

## Ottawa-Carleton Institute of Biology

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### The Institute

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*Director of the Institute:*

D.J. Currie

*Associate Director:*

R.C. Wyndham

Students wishing to pursue studies in biological sciences at the M.Sc. and Ph.D. levels in the Ottawa area do so in a cooperative program that combines the resources of the Departments of Biology of Carleton University and University of Ottawa. The two universities have a joint committee supervising the programs, regulations, and student admissions.

Students are admitted for graduate work under the general regulations of the Institute. Additional criteria for admission include academic performance, research experience, and referees' appraisals. The student must also be accepted by a faculty member who will supervise the research project, and the choice of supervisor will determine the primary campus location of the student. The student's advisory committee will normally include faculty members from both universities.

Requests for information, and completed applications should be sent to the director of the Institute, or to the supervisor of graduate studies at either institution.

### Members of the Institute

J.B. Armstrong, *Developmental Biology*  
J.T. Arnason, *Biochemical Ecology*  
C.A. Barlow, *Experimental Ecology*  
W.R. Bates, *Developmental Biology*  
Linda Bonen, *Molecular Biology*  
D.C.W. Brown, *Plant Genetic Engineering*  
D.L. Brown, *Cell Biology*  
M.J. Canny, *Whole Plant Physiology*  
G.R. Carmody, *Population Genetics*  
P.M. Catling, *Plant Biosystematics*  
Nathalie Chaly, *Cell Biology*  
François Chapleau, *Fish Evolution*  
Christiane Charest, *Plant Physiology*  
R.L. Charlebois, *Microbiology*  
D.J. Currie, *Community Ecology, Biogeography*  
Hans Damman, *Insect Behavioural Ecology*  
J.R. Dillon, *Molecular Genetics*  
Guy Drouin, *Molecular Genetics*

Lenore Fahrig, *Population Ecology and Ecological Modelling*

J.M. Farber, *Food Microbiology*

L.B. Flanagan, *Plant Ecology and Physiological Ecology*

J.C. Fenwick, *Comparative Endocrinology*

C.S. Findlay, *Evolution*

D.R. Gardner, *Pesticide, Nerve Interactions*

A.J. Gaston, *Conservation Biology*

S.C. Gleddie, *Somatic Cell Genetics*

W.D. Gould, *Biotechnology*

D.A. Hickey, *Population Genetics*

J.G. Houseman, *Insect Physiology*

H.F. Howden, *Biogeography, Systematics of Insects*

V.N. Iyer, *Bacterial Genetics*

S.L. Jacobson, *Excitable Cell Physiology*

D.A. Johnson, *Molecular Biology*

B.F. Johnson, *Cell Biology of Yeast*

P.A. Keddy, *Plant Ecology*

J.D. Lafontaine, *Insect Systematics*

I.B. Lambert, *Molecular Biology and Genetic Toxicology*

J.D. Lambert, *Plant Communities and Man*

L.R. Lefkovitch, *Mathematical Biology*

M.W. McBurney, *Developmental Biology*

M.E. McCully, *Plant Ultrastructure and Development*

H.G. Merriam, *Woodland Ecosystems*

T.W. Moon, *Comparative Physiology*

Antoine Morin, *Freshwater Ecology*

C.E. Morris, *Physiology of Excitable Cells*

J.M. Neelin, *Nuclear Proteins and Differentiation*

Micheline Paulin-Levasseur, *Cell Biology*

S.B. Peck, *Arthropod and Beetle Evolution Systematics*

S.F. Perry, *Comparative Respiratory Physiology*

B.J.R. Philogène, *Ecophysiology of Insects*

Frances Pick, *Microbial Physiology and Ecology*

Jaroslav Picman, *Behavioural Ecology*

G.P. Raaphorst, *Radiation Biology*

D.J. Rapport, *Environmental Statistics*

V.L. Seligy, *Molecular Genetics*

John Sinclair, *Biophysics of Cells*

K.B. Storey, *Biochemical Adaptations*

J.P. Vierula, *Molecular Biology*

S.I. Warwick, *Plant Systematics*

P.J. Weatherhead, *Behavioural Ecology*

J.A. Webb, *Plant Metabolism*

J.M. Weber, *Metabolic Physiology*

D.M. Wood, *Insect Systematics*

R.C. Wyndham, *Applied Microbiology and Ecology*

Hiroshi Yamazaki, *Bacterial Metabolism, Biotechnology*

### **Ottawa-Carleton Graduate Specialization in Neuroscience**

The Departments of Biology and Psychology at Carleton University, and the Departments of Anatomy, Physiology, and Psychology at the University of Ottawa provide a graduate specialization in neuroscience at the M.Sc. and Ph.D. level. For further details see page 275.

