UNIVERSITY OF TORONTO
FACULTY OF ARTS & SCIENCE

.

Faculty of Arts and Science, Major Calendar Changes, 2011-12

Appendix A: New Program Proposals

Biodiversity and Conservation Biology, BSc, Major

Department of Ecology & Evolutionary Biology

The University of Toronto is at the forefront in discovery, innovation, and teaching of biodiversity and conservation issues in Canada. Ecology and Evolutionary Biology (EEB), which conducts research and teaching in biodiversity and conservation, is at the core of this effort. The Department's collaboration with the Royal Ontario Museum (ROM) is unique in Canada; cross-appointed ROM curators are all internationally recognized experts in the taxonomy and systematics of particular groups of organisms and are at the forefront of biodiversity discovery and museum-based research. Cross-appointments from the Faculty of Forestry emphasize resource conservation and management. Partnerships with the Ministry of Natural Resources allow the Department to bridge fundamental and more applied topics and enhance our teaching.

The Department was established in 2006 and has been reviewing its offerings in line with its new mission. This new program proposal has resulted from this planning process. EEB currently sponsors three Specialist programs, with a total of about 100 students in all years: Ecology, Evolutionary Biology, and Behaviour. These three programs have existed for many years (and prior to 2006-07 were administered by Department of Zoology). The differences among these programs were small in terms of required courses for each. The faculty in EEB had a day-long retreat in Oct. 2009 to discuss undergraduate curriculum issues, where it was agreed to reduce the number of EEB Specialist programs from three to one (Ecology and Evolutionary Biology) with three defined streams (areas of concentration in Ecology, Evolutionary Biology, Behaviour).

Description and Calendar Entry

In an era of unprecedented global change, natural ecosystems are under attack and thousands of species are threatened with extinction and many more have experienced unprecedented declines. Students in the Biodiversity and Conservation Biology Major program will be equipped to aid in the response to what is perhaps humanity's most pressing challenge, the conservation of biological diversity. Students in this program will take courses in their first and second years that provide foundations in ecology, evolutionary biology, biodiversity and conservation biology, environmental biology, mathematics, and statistics. In their upper years students will obtain in-depth knowledge about the diversity of living organisms and take advanced courses in ecology, evolution, and biodiversity and conservation biology. Capstone course options at the 400-level include conceptual and practical issues in conservation biology, approaches to the study of biodiversity in a museum setting, an independent research project course, a seminar course, and field courses.

Biodiversity and Conservation Biology Major program:
(8 full courses or their equivalent, including at least 2.0 FCEs at 300+ series with at least 0.5 FCE at 400 series)

First Year (2.0 FCEs): BIO120H1; BIO130H1; MAT135Y/137Y/JMB170Y1

Higher Years:

1. 2.0 FCEs: BIO220H1 (ecology and evolutionary biology); EEB225H1 (statistics); EEB255H1 (intro to biodiversity and conservation biology); ENV234H1 (environmental biology)

2. 1.5 FCE in organismal biology (with at least 0.5 FCE from Group 1 and 0.5 FCE from Group 2) from:
   Group 1 (plant or microbial): BIO251H1; EEB 268H1, 330H1, 331H1, 337H1, 340H1
   Group 2 (animal): EEB 263Y1, 266H1, 267H1, 356H1, 360H1, 382H1, 384H1, 386H1, 388H1, 389H1

3. 0.5 FCE in evolution: EEB 318H1, 323H1, 362H1

4. 0.5 FCE in ecology from: EEB 319H1, 321H1, 328H1, 370H1; EHJ351H1

5. 0.5 FCE: EEB365H1 (biology of conservation)

6. 0.5 FCE from: BIO251H1; EEB 263Y1, 266H1, 267H1, 268H1, 318H1, 319H1, 321H1, 322H1, 323H1, 324H1, 328H1, 330H1, 331H1, 337H1, 340H1, 356H1, 360H1, 362H1, 370H1, 375H1, 382H1, 384H1, 386H1, 388H1, 389H1, 397Y1, 398H1, 399Y1, 428H1, 440H1, 459H1, 497H1/498Y1, 499Y1; ENV334H1; EHJ351H1; FOR306H1, 307H1, 413H1

7. 0.5 FCE at 400 series from: EEB465H1, 466H1; field course, EEB 401H1, 403H1, 404H1, 405H1, 406H1, 407H1, 409H1, 410H1; seminar, EEB495H1; research project (in biodiversity and/or conservation biology), EEB 497H1/498Y1/499Y1

NOTE: BIO260H1/HMB265H1 (genetics) is recommended. Note that both BIO260H1 and HMB265H1 require BIO130H1 and BIO230H1; BIO230H1 requires both CHM138H1 and CHM139H1.

Students interested in law, economics, policy, or environmental studies may choose to pair their Biodiversity and Conservation Biology Major with another Major, such as Economics, Environmental Ethics, or Environmental Studies (all three are Arts program), or Science programs (e.g., Environment programs).

Academic Context

The current “biodiversity crisis” represents perhaps the greatest threat yet encountered to the long-term cultural, societal, and economic stability of all nations. In addition to the goods we harvest from our ecosystems, we also depend on numerous services, such as water purification, pollination, pharmaceuticals, and carbon sequestration. The staggering dollar value associated with these ecosystem services has convinced even sceptics that our future health and prosperity—indeed our very survival as a species—depends on the conservation and sustainable use of our natural ecosystems. Landmark laws—the Canadian Species at Risk Act and the US Endangered Species Act—have spelled out legal responsibilities.

How to conserve species is a complex and multifaceted issue. Extinctions typically involve many factors, including habitat loss and fragmentation, small population sizes, deterioration of genetic quality, changes in behaviour, increased susceptibility to disease, and pathogen spill-over. Global climate change has added more pressure to the already daunting challenge. As humanity urgently seeks innovative ways to reduce our collective impact on our fragile planet, including controlling the growth of our own species, a new generation of scientists is stepping forward to develop imaginative strategies that can safeguard our natural heritage and secure a sustainable future.

Students in the Biodiversity and Conservation Biology Major will receive training in the relatively young,

but already firmly established, synthetic fields of biodiversity and conservation biology. They will be equipped to aid in the response to what is perhaps humanity's most pressing challenge, the conservation of biological diversity. As ecologically responsible and informed citizens, they will appreciate the increasing complexity and uncertainty of the world in which we all live, and be in a position to make informed policy and decisions about sustainable development, global environmental change, control of invasive species, and the conservation of genetic diversity and ecosystem integrity.

Successful stewardship of life on earth can succeed only when it is rooted in the basic scientific knowledge derived from the fields of ecology and evolutionary biology, which address the central question of the origin and maintenance of biological diversity, from molecules to ecosystems. Students in this program will take courses in their first and second years that provide foundations in ecology, evolutionary biology, biodiversity, conservation biology, environmental biology, mathematics, and statistics. In their upper years students will take several courses (a total of 1.5 FCEs) from which they obtain in-depth knowledge about the diversity of living organisms on earth, including courses taught by EEB faculty who are also natural history curators at the Royal Ontario Museum. Core 300-series required offerings (a total of 1.5 FCEs) include advanced courses in ecology, evolution, and biodiversity and conservation biology. Options for the required capstone course at the 400-series (0.5 FCE) include conceptual and practical issues in conservation biology, approaches to the study of biodiversity in a museum setting, an independent research project course, a seminar course, and a field course. Field biodiversity education provides urban undergraduates a rare, and for many students, their first, opportunity to experience nature directly. Field courses take place in Canada, such as at U of T's Koffler Scientific Reserve or Algonquin Park, as well as in the tropics, including the forests of Peru.

