

# WESTERN SCIENCE



2017  
2018

VIEWBOOK  
UNDERGRADUATE STUDIES

Western  Science



2017  
2018

westernu.ca/sci

# WELCOME TO SCIENCE & BASIC MEDICAL SCIENCES

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# MESSAGE FROM THE DEAN

Welcome to the Faculty of Science at Western University, one of Canada's finest institutions of advanced learning. Our diverse community is comprised of nearly 6,000 undergraduate students taught by faculty from eight departments in Science and seven in the Basic Medical Sciences. Each member of Western Science contributes distinct character, interests and strengths that, combined, result in a mosaic of dynamic, socially-engaged scholars.

The Western undergraduate academic experience is unique in Canada, offering the gift of choice to design a custom course of study that ultimately helps you meet your career aspirations. Students can choose from approximately 140 modules and 480 courses in Science and Basic Medical Sciences, combine modules across departments and faculties, and pursue dual degrees with professional schools, including one of the finest business schools in the world.

We aspire to be the catalyst for your eureka moments – in the classroom, in the lab, and in the field. National 3M Teaching Award-winning instructors, Canada Research Chairs, and the largest number of Industry Research Chairs in Science at any Ontario university will share their expertise and passion for science while facilitating your learning by using novel techniques, cutting-edge technologies, unique facilities, and inspiring local, national and international venues.

Our community is committed to engaging Western Science students in high-impact and interdisciplinary learning. Inaugurated in 2016, Western's Integrated Science program is the jewel in our crown of both advanced and applied learning at the undergraduate level. Students interested in exploring societal issues and developing science-based solutions will thrive in this challenging multi-dimensional program. From hands-on experiences in labs and world-class research facilities,

academic exchanges and field schools that take place on three different continents, to capstone projects, community-engaged learning and our 8–16-month internships in the public and private sectors, Western Science students graduate inspired, and with marketable skills in their field of choice.

Among the most breathtaking campuses in Canada, Western also provides a warm, supportive and vibrant environment to help our students grow as individuals, scholars and members of a life-long international alumni community. Our academic counsellors facilitate your introduction to university life. Internships and career teams are available to guide your pursuit of opportunities and develop your professional portfolio as a technical specialist. With multiple associations and societies, and an active Science Students' Council, opportunities to engage in our rich student life are numerous.

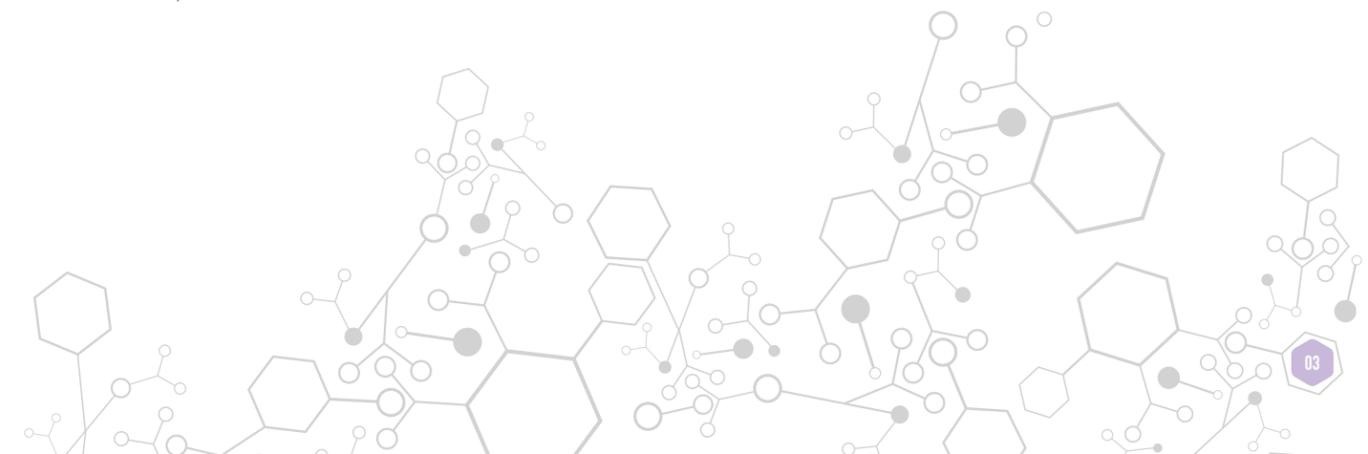
Choosing a post-secondary institution is among the most important decisions you will make. With this in mind, I invite you to explore our 2017 Viewbook to become more familiar with our programs and services, and the people who make the Faculty of Science at Western an extraordinary place to grow.

I hope that the prospect of a Western Science education motivates you to consider joining our community.

Sincerely,



**Dr. Charmaine B. Dean, PhD**  
Dean, Faculty of Science

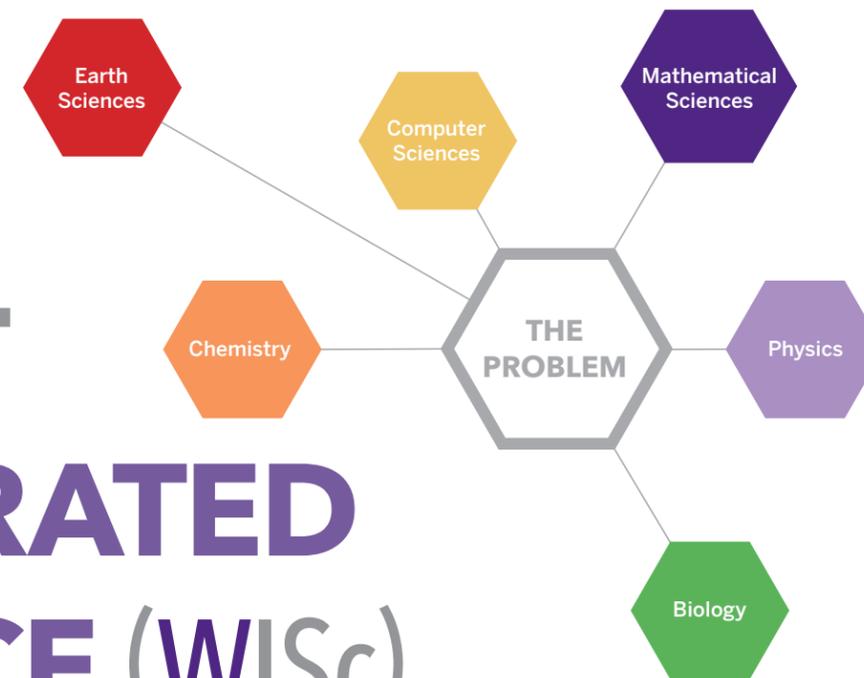




# ADMISSION

Approximately 6,000 undergraduate students are registered in Science and the Basic Medical Sciences.

## ABOUT INTEGRATED SCIENCE (WISc)



### Admission Requirements

For SCIENCE (OUAC code: ES) INTEGRATED SCIENCE PROGRAM (OUAC code: ES)	
MANDATORY	+TWO COURSES FROM
English (ENG4U)	Advanced Functions (MHF4U)
Calculus and Vectors (MCV4U)	Biology (SBI4U)
	Chemistry (SCH4U)
	Computer and Information Science (ICS4U)
	Earth and Space Sciences (SES4U)
	Math and Data Management (MDM4U)
	Physics (SPH4U)

*Note: First-year Biology and Chemistry courses require Grade 12 Biology (SBI4U) and Grade 12 Chemistry (SCH4U), respectively. First-year Biology and Chemistry courses are required for all modules offered by the Department of Biology and some modules offered by the Department of Chemistry and other Science departments.*

*Integrated Science students must complete Grade 12 Chemistry (SCH4U).*

### For BACHELOR OF MEDICAL SCIENCES PROGRAM (OUAC code: ESM)

English (ENG4U)	Biology (SBI4U)
Calculus and Vectors (MCV4U)	Chemistry (SCH4U)

*Note: Although Western offers first-year physics courses that do not require high school physics as a prerequisite, it is strongly recommended that students complete Grade 12 Physics (SPH4U).*

**FOR MORE INFORMATION:**  
[www.uwo.ca/sci/undergrad/future\\_students](http://www.uwo.ca/sci/undergrad/future_students)  
[www.westerncalendar.uwo.ca](http://www.westerncalendar.uwo.ca)

### Once You Have Been Granted Admission to Western

Assistance with course selection is available during Summer Academic Orientation and is highly recommended. This service provides you the opportunity to discuss your courses, attend learning skills sessions and a student panel, take a tour of the campus and residences, set up a timetable and a Western email account, and register for your courses.

**FOR MORE INFORMATION:**  
[www.westerncalendar.uwo.ca/FirstYear](http://www.westerncalendar.uwo.ca/FirstYear)

Many of the biggest challenges facing humanity are interdisciplinary. Problems such as climate change are not limited to a single science, but rather require expertise from a range of disciplines to come together to work on solutions.

Western's Integrated Science program is a new approach to undergraduate education that provides a select group of students the opportunity to address real-world problems by breaking down traditional discipline barriers.

### What You'll Learn

Western's four-year honors program in Integrated Science (WISc) will combine the focused coursework of a traditional science honors degree with a unique set of courses in Integrated Science.

Through novel classroom and laboratory experiences, the WISc courses will foster critical thinking and creative problem-solving as students learn foundational scientific concepts and apply them to a diversity of problems. Examples of the kinds of questions that will be addressed include: Where did the fundamental forces of nature come from? Why is Jupiter different than Earth? What is the chemistry behind protein folding? What is life, and how did it arise? Why are earthquakes so hard to predict? Can computers think? How does a cell phone work?

Throughout Integrated Science, students will refine their critical thinking and problem-solving skills. As well, the curriculum is designed to build and strengthen teamwork, leadership abilities, and community engagement.

Besides courses in Integrated Science, students will specialize in a defined discipline (e.g., Biology, Chemistry, Computer Science, Earth Sciences, Mathematics, and/or Physics). This will provide graduates with the focused education necessary to pursue further studies, developing the expertise valued by both industry and academia.

### Careers

Graduates of Western's Integrated Science program will have a unique skill set allowing them to work more effectively on some of today's most pressing issues. This will prepare students for a wide range of research careers in the public and private sectors and develop the flexibility to be effective in multiple endeavours. As well, it is expected that other graduates will go on to professional programs in medicine, dentistry, law and teaching.

**FOR MORE INFORMATION:**  
[www.uwo.ca/sci/WISc](http://www.uwo.ca/sci/WISc)



# EXCEPTIONAL PROGRAMS FOR HIGH-ACHIEVING STUDENTS

## Western Scholars

Students entering full-time study with averages of 90% or more are invited to be recognized as Western Scholars prior to the beginning of their first year as part of the registration process. Western Scholars have the opportunity to network with like-minded peers, Associate Deans, and community leaders, and are invited to events exclusive to the Scholar cohort. In upper years, Western Scholars can apply for the Scholar's Program Scholarship. Upon graduation, Western Scholars are recognized for their academic achievement on both their transcript and diploma.

## Scholar's Electives Program

The goal of this program is to foster a community of scholars who have a general intellectual curiosity about most disciplines. Those selected will, in addition to their four-year honors degree courses, enrol in a Scholar's Elective module. Enrolment is limited to a select 50-75 full-time students campus-wide who qualify for membership by having at least a 90% admission average. Selection will be determined on the basis of grades and personal accomplishments as detailed on a supplementary admissions form.

