

705-748-1011 ext. 7360 enls@trentu.ca
 Fax: 705-748-1026 www.trentu.ca/els

The Environmental & Life Sciences Graduate Program is an interdisciplinary program leading to either a MSc or a PhD degree in the natural sciences. It is served by faculty principally from the departments of Biology, Chemistry, Forensic Science, and School of the Environment, as well as adjunct faculty from non-governmental organizations, industry, provincial and federal government agencies. Four Canada Research Chairs and one NSERC Senior Industrial Research Chair are appointed to the program. The program serves as a broad umbrella for these disciplines to interconnect. Three Canada Research Chairs and one NSERC Senior Industrial Research Chair are appointed to the program. Students conduct research in applied and basic science and many students develop their research projects in partnership with other universities, organizations, industry and governmental agencies. The centrepiece of student training is the thesis – an original investigation in the natural sciences – augmented by seminars, a mandatory core course (for MSc students), elective courses, and the candidacy examination (for PhD students).

The program offers instruction in six areas of emphasis:

- Cell Biology and Genetics
- Stress Physiology
- Physical Geography
- Trace Contaminant Toxicology and Chemistry
- Ecosystem Biogeochemistry
- Ecology and Conservation Biology

The aim of the program is to provide students with a background in the theory and practice of environmental and biological science that will enable them to function and thrive in a variety of work environments.

Graduate Program Director

M. Dorken, BSc (Guelph), MSc (Queen's), PhD (Toronto)

FACULTY AND RESEARCH AREAS

Anthropology

J. Conolly, BA (Toronto), MA, PhD (London), *spatial ecology & conservation biology, palaeoecology*

P. Szpak, BA (McMaster), PhD (Western), *stable isotopes, palaeoecology, historical ecology, archaeological science, environmental archaeology, bone chemistry, palaeodiet, domestication and animal husbandry; North American Arctic, Peru and Chile, British Columbia, California*

Biology

D. V. Beresford, BEd (Queen's), BSc, PhD (Trent). *Role of dispersal in insect and mite populations, stable flies as pests, insects that colonize corpses*

C. Brunetti, BSc, PhD (McMaster), *molecular biology of human poxviruses*

G. Burness, BSc (Memorial), MSc (Brock), PhD (British Columbia), *animal energetics, avian physiological ecology*

M. Dorken, BSc (Guelph), MSc (Queen's), PhD (Toronto), *plant evolution and reproductive strategies*

N. Emery, BSc (Queen's), PhD (Calgary), *physiological ecology of plants*

M. Fox, BA (Pennsylvania), MEds. (Calgary), PhD (Queen's), *fish ecology, pond culture*

J. R. Freeland, BSc (Saskatchewan), MSc, PhD (Queen's), *molecular ecology, population and conservation genetics*

P. Frost, BSc (Rochester), MSc (Ohio State), PhD (Arizona State), *biological stoichiometry in aquatic ecosystems (David Schindler Professor in Aquatic Science)*

R. Huber, BSc, PhD (Toronto), *social amoeba Dictyostelium discoideum as a model system for studying the functions of proteins linked to human disease and the structure and function of the extracellular matrix (ECM)*

C. Kapron, BSc (Waterloo), MSc, PhD (McGill), *cellular and molecular mechanisms of embryonic toxicity and teratogenicity*

L. Kerr, BSc, MSc (Carleton), PhD (British Columbia), *behavioural neuroscience, cellular mechanisms, cancer growth and chemotherapeutic efficiency*

D. Murray, BSc (McGill), MSc (Alberta), PhD (Wisconsin), *mammal and amphibian ecology, population dynamics, behavioural ecology, predation, parasitism (Canada Research Chair in Integrative Wildlife Conservation)*

E. Nol, BSc (Michigan), MSc (Guelph), PhD (Toronto), *conservation ecology of birds*

J. A. Schaefer, BSc (McGill), MSc (Manitoba), PhD (Saskatchewan), *behaviour and population dynamics of terrestrial mammals*

B. White (Emeritus), BSc (Nottingham), PhD (McMaster)

P. Wilson, BSc, MSc, PhD (McMaster), *evolutionary genetics, DNA profiling (Canada Research Chair in DNA Profiling, Forensics, and Functional Genomics)*