### **Ottawa-Carleton Collaborative Program in Chemical and Environmental Toxicology**

The Departments of Biology and Chemistry at Carleton University and at the University of Ottawa, and the Department of Psychology at Carleton University, provide a collaborative program in chemical and environmental toxicology at the M.Sc. level. For further details see page 173.

Each campus is well equipped for a wide range of biological research; some major equipment and facilities include transmission and scanning electron microscopes, spectrophotometer, liquid scintillation and other radioactivity counters, high performance liquid and gas chromatographs, amino acid analyzer, preparative and analytical ultracentrifuges, electrophysiology equipment, animal and plant growth facilities, controlled environment cabinets, and on-line computer access. Students also benefit from the resources of nearby government laboratories and libraries, for example, Agriculture Canada, Environment Canada, Health and Welfare Canada, and the National Research Council.

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## **Master of Science**

### **Admission Requirements**

An honours B.Sc. or equivalent degree at a standard acceptable to the two universities is required for admission to the M.Sc. program. Applicants with acceptable standing in a non-honours degree may be admitted to a qualifying-year program which will be determined in each case by the admissions committee.

Applicants must demonstrate a fluent knowledge of English (Carleton), or either English or French (Ottawa).

### **Program Requirements**

The M.Sc. degree will be conferred upon a candidate who has fulfilled the following requirements:

- Completion of the advanced courses specified by the admissions committee and the student's advisory committee; these will range from one to three full (two-term) courses, depending on the

background and research program of the student. At least one course at the graduate level must be included, and not more than one course at the fourth-year honours level (completed while registered as a graduate student) may form part of the candidate's course requirements. The passing grade for all required courses is 70% or equivalent, and the student is not allowed a supplemental examination. Directed studies or reading courses may not make up more than half of the required numbers of courses. The admissions committee or the student's advisory committee may also direct the student to take or to audit additional courses. Knowledge of a second language may be specified as a requirement

- Completion of at least two terms as a full-time student resident at one of the two universities is normally required. Programs for part-time students may be arranged
- Presentation of one public seminar on the candidate's thesis research
- Completion of a thesis incorporating the results or original research carried out under the direct supervision of an approved faculty member
- Successful oral defence of the thesis before an examination board of at least three faculty members, normally drawn from both universities.

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## **Doctor of Philosophy**

### **Admission Requirements**

An M.Sc. from a recognized university is usually required for entry to the Ph.D. program; however, an applicant with a first class B.Sc. and excellent references may be admitted directly to the Ph.D. program. A student already registered for the M.Sc. may be permitted to transfer to the Ph.D. program following a recommendation by the departmental graduate committee and successful completion of the comprehensive examination required of Ph.D. candidates.

All applicants must demonstrate a fluent knowledge of English (Carleton), or either English or French (Ottawa).

### **Program Requirements**

The Ph.D. degree will be conferred upon a candidate who has fulfilled the following requirements:

- Completion of the courses at the graduate level specified by the admissions and advisory committees; these will range from two to four full courses (three to six courses if admitted without an M.Sc.), depending on the background and research program of the student. Only graduate courses may form part of the

candidate's course requirements. The passing grade for all required courses is 70%, and the student is not allowed a supplemental examination. Directed studies or reading courses may not make up more than half of the required number of courses. The admissions committee or the student's advisory committee may also direct the student to take or to audit additional courses. Knowledge of a second language may be specified as a requirement

- Completion of an oral comprehensive examination within approximately twelve months of entry into the program; this examination will cover the candidate's area of research, and general biology. The format of the examination will be established by the departmental graduate committee and approved by the admissions committee. The examination committee will generally be composed of faculty members of both universities
- Presentation of at least one public seminar on the candidate's thesis research
- A thesis incorporating the results of original research carried out under the direct supervision of an approved faculty member
- Completion of at least four terms as a full-time student resident at one of the two universities (or six terms if admitted without an M.Sc.) is normally required. Under exceptional conditions programs may be arranged for part-time students
- Successful oral defence of the thesis before an examination board of at least five faculty members, with representation from both universities, and including an external examiner from outside the two universities who is an authority on the thesis research area

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## Graduate Courses\*

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The following courses are offered in the graduate program, but not all are available in any academic year. A list of the courses scheduled for the year is available from the Institute in May.