Graduates of this program will be prepared to pursue graduate studies in taxonomy and systematics, conservation biology, ecology, and evolutionary biology, as well as careers in museums, universities, colleges, primary and secondary schools, environmental consulting firms, environmental law, science journalism, national or provincial parks, zoological parks, government and non-governmental agencies, resource management agencies, private industry, research labs, and public utilities.

Learning Outcomes

At the completion of this program students will:

- Be equipped to aid in the response to what is perhaps humanity's most pressing challenge, the conservation of biological diversity.
- Appreciate the complexity and uncertainty of the world in which we live, and, as ecologically responsible and informed citizens, be in a position to make informed policy and decisions about sustainable development, global environmental change, control of invasive species, and the preservation of genetic diversity and ecosystem integrity.
- Recognize that all life has evolved and that an understanding of the central question of the origin and maintenance of biological diversity − from genomes to ecosystems − underlies all life sciences and is critical to our stewardship of life on this planet.
- Obtain an in-depth understanding of the diversity of life forms (microbes, fungi, plants, animals) and the diverse aspects of organismal biology in the natural world.
- Be exposed to a broad array of scientific approaches – including laboratory experiments, computer and mathematical modeling, and field studies – as well as have opportunities to conduct independent research projects in the laboratory and/or the field.
- Critically evaluate scientific information, use information to generate hypotheses, assess whether evidence supports their conclusions and the conclusions of others, and use this knowledge to solve problems.
- Possess an understanding of evolutionary and ecological principles so that they can make informed decisions on pressing societal issues that include human population growth, emerging diseases, global

environmental change, and, especially, the conservation of biological diversity.

- Understand that ecological and evolutionary change in biological systems requires a multidisciplinary approach and the integration of information from different levels in the hierarchy of life, from genes through organisms to ecosystems; and that a focus on any one level will often fail to provide comprehensive insight.

Degree Objectives

a. DEPTH OF KNOWLEDGE

This program gives students an in-depth understanding of principles in biodiversity and conservation biology and a strong foundation in ecological and evolutionary principles, including laboratory and field-based coursework. Depth of knowledge in biodiversity and conservation biology is achieved through eight courses: (1) A sequence of five courses (2.5 FCEs): BIO120H1 (Adaptation and Biodiversity) in first year, EEB255H1 (Introduction to Biodiversity and Conservation Biology) and BIO220H1 (From Genomes to Ecosystems in a Changing World) in second year, EEB365H1 (Biology of Conservation) in third year, and EEB465H1 or EEB466H1, advanced "issues" courses in conservation biology and biodiversity, respectively. (2) Completion of three courses (1.5 FCEs) to obtain an in-depth understanding of the diversity of living organisms. Depth of knowledge is also achieved in ecology and evolutionary biology as each student in this program will complete at least 0.5 FCE at the 300-level in ecology (from EEB 318H1, 321H1, 328H1, 370H1) and 0.5 FCE in evolution (from EEB 318H1, 323H1, 362H1). The upper-year evolution courses provide essential training in understanding the origins of biological and genetic diversity, and the implications for conservation. Through the completion of these courses, students will demonstrate a command of increasingly advanced material, use the scholarly materials and research tools relevant to biodiversity studies, conservation biology, ecology, and evolutionary biology, and learn to synthesize information from a broad range of prior learning and previous research.

b. COMPETENCIES

i. Critical and Creative Thinking

Students critically evaluate scientific information, generate hypotheses, assess whether evidence supports their conclusions and the conclusions of others, and use this knowledge to solve problems. In BIO120H1 and BIO220H1 students read the primary scientific literature, reason about data, and pose hypotheses and ways of testing these hypotheses. In the core biodiversity and conservation biology course at the 300-level (EEB365H1) students read and critique scientific papers on current conservation issues and concepts. BIO120H1, BIO220H1, EEB365H1, and EEB466H1 each have hands-on laboratories; EEB255H1 and EEB465H1 each have interactive tutorials. Students in 300+ level required courses participate in critical and creative thinking activities ranging from study and analysis of the primary literature to writing essays and lab reports where hypotheses generated and conclusions from data are developed, to oral presentations and discussions regarding conclusions drawn from the primary literature. The 300-level required core ecology and evolution courses have either weekly hands-on labs or interactive tutorials. Well developed critical and creative thinking skills are required for success in the capstone courses available at the 400-level; for example, EEB465H1 uses case studies to critically examine current conservation biology policies and practices, where students analyze and critique published reports and discuss and debate in class.

ii. Communication

Students in this program will obtain proficiency at expressing their ideas effectively in writing, as well as be required to present their work orally in their capstone 400-series course. Introductory writing instruction is provided in the laboratories in BIO120H1 and BIO220H1. ENV234H1 and many 300+ series ecology and evolutionary biology courses require students to write essays, critiques of scientific papers, or formal lab reports from activities or experiments conducted in practicals. Results of independent research project courses and field courses are usually written up in the format of a publication in a scientific journal, and are communicated via an oral presentation or scientific poster.

iii. Information Literacy
Beginning in first year (BIO120H1), students are introduced to effective strategies for finding, evaluating, and using scholarly information in the biological sciences, and this is expanded upon in BIO220H1 and upper-year EEB courses. Through the requirement of writing essays, reports, and/or critiques, students in this program become familiar with the primary databases used in conservation biology, ecology, and evolutionary biology; learn to evaluate resources for relevance, authority, and reliability, including information available on the web; synthesize information from various sources; understand the importance of expressing thoughts in their own words and citing sources appropriately; and learn to analyze information to test a particular hypothesis.

iv. Quantitative Reasoning

Students in this program will be proficient at reasoning with mathematical and statistical concepts in order to present, interpret and discuss results of scientific experiments and enhance their understanding of ecological and evolutionary principles. Required courses in this program include calculus in first year (e.g., MAT135Y1) and statistics (e.g., EEB225H1 – Biostatistics for Biologists). The required BIO120H1/220H1 and upper-year EEB courses with practicals have laboratory activities in which students develop their quantitative skills by analyzing and interpreting data, including statistical inference. In courses with computer labs (e.g., BIO365H1) quantitative data are analyzed and interpreted. Advanced EEB core courses introduce the theoretical underpinnings of ecology and evolution

v. Social and Ethical Responsibility
Lectures, essays, lab exercises, and tutorial activities in 100- to 400-level courses within this program will prepare students to make informed decisions about many pressing societal issues, such as global environmental change (e.g., BIO120H1, BIO220H1, ENV234H1, ENV334H1, EEB428H1), the conservation of biodiversity (e.g., EEB 255H1, 365H1, 465H1, 466H1, and many organismal biology courses), human population growth (e.g., EHJ351H1), emerging diseases (e.g., BIO220H1), and the sustainable management of resources (e.g., EEB319H1, 321H1, 365H1, ENV334H1).