M. A. Xenopoulos, BSc, MSc (Québec), PhD (Alberta), *global change and its effects on aquatic communities in lakes and rivers*

J. Yee, BSc, MSc, PhD (British Columbia), *molecular & biochemical parasitology*

Chemistry

- D. A. Ellis**, BSc (Glasgow), MSc (Aberdeen), MSc, PhD (Toronto), *fluorine impacts on organic compounds and their effects on dissemination in the environment*
- H. Hintelmann**, BSc, MSc, PhD (Hamburg), *fate of metals in environment, bioavailability/speciation of metals and organometals, stable isotope methods and hyphenated ICP-MS techniques*
- S. Narine**, BSc, MSc (Trent), PhD (York), *biomaterials precursor synthesis, formulation and materials characterization (NSERC Industrial Chair in Biomaterials)*
- M. Parnis**, BSc., PhD (Toronto), *estimation and application of partition coefficients in environmental fate modelling*
- S. Rafferty**, BSc (Waterloo), PhD (British Columbia), *environmental biochemistry*
- A. Vreugdenhil**, BSc, PhD (McGill), *trace contaminants, transformation of organic & non-organic contaminants*

Computing & Information Systems

- S. McConnell**, BSc, MSc, PhD (Queen's), *high performance computing, Big Data, data mining and analytics, astronomical data analysis*

Forensic Science

- C. Kyle**, BSc (Bishop's), MSc (Guelph), PhD (Alberta), *conservation and population genetics, molecular ecology*
- S. Martic**, BSc (Bishop's), MSc (McMaster), PhD (Queen's), *biological biomarker identification, detection and toxicology screening using a variety of bioanalytical and biochemical tools*
- B. J. Saville**, BSc (Guelph), MSc PhD (Toronto), *fungus genomics*
- A. B. A. Shafer**, BSc (McMaster), MSc (Acadia), PhD (Alberta), *applying genomic methods to conservation, wildlife management, and legal issues. understanding the drivers of important processes like migration and adaptation in nature*

School of the Environment

- J. Aherne**, BA (Trinity College, Dublin), MAppSc, PhD (University College Dublin), *impacts and disturbance on aquatic and terrestrial ecosystems.*
- J. M. Buttle**, BA (Toronto), PhD (Southampton), *hydrology, fluvial geomorphology*
- P. J. Dillon**, BSc, MSc, PhD (Toronto), *nutrient cycling, trace metals, acid precipitation studies*
- C. Eimers**, BSc (Toronto), MSc (Trent), PhD (Waterloo), *soil processes, water quality, hydrology and climate change*
- R. D. Evans** (Emeritus), BSc (Toronto), PhD (McGill)
- C. Furgal**, BSc (Western), MSc, PhD (Waterloo), *environmental health, planning and resource development, risk management and communication, and Arctic Indigenous issues.*
- S. E. Franklin**, BES, MA, PhD (Waterloo), *GIS*
- B. E. Hickie**, BSc (Guelph), MSc (Waterloo), PhD (Waterloo), *environmental toxicology, pharmacokinetic modelling*

P. M. Lafleur, BSc (Brandon), MSc (Trent), PhD (McMaster), *forest-atmosphere energy interactions, impacts of climatic change*

C. L. McKenna Neuman, BSc (Queen's), MSc (Guelph), PhD (Queen's), *process geomorphology, mechanics of sediment transport, periglacial/coastal aeolian geomorphology*

C. D. Metcalfe, BSc (Manitoba), MSc (New Brunswick), PhD (McMaster), *aquatic organic contaminants*

R. Ponce-Hernandez, BEng (Universidad, Chapingo), MSc (Colegio de Postgraduados), DPhil (Oxford), *geographical information systems applied to suitability and impact assessments in agricultural and forest ecosystems*

I. Power, BSc and PhD (Western), *carbon sequestration and tailings management, natural analogues for carbon mineralization, and geobiological approaches to carbon management*