- Biology 61.501F1 (BIO5101)  
Topics in Biotechnology  
A course concerned with the utilization of biological substances and activities of cells, genes, and enzymes in manufacturing, agricultural and service

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\* F,W,S indicates term of offering. Courses offered in the fall and winter will be followed by T.  
The number following the letter indicates the credit weight of the course: 1 denotes a half-course credit, 2 denotes a full-course credit, etc.

industries. A different topic will be selected each year.

*Prerequisite:* A course in cell physiology or biochemistry, or permission of instructor.

Hiroshi Yamazaki.

- Biology 61.502F1 (BIO8300)  
Applied and Industrial Microbiology  
A lecture and reading course on the use of microorganisms in industrial processes. Subjects to be covered will include microbial fermentations, enzymology, secondary metabolites, biomass and fuel production.

D.J. Kushner and others.

- Biology 61.503F1 (BIO5103)  
Comparative Biochemistry  
Advanced topics emphasizing biochemical structures, functions and methodologies in the context of animal (invertebrates and vertebrates) adaptations to environmental stress. The course will be offered in alternate years.

*Prerequisite:* An undergraduate biochemistry course.

T.W. Moon and K.B. Storey.

- Biology 61.509F1, W1 (BIO8124)  
Ontario Vegetation: Patterns, Processes and Protection  
Patterns of vegetation and plant species distributions in Ontario will be investigated with respect to their origin and maintaining processes. Current methods of protection of significant and representative vegetation using zonal concepts will be considered.

P.M. Catling.

- Biology 61.510W1 (BIO5301)  
Plant Development  
An advanced course dealing with selected topics in the experimental study of plant development.

M.E. McCully.

- Biology 61.517T2 (BIO5202)  
Molecular Genetics  
Development and use of genetic methods in the solution of problems in molecular biology, including discussion of innovations and current efforts of *in vivo* and *in vitro* genetic engineering. Lectures, seminars, laboratory, essays.

*Prerequisite:* Graduate standing and permission of the Department.

V.N. Iyer.

- Biology 61.521F1 (BIO8301)  
Evolutionary Genetics  
A lecture/seminar course on the genetic mechanisms and forces responsible for variation and evolutionary change in natural populations. The course will

consider both ecological and molecular questions from an evolutionary perspective. Topics will include protein and genome evolution, molecular phylogenies, DNA sequences in population biology, and the evolution of multigene families.

*Prerequisites:* Graduate standing plus basic courses in genetics and evolution, and permission of the Department.

(Offered in alternate years; one three hour lecture per week).

Before 1994-95 course 61.521 (BIO8301) was offered as 61.519 (BIO8219).

D.A. Hickey, G.R. Carmody, Guy Drouin and Linda Bonen.

- Biology 61.522W1 (BIO8302)

Topics in Evolutionary Genetics

A lecture/seminar course on further issues of the genetic mechanisms and forces responsible for genetic variation and evolutionary change. Topics will include the evolutionary significance of regulatory, structural and developmental gene variation, concepts of individual, deme and group selection, relationships of micro-evolution to macro-evolutionary trends, the evolution of sex, selfish DNA.

*Prerequisite:* Biology 61.521F1 (BIO8301).

(Offered in alternate years; one three hour lecture per week).

Before 1994-95 course 61.522 (BIO8302) was offered as 61.519 (BIO8219).

D.A. Hickey, G.R. Carmody, Guy Drouin and Linda Bonen.

- Biology 61.523F1 (BIO8303)

Techniques of Light Microscopy

An advanced laboratory and lecture course on the principles and techniques of light microscopy. One hour lecture per week, five hours laboratory work per week.

*Prerequisite:* Open to fourth year and graduate students with consent the instructor.

Before 1994-95 course 61.523 (BIO8303) was offered as 61.520 (BIO8238).

D.L. Brown.

- Biology 61.524W1 (BIO8304)

Techniques of Electron Microscopy

An advanced laboratory and lecture course on the principles and techniques of electron microscopy. (One hour lecture per week, five hours laboratory work per week).

*Prerequisite:* Open to Fourth year and graduate students with consent of the instructor.

Before 1994-95 course 61.624 (BIO8304) was offered as 61.520 (BIO8238).

D.L. Brown.

- Biology 61.525T2 (BIO5204)

Plant Physiology and Metabolism

An advanced course dealing with selected topics in plant physiology and plant metabolism.

*Prerequisite:* Graduate standing or permission of the Department.