c. AN INTEGRATIVE, INQUIRY-BASED ACTIVITY

Students in this program will engage in an integrative, inquiry-based activity in their capstone 400-series course; options include: theoretical and practical issues in conservation biology (EEB465H1), approaches to the study of biodiversity in a museum setting (EEB466H1), a seminar course (EEB495H1), an independent research project (EEB497H1/498Y1/499Y1), and a field course (from EEB 401H1, 403H1, 404H1, 405H1, 406H1, 407H1, 409H1, 410H1/ FOR306H1). EEB465H1 uses case studies to critically examine current conservation biology policies and practices, where students analyze and critique published reports and discuss and debate in class. During a weekend field excursion in EEB466H students will collect and prepare plant, fungal and animal specimens for identification and accessioning; this material may form the basis for their individual research project. In EEB495H1, students read and critique primary scientific literature, write review papers, and actively participate in class discussions each week. In independent research project courses (EEB497H1/498Y1/499Y1), students read the scientific literature, develop a research question, write a proposal including experimental design, conduct independent research, anaylse and interpret data, write a paper in the format of a publication in a scientific journal, and communicate via an oral presentation or scientific poster. EEB field courses require each student to complete an individual project – develop hypothesis, design experiment, collect, analyse and interpret data – which is written up as a scientific article and presented orally.

Departmental/College Resource Implications

Estimated Enrolment per Academic Year in this program (please explain)	50-100 students per year
New courses necessary to mount for this program	New: EEB255H1 - Introduction to Biodiversity and Conservation EEB466H1 - Approaches to the Study of Biodiversity Modification of existing course: ENV234H1 - Environmental Biology: Structure and Function of Ecosystems [from ENV234Y1]
Additional Instructor(s) Requirements	None
Teaching Assistant(s) Requirements	Use of existing TA resources.
Laboratory Equipment Requirements	Use of existing resources. (EEB466H1 will use equipment belonging to the Royal Ontario Museum.)
Computing Resources Requirements	EEB 255H1, 365H1, 466H1 (among other EEB courses) require the use of computing facilities in Ramsay Wright building.
The Department will provide the resources required for this Program from its existing budget.	

Environmental Biology, BSc, Major
Department of Ecology & Evolutionary Biology

The Department offers a minor program in Environmental Biology and considers that student demand, as well as the availability of interdisciplinary courses already offered by the Department and cognate units, will result in a successful major program. There is sufficient student demand as well as diversity in the breadth of course offerings offered in the Department and the Faculty (chemistry, geology, geography, physics) to offer an integrative Environmental Biology Major program. The existing Minor program has been in existence for many years (about 60 students are enrolled in this program, in all years); and there are existing programs in Environmental Chemistry, Environmental Geoscience, and Physics and Environment.

The Department was established in 2006 and has been reviewing its offerings in line with its new mission. This new program proposal has resulted from this planning process. EEB currently sponsors three Specialist programs, with a total of about 100 students in all years: Ecology, Evolutionary Biology, and Behaviour. These three programs have existed for many years (and prior to 2006-07 were administered by Department of Zoology). The differences among these programs were small in terms of required courses for each. The faculty in EEB had a day-long retreat in Oct. 2009 to discuss undergraduate curriculum issues, where it was agreed to reduce the number of EEB Specialist programs from three to one (Ecology and Evolutionary Biology) with three defined streams (areas of concentration in Ecology, Evolutionary Biology, Behaviour).

Description and Calendar Entry

Environmental science is an interdisciplinary field that integrates biological, chemical, and physical sciences to study human interactions with their environment. The Environmental Biology Major provides a broad background in biology that is essential to understand the impact of humans on other organisms and their environments. It provides students with an understanding of ecology, the diversity and function of living organisms, the physical and chemical environment, and the ways organisms interact with, and affect, ecosystem processes. Students are exposed to ecosystem management, issues related to environmental change, and the consequences of interactions between humans and the environment.

Environmental Biology Major program:
(8 full courses or their equivalent, at least 2.0 FCEs at 300+ series with at least 0.5 FCE at 400 series)

First Year (3.0 FCEs): BIO120H1; CHM(138H1, 139H1)/151Y1; MAT135Y1/137Y1/ JMB170Y1; PHY131H1/151H1 or BIO130H1

1. 2.0 FCEs: BIO220H1 (ecology and evolutionary biology); ENV234H1, 334H1 (environmental biology); EEB225H1/ STA220H1/ GGR270H1 (statistics)

2. 0.5 FCE in biological diversity and function from: BIO 251H1, 270H1; EEB 266H1, 267H1, 268H1, 340H1; BIO260H1/HMB265H1 (note that both require BIO130H1 and BIO230H1)

3. 0.5 FCE in physical environment from: CHM210H1; GGR 201H1, 203H1, 205H1, 206H1; GLG202H1; PHY235H1 (requires MAT135Y1/137Y1 and PHY131H1/151H1)

4. 0.5 in core ecology from: EEB 319H1, 321H1, 328H1

5. 1.0 FCE from: EEB 319H1, 321H1, 328H1, 365H1, 370H1, 375H1; EHJ351H1; FOR 305H1, 307H1; GGR 305H1, 307H1, 308H1; GLG351H1; ENV315H1

6. 0.5 FCE at the 400-series from: field course, EEB 401H1, 403H1, 405H1, 406H1, 407H1, 409H1, 410H1/ FOR418H1/ GGR490H1/ GLG 445H1, 448H1; seminar/lecture course, EEB 428H1, 495H1/

JFG470H1/ GGR 403H1, 409H1/ GLG436H1; independent research project, EEB 497H1, 498Y1, 499Y1.

This program can be combined with other Environmental programs (see Centre for Environment) as well as Science (e.g., Chemistry, Geology) and Social Science (e.g., Economics) programs.

Academic Context

Environmental science is an interdisciplinary field that integrates biological, chemical, and physical sciences to study human interactions with their environment. It includes elements from biology, chemistry, geology, geography, physics, forestry and soil science. It has been a substantive and active field of scientific study since the 1960s and is guided by public demand for action in addressing environmental problems and the need for multi-disciplinary approaches to studying complex environmental issues at local, regional, and global scales. Topics include global environmental changes, pollution impact and control, natural resource management, sustainable development, and ecosystem restoration.

The Environmental Biology Major provides a broad background in biology that is essential to understand the impact of humans on other organisms and their environments. It provides students with an understanding of ecology, the diversity and function of living organisms, the physical and chemical environment, and the ways organisms interact with, and affect, ecosystem processes. Students are exposed to ecosystem management, issues related to environmental change, and the consequences of interactions between humans and the environment.

The program prepares students for post-graduate work in environmental biology and related life sciences and provides a foundation for students wishing to pursue careers in teaching, government service, public policy, conservation, science education, science journalism, environmental law, environmental consulting, the private sector, and international relations.

