct research with eye tracking. Honda set him up with an apartment a 10-minute walk from work and five minutes from the Wakōshi train station, which allows Adair to travel every weekend. He is also learning about Japanese culture through experiences such as the jikoshoukai (self-introduction) he gave in Japanese at a welcome party thrown by his supervisors. "I've always wanted to visit Japan because the culture is so different from what I'm used to," says Adair. "I'm half Japanese, so I thought it would be a good chance to experience that part of my background while advancing my skills through invaluable work experience."

"

As a Computer science student, the chance to work in Japan as a Software Developer for Honda is a once-in-a-lifetime opportunity to further the skills I have acquired at Ryerson."

Adam Adair
COMPUTER SCIENCE STUDENT

International Conferences at Ryerson

Computer Science

Both the 20th International Conference on Network-Based Information Systems (NBiS) and the 9th International Conference on Intelligent Networking and Collaborative Systems (InCoS) were held at Ryerson in August.

NBiS featured two keynote speakers and over 80 contributed papers in network and information systems. Topics included the latest advances in the design and deployment of distributed, scalable and reliable data infrastructures and information systems, with diverse applications to areas such as transaction processing, information management, and decision support.

InCoS featured two keynote speakers and over 100 contributed papers in intelligent social networks and collaborative systems. This conference covered topics in the latest advances in collaborative systems and intelligent social networks design, with focused applications that involve the development of adaptive, secure, mobile, and intuitive intelligent systems for collaborative work and learning.

Canadian Discrete and Algorithmic Mathematics (CanaDAM)

The sixth biennial CanaDAM Conference was held at Ryerson in June, bringing together 320 researchers in discrete mathematics – the largest conference of its kind in North America. The program included eight keynotes by world-renowned researchers, over 100 contributed talks, and a public lecture by New York Times bestselling author Jordan Ellenberg. Discrete mathematics is a rapidly advancing area of pure mathematics that has diverse applications to areas such as social networks, cryptography, and computational biology.

ABOVE: Group of attendees at conferences held at Ryerson.
OPPOSITE: 10x magnification of electrosprayed sodium alginate into calcium chloride.

PHOTO: CLIFTON LI

Canada-China Imaging Partnership

—

In early 2012, Dr. Michael Kolios received funding from the Canadian Institutes of Health Research (CIHR) for a Canada-China joint research project to develop special nanoparticles that increase the ability of ultrasound and photoacoustic imaging to detect and treat tumours. The Chinese collaboration team, which has sent five students/postdocs to Ryerson over five years, is led by Professor Zhigang Wang from Chongqing Medical University and Professor Yuanyi Zheng, now at Shanghai Jiaotong University. Ryerson doctoral candidate Yan Jie Wang has been involved in the collaboration from the beginning, including travelling to Chongqing in April 2014 to participate in experiments and give an invited talk. Together, the group has published four peer-reviewed journal papers and several conference proceedings while also presenting their joint research at several international conferences and symposiums.

Canada-US Proton Therapy Collaboration

—

Dr. James Gräfe, a clinical medical physicist and member of the Department of Physics, and Dr. Rao Khan, a clinical medical physicist at the Washington University School of Medicine in St. Louis and adjunct professor at Ryerson, are collaborating across borders to investigate a new form of tumour localization during proton therapy. "This collaboration provides access to clinical equipment not yet available in Canada and gives graduate students in our Biomedical Physics program experience at one of the top 10 radiation oncology facilities in the United States," says Gräfe. High energy proton therapy units are not part of current routine clinical practice in Canada but that may one day change, especially if local expertise in this area develops via this sort of collaboration. This research is funded by NSERC and the Faculty of Science Dean's Research Funds – Research Tools and Instrumentation grants.

ABOVE: Dr. James Gräfe, a clinical medical physicist, is developing innovative techniques in applied nuclear medicine or radiation therapy through experiment and simulation.