- Biology 61.534T2 (PSY6201)

Basics of Neuroscience

A comprehensive neuroscience course from the membrane and the cellular levels through to the behavioural aspects of invertebrates and vertebrates. Lectures and tutorials will cover such aspects of neuroscience as neuroanatomy, neurophysiology, behavioural neuroscience and neuropharmacology. (Also offered as Psychology 49.520)

- Biology 61.535T2 (BIO5212)

Special Studies in Physiology

Advances in cellular neurophysiology. Two lectures per week, four hour laboratory and essay assignment. D.R. Gardner.

- Biology 61.536F1, W1 (BIO9201)

Photobiology

A course dealing with the interaction between light and living organisms, including an introduction to photochemistry, and a detailed study of photosynthesis, vision, photosensitivity, and photoperiodism.

*Prerequisite:* An advanced course in animal or plant physiology or biochemistry, or permission of the Department.

John Sinclair, J.T. Arnason and B.J.R. Philogène.

- Biology 61.537F1 (BIO8122)

Advanced Insect Physiology

Physiological characteristics of insects. In addition to the course material, students will write two term papers.

J.G. Houseman.

- Biology 61.542T2 (BIO8162)

Developmental Endocrinology/Topics in

Comparative Endocrinology

A lecture and reading course concerned with classical as well as current topics in the field of comparative endocrinology. Special emphasis will be placed on the vertebrates. Offered in alternate years.

*Prerequisite:* An undergraduate course in endocrinology.

J.C. Fenwick.

- Biology 61.545T2 (BIO9202)

Project in Applied Ecology

A course in the form of a special research project in which the student identifies an environmental problem and the corporate or governmental body that has the power to rectify the problem. Work includes:

1) a literature review with a report on this review;

2) a second report, in the form of an article in a newspaper or magazine, to convey the relevant results to non-scientists; 3) an approach to the relevant private or governmental agency with an attempt to have the solution implemented and a detailed report on this experience. (Enrolment limited).  
P.A. Keddy.

- Biology 61.546F1 (BIO9303)  
Advanced Plant Ecology  
Plant population biology, and its usefulness in explaining attributes of plant communities, will be discussed in weekly seminars based on assigned readings. During the labs projects will be carried out to clarify topics such as vegetation classification and competition.  
P.A. Keddy.

- Biology 61.547T2 (BIO5205)  
Quantitative Ecology  
A course on analysis of the distribution and abundance of plants and animals, and of related environmental phenomena. Computer assignments and a major data analysis project will be required.  
*Prerequisites:* Graduate standing, courses in elementary ecology and statistics and permission of the Department.  
Lenore Fahrig.

- Biology 61.549T2 (BIO5206)  
Mathematical Modelling for Biologists  
This course is designed to develop mathematical tools for the modelling of biological processes. The student is taught the necessary mathematics, a computer language, and guidance is given in the choice of simulation of a biological process.  
L.P. Lefkovitch.

- Biology 61.550T2 (BIO5207)  
Selected Topics  
Courses in selected aspects of specialized biological subjects, not covered by other graduate courses; course details will be available at registration.

- Biology 61.551F1 (BIO8104)  
Selected Topics in Biology I  
Courses in selected aspects of specialized biological subjects, not covered by other graduate courses; course details will be available at registration.

- Biology 61.552W1/S1 (BIO8102)  
Selected Topics in Biology II  
Courses in selected aspects of specialized biological subjects, not covered by other graduate courses; course details will be available at registration.

- Biology 61.553T2 (BIO5901)

Recent Advances in Biology  
A course intended for all first-year graduate students to bring them up to date in the various major areas of biology. The course will consist of selected readings, lectures and invited speakers.

- Biology 61.556T2 (BIO5213)  
Advanced Insect/Animal Systematics  
A lecture and seminar course concerning methods, roles and advances in systematics of insects and other animals. One research project required.  
*Prerequisite:* A 400-level course in identification or classification of insects or other animals.  
H.F. Howden.

- Biology 61.558F1 (BIO8306)  
Advanced Population and Community Ecology I  
Lectures, seminars and discussions on current literature on experimental approaches, concepts and findings in population and community ecology. Course content will complement that of 61.559W1 (BIO8307); the two courses need not be taken in a particular order. Offered jointly by the staff of Carleton University and the University of Ottawa. Before 1994-95 course 61.558 (BIO8306) was offered as 61.548 (BIO9200).

