AT A GLANCE

DISCIPLINES

Biochemistry
Cell & Molecular Biology
Ecology & Evolutionary Biology
Neuroscience
Physiology
Plant Biology

RESEARCH STRENGTHS

Biological Dynamics of Environmental Change
Cells & Infection
Integrative Behaviour & Neuroscience
Neurobiology of Stress
Plant Cellular & Molecular Processes
Physiology

Think: *Discovery*

Biological Sciences

Working with international partners such as the International Rice Research Institute in the Philippines, Professor Herbert Kronzucker and his research team study the nutrient flow of rice at the cellular level. Their work aims to improve crop yields and, ultimately, the planet's food supply.

Biological Sciences at the University of Toronto Scarborough focuses on a detailed investigation of the natural world. From health to agriculture, from the microscopic to the global, our biologists are well engaged in the issues that will concern society for years to come. And as researchers and educators, our faculty are committed to making a difference.

Biological Sciences research and teaching at UTSC covers the full breadth of biology, from the molecular to entire ecosystems and from human-centric aspects to the floral and fauna of the Canadian environment. The choice of student experiences too is broad, from traditional disciplines to interdepartmental options, from co-op and joint programs to Science Engagement experiential learning.

The department is committed to excellence in scholarship and publishes in the premier national and international journals in many areas of contemporary biology. Critical mass has been built in several research nodes, which has enhanced UTSC's unique strengths as well as facilitated collaborative research efforts critical to today's research environment.

Five research clusters comprise the department: Biological Dynamics of Environmental Change; Cells and Infection; Integrative Behaviour and Neuroscience; Neurobiology of Stress; and Plant Cellular and Molecular Processes. We are currently involved in adding a sixth – Physiology – which will strengthen organismal biology scholarship and teaching within the department.

Every member of our Biological Science faculty conducts externally funded research and 4 out of the 20 faculty hold Canada Research Chairs (CRC).

One visible aspect of the intensity of research at UTSC has been the opportunities generated by the new Science Research Building (SRB), which has enabled a cluster of our plant biology scientists to work in six adjoining cellular molecular biology labs with an open-concept layout that encourages interaction.

The SRB also made possible the construction of new state-of-the-art plant growth rooms. With a $200,000 investment from the Canada Foundation for Innovation (CFI), these climate-controlled rooms allow scientists such as Professor Herbert Kronzucker, for instance, to replicate the tropical conditions for growing rice.

Renovated space freed in the original Science Wing now houses other research teams. Of special significance is the upgrade – also made possible by CFI funding – to the Centre for the Neurobiology of Stress, which benefits from the contributions of two Canada Research Chairs – professors Ian Brown and Michelle Aarts.

UTSC has another core group of faculty, at the Centre for Integrative Behaviour & Neuroscience, led by another neuroscience Canada Research Chair on campus, Professor Maydianne Andrade.

The aging of North American populations is putting ever-increasing pressures on the health care system. Therefore, research in neuroscience – one of the central disciplines supporting advances in health care and medicine – is critical to meeting those demands and will likely remain a high priority for scholarship and funding in the long term. Within this vast field, UTSC's strengths in major sub-disciplines have made neuroscience a cornerstone of our research and teaching in Biological Sciences. >

Experiential learning at the cellular level

Biotechnology – the use of biological information in technology applications – has significant potential to contribute to Canada's innovation economy. Our country ranks second after the U.S. in terms of the number of firms headquartered here, of which 80 percent are in the Greater Toronto Area. And the demand for qualified scientists has exploded, whereas supply has not kept pace.

Biological Sciences Professor Clare Hasenkampf recognized the opportunity that this presented for her students and, in 2003, helped launch a co-op program in Cell and Molecular Biology to give talented students a head start on their careers.

UTSC designed the program to develop a high standard of professionalism in our students, as well as meet industry needs. Statistics and computer courses, for example, were added to the academic program in response to requests from employers. So that students are qualified for the best work opportunities, our program requires two years of classroom education before job placements begin.

Students have received job placements at Health Canada, pharmaceutical firms and, more recently, the University of Toronto's Structural Genomics Consortium at the MaRS Centre, where students help produce vaccines and participate in investigations of the role of proteins in diseases.

Attracting some of the university's best incoming students, the Cell and Molecular Biology program typically provides two four-month work placements or, occasionally, an eight-month placement, which offers more continuity on the job.

"Co-op helps enrich the experience for students," says Hasenkampf. "They go out and find out why those skills and subjects they are learning are important and they come back highly motivated. The biotechnology industry benefits from having good employees and, ultimately, the people who will make a difference in [its] future."

Co-op student Zhifen Zhang at the MaRS Centre, where she is working on test expression, protein purification and cloning for the Structural Genomics Consortium.

This expertise allowed us to develop the highly successful undergraduate program in neuroscience, which is unique to the University of Toronto and shared by UTSC's departments of Biological Sciences and Psychology. Plans are underway for a graduate program in neuroscience, whose administrative and intellectual home will be here at UTSC.