BELOW: Yan Jie Wang, a Biomedical Physics PhD student, is working on specialized particles that can be used for both imaging and therapy in the iBEST facility at St. Michael's Hospital.

"

Through our partnership with Washington University School of Medicine in St. Louis, we can offer advanced research and learning opportunities that enable our students to deepen their understanding of biomedical physics and generate new knowledge."

Dr. James Gräfe

PHOTO: IAN PATTERSON

Section 5:

Advancement

It was a busy year in Advancement at the Faculty of Science, during which the ongoing support of alumni, faculty, staff and industry partners was as evident as ever. Through their generosity, we continue to increase the number of scholarships and awards available to students while providing much needed support for experiential learning activities, such as international exchanges and research opportunities.

In 2017, alumni contributions to the annual fund continued to increase. These donations enable us to provide critical student financial support, expand experiential learning opportunities, and enhance curricular programming.

This year, we received a legacy gift from the estate of Geoff Boyes, a former professor of mathematics at Ryerson. These funds were used to establish the Geoff Boyes Graduate Award, an endowed fund which will be awarded each year to a graduate student studying in the Department of Mathematics.

During Alumni Weekend, we welcomed several Faculty of Science alumni back to campus to celebrate milestone anniversaries and take part in a variety of activities. Among them was Andrew Dwornik, Chemical Research Technology '52 who celebrated 65 years since his Ryerson graduation. As well, Sathish Bala,

Computer Science '99, was one of six Alumni Achievement Award recipients celebrated at the Ryerson Dinner.

Over the past year, we have connected with more Faculty of Science alumni than ever before through the new Faculty of Science Alumni Newsletter and STEAM Café, our hub on the Ten Thousand Coffees networking platform. This year, we have also begun reaching out to alumni across various programs who are interested in establishing alumni associations. In the coming year, we will continue to deepen our relationship with our over 7,000 alumni.

The innovative research and exceptional educational experience at the Faculty of Science is made possible through the commitment of alumni, donors, friends, faculty and staff, and we are profoundly grateful for your ongoing support.
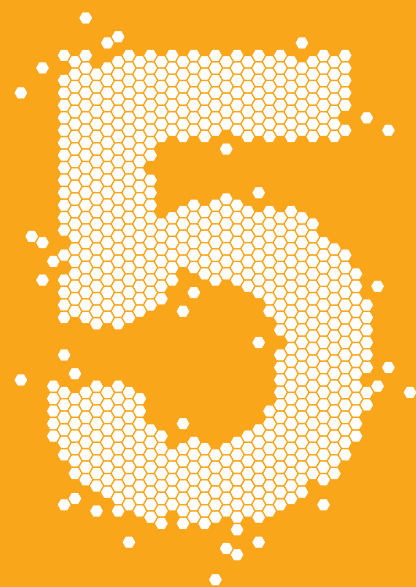
Select Advancement Highlights

4% ▲

increase of the annual fund from 2016

Awards and Scholarships

In 2017, the Faculty of Science awarded 52 undergraduate scholarships, funded by our loyal donors. This total included several awards that were presented for the first time: Rodney Yip Award in Science, Lucia Flaim Award, Geoff Boyes Graduate Award, Emmy Noether Graduate Scholarship and the Department of Computer Science Entrance Awards.

G. Raymond Chang Outstanding Volunteer Awards

The G. Raymond Chang Outstanding Volunteer Awards celebrate the exemplary generosity and contributions of alumni and friends of Ryerson University. At the Faculty of Science, volunteers are integral members of our community and play a vital role in the quality of the Ryerson experience for students, faculty, staff and alumni. This year, three of the 58 recipients were Faculty of Science volunteers – Vanessa Vakharia for her work in Equity, Diversity and Inclusivity in STEM, Tom Kaszas for his work with Ryerson Urban Water Board of Advisors, and Dennis McCormac for his mentorship of students working in the areas of science communications and innovation.

BELOW: Students presenting Dennis McCormac with his G. Raymond Chang Outstanding Volunteer Award.

