AT A GLANCE

DISCIPLINES

Chemistry
Environmental Science
Physics
Astronomy

RESEARCH STRENGTHS

Environmental Chemistry
Biological Chemistry
Biological, Chemical, & Physical Processes in the Environment
General Relativity, Planetary System Formation & the Evolution of Planetary Interiors

Think: *Sustainable*

Physical & Environmental Sciences

Rarely offered at Canadian universities, field camp courses at UTSC help students learn hands-on skills to assess environmental problems first-hand. Faculty conduct UTSC courses across North America, from Arizona to the Canadian Rockies in Western Canada and Ontario's Algonquin Provincial Park, as well as Costa Rica.

In collaboration with Fisheries and Oceans Canada, Professor Mathew Wells uses fluorescent tracer dye in Goderich Harbour on Lake Huron to study the dispersion of ship ballast water and the factors that affect the survival of invasive species, such as zebra mussels and spiny water fleas.

Pressures on the planet generated by human activity are posing major challenges to science – challenges that could alter life on Earth. In Physical and Environmental Sciences, solutions to these challenges provide the thrust behind some of the most distinctive research projects and course programs at the University of Toronto Scarborough.

Universities, business and government are all tackling environmental problems and developing adaptive and mitigative strategies to minimize the negative impact of human activity on the environment. Such endeavours have sparked the surge in collaborative research and jobs in the environmental industry. At UTSC, our scientists are leaders in cutting-edge research that will result in a more sustainable planet, providing inspiration to a new generation of students to follow their lead.

Built on disciplinary strength, the multidisciplinary structure of Physical and Environmental Sciences at UTSC has given the department a strategic edge in the pursuit of solutions, and our major research initiatives have been enhancing the global understanding of environmental issues.

For example, our research has yielded insights into the reasons why certain chemical contaminants bio-concentrate to toxic levels, while others do not. Another UTSC research project is involved in the study of the role of soil in the carbon cycle, which includes analyzing how climate change might cause Arctic soils to release large quantities of stored carbon into the atmosphere.

But in order to achieve progress in addressing environmental concerns, fine minds must also be marshalled to focus on solutions. At UTSC, our recently hired Physical and Environmental Sciences faculty members are building on the department's strengths in research as well as in the teaching field, particularly in Environmental Science, Planetary Physics and Biological Chemistry while maintaining the university's level of excellence and broadening the diversity of its fields of expertise. Seven new faculty have joined the department since 2007, with two more searches underway – an increase of almost 40 percent in teaching faculty. One such new faculty member is Dr. Carl Mitchell, who joined the department in mid-2008 after a year at the Smithsonian Institution in Maryland. Dr. Mitchell's research specialty is the transport and fate of mercury in the environment.

Another significant achievement for the department is the relocation of a large research group to the new state-of-the-art Science Research Building and the renovation of the freed-up space. The enhanced facilities enable us to bring together groups involved in related research – mainly environmental chemists, biologists, and microbiologists working on environmental problems. Graduate students also play an integral part in this multidisciplinary department's research, and their close proximity to faculty here will promote a dynamic interchange of ideas.

Members of the Environmental Chemistry group are currently investigating how chemical contaminants are transported and distributed in soils, sediments, water and the atmosphere. Other researchers are developing novel analytical approaches utilizing nuclear magnetic resonance (NMR) and magnetic resonance imaging (MRI), and then >

A distinctive blend of academic and professional

Now in its third year, the **Master of Environmental Science Program** at UTSC has been gaining recognition as a significant mark of excellence. This one-year graduate program aims to provide skills that are in high demand in the environmental industry in both the public and private sectors. It is attracting high-calibre students from across Canada, and the number of applications has been exceeding projections.

Offering a unique balance of academic and professional content, the program features a four-month paid internship that places students in a broad range of private-industry settings or in government departments at all levels. As a result, students acquire exceptional work experience, often receiving offers of full-time employment at the end of their internship. Those students who choose the Research Paper option, which involves working with a faculty advisor, often pursue further graduate degrees.

The program's courses are delivered by our professorial faculty and a select number of practitioners with years of solid experience in their particular fields.

Students analyze samples in the lab, sample the biota in the Highland Creek on the UTSC campus and participate in a field camp on Lake Opeongo in Algonquin Park.

applying those approaches in assessing environmental stress in living systems. Professor Frank Wania and his team have made major advances in research on the transport of low-volatility organic chemicals and have developed an inexpensive new passive sampling technique for the remote monitoring of airborne contaminants at low concentrations. This technique has since been adopted by researchers around the world.