Learning Outcomes

At the completion of this program students will:

- Appreciate the complexity and uncertainty of the world in which we live, and, as ecologically responsible and informed citizens, draft policy and make informed decisions about the impact of humans on our environment, including human population growth, global environmental change, environmental resource management, sustainable development, conservation of biological diversity, and preservation of ecosystem integrity.
- Recognize that environments change and that all life evolves, and that an understanding of the origin and maintenance of biological diversity is critical to our stewardship of life on earth.
- Obtain an understanding of the diversity of life forms (microbes, fungi, plants, animals), how they function, and how they interact with the natural world.
- Understand the inter-connectivity between ecosystems, both regionally (e.g. in a landscape) and at the global scale.
- Be exposed to a broad array of approaches to studying the environment, including laboratory experiments, computer and mathematical modeling, and field studies.
- Critically evaluate scientific information, use information to generate hypotheses, assess whether evidence supports their conclusions and the conclusions of others, and use this knowledge to solve problems.

Degree Objectives

c. DEPTH OF KNOWLEDGE

This program is designed to give students a broad understanding of how humans interact with their biological, chemical, and physical environments, starting with BIO120H1 in first year, and BIO220H1 and ENV234H1 in second year. An increasing depth of understanding of ecology, the diversity of living organisms, and the physical and chemical environment occurs in second- and third-year required courses. Beginning in first year (BIO120H1), students will use the scientific literature and research tools relevant to biology, and synthesize information from the scientific literature. In the labs, assignments, and discussions in core ecology courses at the third year, and especially in 400-level courses, students summarize and critique scientific information. Capstone field courses and individual research projects at the 400-level each produce a substantial, inquiry-based piece of work. Prerequisites ensure a progression from one level to the next: BIO120H1 is a prerequisite for BIO220H1 and ENV234H1; BIO220H1 and ENV234H1 are prerequisites for ENV334H1; BIO120H1 and BIO220H1 are prerequisites for all 300-level EEB courses.
Notably, we also add disciplinary breadth in this program by having the two core environmental biology courses co-taught by faculty in EEB, Forestry, and Geology (ENV234H1 - Environmental Biology: Structure and Function of Ecosystems, and ENV334H1 - Environmental Biology: Applied Ecology).

d. COMPETENCIES

i. Critical and Creative Thinking
Students critically evaluate scientific information, generate hypotheses, assess whether evidence supports their conclusions and the conclusions of others, and use this knowledge to solve problems. In labs and field trips of core ecology courses in the first, second and third year, students progressively learn to summarize and critically review their own data. In field courses and project courses in fourth year, students design, execute, analyse, and critically interpret their own project/experiment relative to the scientific literature. In 400-level seminar courses students learn to critically discuss the scientific literature.

ii. Communication
Students in this program will obtain proficiency at expressing their ideas effectively in writing. Introductory writing instruction is provided in the laboratories in BIO120H1 and BIO220H1. ENV234H1, ENV334H1, and the ecology core courses require students to write essays, critiques of scientific papers, or formal lab reports from activities or experiments conducted in practicals. Results of independent research project courses and field courses are usually written up in the format of a publication in a scientific journal, and are communicated via an oral presentation or scientific poster.

iii. Information Literacy
Beginning in first year (BIO120H1), students are introduced to effective strategies for finding, evaluating, and using scholarly information in the biological sciences, and this is expanded upon in BIO220H1, ENV234H1, ENV334H1 and upper-year EEB courses. Through the requirement of writing essays, reports, and/or critiques, students in this program become familiar with the primary databases used in environmental biology, ecology, and evolutionary biology; learn to evaluate resources for relevance, authority, and reliability, including information available on the web; synthesize information from various sources; understand the importance of expressing thoughts in their own words and citing sources appropriately; and learn to analyze information to test a particular hypothesis.

iv. Quantitative Reasoning
Students in this program will be proficient at reasoning with mathematical and statistical concepts in order to present, interpret and discuss results of scientific experiments and enhance their understanding of ecological principles. Required courses in this program include calculus in first year (e.g., MAT135Y1/JMB170Y1) and statistics (e.g., EEB225H1 – Biostatistics for Biologists). The required BIO120H1/220H1/ENV234H1 and higher-level core courses have laboratory activities in which students develop their quantitative skills by analyzing and interpreting data.

v. Social and Ethical Responsibility
Students in this program will appreciate the complexity and uncertainty of the world in which they live, and be in a position to make informed policy and decisions about the impact of humans on the environment, including sustainable development, global environmental change, and the preservation of ecosystem integrity. Lectures, essays, and lab exercises in ecology courses in 100- to 400-level courses within this program address pressing societal issues, including human population growth (e.g., EEB319H1, EHJ351H1), global environmental change (e.g., BIO120H1, BIO220H1, ENV234H1, ENV334H1, EEB428H1, GGR403H1, GGR409H1, GLG436H1), the conservation of biodiversity (e.g., EEB 255H1, 365H1, 465H1, 466H1, and many organismal biology courses), and the management of exploited resources (e.g., EEB319H1, 321H1, 365H1, ENV334H1).

c. AN INTEGRATIVE, INQUIRY-BASED ACTIVITY

Students in this program will engage in an advanced integrative, inquiry-based activity in a capstone 400-series course; options include: field course, EEB 401H1, 403H1, 405H1, 406H1, 407H1, 409H1, 410H1/ FOR418H1/ GGR490H1/ GLG 445H1, 448H1; seminar/discussion course, EEB 428H1, 495H1/ JFG470H1/ GGR 403H1, 409H1, 436H1; independent research project, EEB 497H1, 498Y1, 499Y1. Field courses require each student to complete an individual research project – develop hypothesis, design experiment, collect, analyse and interpret data – which is written up as a scientific article and often presented orally to classmates. In seminar/discussion courses, students present articles in a critical fashion to classmates and lead discussions; they also read critically and participate in discussions each week. In independent research project courses, students read the scientific literature, develop a research question, write a proposal including experimental design, conduct independent research, analyse and interpret data, write a paper in the format of a publication in a scientific journal, and communicate via an oral presentation or scientific poster.

Departmental/College Resource Implications

Estimated Enrolment per Academic Year in this program (please explain)	50-70 per year
New courses necessary to mount for this program	The existing ENV234Y Environmental Biology (120 students) is being split into two courses, both are the foundation courses of this program, and are co-taught by faculty in EEB, Forestry, and Geology: (1) ENV234H1 - Environmental Biology: Structure and Function of Ecosystems (192 students) (2) ENV334H1 - Environmental Biology: Applied Ecology (60 students)
Additional Instructor(s) Requirements	Use existing resources.
Teaching Assistant(s) Requirements	Use existing resources.
Laboratory Equipment Requirements	Use existing resources. A proposal will be made to Curriculum Renewal Initiatives Fund to purchased equipment for collection and analysis of environmental data.

Computing Resources Requirements	Use existing resources.
The Department will provide the resources required for this Program from its existing budget.	

