

Ottawa-Carleton Institute of Biology

Tory Bldg. 583

The Institute

Director of the Institute:

P.J. Weatherhead

Associate Director:

D.J. Currie

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 referee's 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. Canny, *Whole Plant Physiology*

G.R. Carmody, *Population Genetics*

P.M. Catling, *Plant Biosystematics*

Nathalie Chaly, *Cell Biology*

F. Chapleau, *Fish Evolution*

C. Charest, *Plant Physiology*

R. Charlebois, *Microbiology*

D.J. Currie, *Community Ecology, Biogeography*

H. Damman, *Insect Behavioral Ecology*

J.R. Dillon, *Molecular Genetics*

G. Drouin, *Molecular Genetics*

L. Fahrig, *Population Ecology and Ecological Modeling*

J.M. Farber, *Food Microbiology*

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

J.C. Fenwick, *Comparative Endocrinology*

S. Findlay, *Evolution*

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

A.J. Gaston, *Conservation Biology*

S.C. Gleddie, *Somatic Cell Genetics*

D.A. Hickey, *Population Genetics*

J. 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*

K.W. Joy, *Plant Metabolism*

P.A. Keddy, *Plant Ecology*

W.A. Keller, *Plant Tissue Culture*

D.J. Kushner, *Microbiology*

J.D. Lafontaine, *Insect Systematics*

J.D.H. 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*

B.L.A. Miki, *Plant Molecular Genetics*

T.W. Moon, *Comparative Physiology*

A. Morin, *Community Ecology*

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

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

Constance Nozzolillo, *Plant Physiology, Phytochemistry*

M. 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*

F. Pick, *Microbial Physiology and Ecology*

Jaroslav Picman, *Behavioral Ecology*

G.P. Raaphorst, *Cellular Repair*

D. Rapport, *Stress Ecology*

S. Reid, *Comparative Physiology*

J.N. Saddler, *Cellulolytic Microbiology*

V.L. Seligy, *Molecular Genetics*

John Sinclair, *Biophysics of Cells*

D.G. Sprott, *Bacterial Physiology*

K.B. Storey, *Biochemical Adaptations*

Jean Vaillancourt, *Animal Ecology*

J.P. Vierula, *Molecular Biology*

S.I. Warwick, *Plant Systematics*

P.J. Weatherhead, *Behavioral 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 242.

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).

Master of Science

Admission Requirements

An honors 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-honors 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 honors 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 defense of the thesis before an examination board of at least three faculty members, normally drawn from both universities.

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 defense 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

Graduate Courses*

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 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 micro-organisms in industrial processes. Subjects to be covered will include microbial fermentations, enzymology, secondary metabolites, biomass and fuel production.
D.J. Kushner, J.N. Saddler and others.

- **Biology 61.503F1 (BIO5103)**
Comparative Biology
Advanced topics emphasizing biochemical structures, functions and methodologies in the context of animal (invertebrates and vertebrates) adaptations to environmental stress.
T.W. Moon and K.B. Storey.

- **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 61.518F1 (BIO8171)**
Techniques in Genetic Engineering
An advanced laboratory course on recombinant DNA techniques including molecular cloning, electrophoretic and hybridization analysis, DNA sequencing and computer analysis, and protein characterization. Seminar presentation/reports on practical applications of these techniques will also be required. Enrollment is limited and permission of the instructor is required.
Linda Bonen and D.A. Hickey.

- **Biology 61.519T2 (BIO8219)**
Evolutionary Genetics
A lecture/seminar course on the genetic mechanisms 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; evolutionary significance of regulatory and structural gene variation; concepts of individual, deme and group selection; relationships of micro-evolution to macro-evolutionary trends; selfish DNA.
Prerequisites: Graduate standing plus basic course in genetics and evolution; permission of the department.
G.R. Carmody, Linda Bonen and D.A. Hickey.

*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.

- Biology 61.520T2 (BIO8238)

Techniques of Microscopy

An advanced laboratory course in the principles and techniques of light microscopy and electron microscopy.

Prerequisite: Open to fourth year and graduate students with permission of the instructor.

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 behavioral aspects of invertebrates and vertebrates.

Lectures and tutorials will cover such aspects of neuroscience as neuroanatomy, neuro-physiology, behavioral neuroscience and neuro-pharmacology.

(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 61.536T2 (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. 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: BIO4113 or permission of the instructor.

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. (Enrollment 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 lecture and laboratory course on concepts and analysis of the distribution and abundance of plants and animals, and of related environmental phenomena. Two analytical or critical essays on an ecological topic will be required.

Prerequisites: Graduate standing, courses in elementary ecology and statistics and permission of the department.

C.A. Barlow.

- Biology 61.548T2 (BIO9200)

Advanced Community and Population Ecology

Lectures and seminars on recent experimental approaches, concepts and findings in population and community ecology.

D.J. Currie, P.A. Keddy and H.G. Merriam.

- Biology 61.549T2 (BIO5206)

Mathematical Modeling 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: 400-level course in identification or classification of insects or other animals.
H.F. Howden.
- 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 behavior. 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 Behavior
A half-credit course in animal behavior 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 Behavioral 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 (one in fall, one in winter), write two term papers on selected topics, and all students will participate in discussions of controversial problems.
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 61.623F1.

(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 (BIO8135)

Topics 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 exposure, 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. Houseman.

- Biology 61.645W1 (BIO9105)

Seminar in Toxicology

A two-term 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 61.660T2 (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 Behavior

A seminar and laboratory course dealing with current topics in the study of animal behavior. Students will be expected to present seminars based on the recent literature, and to conduct a research project on some aspect of animal behavior.

Prerequisites: Biology 61.581 or equivalent, or permission of the department.

P.J. Weatherhead.

- Biology 61.699F, W, S

Ph.D. Thesis