ACADEMIC BENEFITS	ANCILLARY BENEFITS
Create unique and exciting theme areas within your degree	More personal attention
Participate in university research with a faculty mentor	Connect with other high-achieving students in the program through planned activities and events
Take interdisciplinary courses exclusive to Scholar's Electives students	Scholarship opportunities in upper years
	Option of requesting the Scholar's Electives Floor in residence

**FOR MORE INFORMATION:**  
[www.success.uwo.ca/scholars/scholars\\_electives](http://www.success.uwo.ca/scholars/scholars_electives)



# ACADEMIC PATHS

# BIOLOGY, HEALTH SCIENCES, MEDICAL SCIENCES... WHAT'S THE DIFFERENCE?

## Western's Modular Degree Structure – Giving You the Power of Choice

A module is a collection of courses that defines an area of concentration. The number of courses included in the module is defined by the amount of specialization in the topic. Western's modular degree structure gives you the opportunity to combine various subjects from different departments and faculties. The specific courses included in each module are determined by the Department, Faculty School or Affiliated University College offering that module.

## You Have Thousands of Options

Western's modular system allows you to combine a Science module with a module in another Science or non-Science discipline to tailor your degree to fit your interests and aspirations. For example, if you are planning to complete a four-year Honors Bachelor Degree, you can pursue an Honors Specialization in Earth Sciences, combined with a Minor in Philosophy. An honors degree can also be constructed from two different major modules, either both in Science or one in Science plus a non-Science. At Western, there are literally thousands of possible combinations of modules.

## Dual Degree Programs

There are cases where reaching a career goal requires more than one degree or certificate. Western offers several combined and concurrent programs so you can earn two degrees in less time, extend the scope of your marketable skills and cross traditional borders in your future careers.

COMBINED DEGREE OPTIONS	CONCURRENT DEGREE OPTIONS
Science/Medical Sciences and Business (Ivey)	Science/Medical Sciences and Engineering
	Science and Nursing
	Science and Music



BIOLOGY	HEALTH SCIENCES	MEDICAL SCIENCES
<p>At Western University, programs in Biology are offered by the Faculty of Science.</p> <p>Modules offered by the Department of Biology allow for the study of organisms at different levels of biological organization – from how organisms interact with each other and the environment at the level of the ecosystem through to the study of individual genes in fruit flies in the laboratory.</p>	<p>The Faculty of Health Sciences at Western University is distinct from the Faculty of Sciences and the Schulich School of Medicine &amp; Dentistry.</p> <p>Modules in Health Sciences focus on the interdisciplinary study of health and wellness in an ever-changing society, in addition to domestic and international health systems.</p>	<p>The Bachelor of Medical Sciences (BMSc) Program is offered jointly by the Faculty of Sciences and the Schulich School of Medicine &amp; Dentistry.</p> <p>Modules offered by the Basic Medical Sciences explore the molecular, cellular and systematic organization of the human body and the biological mechanisms it uses to adapt to environmental changes and the challenge of disease.</p>

### CAREER OPPORTUNITIES

Many graduates with honors degrees in Biology go on to graduate studies (MSc and/or PhD) and professional schools.

There is a broad range of employment opportunities for graduates with a Biology background at all levels (BSc, MSc or PhD), including:

- Government: agriculture, environment, fisheries, and health
- Business and industry: research, development and marketing in biotechnology, consulting and healthcare
- Teaching: elementary, secondary or post-secondary institutions

Health Studies graduates have successfully established careers in a wide variety of health-related fields, including:

- Health promotion
- Community health programming
- Public sector administration and policy development areas (such as Health Canada)
- Biomedical ethics
- Business and industry: wellness and rehabilitation organizations, pharmaceuticals
- Non-profit sector (such as the Heart and Stroke Foundation and the Canadian Cancer Society)

Many graduates with BMSc degrees in Basic Medical Sciences modules go on to professional schools (e.g., medicine or dentistry) and graduate studies (MSc and/or PhD).

Other career/employment opportunities include:

- Law: bioethics, patent development for medical products
- Business: biotechnology, marketing, research and development, quality control
- Government laboratories: agriculture, marine, and environmental sciences
- Industry: pharmaceuticals, biotechnology, biosafety, regulation and enforcement
- Teaching: elementary, secondary or post-secondary institutions



# ACADEMIC SUPPORT

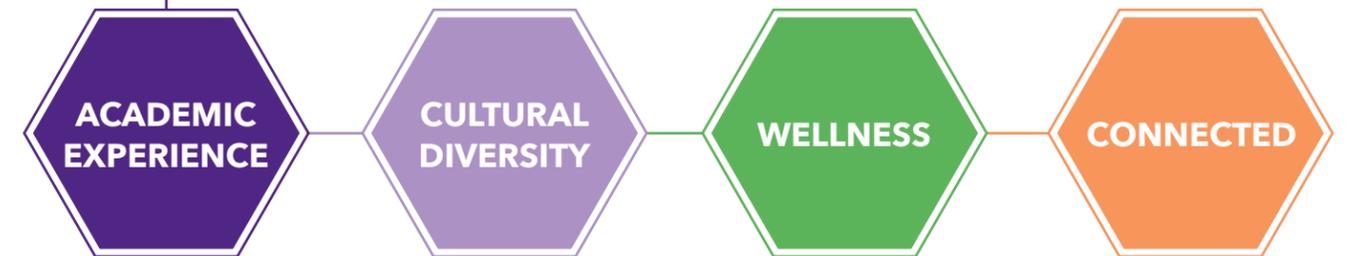
## Science Academic Counselling

Science Academic Counselling is your one-stop shop for academic support in Science and the Basic Medical Sciences at Western. Our counsellors focus their expertise on critical areas to address those issues of greatest importance to our students, so they can proactively support your academic journey towards the degree of your choice.

We understand the post-secondary context and will help you navigate the system. Our team provides a confidential and secure environment for discussion while guiding you through academic challenges, identifying options and helping you through the decision-making process.

**CONTACT US:**  
**Academic Counselling**  
[scibmsac@uwo.ca](mailto:scibmsac@uwo.ca)  
[www.uwo.ca/sci/undergrad/academic\\_counselling](http://www.uwo.ca/sci/undergrad/academic_counselling)

# WE ARE YOUR ACADEMIC ADVOCATES



Our team offers year-round individual and group counselling to facilitate your introduction to university life, help you transition into second year by addressing issues like course and program selection and guide your way to graduation in the final year of your undergraduate studies.

Academic Counselling collaborates with Western International and Indigenous Services to offer culturally sensitive interactions.

Our strong connection with Student Health Services ensures that the organization works in concert to support good physical and psychological wellness within the student body.

Transfer and mature students are provided tailored services to facilitate the evaluation of courses from other institutions to ensure you have the prerequisites you need to progress or receive appropriate credit toward your degree at Western.

# ACADEMIC

# SUPPORT

## Science Internships

High-impact learning, professional development and career counselling are available to all Western Science and Basic Medical Sciences students through Science Internship and Career Services.

Students who have completed their third year of undergraduate study have the option of participating in the Science Internship Program, which prepares them to undertake a paid career-related placement for a term ranging from eight to sixteen months.

A dedicated group of science, engineering, communications and business professionals with technical and industry experience supports students in their quest to develop marketable skills, gain work experience and be in a position to gain employment post-graduation.



## INDUSTRY PLACEMENT OPPORTUNITIES



## Career Services

Transitioning from school to the workplace requires a plan that can begin as soon as your first year on campus – and Western Science Career Services can help you.

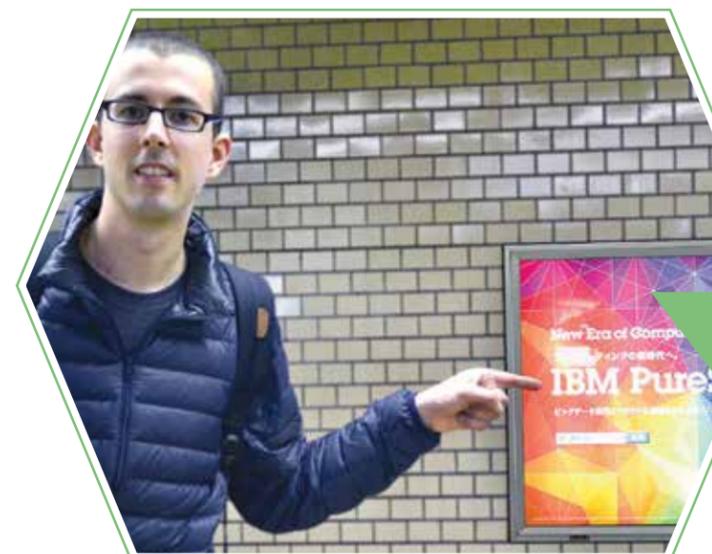
Our services range from providing tips on self-marketing strategies in professional circles to guidance regarding job-search techniques to facilitating network development through events like: networking breakfasts; *What to do with a Science Degree* panel sessions; and

industry-specific Career Nights – all with prospective employers, influential alumni, and industry experts. Jump-start your career search here!

**CONTACT US:**  
**Science Career Services**  
[scicareers@uwo.ca](mailto:scicareers@uwo.ca)  
[www.uwo.ca/sci/undergrad/career\\_services](http://www.uwo.ca/sci/undergrad/career_services)

*The Science Internship Program gave me the opportunity to apply the knowledge I had gained from my three years at Western. This combination of education and experience provided me with the confidence to be successful in the workplace and acquire a permanent position following graduation.*

– Margaret Weryk



*I took a two-week trip to Japan and found an advertisement for the branch of products I was working on. It was located in one of Tokyo's main transit lines. This made me realize how important computer software is all around the world.*

– David Gallant

# HIGH-IMPACT LEARNING AT WESTERN SCIENCE

The university experience is far more than the sum of your lectures and textbooks. At Western Science, you'll experience research, hone practical skills with labs and field courses and build communications skills through written reports and presentations. We call it high-impact learning. You'll call it highly rewarding.



## Authentic Learning Contexts

- Take courses that simulate the development arm of software companies and game studios.
- Develop an innovative business plan to commercialize novel science and emerging technologies by competing in the Proteus competition.
- Experience interdisciplinary science problem-solving as a participant in the annual multi-university SCINAPSE Science Case Competition or in Industry Problem-Solving Week.
- Receive course credit while attending the National Undergraduate Capstone Open Source Project.
- Apply academic knowledge to exciting projects on the ground in national and international locales; study forest ecology in the Adirondacks, desert ecology in the American southwest, tropical marine environments in Belize, and craters in the Sultanate of Oman.



## Capstone Projects

Both the BSc and BMSc programs offer mentored research projects in a world-class professor's lab. This could be your hands-on introduction to our cutting-edge facilities, science research, and may even result in your first technical publication.



## Science Internship Program

Gain significant work experience, 'try on' a career, and make valuable contacts – all while earning a full salary. These 8- to 16-month paid positions in industry and government are open to Year 3 students.



## Integrated Science (WISc)

Combine all of the specialized knowledge of an honors degree with a broad general science background and add marketable corporate skills to work on cutting-edge problems that span the traditional science disciplines leveraged in industry and academia.

[www.uwo.ca/sci/WISc](http://www.uwo.ca/sci/WISc)



## International Learning Opportunities

Interested in experiencing a new culture, language or exotic venue while developing your knowledge, skills and network? Western encourages global exploration through exchanges and study abroad programs with other universities, field schools, summer research, internships and volunteer opportunities.