Genome Biology, BS Major

Department of Cell and Systems Biology, Department of Ecology and Evolutionary Biology, and Faculty of Medicine Department of Molecular Genetics (joint)

The Genome Biology major fits well with the goals of the three sponsoring departments, Cell and Systems Biology, Ecology and Evolutionary Biology and Molecular Genetics, in terms of exposing students to the larger 'systems' perspective that is currently transforming research in molecular biology. This major will educate and train the next generation of scientists, policy makers and physicians who no longer think of biology as an integrated organism rather than a collection of molecules, cells, organs or organisms.

Description and Calendar Entry

Genomics, the study of the structure, function and evolution of the genome, is among the newest and most rapidly growing fields of both basic and applied science, and nearly all of the more traditional disciplines in biology are being revolutionized by genomic tools. The growing flood of data on the DNA, RNA and protein sequences of organisms provides unprecedented opportunities to address fundamental biological questions such as the causes of disease, the genetic basis of development, the extent and causes of adaptive evolution, and the nature of gene regulation. Genome biology is a highly interdisciplinary field, encompassing concepts and practices from such diverse fields as Cell and Molecular Biology, Evolutionary Genetics, and Computer Science. Students in the Genome Biology program will receive a uniquely broad training in these concepts and practices, with a key focus on conceptual training in molecular biology, bioinformatics and evolutionary genetics, and practical training in both computational and wet-lab genomics research. A key focus of the program is to train biologists in the breadth of knowledge and skills required to understand, generate, and use results from genomics. A major in Genome Biology provides a diversity of career options, and given the exponential growth of the field in both the private and public sectors, graduates will have unique skill sets for a wealth of employment opportunities.

The Genome Biology Major Program begins with a core set of courses providing a foundation in biology in the first and second years of study. In the upper years, the departments of Cell and Systems Biology, Ecology and Evolutionary Biology, and Molecular Genetics offer a range of courses that cover various aspects of genomics. These include advanced lecture, seminar and laboratory courses in addition to research project courses that take students into active labs to pursue their own research. A critical requirement of the Genome Biology Major program is a practical laboratory component that provides hands-on experience with the collection and/or analysis of genomic datasets. This diverse course offering allows students to customize their educational experience to match their personal interests.

Genome Biology Major Program (8 full courses or their equivalent)

First year:
BIO120H1, 130H1; CHM(138H1, 139H1)/151Y1; MAT135Y1/137Y1/157Y1

Higher years:
1. BIO220H1, 230H1; BIO260H1/HMB265H1; EEB225H1/STA220H1
2. 1.5 FCE Genomics fundamentals: CSB349H1, 352H1, EEB323H1
3. 0.5 FCE Laboratory courses from: CSB472H1, 474H1, EEB460H1
4. 1.0 FCE Genomics electives from: CSB330H1, 350H1, 435H1, 450H1, 473H1, 497H1/498Y1/499Y1, EEB459H1, 362H1, 497H1/498Y1/499Y1, EHJ352H1, MGY350H1/428H1/470H1/480Y1

NOTE: Students taking CSB497H1/498Y1/499Y1, EEB497H1/498Y1/499Y1 or MGY480Y1 are encouraged to conduct a genomics-related research project.

Academic Context

The "-omics" revolution (genomics, transcriptomics, proteomics, etc.) has captured the imagination of a wide segment of our society, from budding scientists to entrepreneurs. The exponential expansion in data coming out of high throughput biological laboratories, much of it accessible to the public, has underscored a need for academically sound training in future users of the data. The Genome Biology major will inspire students to think about biology with genomic perspective, while introducing them to the current research and techniques in the area: given a genomic sequence, how can one determine the gene content of an organism; how have these sequences been shaped by evolution over time; which suites of genes wired into what networks are necessary for an appropriate response to an environmental stimulus; how does the genetic complement of an organism direct its phenotypic states? This challenging major is aimed at highly motivated students interested in a more quantitative, data-driven, large-scale perspective in biology.

Employment may be found in the public and private sectors in such areas as: basic, applied and clinical research; biotechnology; education; sales; consulting; publishing; and information technology. In addition to occupations in the areas listed above, students who go on to complete graduate degrees may find employment as professors and/or lead researchers in universities, government, research institutes and industry. Occupations also include those associated with: bioinformatics; high-throughput technologies; pharmaceutical discovery, agricultural improvement, testing, and regulation; and patent law.

A BSc degree in Genome Biology will also form a strong foundation for individuals who choose to pursue a professional degree in areas such as: medicine; dentistry; nursing and other health sciences; veterinary medicine; forensic sciences; business administration; and law.

Graduates with a BSc in Genome Biology will be well informed citizens able to critically evaluate information in the public domain that is used to guide public policy discussion and implementation of new legislation.

The University of Toronto has some of the world's best researchers in genome biology. It has demonstrated its commitment to the field through the establishment of an academic priorities program in Genome Biology & Bioinformatics at the Ph.D. level, the foundation of the Centre for Cellular and Biomolecular Research (CCBR), the Centre for the Analysis of Genome Evolution and Function, and through hiring of genome biologists as faculty in several departments. What is still lacking is a visible commitment to developing the foundations of this science by training its next generations.

Learning Outcomes

Genome Biology encompasses a broad range of disciplines, with concepts and practice in the field integrating Cell and Molecular Biology, Evolutionary Biology, and computer programming. The curriculum in the first year begins with two introductory biology courses, one in cell and molecular biology (BIO 130H1), and one in ecology and evolutionary biology (BIO120H1). These two courses will be the initial foundation for students to understand the processes important in driving the function and evolution of genomes. The curriculum also includes training in physical and organic chemistry, and mathematics. All of these foundational courses provide students with the framework to connect related concepts and begin to expose them to the interdisciplinary nature of the field. The second year also incorporates further development of general concepts in biology, while beginning to introduce the genomic perspective. This includes discussion training in the use of genomic approaches in ecology and evolutionary biology (BIO220H1) and discussion of how the genome gives rise to functioning organisms (BIO230H1). The second-year also incorporates further essential concepts in inheritance and the relationship between genotype and phenotype in genetics (BIO260H1/HMB265H1). In addition, essential quantitative skills for analysis of genome data are developed in statistics (EEB225H1/STA220H1).

The upper year curriculum incorporates the breadth of specialized knowledge required for a deep understanding of genome biology. Three courses in genomics fundamentals provide key training in the diverse aspects of genome biology: evolutionary genetics (EEB323H1), functional genomics (CSB349H1), and bioinformatics (CSB352H1). The upper-year curriculum also includes courses that

primarily focus on moving from textbooks to the cutting edge of research (primary literature-CSB 349H1), as well as gaining practical experience in collecting and analysing genome data. The laboratory course requirement gives students practical, hands-on research experience, either in the wet lab (CSB474H1), or the computer lab (CSB472H1 and EEB460H1). Students also have several options for genomics electives which allows them to choose courses focused on their major interests, incorporating evolutionary genomics (EHJ352H1, EEB 362H1, EEB459H1), molecular genomics (CSB330H1, CSB350H1, CSB435H1, CSB450H1, CSB473H1, MGY428H1), and independent research projects (CSB497H1/498Y1/499Y1, EEB497H1/498Y1/499Y1, MGY480Y1)

Students who graduate with a major in Genome Biology are well positioned to pursue careers in the academic, government, or industrial sectors as well as gain entry to a wide range of professional and graduate schools.

