BIOLOGY

Departmental Facilities
The Biology Department is located in the BioSciences Complex, a large building with offices, teaching laboratories, lecture rooms and extensive research facilities. The Department also maintains the Queen’s University Biological Station: more than 3000 ha of woodland, fields and shoreline on both Lake Opinicon and Elbow Lake, 50 km north of Kingston. This station has extensive laboratory and teaching facilities and can provide accommodation for 75 or more researchers and students interested in population and community ecology, limnology, behavioural ecology, and conservation biology.

Our research is focused mainly on two currently vibrant areas of biology:

1. molecular, cell, and integrative biology, and
2. ecology, evolution and behaviour.

In support of this research, we have both aquatic and animal care facilities in the BioSciences Complex, an excellent herbarium for local and arctic flora, a gentotyping facility, and a large, well-equipped Phytotron (greenhouse) for plant growth and tissue culture. Our research laboratories are also well equipped for studies in a wide variety of disciplines including physiology and biochemistry, genetics, genomics and proteomics, paleolimnology, and cell biology (including microscopy and imaging).

Throughout our graduate program we emphasize both communication and quantitative skills to prepare our graduates for a wide range of employment opportunities in academia, government, and the private sector. We achieve this through hands-on research, seminars and journal clubs, lab meetings, and a suite of graduate courses and workshops.

Graduate students are guaranteed a minimum annual income for the first two years of the MSc degree and the first four years of the PhD, in the form of scholarships, teaching assistantships, and stipends from supervisors’ research grants. This guaranteed income is sufficient to cover the costs of tuition, food and lodging. Detailed information on faculty and graduate student research, and the current minimum guaranteed income for graduate students is available on the Department’s website.

Faculty
Head
Cumming, B.F.

Associate Head
Eckert, C.G.

Coordinator of Graduate Studies
Friesen, V.L.

Professor

Associate Professor
Bonier, F., Colautti, R., Friedman, J., Martin, P.R., Nelson, W.A., Seroude, L., Wang, Y.

Assistant Professor
Aristizabal, M., diCenzo, G.C., Little, A., Monaghan, J., Orihel, D., Yakimowski, S.

Professor Emeritus

Cross-Appointed

Adjunct Faculty

1 On Sabbatical January 1, 2021-June 30, 2022
2 On Sabbatical January 1, 2022- June 30, 2022

Programs
- Biology - Doctor of Philosophy (https://queensu-ca-public.courseleaf.com/graduate-studies/programs-study/biology/biology-phd/)
Courses

All courses (except BIOL 899 and BIOL 999) are half courses (3.0 credit units) which are offered either in the fall or winter term if there is sufficient student interest. Detailed outlines of course content are available during the summer of each year. Most courses are offered in alternate years.

**BIOM 800** Introduction to Mathematical Modeling in Ecology and Evolution
Modeling will be presented in the context of biological examples drawn from ecology and evolution, including life history evolution, sexual selection, evolutionary epidemiology and medicine, and ecological interactions. Techniques will be drawn from dynamical systems, probability, optimization, and game theory with emphasis put on how to formulate and analyze models. Three term hours. Not offered 2021-22.

**BIOL 801** Evolutionary Medicine
A survey of the ways in which concepts from evolutionary biology can be used to better address and understand issues related to human health. Topics might include the evolutionary biology of infectious diseases, the utility of phylogenetics in infectious diseases, the evolution of drug (e.g., vaccines) and antibiotic resistance, the evolutionary biology of human genetic disorders, aging and senescence. Three term hours. Not offered 2021-22.

**BIOL 806** Plant Molecular Biology
Model systems for plant molecular genetics; gene identification and cloning; gene transfer techniques including vector construction; transposons; genetic regulation and expression. Not offered 2021-22.

**BIOL 813 Statistical and Machine Learning in Biology**
A course in advanced techniques for analyzing biological data. Possible topics include statistical and machine learning (e.g. likelihood models, Monte Carlo methods, approximate Bayesian computation), and neural networks (e.g. deep, recursive, convolutional). Topics covered will depend upon student and faculty interests. Lectures & Tutorials (3hrs). Course weight: 3.0 credit units. Three term hours. Not offered 2021-22.

