



UNIVERSITY OF  
**TORONTO**  
SCARBOROUGH

## Major Curriculum Changes for 2010-2011 Academic Calendar

### NEW PROGRAM

#### DEPARTMENT OF BIOLOGICAL SCIENCES

#### Specialist Program in Biodiversity, Ecology & Evolution, B.Sc.

##### ***Program Rationale***

Currently, UTSC has no program with a focus on the ecology and evolutionary biology of organismal diversity. Understanding processes shaping and shaped by the diversity of life on earth is one of the major goals of modern biology, and a program of this type is available at every peer institution in Canada, the USA and Britain. This program presents students with a foundation for understanding how ecology and evolution shape organismal features (from morphology and physiology to behaviour) and the structure and function of communities and ecosystems. Ultimately, these processes determine the broad patterns of organization of life on earth - biodiversity. The challenges to biodiversity are daunting: habitat destruction, biological invasions and climate change are causing loss of species and disruption of ecosystems worldwide. BEES graduates will be well trained to understand and actively seek solutions to these problems.

##### ***Comparison with Similar Programs Offered by Peer Institutions***

In its balance of core courses in ecology, evolutionary biology and organismal biology (biodiversity), this program is comparable to programs or focal streams offered at most major institutions in North America, including:

**UBC** (Ecology & Environmental Biology Program; Evolutionary Biology Program, Dept. Zoology)

**McGill University** (streams in Evolutionary Biology, Ecology or Conservation Biology, Dept Biology)

**Cornell University** (Ecology & Evolutionary Biology, streams in Ecology, Evolution & Organismal Biology, Dept Ecology & Evolutionary Biology)

**Harvard University** (Organismic & Evolutionary Biology Program, Dept Organismic & Evolutionary Biology)

**Yale University** (concentration in Ecology & Evolutionary Biology, Dept Ecology & Evolutionary Biology)

**Oxford University** (2<sup>nd</sup> year core requirements include Evolution & Systematics and themes include Animal Behaviour, Ecology and adaptation, Department of Biology)

##### ***Goals & Learning Objectives of the Program***

**Goals.** The program seeks to create students (1) literate in basic and advanced theory in ecology & evolutionary biology, (2) with an appreciation of the range of types of inter-relationships among organisms at varied levels of organization and (3) able to educate others in the importance of ecology and evolution to our understanding of biodiversity and challenges to biodiversity.

**Learning objectives.** In addition to the factual knowledge related to the goals of this program, students will learn problem solving based on rigorous application of the scientific method. A significant component of this is numeracy related to abstract mathematical reasoning inherent in key models in Ecology, and statistical aspects of Evolutionary Biology.

Program **goals** and **learning objectives** are to be realized through requiring all BEES students to master material in our first and second year core along with critical third year foundation courses, which have been chosen to ensure coverage of the range and breadth of material and methodologies necessary for an educated ecology & evolutionary biologist. The four 3<sup>rd</sup> year foundation courses will ensure higher-level integration of basics established in the general biology core of the first two years.

A number of the C and D-level courses in BEES will form capstone experiences for students in different areas of interest through intensive examination of the primary literature, applications of theory or mathematical reasoning to natural populations and/or opportunities for independent research and scientific communication. These courses include:

C-level: Tropical Marine Ecology and Evolution Ecology Field Course, Conservation Biology, Animal Behaviour;

D-level: Causes & Consequences of Biodiversity, Special Topics in Behavioural Ecology, Spatial Ecology.

### ***Evidence of Student Demand***

Many of the third and fourth year courses that would become part of this program are already high-enrolment offerings. Current enrolments (October 2009) include BIOC16H (25), BIOC61H (63), BIOC58 (48), BIOC63 (46), BIOC65 (83), BIOC62 (29), BIOC54 (119), BIOD33 (58), BIOD25 (24), EESC04 (95), EESC30 (61).

Ecology and Evolutionary Biology are core biology disciplines and, as such, numerous universities have built entire departments focused around these disciplines (eg. Departments of Ecology and Evolutionary Biology, St. George, Yale University; Princeton University).

This program should also parallel the interests of students in Environmental Science, particularly students in the previous Environmental Biology major program, which has been discontinued. That program had a Fall 2008 enrolment of ~88 students..

