

## BIOLOGY (PhD, MS)

BIOLOGY (MS), ENVIRONMENTAL SCIENCES (PhD)/ENVIRONMENTAL BIOLOGY TRACK,  
MOLECULAR, CELLULAR, AND ORGANISMAL BIOLOGY TRACK

### Faculty

**Steven M Ackerman**, PhD, *University of Pennsylvania* • Gene Regulation in Plants and Animals

**Kamaljit S Bawa**, PhD, *Punjab University* • Conservation Genetics

**Gregory Beck**, PhD, *State University of New York, Stony Brook* • Evolutionary Immunology

**Solange Brault**, PhD, *University of London* • Population and Conservation Ecology

**Kenneth L Campbell**, PhD, *University of Michigan* • Reproductive Endocrinology

**Robert Chen** (Department of Environmental, Earth, and Ocean Sciences), PhD, *University of California, San Diego* • Environmental Monitoring

**Adan Colon-Carmona**, PhD, *University of California, Irvine* • Plant Signal Transduction and Molecular Biology

**Jeffrey Dukes**, PhD, *Stanford University* • Plant Community and Ecosystem Ecology and Global Environmental Change

**John P Ebersole**, PhD, *University of California, Los Angeles* • Effects of Natural Events and Human Activities on Structure of Coral Reef Fishes

**Ron J Etter**, PhD, *Harvard University* • Evolution and Ecology of Marine Invertebrates

**William Hagar**, PhD, *Temple University* • Environmental Monitoring and Photobiology

**Jeremy J Hatch**, PhD, *Duke University* • Animal Behavior and Ecology

**Linda Huang**, PhD, *California Institute of Technology* • Signal Transduction and Regulation of Cell Morphology

**Richard Kesseli**, PhD, *University of California, Davis* • Population and Molecular Genetics

**Kenneth C Kleene**, PhD, *University of Washington* • Molecular and Developmental Biology

**Alexia Pollack**, PhD, *University of Virginia* • Neuropharmacology • Neuroanatomy

**Michael A Rex**, PhD, *Harvard University* • Deep-Sea Biology

**William E Robinson** (Department of Environmental, Earth, and Ocean Sciences), PhD, *Northeastern University* • Aquatic Toxicology

**Michael P Shiaris**, PhD, *University of Tennessee* • Microbial Ecology

**Rachel C Skvirsky**, PhD, *Harvard University* • Molecular Genetics

**Robert Stevenson**, PhD, *University of Washington* • Animal Physiology

**Manickam Sugumaran**, PhD, *Indian Institute of Science* • Protein Chemistry and Enzymology

**Ying Tan**, PhD, *Yale University* • Molecular Evolution

**Brian White**, PhD, *Massachusetts Institute of Technology* • Science Education

**Richard H White**, PhD, *Washington University* • Insect Vision

**H Garrison Wilkes**, PhD, *Harvard University* • Origin and Evolution of Maize and Its New World Relatives

### The Program

The Graduate Program in Biology is designed to accommodate students of various backgrounds who wish rigorous training leading to the master of science degree in biology, or to the PhD tracks in Environmental Sciences—Environmental Biology or Molecular, Cellular, and Organismal Biology—that the Biology Program administers. (For complete information on doctoral study, see the “Degree Requirements” section of this publication.) In most cases, students are supported by either teaching or research assistantships.

Students may choose to concentrate in one or more of these areas: biodiversity, cell biology, conservation biology, developmental biology, endocrinology, immunology, microbiology, molecular biology, neurobiology, physiology, plant sciences, population biology, reproductive biology, and science education. With the help of a faculty advisor, a cohesive course of study is designed from among the wide variety of faculty research and study interests.

### Facilities and Resources

The Biology Department’s modern facilities support a broad spectrum of research interests within the biological sciences. The well-equipped research laboratories contain facilities for automated DNA sequencing and analysis, real-time PCR, electron and light microscopy, filmless autoradiography and fluorescence imaging, protein analysis and chromatography, electrophysiology, immunoanalysis, video analysis, and animal care. In addition, ample field equipment, boats, a greenhouse, salt water tanks, and other support facilities are available for enhancing studies in marine, aquatic, and terrestrial environments.

Because the campus is located on Boston Harbor, one type of marine environment is readily accessible. Near the campus are island systems, protected bays, and exposed open ocean areas. Arrangements can be made for the use of the marine facilities and laboratories on Nantucket Island that provide access to additional marine, aquatic, wetland, and terrestrial ecosystems. Through the cooperation of the Waltham Field Station of the University, facilities are available for large plantings of botanical materials. In addition, the Department runs the University’s tropical greenhouse. The program also has informal arrangements with other institutions in the area, which provide access to additional specialized facilities.

### PhD Requirements

#### *The PhD in Environmental Sciences/Environmental Biology*

#### Course Work

For the PhD in Environmental Sciences/Environmental Biology Track, sixty-four credits are required, distributed as follows:

- required (core) courses (12 credits) and elective courses (20 credits);
- journal readings (5 credits); and
- research credit (27 credits).