**BIOL 817** Contemporary Issues In Biology
The focus will be on biological issues of current importance to provide a broad exposure within a range of specific disciplines. Topics will include critical analysis of biological issues that have been featured as news items either in the popular press or in science news journals within the previous 12 months. Three term hours. Not offered 2021-22.

**BIOL 818** Stress Biology
Environmental stress is addressed with respect to water, nutrition, temperature, toxins, and competition between organisms. Topics include adaptations to cope with stress; biological responses at the organismal, cellular, biochemical, physiological and molecular genetic levels. No specialized molecular biology background is required. Three term hours. Winter. W. Snedden.

**BIOL 819** Selected Topics in Molecular Genetics
Topics will range from population genetics to transcriptional regulation in both plants and animals. Application of the tools of molecular genetics to biological problems will be emphasized. No previous specialization in molecular biology is required, although some background in this area is highly recommended. Three term hours Winter. W.G. Bendena.

**BIOL 820** Commercialization of Biological Research
Current issues relating to the biotechnology industry will be dealt with in detail. Topics covered include: grant writing; patenting; circumventing patents; funding sources; business plans; venture capital investments; public awareness; public perspective; and layperson presentations. Three term hours. Three term hours. Fall. K. Ko.

**BIOL 821** Introduction to computational analysis in biology
This course will be a hands on introduction to essential bioinformatics skills. The goal is to build a foundation of computational skills that enable analysis of large biological data. We will learn command line Unix/Linux, shell scripting, and installation/testing/usage of popular public bioinformatics packages. We will spend significant time learning Perl and/or Python and Matlab. The course will rely heavily on problem based learning and in class discussion. Assignments will involve analyses that use primary literature data, particularly next gen sequencing data. 50% of the final grade is based on a research project conceived and carried out independently. No prior programming experience is necessary. Three term hours. Winter. R. Colautti.

**BIOL 825** Ecology and Evolution
The focus will be on biological issues of current importance to provide a broad exposure within a range of specific disciplines. Topics will include critical analysis of biological issues that have been featured as news items either in the popular press or in science news journals within the previous 12 months. Three term hours. Not offered 2021-22.
EXCLUSION: PHGY 801.

**BIOL 821 Communication Skills**
Scientific writing and methods for the presentation of research in seminars, posters, and the popular media. Three term hours. Not offered 2021-22.

**BIOL 822 Long Term Environmental Change**
The main focus of this course will be to review and assess the many techniques currently available to track long term environmental change. An emphasis will be placed on biological approaches dealing with sedimentary analyses, but other proxy methods (e.g. ice cores, bore holes, etc.) will also be covered. General topics to be covered will include climatic change, acidification, eutrophication, lake and reservoir management, UV penetration, etc. Three term hours. Fall. D.D. Lefebvre.

**BIOL 839 Plant Ecology and Evolution**
Mechanisms of natural selection involving adaptive strategies for growth, survival and reproduction in plants and the consequences of this selection on the characteristics of plant populations and communities. Recent research topics and theoretical developments are stressed. Three term hours. Not offered 2021-22.

**BIOL 843 Advanced Data Management and Experimental Design**
This course provides an introduction to advanced statistical methods (multivariate analysis, randomization methods, phylogenetic analysis) and experimental design for biologists. The emphasis is on problem solving and the use of microcomputers for data acquisition, management, analysis and publication. Three term hours. Not offered 2021-22.