### ***Degree Level Expectations***

1. How does the program link with scholarship and rigour in the discipline?

The program will draw on the strengths of a diverse group of research professors in Ecology & Evolutionary Biology; each recognized experts in their respective fields. The 2<sup>nd</sup> year core and 3<sup>rd</sup> year foundation courses will provide the students with broad conceptual training in all the key sub-fields of ecology and evolution. This broad training will provide students with the ability to comprehend and evaluate current literature. Advanced courses will build on the foundation courses to provide rigorous training in specialized research areas, and include statistical modelling and reasoning, computer programming and written and oral communication of independent research or critical reviews of the scientific literature.

2. How does the structure of the program ensure that depth is achieved in the subject?

The program structure, from broad core courses, to detailed foundation courses, to specialized advanced courses, ensures both a broad and deep treatment of ecology and evolution. All students in the program are required to take a series of core and foundation courses that collectively cover most of the major evolutionary and ecological processes, providing students with a deep understanding of the processes generating biological diversity. Further, students are required to take at least 1 (and up to 2.5) credits of D-level courses, allowing them to delve into particular topics of interest.

3. How will students gain a knowledge of methodologies?

There are a number of methodology-intensive courses in which students will learn through hands-on experience how ecological and evolutionary research is done. The program will require students to take an Ecology and Evolutionary Biology Laboratory (BIOB52H), training them in a broad array of ecology and evolution techniques. Also required is Evolutionary Genetics and Genomics (BIOC16H) which will train students in the latest computational methodology for analysing large genetic data sets. Further, advanced electives offer opportunities to learn methodology in field research (BIOC52H & BIOC67H), emphasize analysis and interpretation of novel data sets (e.g., BIOC54) and require mastery of high-end statistical techniques (e.g., BIOD60H).

4. Will students completing the program be able to frame relevant questions for further inquiry? Will they be able to seek the tools through which they can effectively address such questions? Please elaborate.

One of the major learning objectives of the program is to train students in the application of the scientific method to a wide range of questions in ecology and evolutionary biology, particularly as these apply to questions of biodiversity. BEES graduates will have abstract reasoning skills which will be portable into any field or situation. In addition, they will have gained a facility in using diverse sources of information to solve problems (e.g., bioinformatics approaches in BIOC16H, analysis of raw field data BIOC52H, C54H and C67H, statistical analyses in BIOD60H).

5. What are the connections, if any, with activities outside the classroom?

Laboratory courses and field courses core to this program emphasize the use of learned theory and methodology in 'hands-on' contexts. In addition, all research faculty in ecology and evolutionary biology provide opportunities for engagement in laboratory research via the three independent study courses (BIOD95, BIOD98 and BIOD99), work-study opportunities, volunteer and science-engagement placements. Finally, BEES students will be encouraged to attend BEES-relevant seminars (anticipated to be 2 per month in the Biological Sciences seminar series) through heavy advertisement in 3<sup>rd</sup> year foundation courses and via the intranet.

6. What skills, competencies or expertise will students completing the program have gained?

In addition to the factual knowledge related to the goals of this program, students will learn problem solving based on rigorous application of the scientific method. A significant component of this is numeracy related to abstract mathematical reasoning inherent in key models in Ecology, and statistical aspects of Evolutionary Biology.

7. Will the program prepare students for further study? Please elaborate

The foundational knowledge gained in this program will leave students well prepared to go on to graduate studies in any field of science, or business or law with a focus on environmental issues.

8. For what sort of occupations might the program prepare students?

Students will be well trained to take positions in government agencies, consulting firms or NGO's in areas related to the environment, maintenance of biodiversity, environmental stewardship and sustainable development.

9. How does the program fulfill the UTSC writing policy?

Two of the four core courses in the second year require student writing, as do most of the C-level and D-level courses. Moreover, writing-intensive pedagogical techniques are key features of several D-level courses (e.g., peer review, multiple drafts of research papers, journal writings, blogs), and an essential part of every independent study course (BIOD95, D98, D99)

## **Resources**

1. Please provide evidence of sufficient commitment among your permanent faculty to make the program viable. In particular:

Are there sufficient permanent faculty to teach the core courses?

Biology courses in the first two years of this program are in common with that of our other specialist programs. As such, these courses are well supported in terms of dedicated faculty, experienced teaching assistants and sessional instructors, a course coordinator (for the highest enrolment courses), and dedicated teaching laboratory technicians (for those courses that include a laboratory).