*In the summer of my third year, I was awarded a fellowship under AAPM, which allowed me to contribute to proton therapy research at the Massachusetts General Hospital. In addition to providing me with the opportunity to work with brilliant scientists from all over the world, this experience gave me freedom to independently explore a different environment and culture. This fellowship opened my eyes to a world of possibilities as well as the value of international collaboration.*

– Kimberley Lam  
(Year 4 BMSc – Honors Specialization in Medical Biophysics)



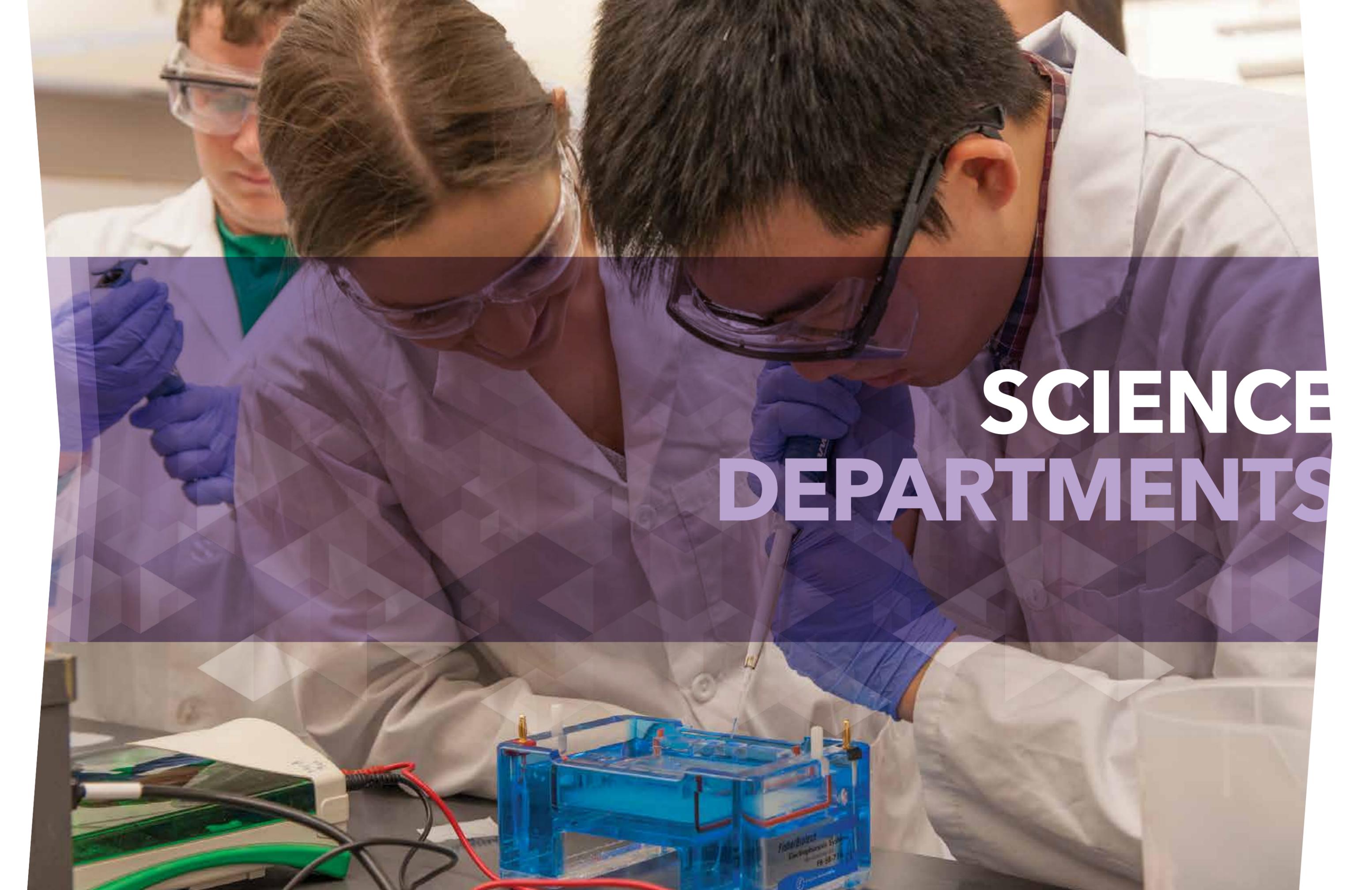
## Science Discovery Café

Explore your interests in science with a small group of like-minded students who meet weekly with faculty or graduate student mentors.



## Summer Research

Working in a lab over the summer is a great way to explore your research interests, develop technical skills, expand your network and be mentored by world-class researchers and their graduate students. The NSERC Undergraduate Summer Research Award, Western programs, and individual researcher's grants combine to offer a wide variety of opportunities. You may even end up authoring your first professional research paper!

A photograph of three students in a laboratory setting. They are wearing white lab coats and safety goggles. One student in the foreground is using a pipette to transfer liquid into a blue microplate. Another student is visible in the background, also working. The scene is overlaid with a semi-transparent purple geometric pattern. The text 'SCIENCE DEPARTMENTS' is written in large, bold, white letters across the right side of the image.

# SCIENCE DEPARTMENTS

Anna is the 2015 Dillon Gold Medal recipient and a two-time beneficiary of an NSERC Undergraduate Summer Research Award who turned her research experience into a peer-reviewed scientific article.

*Getting involved in summer research gave me the opportunity to work on problems that have real impact on how experiments could be carried out to study biological mutation.*

*It's exciting to know that the powerful math and computing tools available to us today can bring a new approach to tackling problems as diverse as managing financial risk and controlling the spread of Ebola.*

– Anna Zhu

# APPLIED MATHEMATICS

Applied Mathematics is the language of science. At Western, the Department of Applied Mathematics models phenomena occurring in the natural or social sciences in order to understand them and make predictions. These phenomena occur in such widely differing areas as the dispersal of pollutants in the environment, the flow of blood in arteries, interactions among subatomic particles, and the behaviour of financial markets. Our small classes and student-to-instructor ratio provide our undergraduates with enhanced opportunities to work closely with world-class faculty who are genuinely interested in fostering discussion and problem-solving ingenuity.

## What You'll Learn

Our department offers undergraduate students a warm, friendly and creative environment in which to learn about mathematical biology, dynamical systems, scientific and symbolic computing, theoretical physics and computational materials science. You will acquire the necessary expertise and have access to powerful tools to solve complex industry, business, natural, social and applied science-relevant problems.

## Careers

The acquired skills of an applied mathematician are in demand in almost every area of science and industry. Matrix algebra and calculus can be used to build mathematical and computational models for pure scientific research and industrial process innovation. They are used in areas ranging from cancer therapy treatment design and liquid crystals development to tracking evolutionary resistance to drug therapy. Many of our graduates choose to pursue a graduate degree to specialize further in a specific domain where their education enables work on the leading edge of innovation.

## DISTINGUISHING FEATURES

### Interdisciplinary Study

We offer, among others, modules that focus on interdisciplinary connections such as the Honors Specialization in Mathematical Science, a Major in Scientific Computing and Numerical Methods and a Major in Theoretical Physics. Students can also pursue a concurrent degree in Engineering and Applied Mathematics.

### Research Opportunities

Students who are in their fourth year of an Honors Specialization are offered opportunities to work on research projects in close association with faculty members, leading to an expanded applied skill set and the potential to be included in the publication of project results.

### Model Champions

Students from Applied Mathematics compete each year in the international COMAP Mathematical Contest in Modeling against over 2,000 teams worldwide. Western is consistently in the top 20 and twice have been world champions.

Taylor recently completed an Honors Specialization in Genetics with a Minor in Psychology. She is President of Best Buddies Western and a member of the national association, a non-profit organization that promotes an inclusive and accepting environment for people with intellectual disabilities.

*Completing an independent research project during my undergraduate studies has given me the opportunity to experience first-hand what it's like to work in the genetics field.*

*It has opened doors for me to present my research at conferences, introduced me to many professionals in the field, but most importantly I feel that I have made a contribution to uncovering the genetics of intellectual disability!*

– Taylor Lyons

# BIOLOGY

The breadth of modern biology is reflected in the more than seventy courses that are offered by the Biology Department. Courses span the whole range of student engagement from intensive laboratory-only offerings that start in second year to small fourth-year seminars where the focus is on refining communication skills. Students have the freedom to focus on a particular sub-discipline (e.g., genetics, animal behaviour) or receive a broad education that touches many areas of biology.

## What You'll Learn

In Biology, emphasis is placed on developing critical thinking and communication skills, expertise in experimental design and a strong foundation in data analysis. Depending on the area of concentration, more specific skills acquired include the ability to assess ecosystems, identify flora and fauna, effectively implement tools of molecular biology and microscopy and gain experience with the use of analytical instrumentation.

## Careers

The breadth of courses in the Biology curriculum prepares graduates for a wide range of research careers in the public and private sectors. Many of our graduates also go on to professional programs in medicine, dentistry, law and teaching.

## DISTINGUISHING FEATURES

### Excellence in Teaching and Learning

Led by Tom Haffie, a 3M National Teaching Fellow, faculty in our department strive for excellence in undergraduate teaching and learning. Whether it's engaging 800 students in a first-year course by using cell phones or small fourth-year offerings that focus on community-based group projects, Biology instructors employ novel and innovative approaches to help students learn more effectively.

### Unique Modules

The Department of Biology offers twelve different modules in a wide range of biology disciplines. Here we highlight just two of these modules:

#### *Honors Specialization in Genetics*

This module reflects one of the core research strengths of the Department. Students take a range of courses focused on gene structure, function and regulation that introduce modern 'omic' approaches (e.g., genomics, transcriptomics, proteomics) that are taught using a range of animal, plant and microbial systems. Related topics such as genetic engineering and developmental genetics form the basis of additional courses.

#### *Honors Specialization in Biodiversity and Conservation*

Students in this module will gain an understanding of the forces that are shaping Earth's ecosystems, including the impact of climate change on biological diversity. Capstone courses in biodiversity science and restoration ecology, as well as opportunities to do field research, are highlights of the module. Graduates will be prepared to pursue a diverse array of careers from basic research to public policy in a range of fields that are particularly pertinent in today's rapidly changing world.

### Field Courses in Unique Locations

As a Biology undergraduate, you will have an opportunity to do a research project in an exotic location and get credit for it. The Department of Biology at Western is a member of the Ontario Universities' Program in Field Biology, which offers about 30 different field courses each year for academic credit. Examples of recent offerings include: Rainforests and Reef Biology in Costa Rica; Tropical Marine Biology in Belize; Forest Ecology in the Adirondacks; Field Ornithology in Virginia; and Tropical Biodiversity in Ecuador.

Sydney received two NSERC Industrial Undergraduate Student Research Awards leading to an internship at 3M, where she designed, built and operated thermal performance instruments, and a work placement with a large automotive firm, where she contributed to the development of a magnesium alloy coating.

She is also a downhill ski racing coach and has run multiple half-marathons in support of local charities.

*The Chemistry professors are so approachable and so passionate about what they teach. We can tell they really want us to succeed.*

*– Lizzy (Sydney) Davenport*

# CHEMISTRY

Chemistry at Western is designed to provide a foundation in the major themes of modern chemistry as applied to the natural, industrial and commercial worlds. This foundation allows for advanced studies in a wide range of research areas, from materials to energy, synthesis, biology, and biochemistry. We focus on providing high-impact learning supported by hands-on study in modern, learning-friendly laboratories; part-time and summer employment in research facilities under the guidance of world-class faculty; career workshops and mock interviews; paid work placements in industry or government; and a capstone Thesis Research Course where students conduct independent research, to ensure that our students develop both essential and transferable skills to successfully transition from Chemistry students to professional chemists ready for the next phase of their careers.

## What You'll Learn

A degree in Chemistry at Western means learning the tools and techniques of chemistry along with the theoretical background required to interpret experimental results and develop new reaction pathways and compounds. The broad range of knowledge acquired and the numeracy, deductive and inductive skills secured are key in the development of our "career-ready" graduates.

## Careers

In addition to the option of entering professional areas such as finance, law, medicine, business and teaching, options for Chemistry graduates include research in government, industry and academic laboratories; process development and control work; detection and characterization of trace substances; and technical sales and service.