RIGHT: Group of student award recipients at the annual Faculty of Science Awards Night.

PHOTO: CLIFTON LI

BELOW: Sathish Bala receives the Ryerson Alumni Achievement Award for his significant contributions.
RIGHT: Alex Finlayson shares his journey from his time at Ryerson to a successful tech career.

2852

Faculty of Science alumni received the new, bi-monthly Faculty of Science alumni newsletter this year.

6

new scholarships added this year.

## Alumni Achievement Awards

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The Alumni Achievement Awards recognize individuals who have not only excelled in their respective careers, but who have made a significant contribution to their profession, their community and their country. This year, Sathish Bala, Computer Science '99, was honoured for his professional accomplishments and his work in the community as co-founder of desiFEST. As a recognized leader in digital marketing and branding, Bala is modernizing the advertising industry with his interdisciplinary approach. He supports the Ryerson community through his work as the entrepreneur in residence for the Science Discovery Zone and as a member of the Dean's Advisory Council.

Alumni Donor Profile:
Alex Finlayson

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When Alex Finlayson, Computer Science '06 started at Ryerson, he had no idea that within a few years, he would be recruited by companies in California. Looking back, he credits his co-op experience as accelerating his career. Before he graduated, Finlayson had already received a job offer to stay on at software company Autodesk. Then, three years later, Finlayson found himself with three job offers – all in California. After he began working at Apple, he joined a team working on a secret project that would turn out to be the iPad.
In 2012, at the beginning of the mobile rush, Finlayson made another leap of faith launching a startup with friends. Today, Finlayson works as a UX Engineer building prototypes for future products/features on the Design team at Nest Labs and continues to invest in the growth of Ryerson's computer science programs and students.
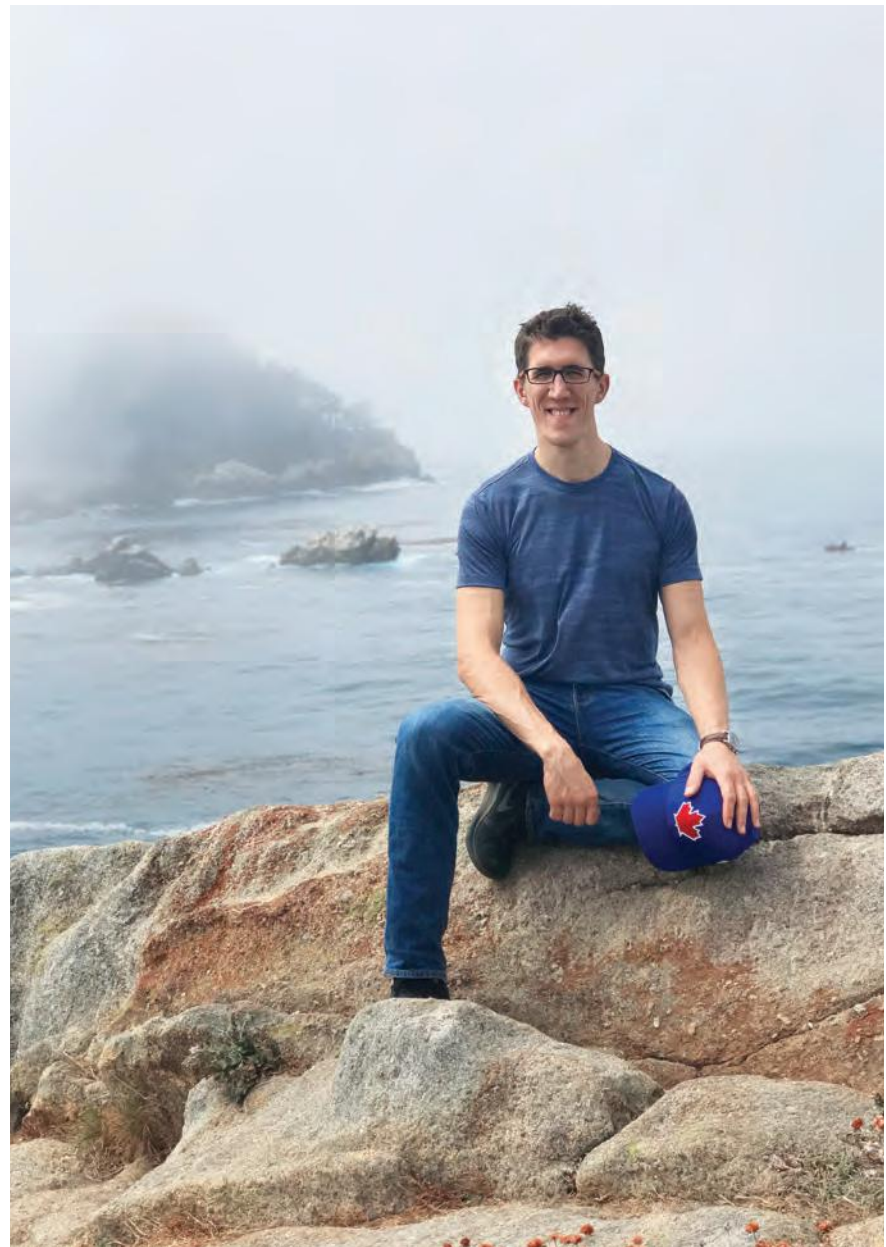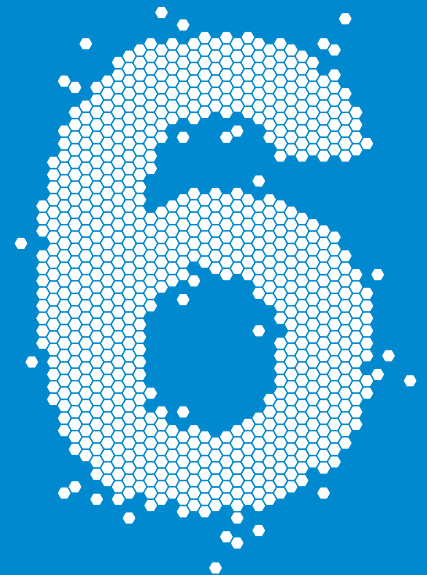
Communications