Of the 24 C and D-level courses listed in the program (22 BIO and 2 EES), 21 of these are proposed to be taught by existing faculty, 2 are currently being taught by sessional lecturers (1 BIO, 1 EES) and 1 will require a new instructor still to be identified. Importantly, the department is currently recruiting two new faculty that will also directly support the program, a tenure-track faculty in Animal Biodiversity and Biogeography and a teaching stream faculty in Ecology and Evolutionary Biology. The expertise and

interests of these faculty will directly complement and support this proposed program. These faculty will teach some of the current courses listed, as well as likely adding additional new courses to the program over time.

Are there permanent faculty prepared to act as program supervisor?

A senior faculty member has agreed to act as program supervisor for at least the first 2 years of the programs existence. Beyond that, we envision that program supervision will be turned over to the Lecturer in Ecology and Evolutionary Biology that we are currently recruiting (see above). We also have a course coordinator who is a first point of contact for all of our biology programs and who is able to handle many of the most routine issues that students may encounter.

2. Are new courses being proposed in order to mount the program? If yes, please specify and attach the appropriate new course forms.

New courses being proposed this year and which will support the program are:

BIOD66H Causes and Consequences of Biodiversity

BIOC50H Macroevolution

BIOD26H Fungal Biology and Pathogenesis

BIOD43H Exercise Physiology

3. Will new resources be required to offer the program and the related new courses (e.g. faculty, T.A. support, teaching space, equipment)? Please elaborate.

For BIOC50H, an instructor needs to be identified. It is likely that this course will be taught by one of two new faculty members currently being recruited (see above). If this were not the case (an unlikely scenario), then a sessional lecturer will be hired for a short period until teaching assignments of permanent faculty can be arranged to accommodate teaching this new course. At least one current faculty member could teach this course if necessary, but is heavily involved in other teaching.

New TA support will be required for the 4 new courses (see above).

None of the new courses will require new teaching lab space or new teaching equipment.

### ***Tricampus Consultation***

The chair of the Department of Ecology and Evolutionary Biology, St. George, the chair of Biology, UTM and the Dean of the Faculty of Forestry (St. George) have all been consulted.

### ***Admission to the Program***

The high school courses either required or recommended are the same as for the majority of the departments other specialist programs. The required courses are English, Chemistry, Calculus & Vectors and Advanced Functions. These high school courses help to ensure that students have the strong academic qualifications and background necessary to pursue a university specialist program in the sciences. The recommended high school courses are biology and physics. Admission to the program will take place as it does for most other UTSC programs at the end of the session in which students achieve their 4<sup>th</sup> credit.

The Department expects an initial intake of approximately 20 students and approximately 40 to 50 students when it reaches a steady state.

### ***Program Requirements***

This program consists of 14.5 required credits. Since a total of 20 credits are required to complete a four year degree, students taking this program should additionally take 5.5 credits of elective courses. It is advised that, including electives, students should plan to take 5 credits in each year of their four year degree.

### ***First Year***

#### **1.0 Credit of Biology Introductory Courses**

BIOA01H, Introductory Biology: Part I

BIOA02H, Introductory Biology: Part II

## **1.0 Credit in Chemistry**

CHMA10H, Introductory Chemistry I: Structure and Bonding

CHMA11H, Introductory Chemistry II: Reactions and Mechanisms

## **1.0 Credit in Mathematics**

*Choose from:*

MATA20H, Calculus A and MATA21H, Calculus B (Discontinued after the 2009/2010 academic year)

MATA30H, Calculus I and MATA35H, Calculus II for Biological Sciences

*Note: Starting in the 2010-2011 academic year, students who have not taken grade 12 Calculus and Vectors (a requirement for MATA30H), must take the preparatory, not-for-credit course at UTSC prior to enrolling in MATA30H*

## **0.5 Credits in Physics**

*Choose from:*

PHYA10H, Introduction to Physics 1A

PHYA11H, Introduction to Physics 1B

## **0.5 Credits in Computer Science**

*Choose from:*

CSCA08H, Introduction to Computer Programming

CSCA20H, Computer Science for the Sciences

PSCB57H, Introduction to Scientific Computing (this course could also be taken in second year)