K. Thompson, BSc (Western), PhD (Guelph), *microbial communities in ecosystem functioning, including SOM stability and GHG fluxes, microbial measures as biological indicators of soil health, agricultural management, industrial disturbance, climate change and land use change*

D. Wallschläger, MSc (Bochum), PhD (Bremen), *speciation of anion-forming trace meta(loid)s, particularly arsenic, selenium and chromium, in natural and industrial environments*

S. Watmough, BSc (Liverpool Polytechnic), PhD (Liverpool John Moores), *impacts of acid rain, climate change, nutrient depletion, forestry and metals on forest and lake ecosystems*

T. H. Whillans, BA (Guelph), MSc, PhD (Toronto), *fisheries, wetland ecology, renewable resource management*

Other

J. Bowman, BSc (Queen's), MSc (Laurentian), PhD (New Brunswick), *spatial population ecology, landscape ecology, ecology of mammal and bird populations (Ontario Ministry of Natural Resources)*

N. Jones, BSc (Guelph), PhD (Alberta), *fish habitat and the productive capacity of aquatic ecosystems (Ontario Ministry of Natural Resources)*

J. Nocera, BSc (Connecticut), MSc (Acadia), PhD (New Brunswick) *species-at-risk, conservation biology, behavioural ecology (Ontario Ministry of Natural Resources)*

B. Patterson, BSc (New Brunswick), MSc (Acadia), PhD (Saskatchewan), *dynamics of vertebrate predator-prey systems (Ontario Ministry of Natural Resources)*

ADJUNCT PROFESSORS

K. F. Abraham, BA (Toronto), MSc (Iowa), PhD (Queen's), *wetlands, waterfowl and wetland bird species (Ontario Ministry of Natural Resources)*

M. R. Ardakani, BSc, MSc, PhD (Azad)

G. Balch, BSc (Trent), PhD (Queen's)

H. Bates, BSc (Ottawa), PhD (Toronto)

S. Baillie, BSc (Acadia), MSc (Memorial), PhD (Massey), *molecular ecology, vertebrate evolutionary biology in freshwater fish and ecosystems*

N. Belzile, BSc, MSc, PhD (Quebec), *speciation and behaviour of toxic trace elements in aquatic systems*

G. Blouin-Demers, BSc (McGill), PhD (Carleton)

R. Boonstra, BSc (Calgary), PhD (British Columbia)

G. S. Brown, BSc (Dalhousie), MSc (Laurentian), PhD (Guelph) *population ecology of large mammals (Ontario Ministry of Natural Resources)*

D. Burke, BSc (Western), PhD (Trent), *forest and avian conservation and ecology (Ontario Ministry of Natural Resources)*

J. Canário, MSc, PhD (New University of Lisbon)

J. G. Cogley, MA (Oxford), MSc, PhD (McMaster), *hydrology, fluvial geomorphology*

G. Copp, BSc (Trent), PhD (France), *geographical variations in life-history traits of native & non-native fishes*

S. Côté, BSc (Laval), PhD (Sherbrooke)

D. H. Dang, BSc, MSc, PhD (Toulon)

J. C. Davies, BSc (Carleton), PhD (Queen's), *caribou, moose habitat, wetland creation (Ontario Ministry of Natural Resources)*

C. Davy, BSc (Guelph), MSc (Western), PhD (Toronto)

M. Donaldson, BSc (Waterloo), M. BioTech (Toronto), PhD (Trent)

E. S. Dunlop, BSc (Guelph), PhD (Toronto)

M. J. Fortin, BSc (Montreal), MSc (Montreal), PhD (State University, New York) *spatial ecology (University of Toronto)*

R. B. Georg, MSc (WWU Muenster), PhD (ETH Zurich)

C. Gibson, BSc (Dalhousie), MEng, PhD (McMaster)

T. Harner, BSc (Toronto), PhD (Toronto), *Hazardous Air Pollutants, fate & transport of organic pollutants (Ministry of Environment)*