Another new departmental initiative is the raising of the level of Biological Chemistry – the interface of biology and chemistry. A rapidly evolving science with major impacts in the fields of medicine, the environment and the food industry, Biological Chemistry has become our most popular undergraduate program.

In Physics & Astronomy, our research strengths are wide-ranging, from theoretical work to high-performance computing. Faculty interpret ground-based and space-borne observations of astrophysical objects, propose novel theories about how planets evolve, and use supercomputers to run large-scale particle-based and continuum fluid-dynamics models.

UTSC research in Environmental Science is investigating biological, chemical and physical processes in air, soil and water. Our researchers are involved in significant fieldwork and remote sensing in geology, hydrology, physical limnology, coastal geomorphology and groundwater. They also conduct modelling studies on aquatic ecology and the dynamics of oceans and climate. Advanced laboratory techniques explore microbial ecology and the fate and behaviour of chemicals in the environment.

The department also offers programs in Chemistry, Environmental Science, Physics and Astronomy. Many of these programs are available as a co-op option – a mode of learning in which UTSC has demonstrated leadership within the larger context of universities. Another distinctive achievement of the department is our Joint Program in Environmental Science and Technology, a collaboration with Centennial College. Combining a solid science education with practical technical and applied courses for environment and industrial settings, this program now has a solid five-year track record and recently received a positive external review. Graduates earn both a UTSC Bachelor of Science degree and a Centennial College diploma in Environmental Protection Technology.

Also unique is our innovative five-year Concurrent Teacher Education Program (CTEP), which leads to both a BEd and BSc upon graduation. We believe that this approach is the preferred path for a science teaching career. •

Professor Myrna Simpson used soil from the valley at UTSC to conduct groundbreaking research that showed unequivocally that global warming will alter soil processes and composition.

Shedding light on the Earth's surface

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Professor Nicholas Eyles is a glacial geologist involved in the study of the formation of ice and rock over millions of years and its impact on climate change and the evolution of humans as a species.

Professor Eyles has also made a difference in the public domain. He served as the scientific authority on the CBC-TV series Geologic Journey, a five-part documentary on the geology of Canada. Seen by 20 million viewers, the series, hosted by ecologist David Suzuki, also aired on Discovery Channel. Its companion book – *Canada Rocks: The Geologic Journey* – co-written by Eyles and his colleague Professor Andrew Miall, became a Canadian best-seller. Two follow-up series, each in four parts, will be produced in 2009 – one on world geology and the other on oceans.

The ability of Eyles to engage people in geology also extends to his classroom. "All my classes, even in first year, get people into the field, so they can see the significance of rocks in ancient landscapes. It sticks with them," explains Eyles. "They look at their area – their country – in a different way."

Professor Nick Eyles (centre) on location in the Canadian Rockies with the film crew from CBC-TV's *The Nature of Things*.

Will we run out of soil before we run out of oil?

In her groundbreaking research on the chemical nature of soil, Myrna Simpson, Professor of Environmental Chemistry, and her research collaborators – professors Dudley Williams and André Simpson – have been the first to show that global warming changes the molecular structure of organic matter in soil. As a testament to the importance of this discovery, her findings were recently published in the prestigious journal *Nature Geoscience*.

It's essential to understand how global warming affects soil composition because such an impact could significantly hinder the ability of agriculture to feed the world. Organic matter is central to soil fertility, as it allows soil to retain water and prevent erosion. Through the carbon cycle, soil holds twice as much carbon dioxide than what is found in the atmosphere.

"We need to look closely at what is happening to [soil's] organic-matter composition," notes Simpson, "because the more detailed you get, the better you can predict the future."

Prior to the research conducted by Simpson and her group, not much was known about the molecular composition of soil. Part of the reason is that soil is difficult to analyze because it has numerous components, including bacteria, fungi and an assortment of fresh, partially degraded and old plant material.

Simpson's team used an outdoor lab in the river valley of UTSC. While electrodes warmed the test soil through winter and summer seasons, soil samples were analyzed at UTSC's nuclear magnetic resonance (NMR) facility – the only NMR facility in Canada specifically dedicated to environmental research. The results of the research point to significant shifts in soil processes as a result of global warming.