**BIOL 844 Gateway to graduate studies**
This course will introduce intellectual and professional skills important for success in graduate school and in careers in Biology. Course structure and content is applicable to all fields of biology, from ecology and evolution to cell biology, biochemistry, and molecular biology. Sessions will span topics from study design and hypothesis testing, to communication skills, to career paths and mentoring. The final assignment will be a written research proposal, following the departmental guidelines for the PhD proposal. The goals of the course include 1) introducing graduate students to an array of skills and topics important to their success, 2) helping to develop a community among new graduate students, 3) improving students' communication skills, and 4) introducing graduate students to several Biology faculty who will lead some of the sessions. Students are required to attend a mandatory weekend at the Queen's University Biological Station, with a cost recovery fee for accommodation and meals. Three term hours. Fall. D. Orihel and P.G. Young

**BIOL 824 Field Course in Population Biology**
This is a two week field course designed to introduce graduate students to field research problems and methods in behavioural ecology, ethology, population and community ecology, and ecological genetics. The course consists of lectures, field research projects and data analysis. Fall/Winter/Summer. Not offered 2021-22. C.G. Eckert, S. Lougheed, and Y. Wang.

**BIOL 849 Environmental Issues**
Consideration will be given to environmental, legal, economic, political, sociological and biological aspects of current issues...
in the management of the Great Lakes. Models for managing nutrients, toxics and fisheries will be compared from a multidisciplinary viewpoint. Three term hours. Not offered 2021-22.

**BIOL 850  Darwinism and cultural evolution**
Contributions of Darwinian evolutionary theory to the understanding of contemporary culture. Through seminars, essays, and group discussions, students explore ideas, research objectives, and recent discoveries in applying Darwinism to the interpretation of cultural products like art and literature, social cultural institutions like religion and marketing, societal problems like war and environmental conservation, and emerging designs for new models of sustainable civilization in the 21st century. Not offered 2021-22.
EXCLUSION: BIOL 535

**BIOL 855  Conservation Biology**
Key issues in conservation biology will be explored in seminars and discussions. Topics will include: minimum viable populations, habitat configuration and sustainable populations, biodiversity, habitat fragmentation, edge effects, keystone species, meta populations, restoration ecology, endangered species, inbreeding, heterozygosity and fitness, genetics of captive breeding, population genetics and conservation. Three term hours. Not offered 2021-22.

**BIOL 860 Introduction to Management and Statistical Analysis of Biological Data**
This course is for students at early stages of planning research and collecting data. Topics include experimental design, matching hypotheses with statistical analyses, parameter estimation and graphing. Analyses will be based on a normal error distribution implemented in the R statistical language. Lectures. (3 hrs) & tutorials (3 hrs); First 6 weeks of fall term. Enrolment may be limited. Course weight: 3.0 credit units. Three term hours. Fall. S. Arnott
EXCLUSION: BIOL 843

**BIOL 861 Introduction to Linear Models for Biological Data**
This course is for students with introductory statistics/experimental design training and a working knowledge of the R statistical language, and will cover fitting linear models to continuous data, model selection, diagnosis of key assumptions and data visualization. Lectures (3 hrs) & tutorials (3 hrs). First 6 weeks of winter term. Enrolment may be limited. Course weight: 3.0 credit units. Three term hours. Fall. C.G. Eckert. PREREQUISITES: BIOL 860 or equivalent.

**BIOL 862 Application of Generalized Linear Models to Biological Data**
Data analysis in Biology often involves counts, densities or proportions that require non Normal analysis. This course introduce generalized linear models (GLMs) implemented using the R statistical language, including logistic regression, overdispersion and Poisson, quasi likelihood, negative binomial and mamma models. Lectures (3 hrs) & tutorials (3 hrs). Second 6 weeks of fall term. Enrolment may be limited. Course weight: 3.0 credit units. Not offered 2021-22.

**BIOL 863 Introduction to Mixed Effects Models for Biological Data**
The course will focus on linear models that include random effects implemented using the R statistical language. Topics will include partitioning of random variance, nested, partially nested and repeated measures experimental designs, and modern approaches to evaluating competing models. Lectures (3 hrs) & tutorials (3 hrs). First 6 weeks of winter term. Enrolment may be limited. Course weight: 3.0 credit units. Not offered 2021-22.