## DISTINGUISHING FEATURES

### Facilities Tailored for Optimal Learning

Our recently renovated first-year labs are flooded with natural light, offer large workstations designed to support learning collaborations and are fitted with computer-controlled modular equipment to simulate an authentic lab environment found in government and industry.

### Professional Development

Chemistry students are highly sought interns in industry and government. Our Science Internship Program facilitates discipline-relevant placements for 8- to 16-months. Those students completing a senior thesis project also acquire both research and corporate skills, in particular in their preparation for mock interviews with representatives from our alumni and industry community.

### Authentic Learning

Part of becoming a professional chemist involves gaining hands-on research experience, preparing technical manuscripts and presenting posters at discipline-specific conferences. On average, 25 chemistry students secure summer research positions with the department. All of our students acquire experience in poster development and presentation in analytical chemistry while students in the Undergraduate Thesis course routinely participate in the annual Southwestern Ontario Undergraduate Student Chemistry Conference (SOU SCC).

### Honors Specialization Modules

In addition to Chemistry modules, we offer two Honors Specialization modules jointly with the Department of Biochemistry. The Biochemistry and Chemistry module has an emphasis in chemistry and is available to students enrolled in the science program. The Chemical Biology module has an emphasis in biochemistry, and is offered to students enrolled in the Basic Medical Sciences Program. These modules comprise of courses from both disciplines, and they both offer Thesis Research courses enabling students to gain experience in interdisciplinary research laboratories.

Charlie is the founder of SCINAPSE and initiator of the SCINAPSE Undergraduate Science Case Competition which, in just its first three years of operation, engaged nearly two thousand science students from a variety of disciplines and 10 universities to develop research proposals addressing real science-based challenges. An NSERC USRA Scholarship recipient, Charlie's own research focused on biological modelling using artificial intelligence and he is a named contributor to research featured in the journal, *Nature*.

*I came to university wanting to learn a bit about everything and Western is the perfect place to do just that. I was stimulated by my capable peers, the collaborative intellectual environment, and professors who cared as much about my personal growth as they did about research. I've grown much as a scientist, and even more so as a person.*

– Weige (Charlie) Zhao

# COMPUTER SCIENCE

Computer science drives innovation in the 21<sup>st</sup> century. From influencing the space program and contributing to models of personalized medicine, to solving life and business challenges through big data applications, computer science is all about exploring possibilities and influencing outcomes. The Department of Computer Science at Western is responsive to rapidly changing businesses, social and natural landscapes, and providing students with innovative programs, courses, co-ops and extracurricular learning opportunities which reflect focus areas of greatest interest to students and their potential employers.

## What You'll Learn

The work of a computer scientist falls into several categories, and students in the Department of Computer Science at Western acquire skills and experience in all. Undergraduates learn skills that will allow them to design and build software as well as develop effective ways to solve computing problems, including storing information in databases, sending data over networks, and providing new solutions to cyber-security issues. Our students also acquire the expertise needed to devise new and better ways to address challenges in big data, game development, medical imaging, social and mobile computing and in bioinformatics.

## Careers

Our flagship programs in Computer Science grant degrees that are accredited by the Computer Science Accreditation Council (CSAC) and the Canadian Information Processing Society (CIPS), facilitating subsequent professional certification as an Information Systems Professional and Information Technology Certified Professional.

Computer Science graduates at Western are prepared for careers in the following fields:

- Database Administrator
- Data Modeller
- Data Scientist
- E-Commerce Analyst
- Game Developer
- Mobile Developer
- Multimedia Programmer
- Network Administrator
- Network Analyst
- Programmer Analyst
- Researcher
- Security Analyst
- Software Engineer
- Systems Analyst
- Systems Engineer
- Technology Manager
- User Interface Designer
- Web Developer

## DISTINGUISHING FEATURES

### Minors in Game Development and Software Engineering

In 2016, the Princeton Review named Western Computer Science among the top destinations in the world to study game design. Our Minor in Game Development examines the design and programming of games, leveraging the latest engines and technologies, and culminates in a year-long game development project modelled after industry practices. Western was one of the first universities in Canada and around the world to introduce studies in gaming. The Software Engineering module offers courses that develop knowledge and skills needed to design, implement and manage large software projects in a practical, industrial setting.

### Honors Specialization in Medical Health Informatics

Medical Health Informatics sits at the intersection of information and computer science, medicine and healthcare. This interdisciplinary module explores how data are collected, processed and used in a healthcare setting while developing an applied expertise in a rapidly emerging field.

### Authentic Learning Contexts

Learning in real-world contexts prepares our students for successful integration into the workforce. Future game developers benefit from courses set up as game development studios. Students take on leadership roles in simulated consultant firms and assume ownership of technical deliverables and project management responsibilities, from the determination of requirements and production of timelines, to communications with the client.

### Entrepreneurship

You don't have to wait until the completion of your degree to get started on a career in computer science. At Western, the Propel Program provides institutional support and guidance to students who are prepared to take their innovations to market through tech transfer facilitation, intellectual property protection, or business planning, resulting in a start-up enterprise.

Sarah is President of The Outcrop Club – the undergraduate Earth Sciences Society. She participated in a month-long analogue mission to simulate the mission control operations that are used for rovers on Mars and served as the Mars Analogue Mission Documentarian.

*The highlight of my undergraduate degree so far has been my field school course. It was hard work but was a wonderful learning experience. I worked with classmates and professors to better understand concepts and transfer my classroom knowledge to real-life field situations, allowing me to become a better-rounded scientist.*

– Sarah McFadden

# EARTH SCIENCES

Earth Sciences is the study of the history, structures and processes that shape planet Earth. Earth Sciences involves a significant breadth of topics including planetary structure and composition, plate tectonics, earthquakes and volcanoes, natural resources, and the history of life on Earth. Although the profession focuses on opportunities to explore, extract, analyze, understand and monetize raw planetary materials, an equally important and rapidly evolving segment of an Earth Scientist's career focuses on the protection of Earth and its most precious natural resources.

## What You'll Learn

- The tectonic mechanisms that create earthquakes and volcanic eruptions
- The processes that occur within the planet, that shape its surface, and that control its atmosphere
- The origin, occurrence, extraction and conservation of Earth's natural resources, including minerals, fossil fuels, soils, and water
- The role of Earth within the Solar System, and the history of life on Earth

## Careers

There is a major demand for geoscientists worldwide. Careers in the Earth Sciences are quite diverse, ranging from work in high-tech industrial research laboratories to corporate and government offices, and to field programs in some of the most remote areas of the world.

Options:

- Management of water resources and remediation of contaminated sites
- Metal and Industrial Mining and Exploration
- Natural Hazards Research
- Petroleum Industry: Exploration and Development
- Resource evaluation for private and public sector organizations
- Satellite and land-based imaging for exploration

## DISTINGUISHING FEATURES

### Interdisciplinary/Collaborative Programs

The Earth Sciences are highly interdisciplinary, using elements of all of the other sciences in studying Earth and other planets. Our department offers collaborative programs in Geology and Biology, Environmental Geoscience and Planetary Science and Space Exploration.

### Field Courses Across the Globe

Western's Department of Earth Sciences offers more undergraduate field courses than any other similar department in Canada. All of our modules involve field components with opportunities for travel within Ontario and the Maritimes, as well as abroad to places such as South Africa, Brazil, the Philippines, and Finland.

### Professional Programs

The Department of Earth Sciences offers Honors degree modules in Geology, Geophysics, and Environmental Geoscience that fulfill the requirements for professional registration as set by the Association of Professional Geoscientists of Ontario (APGO) and the Canadian Council of Professional Geoscientists (CCPG). Students graduating from one of our professional programs will meet all knowledge requirements toward becoming a professional geoscientist qualified to practice in Canada.

Rebecca travelled to the remote Uinta Mountains in Utah to collect samples for her fourth-year thesis project which involved using stable isotope science to characterize sources of organic matter to lake sediments.

*The Honors Specialization in Environmental Science provided me with the flexibility to explore my interests in a variety of disciplines. It was because of this flexibility, and the experience that I gained during my honors thesis, that I decided to attend graduate school at Western.*

– Rebecca Doyle

# ENVIRONMENTAL SCIENCE

The Centre for Environment and Sustainability was created in 2007 to provide and foster an interdisciplinary platform for teaching and research on environment and sustainability. Interdisciplinarity is the key to environmental science. The Centre brings together the strengths of the Faculties of Science, Engineering, Social Science, Arts & Humanities, Information & Media Studies, the Schulich School of Medicine & Dentistry, the Richard Ivey School of Business and the Faculty of Law. Our students take courses that bring them a wide variety of outlooks on processing environmental issues ranging from biodiversity loss, access to safe and clean water, energy, renewable resources, to ecosystem health, natural disasters, and sustainable business practices.

## What You'll Learn

Our students learn to communicate environmental science across disciplines and to apply knowledge from these different fields to develop solutions to real-world issues. Building on a solid core of science – including content in biology, chemistry, mathematics, earth sciences, geographic information science and physical geography – Environmental Science students have the added benefit of access to training in other disciplines ranging from anthropology, business, and economics, to First Nations studies, philosophy, political science, human geography and sociology.

## Careers

The environmental sector is one of the fastest growing and diverse job markets in Canada. Our students go on to careers in resource industries, sustainability positions in businesses of all kinds, conservation, environmental policy, environmental research, and environmental education.

## DISTINGUISHING FEATURES

### Research Opportunities

All of our undergraduate students pursuing an Honors Specialization in Environmental Science undertake a two-semester research project with a Western faculty member engaged in environmental science research in any one of a number of disciplines including biology, chemistry, earth science, geography, engineering or business. Students pursuing the Specialization or Major modules may conduct a one-semester research project. The opportunity to work in state-of-the-art research facilities, like the BIOTRON for climate change research, is one of the benefits that sets Environmental Science at Western apart.

### Field Schools

Field courses and exchange semesters incorporating field studies provide some of the best hands-on learning opportunities in environmental science. The range of destinations is broad, but all yield unforgettable experiences and build skills and knowledge that may have seemed abstract in lectures.

### Bridging/Articulation Agreements/ Advanced Standing

Students coming to Western with a two-year Environmental Technician or three-year Environmental Technology Advanced Diploma from many Ontario colleges (or Science Lab Technician Diploma from Fanshawe College) can receive advanced standing credits towards a range of Environmental Science degrees. Western students can also take their Environmental Science degree to Fanshawe for advanced standing in an Environmental Technology Diploma. Other institutions, such as Durham College, offer compressed, fast-track programs to students who have completed a BSc degree.

Helen serves as a Math/  
Applied Math representative  
on the Science Students'  
Council and is an active  
participant in the Math  
Scholars Group.

*All of my professors in the Mathematics department have done an outstanding job of getting to know their students and tailoring their lectures to pique student interest while showcasing elements of their individual research.*

*The versatile and interdisciplinary nature of my mathematics degree highly influenced my decision to jump into industry as a data scientist.*

– Helen Ngo

# MATHEMATICS

Mathematics is the rigorous study of quantity, structure, space and change. In 1623, Galileo wrote that mathematics is the language of science, and it is no less true today. Research in pure mathematics is more active now in the 21<sup>st</sup> century than ever in the past. While a beautiful and intriguing subject of study in itself, contemporary mathematics provides a solid foundation for every modern scientific endeavour from quantum mechanics to quantitative finance.

## What You'll Learn

Modern mathematics is classified into broad divisions: foundations, algebra, analysis, combinatorics, and geometry and topology. Students will gain a working knowledge of each of these subjects. For example, logic and the concept of mathematical proof are a part of foundations, while number theory, group theory and cryptography are fields in modern algebra.