## **Second Year**

### **3.0 Credits of Biology Core Courses**

BIOB10H, Cell Biology

BIOB11H, Molecular Aspects of Cellular and Genetic Processes

BIOB30H, Mammalian Physiology I

BIOB31H, Plant Physiology

BIOB50H, Ecology

BIOB51H, Evolutionary Biology

### **0.5 Credits of Biology Core Labs**

BIOB52H, Ecology and Evolutionary Biology Laboratory

### **0.5 Credits in Statistics**

*Choose from:*

STAB22H, Statistics I

PSYB07H, Data Analysis in Psychology

## **Third Year**

### **2.0 Credits of C-level Ecology and Evolution Foundation Courses**

BIOC16H, Evolutionary Genetics and Genomics

BIOC50H, Macroevolution

BIOC59H, Advanced Population Ecology

BIOC61H, Community Ecology and Environmental Biology

## **Third / Fourth Year**

4.5 credits of C & D level courses from Bins 1 and 2 below. This must include at least one credit from each bin and at least one credit total at the D level

### ***Bin 1: C and D-level Ecology and Evolution Courses***

*Choose from:*

BIOC51H, Tropical Marine Ecology and Evolution

BIOC52H, Ecology Field Course

BIOC58H, Biological Consequences of Global Change  
BIOC63H, Conservation Biology  
BIOC65H, Environmental Toxicology  
BIOC67H, Advanced Field Course in Ecology  
BIOD25H, Genomics  
BIOD52H, Senior Seminar in Biodiversity and Conservation Biology  
BIOD60H, Spatial Ecology  
BIOD66H, Causes & Consequences of Biodiversity  
EESC04H, Biodiversity and Biogeography

### **Bin 2: C & D level Organismal Biology Courses**

*Choose from:*

BIOC62H, Role of Zoos in Conservation  
BIOC54H, Animal Behaviour  
BIOD26H, Fungal Biology & Pathogenesis  
BIOD33H, Comparative Environmental Physiology  
BIOD37H, Biology of Plant Stress  
BIOD43H, Exercise Physiology  
BIOD45H, Animal Communication  
BIOD53H, Special Topics in Behavioural Ecology  
EESC30H, Microbial Biogeochemistry

### **B. Senior Research Courses (optional)**

Students interested in graduate research are encouraged to take one or more of the independent research courses offered in Biological Sciences as part of their degree.

BIOD95H, Supervised Study in Biology  
BIOD98Y, Directed Research in Biology  
BIOD99Y, Directed Research in Biology

### **C. Complementary Elective Courses (optional)**

This list of courses from other departments complements a degree in Biodiversity, Ecology and Evolution and hence students may want to consider these courses as potential electives. Please note that some of these courses require prerequisites not included in this program. Students are not required to take any of these courses; they are provided for guidance only.

EESA06H, Introduction to Planet Earth  
EESA10H, Human Health and the Environment  
EESB16H, Feeding Humans - The Cost to the Planet  
EESD15H, Cleaning Up Our Mess: Remediation of Terrestrial and Aquatic Environments  
GGRA02H, The Geography of Global Processes  
GGRA30H, Geographic Information Systems (GIS) and Empirical Reasoning  
GGRB20H, Environmental Conservation and Sustainable Development  
NROB60H, Neuroscience I: Cell Anatomy and Physiology  
NROC34H, Neuroethology  
NROC61H, Neuroscience II, Learning and Motivation  
NROC64H, Neuroscience III, Sensory and Motor Systems  
PSYA01H, Introductory Psychology: Part I  
PSYA02H, Introductory Psychology: Part II  
PSYB45H, Behaviour Modification: Origins and Applications  
PSYB64H, An Introduction to Physiological Psychology

### **Associated new courses**

#### **BIOC50H3      Macroevolution**

An overview of recent developments in evolutionary biology that focus on large-scale patterns and processes of evolution. Areas of emphasis may include phylogenetic reconstruction, historical biogeography, the origins of evolutionary novelty, speciation, and patterns of diversification and extinction in the fossil record.

*Breadth category:* Natural Sciences

*Exclusions:* EEB362H (Introduction to Macroevolution)  
*Prerequisites:* BIOB50H3 (Ecology) & BIOB51H3 (Evolutionary Biology)  
*Corequisites:* None  
*Limited enrolment:* None  
*Frequency of course offering:* Once a year.