With so many top researchers on campus, the department is active in the on-campus training of future scientists, which currently includes 50 MSc and PhD graduate students and 20 post-doctoral fellows, research assistants and technicians. It also means we are able to offer a richer, more comprehensive experience for our undergraduates.

Professor Clare Hasekampf exemplifies our commitment to teaching in Biological Sciences. Hasenkampf helped found the first-year program Foundation Skills for Scientists and a Science Engagement program that sends out UTSC students to high schools to inspire the next generation. For her efforts, she has been recognized with numerous awards, including the Ontario Ministry of Training, Colleges and Universities' Leadership in Faculty Teaching (LIFT) Award.

In fall 2008, faculty began making presentations on their research projects and the scientific process to students in second-year tutorials. These presentations gave biology students vital early insights into both the powers and limitations of research. We expect that, with an early exposure to research, more students will seek lab placements or summer research work funded through the Natural Sciences and Engineering Research Council of Canada (NSERC). This year, more than 80 UTSC students benefitted from these opportunities.

As well, our upper-year Biological Sciences students typically engage in eight-month independent research projects, interacting one-on-one with faculty and early-career scientists in a Principal Investigator's lab. Last year, 45 senior students gained this experience. For many of our students, such experiences were a high point of their undergraduate years. •

Undergraduate student Nirusan Rajakulendran conducts plant biochemical analyses as part of his fourth-year research project course in the laboratory of Professor Greg Vanlerberghe.

Bone cells in space

Professor Rene Harrison (pictured below, centre) has shown her students that research can be, literally, out of this world. In Harrison's second- and fourth-year classes, cell biology comes to life through stories of her research experiment launched into space on-board a Russian rocket.

In fall 2007, experiments from Harrison's cell biology lab went on a 12-day unmanned space flight as part of an international mission to learn more about bone loss and osteoporosis. A joint study between the Canadian Space Agency and the European Space Agency (ESA), the experiments were the first done on living cells in space without on-site supervision by astronauts.

Through that collaborative project, Harrison's team hopes to learn more about disuse osteoporosis, wherein patients lose bone mass by being bedridden or paralyzed and not weight-bearing. Astronauts suffer a similar affliction in the weightlessness of deep space – a condition that is not rectified even five years after they return to Earth.

"When the undergraduate students see my graduate students – who are their TAs [teaching assistants] – and they hear me say that they did this experiment, the science becomes a lot more meaningful to to them," notes Harrison.

Harrison worked with PhD student Noushin Nabavi and research assistant and technician Arian Khandani. The trio were based in the Netherlands, at ESA's new microgravity space lab, and living bone cells were launched from a remote site in Baikonur, Kazakhstan. After re-entry, the cells were brought back to UTSC, where Harrison has engaged her undergraduate students at every stage—from her early hypothesis to prototype demonstrations and hands-on lab work.

Since her arrival at UTSC in 2003, Harrison's research program has drawn $2.6 million in research-grant support.

"Being able to bring your own research into the classroom has a much more profound effect than talking about somebody else's work."

– Professor Rene Harrison

Research to address world hunger

The challenge of feeding the world has become a daunting and pressing concern. Because we are consuming more food than we produce, food stockpiles are falling rapidly and prices are rising in many of the world's most vulnerable regions, while hoarding and market speculation compound the problem.

"The fundamental issue of our time is that the rate of human population growth is outpacing the rate at which crop increases are growing – by about threefold," says Herbert Kronzucker, Professor of Biological Sciences and Canada Research Chair in Metabolic Bioengineering of Crop Plants.

Kronzucker leads a research team studying the transport of ions across membranes in plant root systems, with the goal of improving the flow of nutrients and reducing toxic intrusions, like salt. Kronzucker's focus is on rice, a non-model plant that's difficult to investigate, yet warrants the effort, as over three billion people receive more than 70 percent of their food calories just from this one crop. The UTSC lab, which is unrivalled in its use of radioisotopes, has discovered phenomena at rice's cellular level that have not been visible to scientists until now.

PhD student Lasse Schulze uses a radioactive Na+ tracer from the McMaster Nuclear Reactor to test salt tolerance in rice in UTSC's new climate-controlled plant growth room.

The larger-plant biology group at UTSC maintains a range of diverse research programs related to central issues of plant productivity – tolerance toward biotic and abiotic stress, the genetics of development and reproduction, and nutrient acquisition. This cluster of research excellence positions UTSC to take a leading role in addressing the issue of world hunger. A proposal is underway to create a centre dedicated to world hunger research that would bring together experts from multiple disciplines to contribute their perspectives on the complex, multifaceted problem of world hunger.

"Students often say they want to attend medical school because they want to help people," says Kronzucker, "and I respond, 'If that is your motivation, you may find [that] the radius of people you can help can be far greater in other scientific pursuits.' "