The competitive market for students and research funding makes it a critical priority to find compelling and engaging ways to tell the story of research and academic excellence at the Faculty of Science. Communicating research findings and discoveries, building Ryerson University's reputation, marketing to prospective students, and keeping donors, alumni and government informed are essential to our long-term success.

Select Communications Projects

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"At heart, our communications strategy is simple: leverage every possible channel to let the world know about the extraordinary work that happens every day at the Faculty of Science."

Suzana Pinto
COMMUNICATIONS AND WEB MANAGER

Media Coverage

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In 2017, the Faculty of Science continued to highlight the activities, research findings, and expert opinions of our members through media outlets.

3.85%
36.54%

Distribution of Faculty of Science Media Coverage

59.62%

Select Stories
- Faculty of Science Open House and Pi Day celebration
- Computer science robot exam (mimicking Egyptian caves)
- EDI in STEM report
- TIFF 2017: Movie magic from math and science

Ryerson Today is the university's daily online news source, publishing stories about and related to the Ryerson community, including students, staff, faculty and alumni.
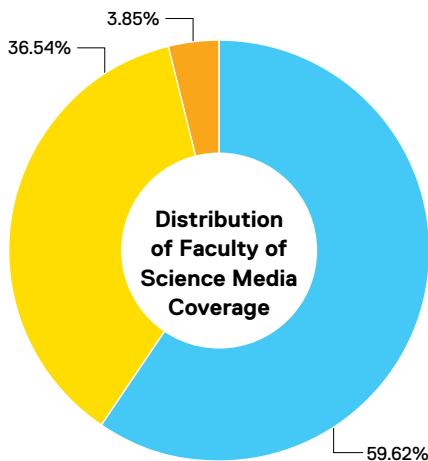
22,000+
unique pageviews of science stories features (significant increase over last year)