This course will be a core (required) third year course in a new Biodiversity, Ecology, and Evolution Specialist program. It represents a survey of evolutionary biology “above the species” level, which has been identified as a major gap in Biological Science’s treatment of subject matter in ecology and evolution. Macroevolution, which includes subject material ranging from developmental evolution to palaeontology, is a timely topic that is attracting considerable interest in the scientific research community. The course is a good fit to existing research and teaching strength in the Department.

### **BIOD26H3 Fungal Biology and Pathogenesis**

A lecture and tutorial based course designed to provide an overview of the fungal kingdom and the properties of major fungal pathogens that contribute to disease in animals (including humans) and plants. This course will address the mechanisms and clinical implications of fungal infections and host defence mechanisms. Topics include virulence factors and the treatment and diagnosis of infection.

*Breadth category:* Natural Sciences  
*Exclusions:* None  
*Prerequisites:* BIOC17H3 (Microbiology: The Bacterial Cell)  
*Corequisites:* None  
*Limited enrolment:* 50 [*Department’s rationale:* To allow for student presentations]  
*Frequency of course offering:* Once a year.

This course has been designed particularly for the new Biodiversity, Ecology & Evolution specialist program and for the revised Integrative Biology specialist. It is intended:

1. To provide students with a background in the fungal kingdom, a subject that is not extensively covered elsewhere in the curriculum.
2. To strengthen departmental offerings in organismal biology.
3. To complement other courses relating to infection and disease (e.g. BIOD65H, Pathologies of the Nervous System; the new BIOD29H, Pathobiology of Human Disease – see “Other Changes” below).

### **BIOD66H3 Causes and Consequences of Biodiversity**

This course will combine lecture and student paper projects and presentations to explore the evolutionary and ecological processes that generate patterns of biological diversity as well as how species interactions and ecosystem function are affected by diversity. Of key interest will be how invasions, climate change, and habitat destruction affects diversity and function.

*Breadth category:* Natural Sciences  
*Exclusions:* None  
*Prerequisites:* BIOB51H3 (Evolutionary Biology) & [BIOC59H3 (Advanced Population Ecology) or BIOC61H3 (Community Ecology & Environmental Biology)]  
*Corequisites:* None  
*Limited enrolment:* 30 [*Department’s rationale:* To allow for student presentations]  
*Frequency of course offering:* Every other year.

This course has been designed particularly for the new Biodiversity, Ecology & Evolution specialist program. It is a senior level course meant to tie together ecology and evolution courses taken at the B and C levels.

## PROGRAM DELETIONS

### DEPARTMENT OF BIOLOGICAL SCIENCES

#### **Specialist Program in Conservation Biology (Non co-op & Co-op)**

This program attracted few students, probably because it was too narrowly focused. Students interested in this area of study are likely apply to the proposed new program Biodiversity, Ecology and Evolution Specialist (BEES) that has a much broader and comprehensive focus that includes the subject of Conservation Biology.

### DEPARTMENT OF HUMANITIES

#### **Minor Program in French as a Second Language**

The program's requirements are insufficiently comprehensive and its focus too narrow. Enrolments have been very low. Students in the program can easily transfer to the Minor Program in French.

### DEPARTMENT OF SOCIAL SCIENCES

The Department of Social Sciences and its undergraduate programs underwent external review in 2008. One of the report recommendations was that the Department undertake a curriculum review of all its programs. The proposed deletions have resulted from the curriculum review.

#### **Specialist Program in Medical Anthropology**

Biological Anthropology is moving in the direction of primate evolution rather than health. Anthropology will now focus on two streams: Socio-Cultural Anthropology (leading to a BA degree) and Biological Anthropology (leading to a BSc degree). Students with this interest may enrol in the Health Studies which is being strengthened with additional courses.

#### **Minor Program in International Development Studies**

It is in the character of interdisciplinary programs such as IDS that they require a combination of courses from other disciplines and fields. This approach can work well when there is a strong core of subjects in the program and the options are tightly structured and allow for the development of comprehensiveness of knowledge even if there is a long list of options, as is the case with the Specialist and Major in IDS. A review of the courses available for the minor indicates that there are not enough related courses and the program thus lacks coherence. Students interested in this area can enrol in discipline-based Minors in Anthropology, Geography, Political Science and Sociology.