T. J. Haxton, BSc (Guelph), MSc (Trent), PhD (Ottawa)

T. Hossie, BSc, MSc (Trent), PhD (Carleton)

D. Kaplan, BA (Clark), PhD (Harvard)

K. C. R. Kerr, BSc, PhD (Guelph)

A. Kisiala, MSc, PhD (Technology & Life Sciences, Poland)

E. Koen, BSc (Western), MSc (Ottawa), PhD (Trent), *wildlife landscape ecology*

W. H. Korver, BSc (Guelph), DVM (Ontario Veterinary College)

J. F. Koprivnjak, BSc, MSc (McGill), PhD (Atlanta, Georgia). *Spatial and temporal characterization of dissolved organic matter in natural waters*

J. Leach, BSc (Guelph), MSc, PhD (British Columbia (UBC))

D. Lesbarrères, BSc (Bordeaux), MSc (Rennes), PhD (Angers)

N. P. Lester, BA, MSc (Queen's), DPhil (Sussex), *fish ecology and fisheries science; life history traits and population dynamics of fish; effects of fish harvesting on aquatic ecosystems*

J. Liu, BMed (Shandong School of Medicine), MSc (Trent), PhD (Toronto)

N. Mandrak, BSc, MSc, PhD (Toronto), *biogeography, biodiversity and conservation biology of freshwater fishes (Department of Fisheries & Oceans)*

M. Manseau, BSc (Québec and British Columbia), MSc (Laval), PhD, (Swedish University of Agricultural sciences), PhD (Laval)

G. Mastromonaco, BSc, MSc, PhD (Guelph), *reproductive biotechnologies, stress hormone analysis*

A. Namayandeh, BSc (Windsor), MSc (York), PhD (Trent), *far north biodiversity project, taxonomy and biogeography of non-biting midges or chironomidae*

S. J. Melles, BSc (Toronto), MSc (British Columbia), PhD (Toronto)

R. Metcalfe, BA, MA (Wilfrid Laurier), PhD (Queen's), *basin-scale runoff processes in cold regions, GIS and remote sensing applications in hydrology (Ontario Ministry of Natural Resources)*

K. Newman, MChem, PhD (Wales Swansea)

B. Nickling, BA (McMaster), MA (Carleton), PhD (Ottawa)

J. Northrup, BS (Bates College), MSc (Alberta), PhD (Colorado State)

M. E. Obbard, BA (Western), MSc, PhD (Guelph), *black bear populations (Ontario Ministry of Natural Resources)*

M. Paterson, BSc (Manitoba), MA (Indiana), PhD (Dalhousie)

S. D. Petersen, BSc (Alberta), MSc (Acadia), PhD (Trent)

B. Pond, BA (York), MA, PhD (Queen's), *response of wildlife populations and ecosystems to anthropogenic disturbance, private land development (Ontario Ministry of Natural Resources)*

A. Poulain, BSc (Angers), MSc, PhD (Montréal)

J. C. Ray, BSc, MSc (Stanford), PhD (Florida), *conservation of wildlands and large mammals (Wildlife Conservation Society Canada)*

M. D. Ridgway, BSc (Miami), MSc (British Columbia), PhD (Western), *aquatic ecosystem science (Ontario Ministry of Natural Resources)*

L. Rutledge, BSc, BEd (Western), MSc (Northern British Columbia), PhD (Trent)

E. Sager, BSc, PhD (Trent), *climate change, pollution, forest and lake ecosystems*

A. Schulte-Hostedde, BSc (Western), MSc (Guelph), PhD (Western), *behavioural and evolutionary ecology (Laurentian University)*

M. Sharifi, BSc, MSc, PhD (Isfahan University of Technology), *Sustainable agriculture, nutrient management (Canada Research Chair in Sustainable Agriculture)*

P. Smith, BSc (Trent), MSc (British Columbia), PhD (Carleton)

S. Smith, BSc, PhD (McMaster)

K. Somers, BSc (Waterloo), MSc (Toronto), PhD (Western), *aquatic science, zoology, environmental monitoring and assessment (Ontario Ministry of the Environment)*

N. Stock, BSc, MSc, PhD (Waterloo), *trace contaminants, organic contaminants*

K. Storey, BSc (Calgary), PhD (British Columbia)

R. Webber, BSc, MSc, PhD (Guelph)

C. Whitfield, BSc, MSc, PhD (Trent), *catchment hydrochemistry, applied biogeochemistry*

C. Wilson, BSc (Queen's), MSc (Windsor), PhD (Guelph), *evolutionary ecology and biogeography of freshwater organisms, (Ontario Ministry of Natural Resources)*