Select Stories
- Centre for Urban Innovation design unveiled
- Dr. Catherine Beauchemin named member of the Royal Society of Canada's College of New Scholars, Artists and Scientists
- The value of co-op: Two years of work-term experience led to dream job at Google for computer science graduate
- Researchers make waves in the ultrasound world: Team creates elegant solution to shrinking microbubbles for imaging use

Online Activity

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While our websites are being redeveloped, there is still significant external traffic on the Faculty of Science webpages.

24%▲
increase in pageviews (230K+)

—

19%▲
increase in unique pageviews (180K+)

—

16%
improvement in the bounce rate

- ■ News Articles
- ■ Broadcast
- ■ Opinion

Digital Campaigns
—

Up to now, our approach has been ad-hoc, but in the coming year we will shift to a strategic annual campaign that will be tactically holistic. Undergraduate studies, graduate studies, general and reputation building campaigns will be organized and scheduled together instead of independently. This will ensure we are always in market, and we can then use these efforts as a benchmark to compare our efforts year over year.

Undergraduate and graduate AdWords
Increasingly, Google is the method of choice for users researching universities and programs of study. Driven by our AdWords campaign, during the Winter 2016–17 and Spring 2017 we saw:

- Reach: 189,000 ad impressions
- Resulting Program Interest: 4,100 FOS program webpage visits, 25 FOS grad program brochure downloads
- Resulting Application Interest: 5 OUAC undergrad application link clickouts, 7 OUAC grad application link clickouts

Compared to 2016, we saw above-average click-through rates (4.20% undergrad, 3.97% grad compared to 2.2% education industry average and 1.3% in 2016) at a cheaper cost-per-click ($2.16 vs $3.12 in 2016).

Biomedical Physics graduate program digital advertising
From July to September 2017, we developed a new digital campaign for the Biomedical Physics graduate program. The Biomedical Physics graduate program webpage was used as the landing page for this campaign and included more relevant content for prospective students. This was the first of its kind for the Department of Physics. Results from this short campaign were:

- Reach: 1.1 million ad impressions
- Resulting Program Interest: 2,300 Biomedical Physics graduate program webpage visits
- Resulting Application Interest: 48 OUAC grad application link clickouts

There was no available data for comparison as this is the first time for this niche digital ad campaign, so they were established as benchmark moving forward. We saw above-average click-through rates (CTRs) compared to industry averages for most tactics: Facebook (0.47% vs 0.25% benchmark), Google AdWords display ads (0.23% vs 0.14% benchmark), and LinkedIn text ads (0.037% vs 0.011% benchmark).

Globe and Mail STEM editorial and digital advertising
As part of our effort to build our reputation and increase our profile, we secured space in The Globe and Mail's Spring 2017 educational supplement (print and web). Our advertising also included an editorial piece (print and online) and big box ads online.

3,300 vs 1,800
increase in editorial content pageviews on The Globe and Mail site
—
.36% vs .19%
increase in click-through rate

Visitors to the Fall 2016 cannabis story page on our website didn't view further pages, while some of the visitors of the Spring 2017 cyber solutions page were more engaged and went on to view the cannabis story, the Kolios story, and the story list page.

Social Media

The Faculty of Science prodominently uses Twitter and Instagram social media channels. Each platform has a unique audience, so we have adopted a strategy suited to each channel that is also in keeping with our overarching messaging objectives.

In keeping with the shifting and evolving nature of social media, we perpetually refine and refresh our messaging and strategy. This year, that included a few new series designed to increase engagement among current students, staff and faculty.

· On Twitter, we began a periodic Twitter Takeover, where an individual takes over the Faculty of Science account and takes followers along with them through-out the day, posting images, tips, articles, and opinions.