- Biology 61.559W1 (BIO8307)  
Advanced Population and Community Ecology II  
Lectures, seminars and discussions on current literature on experimental approaches, concepts and findings in population and community ecology. Course content will complement that of 61.558F1 (BIO8306); the two courses need not be taken in a particular order. Offered jointly by the staff of Carleton University and the University of Ottawa. Before 1994-95 course 61.559 (BIO8307) was offered as 61.548 (BIO9200).

- Biology 61.560T2 (BIO5160)  
Advanced Topics in Insect Evolution  
The course will explore major concepts and questions in insect evolution in the areas of systematics, morphology, the fossil record, biology and behaviour. Lectures or discussions will be two hours per week and labs to be arranged.  
S.B. Peck.

- Biology 61.565F1, W1, S1 (BIO5102)  
Field Course  
Credit for this half course is based on a total of three weeks of field-course modules, involving one or two weeks of intensive and continuous field work with attendant assignments. For details, see coordinator.

*Coordinator:* P.J. Weatherhead.

- Biology 61.570T2 (BIO5209)

Evolution and Biogeography

A lecture course in biogeography and evolution requiring a graduate level literature project.

*Prerequisites:* Graduate standing and permission of the Department.

H.F. Howden.

- Biology 61.581F1 (BIO5105)

Animal Behaviour

A half-credit course in animal behaviour from an ecological and evolutionary point of view with additional independent assignments.

*Prerequisites:* Biology 61.335 and 61.361 or equivalents and registration in a graduate program, or written permission of the Department.

P.J. Weatherhead.

- Biology 61.582F1 (BIO8365)

Advanced Studies in Behavioural Ecology

Recent ideas and research on advanced topics dealing with the evolution of foraging, temporal, spatial, and reproductive strategies will be discussed and critically examined. Each student will be required to give two seminars, write two term papers on selected topics, and all students will participate in discussions of controversial problems.

Offered in alternate years.

Jaroslav Picman.

- Biology 61.599F, W, S

M.Sc. Thesis

- Biology 61.601F1 (BIO8109)

Advanced Molecular Biology I

Recent advances in molecular biology. Topics for discussion may include the following: DNA structure and function, the organization of the genome; DNA, RNA and protein synthesis; the regulation of gene expression in eucaryotes and procaryotes. Topics will reflect the interests of the teaching staff. Biology 61.602W1 (BIO8217) and this course normally will be offered together in the same year but only in alternate years. Not all topics will be covered each year.

- Biology 61.602W1 (BIO8116)

Advanced Molecular Biology II

Recent advances in molecular biology. Topics for discussion may include the following: metagenesis and DNA repair mechanism; molecular aspects of gene transfer recombination and gene arrangement; gene transfer mechanisms, the molecular biology of yeasts and fungi, especially with regard to industrial applications; the modern techniques of genetic engineering as applied to industrial and medical problems. Topics will reflect the interests of the teaching staff. Biology 61.601F1 (BIO8209) and this course normally will be offered together in the

same year but only in alternate years. Not all topics will be covered each year.

- Biology 61.621F1 (BIO8117)

Advanced Cell Biology I

Recent advances in cell biology. Topics for discussion may include the following: the composition, biosynthesis and three-dimensional organization of the cytoskeleton, factors regulating its deployment and the role of cytoskeletal elements in mitosis, cell-substrate attachment, cell motility, transport of organelles and axoplasmic transport, cell surface and extracellular matrix. Topics will reflect the interests of the teaching staff. Biology 61.622W1 (BIO8118) and this course normally will be offered together in the same year but only in alternate years. Not all topics will be covered each year.

- Biology 61.622W1 (BIO8118)

Advanced Cell Biology II

Topics for discussion may include the following: the structure, composition and three-dimensional organization of the nucleus, mechanisms and regulation of genome replication, structure organization of transcription. Role of the nucleus in virus replication and hormone response, structural and functional reorganization of nuclear components during gamete development, fertilization and the mitotic cell cycle. Topics will reflect the interests of the teaching staff. Biology 61.621F1 (BIO8117) and this course normally will be offered together in the same year but only in alternate years. Not all topics will be covered each year.

- Biology 61.623F1 (ANA7400 Fall Term)

Neuroscience Techniques I

Completion of a research project carried out under the supervision of a neuroscience faculty member from a department other than the student's enrolling department.

(Also offered as Psychology 49.624)

- Biology 61.624W1 (ANA7400 Winter Term)

Neuroscience Techniques II

Completion of a research project carried out under the supervision of a neuroscience faculty member from a department other than the student's enrolling department. The supervisor must be different from that of 61.623.

