

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 genotyping 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

Aarssen, L.W., Arnott, S.E., Bendena, W., Chin-Sang, I.D., Chippindale, A.K.², Cumming, B.F., Eckert, C.G., Friesen, V.L., Grogan, P., Ko, K., Lefebvre, D.D., Loughheed, S., Moyes, C.D., Regan, S.M., Smol, J.P., Snedden, W.A., Tufts, B.L., Young, P.G.

Associate Professor

Bonier, F., Colautti, R., Friedman, J.², Martin, P.R., Nelson, W.A., Seroude, L., Wang, Y.²

Assistant Professor

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

Professor Emeritus

Bidwell, R.G.S., Boag, P.T., Crowder, A.A., Dennis, D.T., Harmsen, R., Hodson, P.V., Leggett, W.C., Montgomerie, R.D., Morris, G.P., Plaxton, W.C., Ratcliffe, L.M., Robertson, R.J., Robertson, R.M., Walker, V.K.

Cross-Appointed

Blennerhassett, M., Daugulis, A.J., Davies, P.L., Day, T., Dumont, E., Paterson, W.G., Quinsey, V.L., Taylor, P.D., Troje, N., Vanner, S.J.

Adjunct Faculty

Antunes, P., Babak, T., Birt, T.P., Blanchford, P., Boag, P.T., Casselman, J.M., Chabot, A., Charmantier, A., Davy, C., Douglas, M.S.V., Guttman, D., Fortin, M.-J., Frank, K., Hasler, C., Hunt, S., Johnson, T.B., Kurek, J., Litzgus, J., Molina, I., Nagel, L., Paterson, A., Provencher, J., Ratcliffe, L.M., Ridgway, M., Robertson, G., Robinson, S.A., Rooney, R., Rusak, J.A., Russello, M., Schamp, B., Selbie, D., Stager, C., Tai, H., Vancoeverdendegroot, P., Waits, L., Young, J., Zeeb, B.A.

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/>)



- Biology - Master of Science (<https://queensu-ca-public.courseleaf.com/graduate-studies/programs-study/biology/biology-ms/>)

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 811 Plant Metabolism

This course explores contemporary research ideas and techniques used to elucidate plant metabolism and its control. Topics include plant signal transduction, plant metabolic adaptations to abiotic and biotic stress, as well as the application of proteomics, genomics, and molecular biology for comprehending plant metabolism and the production of 'improved' transgenic crops via metabolic engineering. Not offered 2021-22.

BIOL 812 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 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.

PREREQUISITE: BIOL 860 & BIOL 812 or equivalent

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.

PREREQUISITE: At least one of the following: BIOL 201 , BIOL 205 , MBIO 318 , BIOL 441 , BIOL 330 /430 or equivalent.

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. J.P. Smol.

BIOL 824 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 830 Ecological and Evolutionary Genetics

Each year brings new molecular tools and significant advances in analytical techniques for using molecular data to address evolutionary and ecological questions. This course is an exploration of these with emphases varying from year to year depending on the expertise of the instructor. Topics may span natural selection and phenotypic plasticity, parentage and mating systems, speciation, hybridization, macroevolution, and phylogenetics. Students gain a thorough theoretical grounding of pertinent topics via lectures, student seminars, and readings from the current primary literature. Hands on analytical experience will be provided through student exercises using the latest software applications. Three term hours. Not offered 2021-22.

BIOL 831 Bioremediation

Bioremediation is the use of organisms to alleviate environmental problems. Topics will include the biology of the organisms involved and their bioremediation processes.

Plants act to absorb and concentrate heavy metals from soils whereas micro organisms, invertebrates and plants degrade organic toxins and remove excess nutrients from soils, substrates and water. The processes include extraction, absorption, concentration, and degradation of contaminants. 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. PREREQUISITE OR COREQUISITE: BIOL 343 or equivalent.

BIOL 847 Data Analysis in Community and Paleoecology

A variety of quantitative techniques are now being used increasingly in the fields of community ecology, paleoecology and paleolimnology (e. g. linear and unimodal regression and calibration, direct and indirect multivariate ordination, quantitative reconstruction models, rate of change analysis and analysis of spatial and temporal data). This course will investigate these computational techniques and explore their applications in the above mentioned fields. This course assumes a working knowledge of classical statistics. Three term hours. Winter. Not offered 2021-22. PREREQUISITE: BIOL 343 or permission by instructor.

BIOL 848 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. Loughheed, 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. Winter. 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 gamma 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