· On Instagram, we developed Souls of Science, a play on *Humans of New York*, which features Faculty of Science community members with an accompanying quote to inspire prospective and current students and descriptions of their experience at Ryerson, including why they got into the sciences and who inspires them.

· We also have "Day in the Life" where a convocating student uses the Faculty of Science Instagram account to take followers with them on the journey from waking up in the morning to crossing the stage (and taking a selfie) on to posing with their diploma and overjoyed family.

· Other Takeovers include Instagram Stories of "The First Day of School" for followers to see what the first day is like for a Ryerson science undergraduate student.

· The account was also taken over by a group of students who attended the Grace Hopper Celebration, a women in tech conference, helping followers see what it was like for these six computer science undergraduate students to go on that journey.

All of these strategies enable us to showcase opportunities for science students and make a positive impression on current and prospective students (and the broader community).

Reddit Ask Me Anything
In alignment with International Women's Day, Dean Imogen Coe was featured in the popular "Ask Me Anything" (AMA) format on Reddit. As a thought leader for Women in STEM, Coe was a draw for followers of the sub-reddit Ladies in Science, which moderated the AMA. In a one-hour session, Coe answered questions, responding with insights, substantial answers, tips and links for recommended resources wherever possible. In the end, there were twice the number of questions we had set as a goal for this first-ever Faculty of Science AMA. When the session was complete, there had been five-times the amount of interaction, through comments and questions, than we envisioned the AMA would generate.

BELOW: Select images from the Faculty of Science Instagram account.
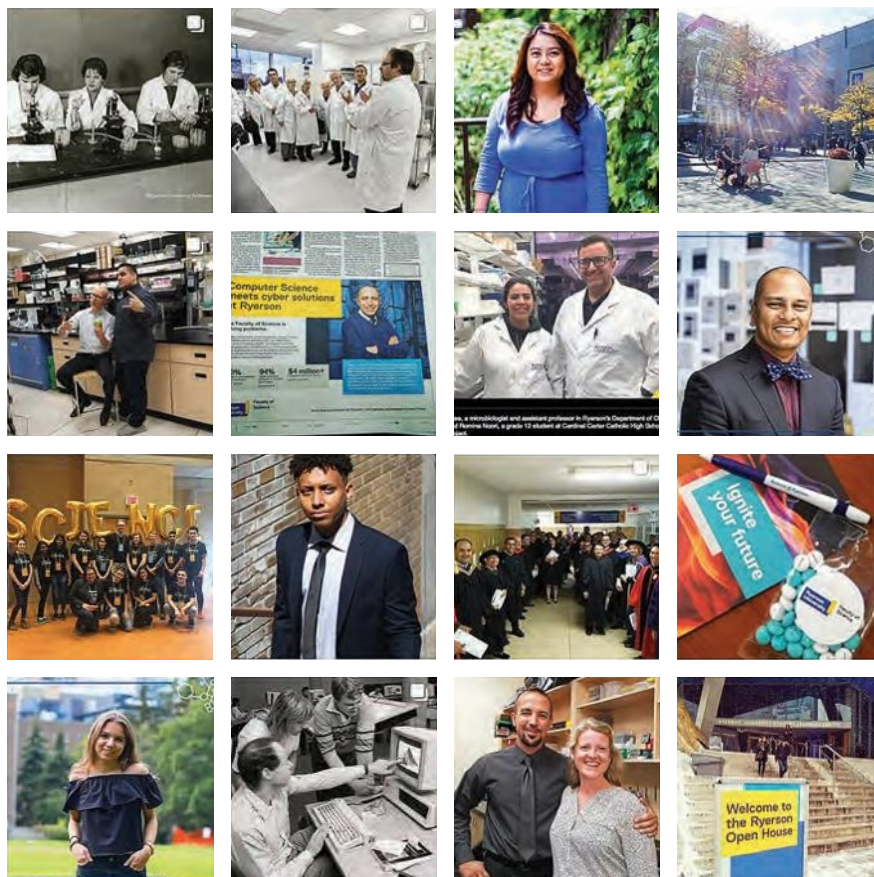
Twitter