Topics of Study:

- Calculus
- Combinatorial mathematics
- Cryptography
- Discrete mathematics
- Functional analysis
- Game theory
- Group, ring and field theory
- Linear algebra
- Mathematical reasoning
- Metric spaces and topology
- Number theory
- Real and complex analysis

## Careers

The analytical and problem-solving skills students learn in mathematics can apply to all disciplines. Mathematicians conduct research in any environment where information is analyzed and used to identify patterns. Due to the increased importance placed on technology, big data and economic efficiency by all kinds of organizations across the globe, mathematicians are increasingly in demand.

Some Options:

- Cryptologist
- Data Scientist
- Financial Analyst
- Geophysical Analyst
- Information security
- Information technology
- Intelligence Analyst
- Management Consultant
- Market research
- Operations research
- Statistical research
- Systems Analyst

Many students graduating from our program choose to pursue graduate degrees in mathematics while others go on to careers in business, economics, investment banking, law or medicine.

## DISTINGUISHING FEATURES

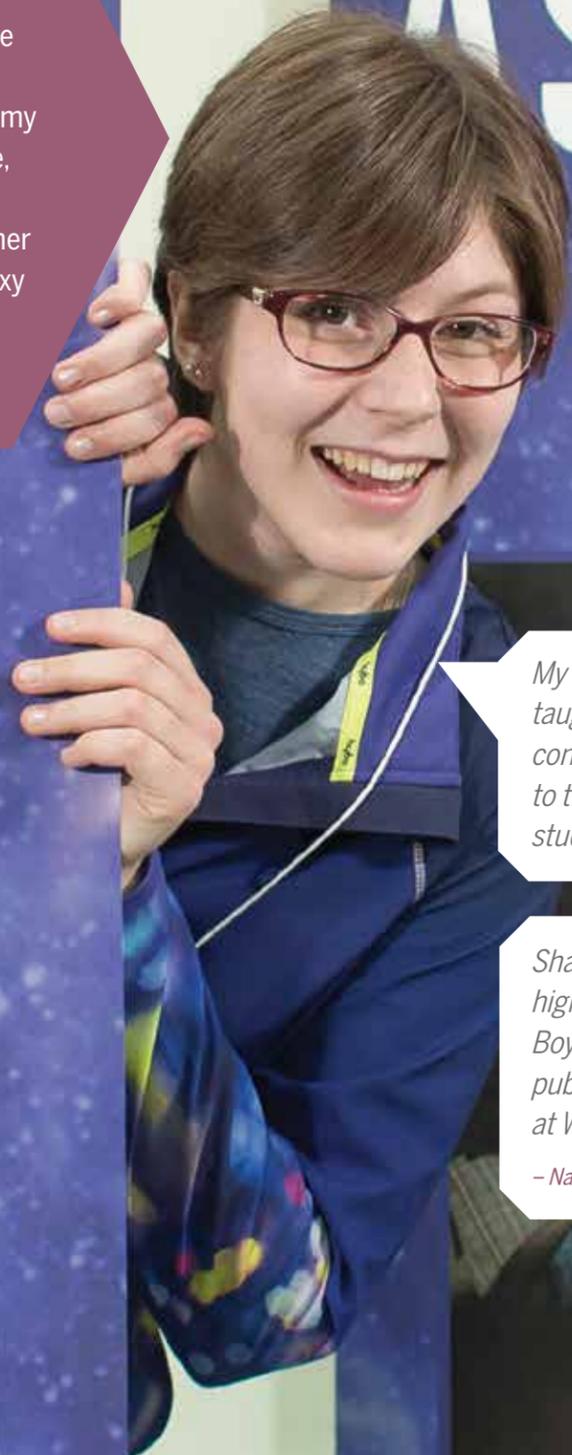
### Mathematics in Society

These modules are perfect for students considering a career or graduate degree in any logically or analytically intensive field, such as economics, finance, business, and law. In addition to a set of core mathematics courses, a broad spectrum of mathematically-oriented courses from other disciplines can be counted towards this module, including particular courses in Applied Mathematics, Computer Science, Earth Sciences, Economics, Financial Modelling, Philosophy, and the Statistical and Actuarial Sciences.

In Forbes Magazine, Mathematician was listed as the "third-best job" in 2015.

Nathalie presented the results of her honors thesis on winds surrounding supermassive black holes at a meeting of the National Science Foundation at the National Radio Astronomy Observatory in Charlottesville, Virginia and was awarded an NSERC Undergraduate Summer Research Award to study galaxy evolution as a function of environment.

# ASTRO



*My research experiences have not only taught me about how real science is conducted but have opened my eyes to the myriad of physics questions studied in astronomy.*

*Sharing the wonder of science with high school students, youth from the Boys and Girls Clubs and the general public has been a joy during my time at Western.*

*– Nathalie Chantal Thibert*

# PHYSICS & ASTRONOMY

**Physics and astronomy involves the study of matter, forces, and energy as they relate to the understanding of our environment from Earth to the distant reaches of the universe. The Department of Physics and Astronomy studies natural phenomena such as star formation, the Earth's atmosphere, and meteors. They also study the applications of physics to medicine in the form of imaging and radiotherapy; as well as technology – specifically, nanofabrication, optoelectronic devices, and biomaterials.**

## What You'll Learn

Physics is a foundational discipline of STEM careers and enables students to develop logical reasoning skills based on underlying principles. Our undergraduates also acquire proficiency in problem-solving, mathematics, experimental design, computer simulation, and data analysis while experiencing the tools and techniques of modern high technology.

## Careers

All of our students are well-prepared to enter graduate school to become professionals in rapidly evolving disciplines. Graduates are employed worldwide in fields as diverse as pure and applied research, medicine, engineering, teaching, science journalism, and finance.

Career examples include:

- Academic and industrial scientist
- Data Scientist
- Financial Analyst
- Educator
- Entrepreneur tech start-up
- Government Scientist in weather forecasting and climate prediction
- Imaging Medical Physicist
- Radiation Oncologist

Recent graduates have gone on to work as industry scientists at medical imaging companies, software specialists working with big data and completing MD degrees at Ontario medical schools.

## DISTINGUISHING FEATURES

### Astrophysics

Our Astrophysics modules emphasize the study of the physics of the universe and its components. Offering a combination of astronomy and physics courses, students learn about a wide range of topics including the life of stars and black holes, and the evolution of the universe from the most diverse astronomy group in Canada. With the skills acquired in this module, our graduates stand out with their involvement in cutting-edge research, including the recent discovery of gravitational waves and new planets beyond our solar system.

### Medical Physics

Western is home to one of the largest groups of medical physics researchers in Canada, with instrumentation, experimental, clinical and theoretical research interests. Our modules in Medical Physics are perfect for students who are interested in medicine or medical imaging, captivated by physics and who look forward to gaining hands-on lab experience with world-class medical physicists.

### Faculty mentorship and research skill development

In their final year, students synthesize their experience by undertaking a significant research project with a faculty member. Financial support for undergraduate research is made available each summer to support experiential learning and the development of professional skill sets and network development.

### Developing skills, networks, and confidence

The ability to share scientific understanding within and well beyond the scientific community is one of the hallmarks of success for our students. The undergraduate seminar course brings together students in all years of the Physics and Astronomy modules to train confident and effective speakers and presenters of complex material. Our Physics and Astronomy Student Association (PASA) hosts an annual research conference and multiple social events throughout the year.

Kristen was VP of Events for the Statistical and Actuarial Science Club. She completed a 16-month internship with London Life through the Science Internship Program and is beginning her career as an actuary at a firm in Tennessee.



*Actuarial Science is hard. That was the first thing I learned. I've also learned that if you put in the time, effort, and ask any faculty member for help, then you can succeed in the program and set up a rewarding career.*

– Kristen Long

# STATISTICAL & ACTUARIAL SCIENCES

**Statistics is the art and science of making conclusions from data; it is particularly useful when deciding how to manage complicated systems, and essential to decide questions like: Is this medical treatment worth doing? Did this marketing campaign work? Is my investment advisor adding value? Our undergraduate statistics programs instruct students in these techniques, which has become increasingly important in our complicated, but data-rich, modern world.**

**Our department also trains actuaries, who are statistically sophisticated business professionals who assess the probability and financial impacts of personal challenges such as premature death, major illness, car crash, or property damage due to wind, fire, or flood. Actuaries are the brains of insurance companies, which create and manage financial products designed to mitigate these impacts.**

**Financial risks also come from markets, such as rising interest rates when it's time to renew a home mortgage, changing interest rates negatively impacting vacation plans, or a stock market crash requiring a delayed retirement. Our program in financial modeling teaches how to quantify, hedge, and manage such financial risks.**

## What You'll Learn

Our Statistics courses give you the tools to collect, analyze and interpret data using probability and other mathematical tools while also enabling you to develop mathematical and stochastic models for phenomena occurring in business, engineering, medicine and government. For example, SS3850 in applied data analysis combines techniques learned in earlier courses to give our students a comprehensive ability to analyze real data using modern computer-based statistical methods.

Actuarial Science courses at Western provide the ability to apply existing models and develop new models and methods used in the analysis and management of risk associated with adverse life events like premature death and disability. For example, Loss Models courses AS3424 and AS4824 explore the techniques used to manage an insurance company to ensure that it has enough capital to withstand the claims that might be made. Our Life Contingencies courses – AS2427, AS3429, and AS3431 – also investigate the complexities of modelling life expectancy for the purposes of setting insurance premiums.

A Financial Modelling education will train you to apply advanced mathematical, computational and statistical techniques to problems arising in modern financial markets. Our Financial Modelling course FM2557, Financial Markets and Investments, teaches a quantitative understanding of the stocks, bonds, and options traded on worldwide financial markets, while courses FM3613B, FM3520B and FM4521B give students an in-depth quantitative understanding of how to price and hedge derivative securities, such as options.

## Careers

Acquiring expertise in statistical methods positions our students to pursue careers in engineering, politics, financial management, insurance, marketing, medicine and social science. Future actuaries will apply their knowledge of mathematics, probability, and statistics to financial problems involving future uncertainty. Their strong financial modelling skills mean that our graduates are primed to succeed in the pricing and hedging of portfolios of stocks, bonds, and their derivative securities as well as in the analysis and quantification of financial risk in large financial institutions.



## DISTINGUISHING FEATURES

### Industry Responsive

As a result of an integrated approach to learning about actuarial science and financial modelling, our students are positioned to respond successfully to the evolving needs of financial institutions that increasingly manage fiduciary and investment risk simultaneously.

The Department of Statistical and Actuarial Sciences at Western is the only department of its kind in Canada to focus on soft-skill development by offering a dedicated business skills course.

Several actuarial scholarships are awarded yearly that provide for an aggregate payout of up to \$45,000 annually to undergraduate students in our Actuarial Science modules. Included are scholarships that are exclusively merit-based as well as industry sponsored scholarships that consider other attributes such as leadership skills. Currently, there are three London Life Actuarial Career Scholarships and one Manulife Financial Scholarship awarded annually, as well as the Freeman of the City of London of North America Scholarship that provides \$5,000 for a student pursuing an exchange program in London, England.

Western has been designated as a Centre of Actuarial Excellence by the Society of Actuaries (SOA), and our Actuarial Science students can pursue professional qualification by the SOA and the Casualty Actuarial Society.

Western is accredited by the Canadian Institute of Actuaries (CIA) and students pursuing a Fellowship in the CIA may receive exam exemptions for courses taken at Western.

Our university is also accredited by the Statistical Society of Canada (SSC) and students completing a degree in statistics may receive accreditation as an Associate Statistician.



# BASIC MEDICAL SCIENCES

Nick is completing an Honors Specialization in Physiology and Pharmacology in the BSc Program. He is the incoming President of the Bachelor of Medical Sciences Association (BMSA) and serves his community off-campus as a volunteer at the Ronald McDonald Family Room at Victoria Hospital in London, Ontario.