Degree Objectives

e. DEPTH OF KNOWLEDGE

The Genome Biology program provides students with in-depth, expert knowledge of the three major fields associated with genomics: evolutionary genetics (EEB323H1), bioinformatics (CSB352H1) and functional genomics (CSB349H1). These three courses build on the broader background in these topics and other aspects of biology in the first two years. CSB349H1 offers a combination of interactive lecture-based learning with an emphasis on critical reading of the primary literature, along with written and oral reports that allow students to explore concepts more deeply. EEB323H1 provides detailed, quantitative training into evolutionary processes, and their role in driving the evolution and diversity of genes and genomes. It builds from and integrates previous courses in evolution, mathematics and statistics by applying quantitative reasoning towards the study of evolutionary genetics. CSB352H1 gives students an introduction to the major computational tools and statistical techniques currently used in bioinformatics. Depth of knowledge is also enhanced through experiential learning and participation in laboratory courses CSB472H1/CSB474H1/EEB460H1) and projects based in faculty laboratories (CSB497H1/498Y1/499Y1/EEB497H1/498Y1/499Y1/MGY480Y1).

f. COMPETENCIES

i. Critical and Creative Thinking

Key goals of the Genome Biology Major program include teaching students to critically evaluate information, be able to use information to generate hypotheses, assess whether evidence supports their conclusions and the conclusions of others, and to be able to use this knowledge to solve problems. Students in the Major program begin working towards excellence in these areas in the first year (BIO120H1, 130H1) where they are asked to read the primary literature, reason about data, and pose hypotheses and ways of testing these. In their second year, students are required to take STA220H1/EEB225H1, BIO220H1, BIO230H1 and BIO260H1/HMB265H1, which require reading and analysis of the primary literature (BIO220H1 and BIO230H1), creative problem solving (STA220H1/EEB225H1 and BIO260H1/HMB265H1) and hypothesis testing. The third-year required course CSB349H1 has a Problem-Based Learning project that all students must complete. The project is newly designed each year and requires that students solve a problem by researching the primary literature, synthesizing and extending available information to draw conclusions and make recommendations or proposals to a government or advisory committee. Students in all upper year courses participate in critical and creative thinking enrichment activities ranging from study and analysis of the primary literature, to written essays and lab reports where hypotheses are posed and conclusions from data are developed, to oral presentations and debates regarding conclusions drawn from the primary literature. At all levels of study in this program, examination questions that require the ability to critically assess and draw conclusions about information are included.

Students graduating from the Major program in Genome Biology have highly developed critical and creative thinking skills that will be crucial to their success in the workplace or post-graduate training.

ii. Communication

The Genome Biology Major program gives students the opportunity to develop written and oral skills as outlined below:

Written skills: The 1st year required courses BIO120H1 and BIO130H1 have a laboratory component with written laboratory assignments. BIO220H1 and BIO230H1 require written laboratory assignments as well as a longer written assignment that includes instruction on the conventions of presenting data in primary research journals (e.g. Figure preparation and the writing of Results). All first and second year BIO courses provide students with the opportunity to receive critical feedback from an experienced writing TA. At least two courses (BIO120H1, BIO230H1) offers students the opportunity to revise their written assignments, thereby deepening writing skill development. Upper year courses continue the development of superior scientific writing skills. The majority of the upper year lecture-based courses require substantial written work in the form of annotated bibliographies, formal lab reports written in the style of a scientific publication, term papers, and summaries. For example, students taking the required course CSB349H are required to write a proposal, mini-review, magazine article, poster, or web-page (see Integrative Inquiry-Based section below). In addition to written assignments in lecture-based courses, students taking research project-based courses (CSB/EEB497H1/498Y1/499Y1/ MGY480Y) write formal thesis-style papers at the end of the course and present their findings at departmental poster and oral presentation days. Thus, all students graduating from the Genome Biology Major program will have training in writing during all four years, leading to the development of superior scientific writing skills. Those students taking research project based courses may co-author peer-reviewed scientific publications in journals.

Oral skills: Students make group and individual oral presentations during all years in the program. Oral presentations develop not only spoken presentation skills, but also visual presentation skills. These skills help students to communicate with audiences that include their non-specialist peers, TAs, course professors, and members of the department who attend departmental oral presentation and poster days. In addition, students participating in research project courses may give oral presentations at lab meetings and scientific conferences. Students in the Genome Biology Major program leave well-equipped to organize their ideas into visual and oral presentations that can be tailored to suit a range of audiences.

iii. Information Literacy

The required BIO120H1/BIO130H1/BIO220H1/BIO230H1 courses have library assignments, developed in conjunction with University of Toronto Reference Librarians, that train students to obtain scholarly sources of information from library and online academic resources such as the Web of Science and PubMed. Students are also trained to assess whether various sources of information are peer-reviewed, and to assess the credibility of a variety of information sources. In upper year courses, the opportunity to develop information literacy skills is enhanced and ranges from learning to use presentation software for oral presentations, to searches of many primary literature databases to research and synthesize written and oral reports, to the use of bioinformatic resources to supplement learning goals and to participate in the discourse of the discipline by creating information with which to test hypotheses (CSB352H1/CSB435H1/MGY428H1). Thus, all students that graduate from the Genome Biology program will have high-level training for locating scholarly information from various sources and will have significant training and experience with tools and technology associated with the creation and presentation of information in the discipline.

iv. Quantitative Reasoning

All students graduating from the Genome Biology major will be provided with significant training in Quantitative Reasoning. In addition, students in this specialist program are required to complete a full year of introductory university-level Math (MAT135Y1/137Y1/157Y1) as well as a half course in statistics (STA220H1/EEB225H1).

The required BIO120H1/BIO130H1/BIO220H1/BIO230H1 have laboratory components in which students further develop their mathematical skills by analyzing and interpreting data, including statistical inference. BIO260H1/HMB265H1, Genetics, provide further training in the manipulation and interpretation of numeric data, including statistical analysis. EEB323H1 provides in-depth training in evolutionary theory and the quantitative analysis of genomic data, incorporating skills from previous math and statistics courses into genomics. This course includes weekly problem sets, where students apply evolutionary theory to solving theoretical and empirical problems.

v. Social and Ethical Responsibility

Students within the Genome Biology major program will receive extensive instruction on social and ethical issues and how these relate to cell and molecular biology. The required BIO120H1 covers ethical issues such as the conservation of biodiversity and the controversy of teaching creationism in schools. The required courses BIO130H1 and 230H1 provide information regarding the ethical implications of molecular genetics and its use in human populations, particularly in relation to gene therapy and genetic testing. The third year required course CSB349H1 deals with the ethical and societal issues regarding adult stem cells and their transplantation, while CSB350H1 requires an oral presentation and class discussion on the ethical issues associated with protein recombinant technologies. Optional courses with a significant social and ethical responsibility education component (ethics topics shown in brackets) include: EHJ352H1 (ethical issues around the study of human genetic variation and adaptation), CSB459H1 (understanding issues surrounding plant biotechnology and exploration and development of individual values with respect to these), and MGY470H1 (ethical issues in human genetics, for example, privacy concerns and the use of personal genetic information, such as acceptable or recommended practice in genetic diagnosis).