76% ▲
increase in Twitter followers

29,000+
average monthly reach on Twitter

115
average monthly mentions on Twitter

Instagram

2×
Instagram followers

73% ▲
increase in Instagram story views

62% ▲
increase in engagement on Instagram posts

Section 7:

Equity, Diversity and Inclusivity

———

Science has a diversity problem. Classrooms, labs, industries and research centres are missing out on the genius of those who are discouraged and denied access. The Faculty of Science is committed to removing barriers to improve science and drive innovation. The ultimate goal is for the field of science in Canada to reflect the population of women and other groups with a history of disadvantage and exclusion.

Select Equity, Diversity and Inclusivity Highlights

—

Forging Paths to Enhanced Innovation

—

How can we ensure that equity, diversity and inclusivity (EDI) are fully embraced in science, technology, engineering and mathematics (STEM) educational and professional pathways? This was the key question asked when Dean Imogen Coe of the Faculty of Science and Dr. Mehrdad Hariri of the Canadian Science Policy Centre co-hosted the "Equity, Diversity and Inclusivity in STEM: Forging Paths to Enhanced Innovation" roundtable on May 29. Forty-four stakeholders from various sectors including academia, companies, government, industry associations, innovation supporters and not-for-profit organizations came together to share perspectives and expertise, identify gaps, and propose solutions for implementing EDI in STEM to advance innovation in Ontario.

The summary report that emerged from the roundtable offers twelve key findings and identifies next steps for uniting sectors and developing effective strategies. The Faculty of Science will continue to lead the dialogue to build a strong ecosystem in Ontario that will leverage diversity and drive national productivity, economic growth, long-term prosperity and global competitiveness.

PHOTOS: DEXTER BARROWS

Happy Ada Lovelace Day!

The first of two events celebrating Ada Lovelace and all women in STEM was held on October 20, in partnership with the Fields Institute for Research in Mathematical Sciences, and featured keynote speaker Dr. Lila Kari (University of Waterloo) followed by a panel discussion on equity, diversity and inclusion in mathematics, present and future. Moderated by Dr. Sheila Embleton (York University), the panel was made up of Kathleen Miao (Ryerson), Dr. Anthony Bonato (Ryerson) and Dr. Almut Burchard (University of Toronto).

On October 25, the Faculty of Science and Ryerson's Centre for Fashion Diversity & Social Change invited activist Elly Zupko, founder of the non-profit SMLX Good which supports girls in STEM, to give a talk titled "From 'That Shirt' to 'That Other Shirt.'" The first shirt, covered in scantily-clad women, was worn by a leading scientist from the European Space Agency during a televised interview. That other shirt, designed by Zupko, features over 50 notable women in STEM.

Making the Hidden Visible

What does it take to launch the first American astronaut into orbit around the earth? The best minds in science. In the early 1960s, that group included three African-American women: Katherine Johnson, Dorothy Vaughan, and Mary Jackson, "human computers" who calculated the complex equations needed for space travel. Johnson, for example, was regularly asked to check the trajectory calculations of the IBM 7090s in use.

On January 20, the Faculty of Science and the Career Centre hosted a celebration of women in science and a screening of the film *Hidden Figures*. Among those in attendance were PhD student Leslie Bone, president of Women in Science at Ryerson; keynote speaker Shohini Ghose, science professor and director of the Centre for Women in Science at Wilfrid Laurier University; Lieutenant Governor of Ontario Elizabeth Dowdeswell; and Dean Imogen Coe.

OPPOSITE (TOP): Dr. Denise O'Neil Green, vice-president of equity and community inclusion at the EDI in STEM event.
OPPOSITE (BOTTOM): Faculty of Science organizers of the EDI in STEM event.