*Getting involved with scientific research through NSERC has helped me strengthen many problem-solving skills that I was able to utilize in my course work outside of the lab. This experience has sparked my interest in getting involved with clinical research in my future career.*

– Nick Tonial

# BASIC MEDICAL SCIENCES

The Bachelor of Medical Sciences (BMSc) degree is a four-year degree offered jointly by the Faculty of Science and the Schulich School of Medicine & Dentistry. It is designed for students interested in advanced study of one or more of the basic medical sciences. This joint approach provides the opportunity to learn and understand the interrelationship between the basic and clinical medical sciences and to explore one or more of the disciplines in depth.

Students interested in the BMSc Program should apply to the Faculty of Science by selecting ESM (Medical Sciences) on the Ontario Universities' Application Centre (OUAC) application. In Medical Sciences 1 and 2, students are registered in the Faculty of Science, and take predominantly science courses (biology, chemistry, genetics, cell biology, etc.). Admission to the BMSc Program occurs in Year 3, at which time registration switches to the Schulich School of Medicine & Dentistry and the study of the basic medical science courses (biochemistry, physiology, microbiology, etc.) begins. Students admitted via Medical Sciences are assured admission to the BMSc Program in Year 3 following the successful completion of Medical Sciences 1 and 2, with the appropriate courses and marks.

The Basic Medical Sciences departments offer 20 different Honors Specialization modules, 8 Specialization modules, 9 Major modules and 5 Minor modules, the latter two of which are available to students in any program at Western.

BMSc students can combine the HBA degree (Business Administration) from the Ivey Business School with either the Honors Specialization in Biochemistry or the Honors Specialization in Interdisciplinary Medical Sciences (IMS) and graduate with two Honors degrees in five years.

## Careers

Graduates will have the background and foundation to follow many career paths in academia, research, or the health science and healthcare sector.

Options Post-Graduation:

- Data analysis
- Graduate studies
- Investigators of foodborne, waterborne, plant and animal diseases
- Mobile health technology industry and its applications
- Pharmaceutical or biotechnology industry where skills will be applied to the careful design and interpretation of clinical trials
- Professional schools and programs in medicine, dentistry, nursing, optometry, pharmacy, physiotherapy, education and law
- Public health policy makers for infectious disease control
- Safety monitors/quality assurance in the food industry, water treatment, agriculture, pollution control
- Sales, marketing, and technical support for scientific and medical suppliers
- Scientific and clinical research in academia, hospitals (clinical trials, diagnostic labs), industry (biotechnology and pharmaceuticals), or government laboratories

FOR MORE INFORMATION:  
[www.schulich.uwo.ca/bmsc](http://www.schulich.uwo.ca/bmsc)

# ANATOMY & CELL BIOLOGY

The department offers a wide range of modular options in **Medical Cell Biology**, which is the study of humans at the **molecular, cellular, tissue and systemic level**. The modules **integrate information from each of these areas to yield an understanding of the relationship between structure and function in the organism as a whole**.

## What You'll Learn

Courses offered in Medical Cell Biology modules allow students to explore the anatomical features of all the human body systems and study the relationship of structure and function at macroscopic and microscopic levels. They develop an understanding of how cells in the human body interact when forming tissues, maintaining homeostasis and regulating behaviour, and learn about the cellular mechanisms governing normal and pathological processes such as cancer, cardiovascular disease, and mental disorders.



## DISTINGUISHING FEATURES

The Medical Cell Biology program offered at Western focuses on understanding the structure and function of cells and tissues and what goes wrong in diseases such as cancer. The program is taught by dedicated faculty including award-winning teachers and scientists that are internationally recognized in their fields of research.

### Joint Modules

The department partners with the Department of Biochemistry to offer the joint Honors Specialization in Biochemistry and Cell Biology which includes foundational courses in biochemistry and molecular biology, genetics, cell biology, and more advanced courses in biochemical regulation, biological macromolecules, and advanced medical cell biology. Understanding of normal structure and function is supplemented through course work in mammalian histology, physiology or human anatomy. Students gain research experience in third-year biochemistry and cell biology labs and in their fourth-year work with a faculty member on a research project.

FOR MORE INFORMATION:  
[www.schulich.uwo.ca/anatomy](http://www.schulich.uwo.ca/anatomy)

# BIOCHEMISTRY

## What You'll Learn

Students can obtain Honors degrees specializing in biochemistry or computational biochemistry or in joint modules combining biochemistry with chemistry, microbiology, cell biology, pathology, medical biophysics, or genetics. Students may also complete the combined BMSc/HBA program with an Honors Specialization in Biochemistry.



## DISTINGUISHING FEATURES

### Joint Modules

Biochemistry offers joint modules like the Honors Specialization in Biochemistry of Infection and Immunity, in which students experience a wide spectrum of learning from an introduction to foundational concepts in biochemistry, molecular biology, microbiology, and immunology to exposure to advanced concepts in biochemical regulation, biological macromolecules, and biology of infection and immunity. They develop an understanding of bacterial pathogenesis and molecular virology with supplementary courses in molecular biology of DNA, RNA, and proteins.

### Practical Research Experience

The Department of Biochemistry offers multiple research courses to third- and fourth-year students with an emphasis on experimental design, critical thinking, and scientific communication.

**Biochemistry is the study of the molecules and mechanisms essential to life. Biochemists strive to understand how living systems function at the molecular level including how cells build and maintain the chemical structures necessary for life; the ways in which organisms obtain and use energy; and how living systems sense and respond to their environment.**

**Of particular interest within the biochemistry modules is understanding the structure, function and regulation of biomolecules as they relate to disease, looking at:**

- Mechanisms of drug action and molecular-targeted therapies;
- gene expression and cellular communication; and
- molecular structure, mechanism and dynamics, and the molecular basis of disease;
- synthetic biology and chemical biology.

FOR MORE INFORMATION:  
[www.schulich.uwo.ca/biochem](http://www.schulich.uwo.ca/biochem)

# EPIDEMIOLOGY & BIostatISTICS

Epidemiology is the discipline concerned with studying the determinants and distribution of diseases in human populations. Biostatistics is the discipline that develops and discovers new statistical methods for collecting, analyzing and interpreting the data arising from medical and epidemiologic studies.

## What You'll Learn

Working with a vibrant faculty of epidemiologists, biostatisticians, and physicians who are dedicated to policy-relevant research, students develop skills that will allow them to contribute to health policy by providing data relevant to health promotion and illness-prevention programs.



## DISTINGUISHING FEATURES

### Honors Specialization in Epidemiology and Biostatistics

This specialization provides students with exposure to a variety of courses in the disciplines of epidemiology, applied biostatistics, health services research, health economics and clinical epidemiology, allowing students to develop:

- Mastery of the methods needed to design clinical and population studies;
- the analytical and critical thinking skills needed to analyze and interpret health data;
- an understanding of how epidemiologic studies are used to identify genetic and environmental causes of major diseases; and
- an understanding of how the knowledge from epidemiologic research is used to make policy and practice recommendations for health and public health services delivery.

Epidemiology and biostatistics is the only population-based discipline, so results from studies can apply directly to clinical advances and public health practice. Interests among department researchers span the life course and include investigations of infectious and chronic diseases. Examples include studies investigating the effects of pregnancy on the long-term course of multiple sclerosis among Canadian women, the cost-effectiveness of breast cancer treatments, and the factors associated with falls in elderly individuals.

FOR MORE INFORMATION:  
[www.schulich.uwo.ca/epibio](http://www.schulich.uwo.ca/epibio)

# MEDICAL BIOPHYSICS

Medical Biophysics is an interdisciplinary field in which the principles and laws of the physical sciences are applied to investigate biological processes relevant in medical applications. This involves collaboration between physicists, biologists, and clinical scientists to learn about diseases and their processes, and to improve diagnosis and treatment.

The teaching and research focus is on the biophysics of the human body and of higher animals. Biological function is explored from the point of view of biochemistry and energy transformation, medical imaging, medical radiation physics and biology, oncology, biomechanics, microcirculation, and biological systems control.

## What You'll Learn

Theoretical, experimental, and applied sciences courses help students develop the required background in Medical Biophysics. Students use basic mathematical tools for a quantitative analysis through "hands-on" laboratory work in a research environment. Areas of study within Medical Biophysics modules facilitate the conceptual understanding of a wide range of biophysical approaches to research.

FOR MORE INFORMATION:  
[www.schulich.uwo.ca/biophysics](http://www.schulich.uwo.ca/biophysics)



## DISTINGUISHING FEATURES

Our program is unique in its research-oriented, multidisciplinary approach to studying biological processes, measurement techniques, and treatments relevant to medical applications. Our third-year research projects allow students to interact directly with faculty and gain substantial experience in solving medically-relevant problems.

### Medical Imaging

Medical Biophysics hosts a number of world-renowned scientists in the field, who investigate the science and practical issues of medical imaging techniques such as ultrasound, CT (Computed Tomography) and MRI (Magnetic Resonance Imaging).

### Honors Specialization in Medical Biophysics (Medical Science Concentration)

In addition to Medical Biophysics courses, this module includes a range of courses from computer science to physiology and biochemistry, providing a strong background to pursue graduate studies in disease diagnosis and therapy using a quantitative approach.

### Honors Specialization in Medical Biophysics (Clinical Physics Concentration)

This module prepares students for taking CAMPEP-accredited graduate programs necessary for Medical Physicist residency.

### Honors Specialization in Medical Biophysics and Biochemistry

This new module equips students to understand quantitative aspects of molecular and cellular systems, including interactions of DNA, RNA and proteins and the governing physical laws.

# MICROBIOLOGY & IMMUNOLOGY

Microbiology is the study of organisms too small to be seen with the naked eye, including bacteria, viruses, algae, fungi and protozoa. Immunology is the study of the immune system, which functions to protect us from disease-causing microbes and cancer. However, it can malfunction and cause a variety of clinical disorders like autoimmune diseases and allergies. Our program includes some environmental microbiology but emphasizes clinical microbiology and immunology.

## What You'll Learn

Microbiology courses explore how microbes exist and affect our health through the study of:

- Microbial structure, classification, genomes and evolution;
- ways that microbes infect hosts and cause disease;
- impact of the microbiome on human health;
- relevance of microbes in industry and the environment;
- antimicrobial therapies and challenges; and
- techniques used to isolate, culture and identify bacteria.

Immunology courses provide students with an understanding of:

- How the immune system eliminates/controls cancer cells and microbes that cause infectious diseases;
- how defects in the immune system can lead to conditions like allergy, transplant rejection, and autoimmune diseases such as rheumatoid arthritis, type 1 diabetes, multiple sclerosis;
- vaccine strategies and challenges; and
- techniques used to evaluate immune health and measure immune responses.

FOR MORE INFORMATION:  
[www.schulich.uwo.ca/microbiologyandimmunology](http://www.schulich.uwo.ca/microbiologyandimmunology)

## DISTINGUISHING FEATURES

Within the Microbiology & Immunology and joint Honors Specialization modules, such as the Honors Specialization in Microbiology & Immunology with Pathology, students perform independent research in areas that include the development of vaccines, immunotherapeutics or antimicrobials; microbiome/probiotics in human health; immunology of multiple sclerosis, rheumatoid arthritis, allergy, cancer, graft rejection; bacterial/viral pathogenesis in HIV, toxic shock syndrome, gastrointestinal infections, cancers; antimicrobial resistance; and bacteria as biofuels and biological controls. Honors students have the option to continue research for one additional year for an accelerated MSc degree.

### International Research Experience

Our department offers unique research opportunities in Africa plus fellowships for second- and third-year students to perform independent research over the summer.