J. Winter, BSc (Liverpool, UK), MSc (Manchester, UK), PhD (Waterloo), *human/aquatic system interactions, nutrient modeling, landscape analysis (Ontario Ministry of Environment).*

Q. Xie, BSc (Wuhan, China), MSc (Beijing), PhD (Saskatchewan), *trace elements and isotopes as environmental tracers (Trent Water Quality Centre).*

REGULATIONS

The general regulations and requirements for graduate degrees at Trent University apply to the Environmental & Life Sciences Graduate Program. Application for admission should be received by February 1 for consideration for scholarships, bursaries, and teaching assistantships for Fall admission into the program. A small number of students are admitted in January and May. Applicants should hold an undergraduate Honours degree in Biology, Environmental Chemistry, Environmental Science or Geography. Students must have a supervisor before acceptance in the program. One of the ENLS core-courses (ENLS 5100H, 5200H, 5300H, 5400H, 5500H, or 5600H) is compulsory for all first-year MSc students. Students without training in advanced statistics are strongly recommended to take ENLS 5001H too. Students are permitted to take a maximum of one half-credit reading course (ENLS 5090H). In addition to the thesis, candidates for the MSc degree will be required to complete the minimum equivalent of 1.0 course credits. The supervisory committee may specify an additional 0.5 credits, in consideration of the student's academic background and research requirements; any such requirement will be determined by the committee within 8 months of admission.

Prospective PhD students will normally have a thesis-based MSc degree. Candidates for the PhD degree will be required to complete at least 0.5 credits; the supervisory committee may require an additional 0.5 credits, determined within 8 months of admission. Applicants who have achieved excellent standing at the Honours baccalaureate level, and who wish to proceed directly to Doctoral study will enroll initially as a Master's student. If the student achieves a superior academic record and shows particular aptitude for research, the Graduate Studies Committee, on the recommendation of the Environmental & Life Sciences Graduate Program Executive, may authorize conversion to the PhD program without completion of the

MSc degree. Direct-entry PhD students (those who have passed the conversion examination) will be required to complete a minimum of 1.0 credit; the supervisory committee may require an additional 0.5 credits, determined within 8 months of the conversion examination. For both degrees, the thesis is expected to include the results of an original investigation. PhD students must enrol in the PhD candidacy examination (ENLS 6100H) at the start of their second year of study; they must undertake the oral candidacy examination within the first 16 months of study. The examination will establish, to the satisfaction of the program, that the student has an effective grasp of her/his research area. Degree candidates (MSc and PhD) have the option of submitting their thesis either in the "traditional" or "manuscript" format. Candidates must pass an oral examination in defence of their thesis research. Students must attain at least a B- (70%) in all course work to remain registered in their program. The expected time for completion is two years for the MSc, four years for the PhD, and five years for those who convert to the PhD program before completion of the MSc. All Environmental & Life Sciences (EnLS) graduate students need to establish a supervisory committee in conjunction with their thesis and research supervisor(s) within the first term. The supervisory committee will consist of 3 EnLS faculty members. They may be derived from EnLS Trent faculty, EnLS adjunct faculty, or EnLS special graduate faculty; every student supervisory committee must have a minimum of one regular (non-adjunct) Trent faculty member.

FINANCIAL SUPPORT

Full financial support is provided (minimum of six terms or the equivalent of two years of study for full-time eligible MSc students and twelve terms or the equivalent of 4 years of study for full-time eligible PhD students) in the form of teaching assistantships, research assistantships and/or scholarships. Candidates are encouraged to apply for external scholarships on their own behalf. Information on scholarships is available from the School of Graduate Studies.

For further information on financial support for graduate students, please refer to the graduate studies website: www.trentu.ca/graduatestudies/financialsupport.php.

Not all courses will be available every year. Please consult the program office for information on courses that will be offered for the upcoming academic year.