g. AN INTEGRATIVE, INQUIRY-BASED ACTIVITY

Integrative, inquiry-based activity begins at the first year level for Genome Biology major students. Students taking BIO120H1, BIO130H1, BIO220H1 and BIO230H1 participate in inquiry-based laboratories that are well-integrated with lectures and with each other. Nearly all of the 3rd and 4th year courses offered as options by the Genome Biology major program have inquiry-based oral and/or written activities that are well-integrated into the curriculum and frequently draw upon the skills and knowledge developed in earlier courses. For example, the third year required CSB349H1 course provides students with the opportunity to work on a poster, magazine, or web-page Problem-Based Learning (PBL) component. The inquiry-based PBL project requires the students to research and write a proposal and mini-review along with either a research proposal or set of recommendations to address a problem of their choice associated with eukaryotic gene expression. Students must define the problem, research the literature, explain the options available for solving or researching the problem, and come up with either a research proposal or set of recommendations to convince their varied audience of researchers, business people, and government agencies of the value of their conclusions. Students present their posters during a publicly-advertised poster day within the department, and make oral presentations of their findings to their peers. This course gives students the opportunity to integrate many of the skills they have learned, in this and other courses, to produce a final poster, web-page, or magazine article of which they can be truly proud. Many students include this activity on their resumes.

Students in research-based courses such as CSB497H1/498Y1/499Y1, EEB497H1/498Y1/499Y1 and MGY480Y1 must create a proposal that defines their research goals for the term. Students then conduct their inquiry-based research, presenting analyses of their findings orally at regular lab meetings. Students receive feedback on their progress throughout the term and produce a thesis-based paper at the end of the term that integrates the investigative research they have performed. Students also have the opportunity to integrate all of the skills they have learned during departmental poster days and by publishing in peer-reviewed journals.

Students graduating with a major degree in Genome Biology will have had a truly integrative and inquiry-based experience. Students are required to take one 3rd year level course (CSB349H1) and at least one 4th-year level course (CSB472H1/474H1/EEB460H1) that have an inquiry-based research project that will be presented as either an oral report, written report, or both (depending on the combination of courses taken). These reports will draw upon the knowledge and skills gained within the course and throughout the program, providing students with the opportunity to integrate knowledge from various sources and activities.

Departmental/College Resource Implications	
Estimated Enrolment per Academic	2nd year – 50

Year in this program	3rd year – 50 4th year – 45
New courses necessary to mount for this program	none
Additional Instructor(s) Requirements	none
Teaching Assistant(s) Requirements	No additional TA requirements
Laboratory Equipment Requirements	No additional laboratory equipment required
Computing Resources Requirements	No additional computing resources required
The Department will provide these resources required for this Program from its existing budget.	

Public Policy, BA, Major

School of Public Policy and Governance (SPPG)

As part of the academic planning process within the Faculty of Arts and Science, the School of Public Policy and Governance along with the Departments of Economics and Political Science have committed to offering undergraduate students opportunities to participate in a multi-disciplinary study of public policy. This major will complement existing majors in most social science departments. This major program offers students an opportunity to explore the types of issues frequently encountered in a career in public service, to prepare in a comprehensive way for post-graduate work in public policy, and the opportunity to be exposed to the broader policy community through the programming offered through SPPG outside the classroom.

Established in 2006, the School of Public Policy and Governance offers the Master of Public Policy program. The Program attracts over 600 applications and is at its full steady state of 40 students per year. In just three years it has become among the top choices for studying public policy in Canada.

The Public Policy major was identified as a priority for the School during its recent academic planning process. The program will draw on many of the strengths of the School, in particular engaging students with policy practitioners in Canada and around the world. The program will serve to provide a unique student experience for top undergraduates considering a career or graduate work in public policy. The program is interdisciplinary and takes advantage of the Faculty's strengths in the Department of Economics, the Department of Mathematics, and the Department of Political Science.

Description and Calendar Entry

An undergraduate Major in Public Policy provides a unique opportunity for students in Social Science disciplines to think in an interdisciplinary way, by drawing on theories and approaches, as well as tool kits, developed in the core disciplines of Economics and Political Science, and beyond. Solving real-world policy challenges requires the use of multi-disciplinary tools to analyze problems, determine the best means to deal with those problems, and decide on the best course of action. Students in this program develop theoretical and applied reasoning skills in policy analysis, as well as a solid grounding in quantitative methods and research.

The Major program in Public Policy is offered jointly by the School of Public Policy and Governance, the Department of Economics, and the Department of Political Science. Students would enroll after first-year, and must meet the prerequisite conditions for all second-year and higher courses.

Major in Public Policy (8.0 FCEs)

First Year:
1. ECO 100Y
2. POL 101Y
3. MAT 133Y/MAT(123H,124H)/MAT135Y/MAT137Y/MAT157Y

Second Year:
1. ECO 200Y/ECO204Y/ECO206Y
2. ECO 220Y
3. POL 214Y

Third and Fourth Years:
1. PPG 301H
2. PPG 401H
3. 1.0 FCEs at the 300+-level drawn from Economics, Political Science, and cognate disciplines. A non-exhaustive list of eligible courses includes:

   ECO 310Y/313H/314H/320H/324H/332H/333Y/336Y/339Y/340H/349H/364H/365H/369Y /433H/434H/435H

   POL 306H/POL 308H/POL 312Y/POL 314Y/POL 315H/POL 316Y/POL 317Y/POL 318H/POL 321F/POL 332Y/POL 334H/POL 336H/POL 337Y/POL 341H/POL 344H/POL 351Y/POL 356YJPR

364H/POL 370H/POL 371H/POL 377H/POL 408H/POL 409H/POL 411H/POL 413H/JPJ 412H/POL 423H/POL 425Y/POL 439H/POL 447Y/POL 448H/POL 450H/JPF 455Y/JPR 457H/POL 457Y/POL 458H/POL 474H/POL 480Y/POL 481Y/POL 482H

With the approval of the program director, students can take public-policy oriented courses outside this list.

This is a limited enrolment program that can only accommodate a limited number of students. Admission will be determined by a student's mark in ECO100Y, POL101Y, and requires students to have taken MAT 133Y or higher. It is expected that a mark of 67 % in ECO 100Y and POL101Y will be required for admission in the coming cycle. Achieving that mark does not necessarily guarantee admission to the program in any given year.

Academic Context

The program in Public Policy is designed to provide students with interdisciplinary training in the broad field of public policy. First, it is designed to provide students with the core analytic skills from Economics and Political Science that can be applied to a wide range of public policy issues. Second, with this foundation, students exploit the advantages of specific courses in public policy, taught by faculty from SPPG. The summative course is a 4th-year seminar course where students can draw upon their specific training to explore “The Role of Government” from both an academic and professional perspective. The program provides excellent professional preparation for employment in public service, but just as importantly, provides solid academic preparation for further studies in business, law, economics, political science, education, health, and public policy itself. Furthermore, the program is designed to be combined with majors from other disciplines (e.g., economics, political science, commerce, geography, sociology).