# PATHOLOGY & LABORATORY MEDICINE

Pathology is the study of human disease and involves genetic, molecular, cellular, and organ level investigation of disease processes. Scientific research is the cornerstone of pathology as understanding the disease process contributes to the development of diagnostic tests and better treatments. The practice of pathology includes the examination of tissues, isolated cells, and surgical specimens. In surgical pathology, for instance, pathologists perform microscopic examination of tissues to determine the nature of disease. The pathologist's findings and diagnosis often guide medical treatment and indicate how the patient will do.

## What You'll Learn

Knowledge about human diseases comes from both clinical and experimental pathology, through observations made on patients and patient specimens, by looking at the causes and mechanisms of disease and the effects of disease upon various organs and body systems, and via experimental studies on tissues, cell cultures or animal models to understand the mechanisms of disease initiation and progression.

FOR MORE INFORMATION:  
[www.schulich.uwo.ca/pathol](http://www.schulich.uwo.ca/pathol)

## DISTINGUISHING FEATURES

Many of our faculty are practicing pathologists and most are involved in state-of-the-art research.

### Modules in Pathology

These modules introduce students to basic principles within pathology and the effects of a variety of chemicals, drugs and toxins on living organisms. To develop an understanding of the normal body, foundational courses in biology, biochemistry, anatomy and histology, and physiology and pharmacology are taken prior to delving into the areas of abnormal structure and function. Introductory pathology courses cover basic disease processes and their appearance in specific organ systems such as the heart, lungs, and brain. Senior-level courses examine more advanced concepts in both clinical and experimental pathology and an introduction to forensic science.

### Joint Modules: An Honors Specialization in Medical Health Informatics

This specialization is offered in conjunction with the Department of Computer Science, bringing together computer sciences, the medical sciences, and healthcare. Students combine foundational courses in both the medical sciences (such as understanding the biochemistry and pathophysiology of disease) and computer sciences (in algorithms, data structures, databases, computer networks and human-computer interaction) to effectively use health-related data and implement new technologies in the health system.

# PHYSIOLOGY & PHARMACOLOGY

Physiology is the study of how the body works. It examines how living systems operate at many levels, including the molecular level; the organ and systems level; and the whole organism level and how the genome translates into function at these levels.

Pharmacology is the study of drug actions on biological systems. It embraces knowledge of the sources of drugs, chemical properties of drugs, biological effects and therapeutic uses of drugs.

## What You'll Learn

Areas of study within Physiology:

- Life processes: how they work and are regulated;
- diseases and how to treat them; and
- how living organisms cope with or adapt to different environments.

Areas of study within Pharmacology:

- How drugs work at the cellular and molecular level;
- the use of drugs as tools to dissect aspects of cell function;
- the formulation of clinical guidelines for the safe and effective use of drugs;
- how new synthetic drugs improve on existing drugs; and
- how to treat new human conditions.



## DISTINGUISHING FEATURES

The Department of Physiology and Pharmacology has many award-winning lecturers and offers an option to complete an accelerated Master's degree. In this program, eligible students can complete both their HSP in Physiology and Pharmacology and MSc in Physiology and Pharmacology in a total of 5 years.

### Honors Specialization and Specialization modules in Physiology, Pharmacology or Physiology & Pharmacology

The undergraduate labs in Physiology and Pharmacology allow students to design and conduct experiments to determine how our body systems function and how drugs can intervene to treat disease. These labs are conducted in a state-of-the-art, recently renovated space. In addition, students in our Honors Specialization modules work on a research project alongside a faculty member in an attempt to advance the treatment of disease. Students in the fourth year of the Honors Specialization programs have a diverse selection of course offerings that specialize in important areas of physiology and pharmacology. Examples include neurophysiology/pharmacology, reproductive and fetal physiology, skeletal physiology, clinical pharmacology, cardiovascular physiology, and pharmacology. These fourth-year classes build off a systems-based approach used to teach physiology and pharmacology in the third year of the programs.

FOR MORE INFORMATION:  
[www.schulich.uwo.ca/physpharm](http://www.schulich.uwo.ca/physpharm)

# INTERDISCIPLINARY MEDICAL SCIENCES



## DISTINGUISHING FEATURES

### Honors Specialization Module

IMS is the choice for approximately 40% of the students enrolled in the BSc program. The flexibility to study at least two basic medical science disciplines is a major attraction of this module. During Years 3 and 4, students take several basic medical science courses, including a required third-year laboratory course. In Year 4, students complete an interdisciplinary disease-focused lecture and laboratory course, as well as advanced level courses in the basic medical sciences.

Students in IMS can graduate in five years with two honors degrees by combining a BSc degree (Honors Specialization in IMS) and an HBA degree (Business Administration) in conjunction with the Ivey Business School.

Greater flexibility in third-year course selection facilitates participation in high impact learning opportunities like Western's international exchanges.

Interdisciplinary Medical Sciences (IMS) modules are designed for students who want to study more than one of the basic medical science disciplines. Undergraduates pursuing this option study at least two disciplines at an advanced (fourth year) level and gain a broad foundation in the basic medical science disciplines.

## What You'll Learn

Our students are exposed to cutting-edge research by world-renowned scientists and clinicians and experience a wide variety of hands-on laboratory techniques used in medical research.

FOR MORE INFORMATION:  
[www.schulich.uwo.ca/bmsc/ims](http://www.schulich.uwo.ca/bmsc/ims)



# NEUROSCIENCE

Neuroscience asks questions about the brain, mind, and behaviour using the methods of cellular and molecular biology, genetics, imaging, and cognitive science. Neuroscience is an interdisciplinary field undergoing rapid growth leading to new discoveries about the fundamental biology of the nervous system, the neural mechanisms of perception, memory and consciousness, and the causes and treatments of diseases and disorders of the brain and nervous system.

FOR MORE INFORMATION:  
[www.schulich.uwo.ca/neuroscience](http://www.schulich.uwo.ca/neuroscience)

## DISTINGUISHING FEATURES

Neuroscience at Western is an interdisciplinary program that brings together the strengths of many fields of science ranging from basic science to human imaging. Western faculty from Psychology, Science, the Schulich School of Medicine & Dentistry, the Robarts Research Institute, the Brain and Mind Institute, and clinical departments participate in the program, providing a wealth of knowledge and learning opportunities. Entry into the program can be through Science, Medical Sciences or Social Science. Enrolment is competitive and limited to 30 students.

### Honors Specialization in Neuroscience

- The Honors Specialization emphasizes a diversity of approaches, critical evaluation of current research and opportunities for research experience, and leads to a Bachelor of Science (BSc) Honors degree granted by the Schulich School of Medicine & Dentistry.
- Professors from across the three faculties collaborate to offer the courses and research opportunities in world-leading research laboratories.



# MODULES AT A GLANCE

A module is a collection of courses that defines an area of study. The number of courses included in the module is defined by the amount of specialization in the topic.

There are four possible modules of study which may be entered after first year:

- Honors Specialization (9.0 or more specified courses)
- Specialization (9.0 or more specified courses)
- Major (6.0 – 7.0 specified courses)
- Minor (4.0 – 5.0 specified courses)

Modules can be combined in three different degree-types:

DEGREE TYPE	MODULE COMBINATIONS
<b>Honors Bachelor Degree</b> (4 Years/20 Courses)	<ul style="list-style-type: none"> <li>• Honors Specialization</li> <li>• Honors Specialization–Major</li> </ul>
<b>Bachelor Degree</b> (4 Years/20 Courses)	<ul style="list-style-type: none"> <li>• Honors Specialization–Minor</li> <li>• Major–Major</li> </ul>
<b>Bachelor Degree</b> (3 Years/15 Courses)	<ul style="list-style-type: none"> <li>• Specialization</li> <li>• Specialization–Major</li> <li>• Specialization–Minor</li> <li>• Major–Major</li> <li>• Major</li> <li>• Major–Minor</li> <li>• Major–Minor–Minor</li> <li>• Minor–Minor</li> </ul>

## Applied Mathematics

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
Applied Mathematics	•	•	•	•
Applied Mathematical Methods			•	
Mathematical Sciences <sup>1</sup>	•			
Mathematical and Numerical Methods				•
Scientific Computing and Numerical Methods			•	
Theoretical Physics <sup>2</sup>			•	

1. Offered jointly with the Department of Mathematics.
2. Can only be completed in combination with a Minor or Major in Applied Mathematics.

## Biology

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
Biodiversity and Conservation	•			
Biology	•	•	•	•
Genetics	•		•	•
INTERDISCIPLINARY MODULES				
Animal Behaviour <sup>1</sup>	•			
Geology and Biology <sup>2</sup>	•	•		
Ecosystem Health <sup>3</sup>			•	
Genetics and Biochemistry <sup>4</sup>	•			

1. Offered jointly with the Department of Psychology.
2. Offered jointly with the Department of Earth Sciences.
3. Offered jointly with the Department of Environmental Science.
4. Offered jointly with the Department of Biochemistry.

## Chemistry

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
Chemistry	•	•	•	•
Advanced Chemistry <sup>1</sup>				•
INTERDISCIPLINARY MODULES				
Biochemistry and Chemistry <sup>2</sup>	•			
Chemical Biology <sup>2,3</sup>	•			
Materials Science	•	•	•	•

1. Can only be completed in combination with an Honors Specialization in Chemistry, a Specialization in Chemistry or an Honors Specialization in Biochemistry and Chemistry.
2. Offered jointly with the Department of Biochemistry.
3. May be completed only within the BMSc program.

## Computer Science

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
Computer Science <sup>1</sup>	•	•	•	•
Information Systems	•			
Applications of Computer Science				•
Software Engineering <sup>2,3</sup>				•
Computer Algebra <sup>4</sup>				•
Theoretical Computer Science <sup>4</sup>				•
Game Development <sup>5</sup>				•
High-Performance Computing				•
INTERDISCIPLINARY MODULES				
Bioinformatics <sup>3</sup>	•			
Medical Health Informatics <sup>6</sup>	•			
Digital Humanities <sup>7</sup>				•

1. The Honors Specialization and Specialization lead to accredited degrees by the Computer Science Accreditation Council.
2. Can only be completed in combination with an Honors Specialization or Specialization in Computer Science.
3. Leads to accredited degrees by the Computer Science Accreditation Council.
4. Can only be completed in combination with an Honors Specialization in Computer Science.
5. Can only be completed in combination with an Honors Specialization, Specialization or Major in Computer Science.
6. May be completed only within the BMSc program.
7. Offered jointly with the Departments of Modern Languages and Literatures.



## Earth Sciences

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
Geology	•	•	•	•
Geophysics	•	•	•	•
INTERDISCIPLINARY MODULES				
Environmental Geoscience	•	•		
Geology and Biology	•	•		
Planetary Science and Space Exploration				•

### EARTH SCIENCE PROGRAMS FOR PROFESSIONAL REGISTRATION

Honors Geology Program	Honors Environmental Geoscience Program	Honors Geophysics Program

These programs fulfill requirements for professional registration as set by the Association of Professional Geoscientists of Ontario (APGO) and the Canadian Council of Professional Geoscientists (CCPG).

## Physics and Astronomy

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
Physics	•	•	•	•
Astrophysics	•	•	•	
Medical Physics	•	•	•	
Advanced Physics <sup>1</sup>				•
Physics of Materials <sup>2</sup>				•
Conceptual Astronomy				•
INTERDISCIPLINARY MODULES				
Materials Science	•	•	•	•

1. May only be completed in combination with an Honors Specialization or Specialization in Physics, Astrophysics or Medical Physics.
2. May only be completed in combination with an Honors Specialization or Specialization in Physics.