CORE COURSES

- » **ENLS 5100H: Cell biology and genetics**
This core course, which may serve as the mandatory half credit required by all first year MSc students, will challenge participants to examine their philosophy of science with particular reference to their own research in cell biology and genetics. Students also present and defend their research proposals. This credit may not be taken in addition to any of the other ENLS core courses. Excludes WEGP 500H.
- » **ENLS 5200H: Stress physiology**
This core course, which may serve as the mandatory half credit required by all first year MSc students, will challenge participants to examine their philosophy of science with particular reference to their own research in stress physiology. Students also present and defend their research proposals. This credit may not be taken in addition to any of the other ENLS core courses. Excludes WEGP 500H.
- » **ENLS 5300H: Ecology and conservation biology**
This core course, which may serve as the mandatory half credit required by all first year MSc students, will challenge participants to examine their philosophy of science with particular reference to their own research in ecology and conservation biology. Students also present and defend their research proposals. This credit may not be taken in addition to any of the other ENLS core courses. Excludes WEGP 500H.
- » **ENLS 5400H: Current themes in physical geography**
This core course, which may serve as the mandatory half credit required by all first year MSc students, will challenge participants to examine their philosophy of science with particular reference to their own research in physical geography. Students also present and defend their research proposals. This credit may not be taken in addition to any of the other ENLS core courses. Excludes WEGP 500H.
- » **ENLS 5500H: Trace contaminant toxicology and chemistry**
This core course, which may serve as the mandatory half credit required by all first year MSc students, will challenge participants to examine their philosophy of science with particular reference to their own research in trace contaminant toxicology and chemistry. Students also present and defend their research proposals. This credit may not be taken in addition to any of the other ENLS core courses. Excludes WEGP 500H.
- » **ENLS 5600H: Ecosystem biogeochemistry**
This core course, which may serve as the mandatory half credit required by all first year MSc students, will challenge participants to examine their philosophy of science with particular reference to their own research in ecosystem biogeochemistry. Students also present and defend their research proposals. This credit may not be taken in addition to any of the other ENLS core courses. Excludes WEGP 500H.

ELECTIVE COURSES

- » **ENLS 5001H: Research design and data analysis**
This course will emphasize advanced statistical techniques for use in field and laboratory studies, including applications of linear and non-linear models, analysis of variance and multivariate statistics. This course is strongly recommended for students who have not taken an advanced statistics course (e.g. analysis of variance, multivariate statistics) as an undergraduate. Prerequisite: an introductory statistics course. Excludes BIOL-ERSC 4030H.
- » **ENLS 5009H: Trends in ecology and evolution**
This course examines developments in ecology, behaviour and evolution, based upon the current journal literature. Topics include sexual selection, game theory, optimality and assessing biodiversity and ecosystem stability. Students will take an active role in the presentation of course material. Specific choice of topics to be determined by course participants. Students should have taken one course in animal behaviour and ecology. A familiarity with population genetics, ecology and basic evolutionary theory will be assumed.
- » **ENLS 5012H: Introduction to environmental models and modelling**
Development, verification and application of models, human construct to help better our understanding of real world systems, is fundamental to scientific research. The course examines key principals and processes of model development and application, offering students an introduction to modelling through exploration of the stages in the 'modelling processes'.
- » **ENLS 5015H-AMOD 5240H: Statistical aspects of modelling**
An intensive study of the application of statistical techniques to research questions and designs, introducing the use of software for data entry, data management, and statistical analysis. Topics include: multiple regression, logistic regression, analysis of variance techniques (and analysis of covariance), factor analysis, discriminant function analysis, and structural equation modelling.
- » **ENLS 5026H: Wetland restoration and creation**
This is a seminar course that explores the global literature on wetland restoration and creation. The course will compare explicitly the technological and ecological experiences with different wetland types and situations, in order to determine opportunities and limitations. At least one field trip will be required. The course assumes a basic knowledge of wetland ecology and is designed for students who have taken a first course in wetland biology or who have equivalent experience.