Learning Outcomes

Students will learn how to critically evaluate government policies in a wide variety of spheres:

1. In first two years, students learn the core methodological tools: (1) Basic economic analysis, especially a solid foundation in microeconomics; (2) Core methods of inquiry in political science, with an emphasis on the operation of government, both theoretical and institutional; and (3) Empirical quantitative skills in order to evaluate evidence on public policy options.
2. In the final two years, students apply these skills to general and specific problems of public policy. In PPG301H, students learn about the policy process, while in PPG401H, students apply their skills to specific questions of public policy, with the organizing question of what the appropriate response of government is to a particular issue, if, indeed, a government response is required. In addition to the PPG courses, students take at least one further course in economics or political science to deepen their understanding of at least one important specific policy area.
3. Students are expected to be able to bring a multi-disciplinary and multi-dimensional set of analytic tools to the analysis of general and specific public policy questions. Students will be able to synthesize empirical evidence on related public policies, and with careful use of economic and political science reasoning, evaluate the pros and cons of specific policy proposals. This understanding includes an appreciation of the political and economic constraints relevant for the implementation of public policy, going beyond the abstract analysis of the impact of an idealized policy.

Degree Objectives

h. DEPTH OF KNOWLEDGE

Rigorous evaluation of public policy challenges, that is, the evaluation of the appropriate response of government to economic, political, or social problems, requires analysis from multiple perspectives. In order to evaluate a policy, as a starting point the policy-maker needs to understand the problem being addressed. This requires an understanding of primary tools of social science research, and the strong foundation in Political Science and Economics is designed to provide these skills. Indeed, the program is designed so that students can choose to specialize even further in either discipline, by taking Political Science or Economics as a second Major, and moving to the frontier of that discipline. But

comprehensive evaluation of public policy requires more than a single approach, and more than an understanding of the underlying problem prompting a policy response. Policy makers need to understand the political and organizational constraints associated with the design and implementation of what may otherwise seem to be straightforward policies. They also need to understand details of institutional constraints associated with the operation of bureaucracies, and government in general. They need to understand the broader political-economic forces at play (e.g., lobbying, special interest groups, and voters more generally). They need to understand the economic and budgetary consequences of a course of action, including the anticipation of unintended consequences that may arise from behavioural responses of firms and individuals. And they need to be able to evaluate the evidence of whether the policy worked, or has worked elsewhere. Skills developed in the study of Economics and Political Science are clearly helpful, but they are insufficient. These skills need to be applied to both the general problem of "public policy", as well as many specific examples. The two courses in public policy are designed to bring students to exactly this point. PPG 301H introduces students to the multidisciplinary study of public policy and the policy process, while PPG 401H addresses head on the role of government. In PPG 401H, students learn how to think about questions of whether government responses are desirable or feasible, and then apply the analytic tools to specific problems in areas as diverse as health care, education, redistribution, the environment, and financial regulation (to list but a few examples). In addition, majors in Public Policy will have at least two courses that provide integrative, inquiry-based activities (PPG301H and PPG401H).

i. COMPETENCIES

i. Critical and Creative Thinking

The foundation of the program is the core courses in Economics and Political Science. The requirement to have courses from at least two disciplines with very different approaches and methodologies will force students to be intellectually nimble. In the fourth year capstone course (required of all students), students use these skills and methods of analysis to "think outside the box" of these disciplines and use their analytic tools to conduct applied policy reasoning and analysis. For example, for many public policy problems, the solutions posed by economics and political science will differ, and in some cases contradict one another. Students will need to identify common ground, and feasible solutions that integrate across the two disciplines. The whole premise of the program is to develop these critical and creative skills through multidisciplinary training.

ii. Communication

The Political Science and Public Policy courses are writing-based courses and require significant elements of written work. POL101Y and POL214Y each have significant essay assignments, helping students to develop their written communication skills, while the fourth-year capstone course offers students the opportunity to cultivate verbal presentation skills in a seminar setting.

iii. Information Literacy

As part of the Political Science and Public policy courses, students will be expected to write research papers, making full use of library and related resources. In the required course ECO 220 *Quantitative Methods*, students also obtain hands on experience with Microsoft EXCEL, and use it to analyze real-world economic data. They also learn where to find such data, as well as how to use it. In addition students will learn to identify what forms of evidence (experimental, quasi-experimental, descriptive) provide causal inference to policy problems and what forms of evidence are inappropriate to use as a basis for policy decision making.

iv. Quantitative Reasoning

The math and economics courses provide a solid foundation of quantitative reasoning, covering calculus, applied mathematical and graphical reasoning, as well as probability and statistics.

v. Social and Ethical Responsibility

All three elements of the program – Economics, Political Science, and Public Policy – focus on how society can best make choices to maximize social well-being, subject to a long list of constraints and considerations. While different methodologies are employed, a major strength of the program is that students learn the different approaches, and apply them to "real world" problems. The focus on these core questions are especially developed in the two mandatory public policy courses, PPG 301H and PPG 401H. In addition, questions of ethics are introduced in POL 101 (required of all students) which is designed to introduce students to questions of democracy, justice, and ethics.

AN INTEGRATIVE, INQUIRY-BASED ACTIVITY

Majors in Public Policy will have at least two courses that provide integrative, inquiry-based activities. First, in PPG301H, they will be required to draw on their previous economics and political science training to study the interaction of these methods as applied to general questions of public policy. While lecture-based, this course will require significant written work. Those assignments require students to integrate materials from multiple disciplines. Second, PPG401H on the role of government exploit both economics and political scientific approaches to the general question of "the role of government", with students analyzing specific topics in greater detail in a small-class setting that allows students to build on what they have learned throughout their program and to apply that knowledge in an advanced way

Departmental/College Resource Implications

Estimated Enrolment per Academic Year in this program (please explain)	Target enrolment for the first cohort of students is around 25-50 students. The program can easily accommodate 100+ students in the first two years, as students take courses in existing large-enrolment sections. The third and fourth year courses will be smaller (e.g., 50 students per section of the third-year course, and 25 students per section of the fourth-year course). We expect the program to be popular, and resource permitting, if we can offer enough sections of the 4th course, we expect long-run enrolment of 100 students per year.
New courses necessary to mount for this program	Two new courses are required: (1) A third year course, "Introduction to Public Policy," a lecture-based course specifically for students in this program; and (2) A fourth-year course, "The Role of Government," a seminar-based summative course specifically for public policy majors.
Additional Instructor(s) Requirements	Instructors will be required for the two new public policy courses. Faculty will be drawn from those affiliated with the SPPG, with resources also drawn from the SPPG.
Teaching Assistant(s) Requirements	No additional TA resources are expected for students in the first two years of the program. However, we expect to need 70 hours of TA support per section of the public policy (third year) course.
Laboratory Equipment Requirements	N/A
Computing Resources Requirements	N/A

Resources from the School of Public Policy and Governance will be provided for new courses at the noted target enrolment..