## Environmental Science

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
Environmental Science	•	•	•	•

## Mathematics

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
Mathematics	•	•	•	•
Mathematics in Society	•	•		
Mathematical Sciences <sup>1</sup>	•			

1. Offered jointly with the Department of Applied Mathematics.

## Statistical and Actuarial Sciences

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
Actuarial Science	•		•	
Statistics	•			
Applied Statistics			•	
Financial Modelling	•		•	

## Basic Medical Sciences

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
Biochemistry	•	•	•	•
Biochemistry and Cell Biology	•			
Biochemistry of Infection and Immunity	•			
Biochemistry and Pathology of Human Disease	•			
Chemical Biology	•			
Computational Biochemistry	•			
Epidemiology and Biostatistics	•		•	
Interdisciplinary Medical Sciences	•	•	•	
Medical Biophysics (Clinical Physics Concentration)	•			
Medical Biophysics (Medical Science Concentration)	•	•	•	•
Medical Biophysics and Biochemistry	•			
Medical Cell Biology	•		•	•
Medical Health Informatics	•			
Microbiology and Immunology	•	•	•	•
Microbiology and Immunology with Pathology	•			

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
One Health	•			
Pathology	•	•	•	
Pharmacology	•	•	•	•
Physiology	•	•	•	
Physiology and Pharmacology	•	•		

**Note:** A degree containing one of the Honors Specialization modules above will lead to a BSc (Honors) degree. Students completing one of the Specialization modules above will graduate with a 4-year BSc (non-Honors) degree. Completion of two of the Majors above will lead to either a BSc (Honors) or a 4-year BSc degree, depending on the marks achieved. The IMS and Pathology Major modules must be completed in a BSc degree. Any of the other Major modules or Minor module(s) above can be completed in other degree types, such as Bachelor of Science (BSc) or Bachelor of Arts (BA). The majority of BSc students choose to complete Honors Specialization modules and some elect to complete an additional Major or Minor module from either the Basic Medical Sciences or another faculty.

### MODULES LEADING TO A BSc DEGREE

MODULE	HONORS SPECIALIZATION	SPECIALIZATION	MAJOR	MINOR
Biochemistry and Chemistry	•			
Genetics and Biochemistry	•			
Medical and Biophysics (Biological Concentration)	•			
Medical Biophysics (Physical Science Concentration)	•			
Neuroscience	•			
Medical Sciences			•	•

The Major in Medical Sciences cannot be completed in combination with any of the following Majors: Biochemistry, Medical Biophysics, Medical Cell Biology, Microbiology and Immunology, Pharmacology, Physiology.



# STUDENT EXPERIENCE

Get Involved with the Science Community at Western



## Science Students' Council

A fundamental element of the Western student experience is the broad range of activities available to students. There are plenty of clubs, societies, and organizations that offer many possibilities for students with varied interests. These extracurriculars are closely intertwined with and managed by student governance.

**The University Students' Council (USC)** is the student government for all Western undergraduates. The USC provides extensive services and programming including a very successful and exciting orientation program, the largest of its kind in Canada.

**The Science Students' Council (SSC)** is a subset of the USC and represents all Science and Basic Medical Sciences undergraduates. It serves as an important link to faculty, academic counsellors, and program-specific clubs. The council provides information and services to inform and engage undergraduates in their current education and future career goals. The SSC also offers a new service called Sci-Wiki that provides the student perspective on courses science students are likely to take.

The SSC organizes events that allow students to showcase their talents, raise money and awareness for noteworthy causes, or enjoy fun times and make lasting memories. Our website keeps science students apprised of these available opportunities.

In general, the SSC is composed of elected representatives and appointed commissioners. Representatives are tasked with voicing the students' opinion to the SSC and other university bodies while commissioners are responsible for specific events or services.

Several opportunities exist for first-year students to participate in Council. They may run for first-year representative positions or take part in many committees. SSC committees manage events like Science Homecoming and Science Formal, allocate financial awards to deserving students, and much more!

FOR MORE INFORMATION:  
[www.westernssc.ca](http://www.westernssc.ca)

## Extracurricular Clubs

There are almost 170 official clubs covering a wide range of interests along with 38 varsity sports teams, and an intramural sports program at Western. Students interested in varsity athletics are advised to contact the appropriate coach or the Intercollegiate Athletics Office [www.westernmustangs.ca](http://www.westernmustangs.ca) as soon as possible, as many sports have try-outs well before September.

Many departments have clubs and associations run by students. These societies are often a source of academic help, seminars, instructional material, job search information, outreach activities and social events specific to their departments.

FOR MORE INFORMATION:  
[www.westernusc.ca/clubs/list](http://www.westernusc.ca/clubs/list)

## Student Science Clubs and Associations

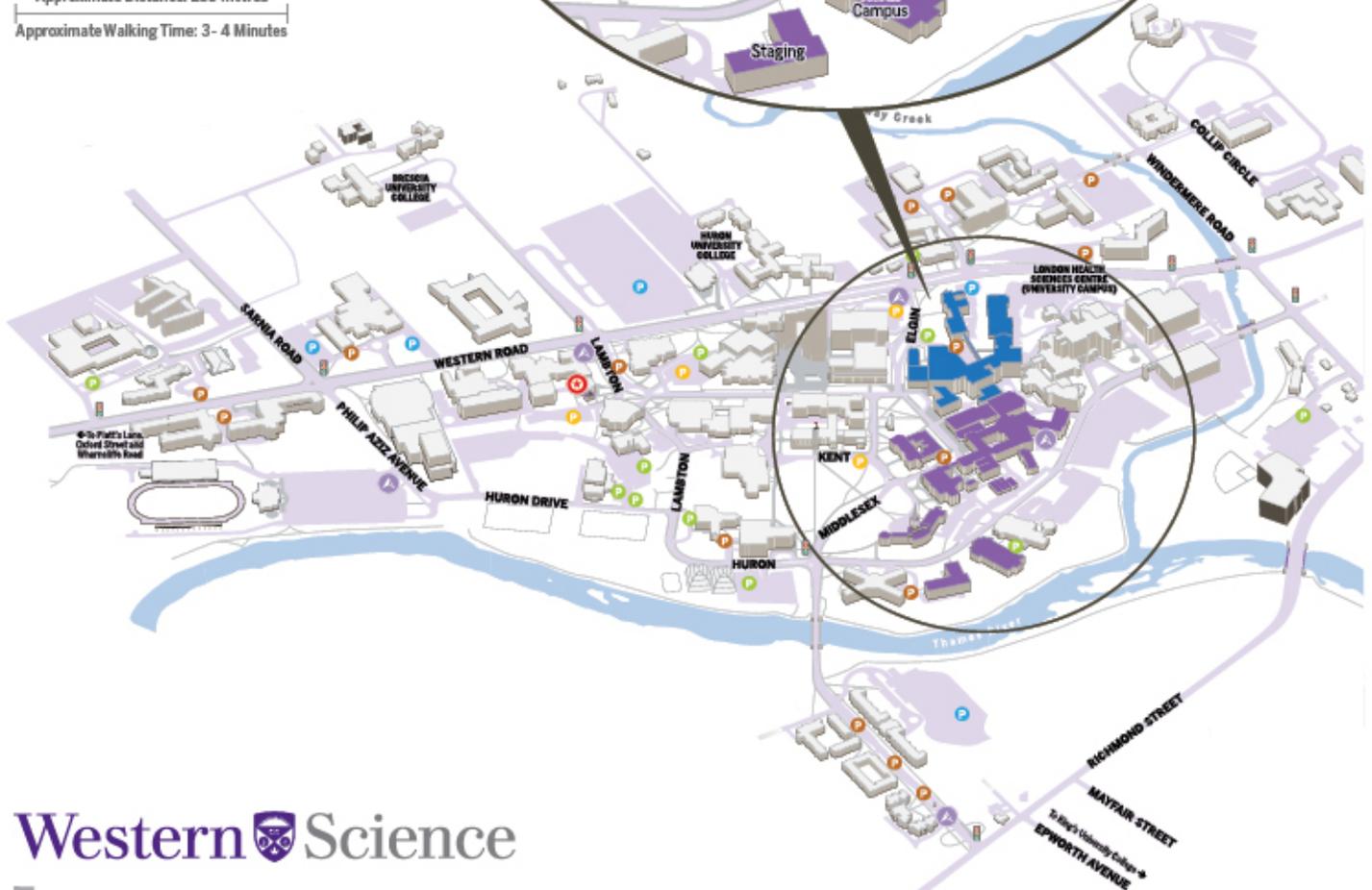
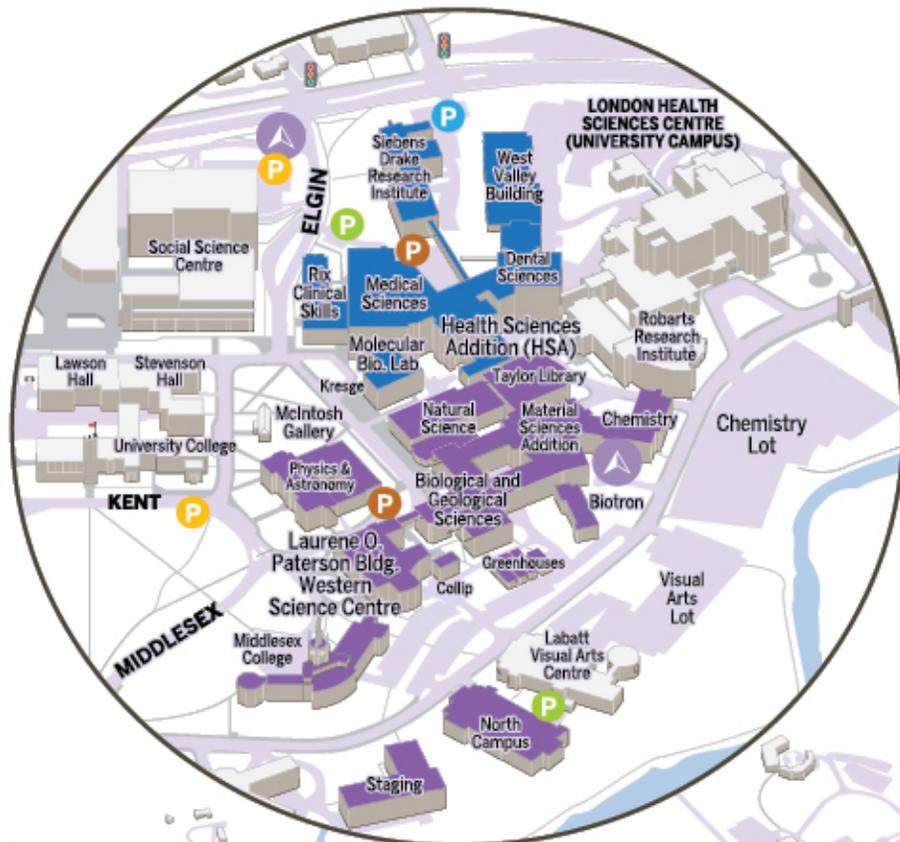
- The Applied Mathematics Society
- The Biology Undergraduate Society
- The Chem Club
- The Computer Science Association
- The Outcrop Club (Earth Sciences)
- The Physics and Astronomy Student Association
- The Actuarial and Statistical Undergraduate Association
- Bachelor of Medical Sciences Student Association
- Pre-Medical Society
- Pre-Dental Society

## LEGEND & PARKING

- Parking available in every lot
- Free weekend parking available (Fridays 5pm - Sunday evening)
- Visitor parking
- Metered parking
- Pay and display parking (credit card capable & exact change)
- Science building
- Medical Science building
- Traffic Light
- Wayfinding map
- Campus tours start at Cronyn Observatory
- One-way traffic
- Paved walkway
- Gravel path

Approximate Distance: 250 metres

Approximate Walking Time: 3 - 4 Minutes



# Western Science

## CONTACT INFORMATION

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