ABOVE (LEFT): Panellists at the Ada Lovelace Day event.
ABOVE (RIGHT): At the women in STEM screening of *Hidden Figures* with Lieutenant Governor Elizabeth Dowdeswell.

SciXchange Highlights

The mission of SciXchange is to make science engaging, comprehensible and accessible to the general public. Led by director Dr. Emily Agard and guided by principles of diversity and inclusivity, SciXchange aims to increase science literacy through community access to science, effective communication of research, and experiential learning opportunities for youth and the general public.

Taking It to the Streets

On May 13, Ryerson hosted Science Rendezvous at Yonge-Dundas Square. Science Rendezvous is a Canada-wide festival that showcases the marvels of science and engineering from Canadian universities and laboratories. Over 6,000 Canadian innovators, researchers, engineers and scientists took their lab to the streets to engage directly with the general public – including over 150 Ryerson students and researchers. A science outreach pioneer in Canada, Science Rendezvous was founded in 2008 by Ryerson, University of Toronto, York University and the University of Ontario Institute of Technology.

This year, Ryerson offered hands-on activities, demonstrations and stage shows in robotics, water science, energy, engineering, architectural science, and many other scientific areas. Visitors were able to build catapults and water filtration units, measure their own carbon dioxide, and view aquatic invertebrates.

BELOW: Student volunteers were on hand to engage and educate the general public about science.
RIGHT: One of the many demonstrations on the Yonge-Dundas Square stage in Toronto.

PHOTOS: CLIFTON LI

Soapbox Science

This spring, SciXchange launched the North American debut of the award-winning UK-based initiative called Soapbox Science. This innovative public outreach program promotes women scientists and the science they do by providing a platform to share their work. Soapbox Science events around the world transform public spaces into learning areas where anyone can talk to scientists.

SciXchange ran Soapbox Science again in the Fall. Between the two events, over 1,200 individuals, family members and youth met talented scientists from Toronto and across Canada. Young people were exposed to role models like Ryerson's ecotoxicologist Dr. Lynda McCarthy. Some of the Soapbox Scientists also participated in SciXchange's free summer camp program aimed at empowering youth from under-represented communities in STEM to pursue science.

> "Expanding beyond Ryerson into the community allows more young Canadians to interact with women scientists and to envision their own future in a science or engineering laboratory engaging in discovery."

Emily Agard
DIRECTOR OF SCIXCHANGE

ABOVE: The first Soapbox Science gave scientists a platform to share their work to the community.

Boosting Your Science Brain

Through our community and school education programs, SciXchange is able to foster critical thinking about relevant scientific issues. Each year, the Faculty of Science participates in one of the biggest celebrations of science education, observed across Canada: Science Literacy Week. The week kicked off the high school education programs this year by engaging high school students, Ryerson students and the general public in topics from biology, physics, chemistry, math and computer science. Special lectures were offered throughout the week from science professors Catherine Beauchemin, Joseph McPhee, Bryan Koivisto, Alexey Rubtsov, Roberto Botelho and visiting researcher Kipp Cannon.

Ryerson Science student volunteers have continued to engage and inspire elementary and high school students through in-class activities that explore cancer biology, biotechnology, chemical reactions and many more. These programs make science accessible, engaging and inclusive while boosting science literacy in the community.

BELOW (TOP): One of the demonstrations at Science Literacy Week.
BELOW (BOTTOM): Group of students interacting in the Student Learning Centre.

The Faculty of Science is fully committed to its core values of equity, diversity, community engagement, inclusion and respect for Aboriginal perspectives. It is out of these values that the best science and scientists emerge. To advance knowledge responsibly and improve lives decisively, the world needs better science. It needs connected science. That's what our students, faculty and alumni do, whether here at Ryerson University or out in the wider world. As thinkers, teachers, researchers and ambassadors, they connect science to the problems that need it most.

"

Don't let anyone rob you of your imagination, your creativity, or your curiosity."

Mae Jemison
PHYSICIAN AND ASTRONAUT