- » **ENLS 5028H: Communicating science**
Science exists only because scientists are writers and speakers. In this course, students will hone their skills at writing and presenting science with clarity and economy. In class, students will present science, in oral and written form, and evaluate the quality of that communication. We will emphasize that conveying science is storytelling, that modeling good writing can improve one's own writing, and that making science accessible means dispensing with jargon. Enrollment is limited.
- » **ENLS 5029H: Scientific peer review in ecology**
Peer review is central to science. In this course, students learn how to be effective reviewers, honing their critical thinking skills and improving their ability to write scientific manuscripts and grants. We review real manuscripts and proposals, discuss techniques and methods, and debate the ethics, policies, and practices.
- » **ENLS 5031H: Molecular genetic techniques and analyses**
The Natural Resources DNA Profiling & Forensic Centre provides a unique opportunity to study molecular genetic techniques in the context of genotyping through automated and robotic technology. This course covers principles of molecular genetic techniques through manual protocols relating to automated processes; analyses of DNA profiles and sequences generated from an automated dataflow.
- » **ENLS 5041H: Environmental effects monitoring in aquatic ecosystems**
A field course in Experimental Lakes Area, offered jointly by Trent University and The University of Manitoba, focused on surface waters in boreal ecosystems. The emphasis is on understanding the impacts of resource development (such as mining, forestry, hydroelectricity, oil and gas development), wastewater discharges on freshwater systems, and socio-cultural impacts, with special emphasis on First Nation, northern, and rural perspectives.
- » **ENLS 5046H: Conservation genetics**
This course will cover a range of genetics topics relating to conservation biology. Students will be expected to lead and participate in discussions of published papers and write a review paper or analysis on a selected topic. Students need some background in population genetics and familiarity with molecular genetic marker systems.
- » **ENLS 5047H: Population genetics**
This course will cover a range of topics within population genetics: its applications, history, evolution and research applications. There will be discussions of seminal and current literature and their applications. Students will be expected to lead and participate in discussion of published papers, present seminars, and write a review paper on a selected topic.
- » **ENLS 5088H: Mass spectrometry**
An Introduction to the nature, thermochemistry, and dynamics of gaseous ions in magnetic and electric fields. Operating principles of modern dynamic, multiple sector mass spectrometers will be discussed together with other analytical techniques. Collision processes between gaseous ions and neutral species, and important application areas in environmental and/or biomedical fields will be explored
- » **ENLS 5090H: Reading course**
This course is available for graduate students who wish to receive instruction on a more discipline-specific basis. The format of the course is designed by the student in consultation with the supervisor or supervisory committee. Written justification for the course must be made to the Program Director and must be arranged before registration for the course. The reading course can be a literature review or a small research project. Under exceptional circumstances, and subject to program approval, a student may register under the ENLS 5090H to take a course from another academic institution for credit. Excludes ENLS 5095H.
- » **ENLS 5091H: IIES- International Environmental Science: Topics & Issues**
The International Institute of Environmental Science (IIES) provides a platform for advanced discussion on significant international environmental issues. IIES member institutes will provide online course(s). Interested students will discuss course with their supervisor, develop a syllabus centered around the online component. Additional requirements include: weekly meetings, topic discussion, readings, a final paper and/or presentation.
- » **ENLS 5099H: Special topic course**
Courses may be offered in a variety of areas as a way of introducing students to new subject matter, research techniques or methodologies. After one year, these courses will be reviewed for inclusion in the regular program curriculum.
- » **ENLS 5380H: Gene expression**
An inquiry into the mechanisms controlling gene expression, including regulation of DNA transcription, RNA processing and splicing, RNA interference, and epigenetics. Strategies on effective reading and critical evaluation of journal articles will be discussed. The course includes a laboratory-based research project. Excludes BIOL 3350H and 4380H.
- » **ENLS 6100H: PhD candidacy exam**
Students are required to develop a research proposal for their dissertation in conjunction with their supervisory committee. Once the proposal is approved by the supervisory committee it is submitted to the program office. The proposal must be submitted between 12 and 16 months after enrolment. A candidacy exam is scheduled once it is approved by the examination committee. It is a closed oral examination in front of the examination committee. A grade of pass, fail, or pass with remediation will be given and will be noted on the transcript. Students who fail the exam will be required to leave the program.