**BIOL 865 Advanced Statistical Analysis of Biological Data**
A course in advanced statistical techniques for biological data. Possible topics include comparative methods, phylogenetic analysis, general additive models, nonlinear regression, network analysis, time series analysis, resampling, path analysis. Topics covered will depend upon student and faculty interests. Lectures & Tutorials (3hrs). Course weight: 3.0 credit units. Not offered 2021-22. PREREQUISITE: BIOL 860 & BIOL 812 or equivalent.

**BIOL 870 Classical Studies in Molecular Biology**
In this course we will explore advances in molecular biology and genetics with a historical perspective. We will read classical papers outlining major discoveries such as the molecular structure of nucleic acids, the genetic code, the genetic basis of inheritance, and others. Classical studies will be paired with modern studies that build upon these earlier findings. Modern studies will change each year depending on the interests of the students. A major goal of the course is to gain an appreciation for how creativity and carefully designed experiments drive innovation. Students should have foundational knowledge of molecular biology and genetics, as evidenced by a BSc degree that included courses in these subjects. Three term hours. Winter. Not offered 2021-22.

**BIOL 893 Mentoring Experience in Biology**
Students will advise and train other students in biological investigations, normally over a two term period. Open to full time students having completed two terms of study in Biology M.Sc. or Ph.D. programs. Activities include guidance on research proposals, research procedures, student
presentations, and drafts of student work. This is a non credit course, graded on a Pass/Fail basis.

PREREQUISITE: Permission of Coordinator of Graduate Studies

BIOL 897  Seminar Course
Attending a diverse array of seminars is an essential component in the development of a student, especially in a department as diverse as biology. The aim of this course is to develop skills in listening, synthesizing and critical thinking, as well as fostering the development of important oral and written communication skills. Students will be required to attend at least 30 department or specialized research seminars, as well as present a seminar based upon their graduate thesis research. Enrolment is extended over six terms and is limited to new graduate students in Biology. Fall/Winter/Summer. L. Seroude.

BIOL 899  Master's Thesis Research

BIOL 951  Advanced Studies in Ecology, Evolution and Behaviour I
Selected topics in ecology, evolution and behaviour. An advanced course on current research in ecology, evolution and behaviour, based on recent research literature. For detailed information, consult the course coordinator.

BIOL 952  Advanced Studies in Ecology, Evolution and Behaviour II
Selected topics in ecology, evolution and behaviour. An advanced course on current research in ecology, evolution and behaviour, based on recent research literature. For detailed information, consult the course coordinator.

BIOL 953  Advanced Studies in Plant Sciences I
Selected topics in plant sciences. An advanced course on current research in plant science, based on recent research literature. For detailed information, consult the course coordinator.

BIOL 954  Advanced Studies in Plant Sciences II
Selected topics in plant sciences. An advanced course on current research in plant science, based on recent research literature. For detailed information, consult the course coordinator.

BIOL 955  Advanced Studies in Molecular and Cellular Biology I
Selected topics in molecular biology. An advanced course on current research in molecular biology, based on recent research literature. For detailed information, consult the course coordinator. Three term hours. Fall. G. diCenzo and S. Regan.

BIOL 956  Advanced Studies in Molecular and Cellular Biology II
Selected topics in molecular biology. An advanced course on current research in molecular biology, based on recent research literature. For detailed information, consult the course coordinator. Three term hours. Fall. G. diCenzo and S. Regan.

BIOL 957  Advanced Studies in Animal Physiology I
Selected topics in animal physiology. An advanced course on current research in animal physiology, based on recent research literature. For detailed information, consult the course coordinator.

BIOL 958  Advanced Studies in Animal Physiology II
Selected topics in animal physiology. An advanced course on current research in animal physiology, based on recent research literature. For detailed information, consult the course coordinator.

BIOL 959  Advanced Studies in Environmental Sciences I
Selected topics in environmental sciences. An advanced course on current research in environmental sciences. For detailed information, consult the course coordinator.

BIOL 960  Advanced Studies in Environmental Sciences II
Selected topics in environmental sciences. An advanced course on current research in environmental sciences. For detailed information, consult the course coordinator.

BIOL 999  Ph.D. Thesis Research