(Also offered as Psychology 49.625)

- Biology 61.625T2 (BIO8119)

Advanced Plant Physiology

A lecture and seminar course dealing with selected topics in advanced plant physiology, available only to graduate students.

*Prerequisite:* Biology 61.429 or equivalent, or permission of the Department.

- Biology 61.627F1 (BIO8164)

Ion Channels

A lecture and seminar course on the physiological and biophysical characteristics of ion channels. Topics will be selected from such areas as: determinants of channels selectivity, conformation changes, chemically-induced and voltage-induced gating, models of excitability, methods of studying channels (single channel studies, gating currents, pharmacological tools), and cellular distribution, modulation and development of channels. Offered in alternate years.

- Biology 61.630T2 (BIO8220)

Advanced Plant Biochemistry

A lecture and seminar course, available only to graduate students, dealing with selected topics in advanced plant biochemistry.

*Prerequisites:* Biology 61.425 and Biology 61.426/427, or permission of the Department.

- Biology 61.631W1 (BIO8121)

Advanced Microbial Physiology

Physiological function of micro-organisms in relation to microscopic and molecular structure; differentiation and regulation; mode of action of antibiotics and toxic substances. Lectures and advanced reading.

- Biology 61.633T2

Advanced Seminar in Neuroscience

An advanced seminar course integrating various aspects of neuroscience.

*Prerequisite:* Psychology 49.520 or 49.623  
(Also offered as Psychology 49.620)

- Biology 61.634F1 (BIO8361)

Advanced Topics in Animal Physiology

In-depth study of areas in animal physiology of current research interest.

J.C. Fenwick, S.F. Perry and T.W. Moon.

- Biology 61.638F1 (BIO8363)

Evolution and Adaptation in Fish

Consideration of evolution and adaptation with emphasis on concepts and ideas. Evolution of certain organ systems and phylogenetic groups. Adaptations to specific habitats. Lectures and seminars.

- Biology 61.641F1 (BIO8935)

Recent Advances in Plant Biology

Special topics of current interest.

- Biology 61.642F1 (BIO9101)

Principles of Toxicology

The basic theorems of toxicology with examples of current research problems. The concepts of expo-

sure, hazard and risk assessment will be defined and illustrated with experimental material from some of the more dynamic areas of modern research. (Also offered as Chemistry 65.578 and Psychology 49.525)

- Biology 61.643F1 (BIO9104)

Ecotoxicology

Selected topics and advances in ecotoxicology with emphasis on the biological effects of contaminants. The potential for biotic perturbation resulting from chronic and acute exposure of ecosystems to selected toxicants will be covered, along with methods of pesticide, herbicide and pollutant residue analysis and the concept of bound residues.

*Prerequisite:* Biology 61.642 (BIO9101)

- Biology 61.644F1 (BIO8436)

Plant: Animal Interactions

Secondary metabolites of plants and their role as attractants or antifeedants to animals and as allelopathic or antifungal agents. Emphasis will be placed on co-evolution of plants and phytophagous organisms such as insects and mammals, and the ecological and physiological dimensions of this relationship. Offered in alternate years.

J.T. Arnason, B.J.R. Philogène, Constance Nozzolillo, J.G. Houseman.

- Biology 61.645W1 (BIO9105)

Seminar in Toxicology

A course in seminar format, highlighting current topics in toxicology. The course will feature student, faculty and invited seminar speakers.

(Also offered as Chemistry 65.585 and Psychology 49.526)

- Biology 61.655W1 (BIO8108)

Advanced Topics in Development

Recent advances in developmental biology. Topics may include embryonic induction, regulation of morphogenesis and differentiation, mechanisms of regional specification and pattern formation, and developmental genetics. Offered in alternate years.

J.B. Armstrong and W.R. Bates.

- Biology 61.660T2 (BIO8242)

Special Ichthyology I

Morphology, systematics and life histories of cyclostomes, elasmobranchii and the soft-rayed telosts.

- Biology 61.680T2 (BIO8221)

Advanced Studies in Animal Behaviour

A seminar and laboratory course dealing with current topics in the study of animal behaviour. Students will be expected to present seminars based on the

recent literature, and to conduct a research project on some aspect of animal behaviour.

*Prerequisites:* Biology 61.581 or equivalent, or permission of the Department.

P.J. Weatherhead.

- Biology 61.699F, W, S

Ph.D. Thesis