Required and elective courses: Students take four courses (12-13 credits) in the core course area. All students take Scientific Communication (BIOL 650), and at least one of the following three courses:

- Applied Statistics (ECOS 611)
- Biological Diversity and Evolution (BIOL 652)
- Environmental Policy and Administration (ECOS 616)

Students may also choose to take one or two of the following courses as part of the core:

- Molecular Genetics of Bacteria (BIOL 626)
- Computer Analysis of DNA and Protein Sequence (BIOL 664)
- Advanced Molecular Biology (BIOL 675 or 676)
- Advanced Eukaryotic Genetics (BIOL 677)

Each student takes at least 20 additional elective credits subject to the approval of the student’s dissertation committee. As part of this group of elective credits, a student may take up to 6 credits of Directed Readings (BIOL 672/673).

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Journal readings: In addition to the 20 elective credits, students take a minimum of five credits of appropriate seminar and journal reading. These courses focus on subfields within biology. They are designed to help students stay abreast of recent developments through readings in the current literature, and to provide opportunities for public speaking.

Research: Students take a minimum of 27 dissertation credits (BIOL 899).

## **The PhD in Environmental Sciences/Molecular, Cellular, and Organismal Biology (MCOB)**

### **Course Work**

To receive the PhD in Environmental Sciences/Molecular, Cellular and Organismal Biology Track, the student must complete sixty-two credits, distributed as follows:

- required (core) courses (15 credits) and elective courses (15 credits)
- journal readings (5 credits)
- research credit (27 credits)

The student must take five courses (15-16 credits) in the core course area. All students must take Scientific Communication (BIOL 650) and a course in molecular, cellular, and environmental biology that was under development as this publication was going to press. Students must take three courses selected from the following:

- Advanced Cell Biology (BIOL 612)
- Molecular Genetics of Bacteria (BIOL 626)
- Computer Analysis of DNA and Protein Sequences (BIOL 664)
- Advanced Molecular Biology (BIOL 675 or 676)
- Advanced Eukaryotic Genetics (BIOL 677)
- Environmental Physiology (BIOL L658/ECOS L658)

A minimum of 15 additional elective credits must be taken, subject to approval of the student's dissertation committee. As part of this group of elective credits, a student may take up to 6 credits of Directed Readings (BIOL 672/673).

Journal readings: In addition to the 15 elective credits, students are required to take at least 5 credits of appropriate seminar and journal-reading courses (BIOL 653, Current Literature in Biology). These 1-credit courses focus on subfields within biology, and are designed to enable students to stay abreast of recent scientific developments in the current literature and to provide opportunities for oral presentations.

Research: Students must take a minimum of 27 dissertation credits (BIOL 899).

### **Other Requirements**

The requirements listed below apply to both PhD tracks.

#### *Teaching*

Students are required to participate in the teaching program as teaching assistants for at least two semesters. The teaching responsibility is intended to enhance the experience and skills of the PhD candidate.

#### *GPA*

To continue in the PhD program, the student must maintain a GPA of 3.0 and may not receive a grade of C in more than one course.

#### *Written Comprehensive and Oral Qualifying Examinations*

Students must pass two examinations administered by the Academic Advisory Committee (ACC), composed of the advisor and three other members acceptable to the Graduate Program Director (GPD) and the Biology Graduate Committee, before they undertake research at the doctoral level: 1) a written comprehensive examination to test the student's command and knowledge of four specific areas of biology and 2) a subsequent oral qualifying examination based on a) the oral description and defense of the student's dissertation proposal, and b) comprehensive questioning focused on the four areas covered in the written exam.

The written comprehensive examination may be taken at the end of the student's first year, or after the completion of at least 18 credits of course work; and it should generally be taken by the end of four semesters or 36 credits of course work. The student will defend four areas, drawn from the array of graduate courses offered in the department or from other areas acceptable to the AAC and approved by the Biology Graduate Committee.

A student who fails the written examination may, at the discretion of the academic advisory committee, be permitted a second and final written examination after six months. A student failing the examination a second time may either 1) withdraw from the program or 2) formally petition the AAC for permission to work toward a master's degree in biology, in biotechnology and biomedical science, or in environmental sciences. A student may not continue in the PhD program after a second failure of the comprehensive examination.

Generally, within one month of the written exam, the student should submit his or her dissertation proposal (suitable for submission to external funding agencies) to the AAC and the GPD. Before taking the oral examination, the student should also confer with members of the AAC on the soundness of the proposal. The student should also discuss any deficiencies in the written exam with the individual members of the AAC. Generally, the oral qualifying exam should be scheduled within one month after the submission of the dissertation proposal.

On successfully completing the qualifying examination, the student becomes a candidate for the PhD degree. The student is allowed up to five more years to complete and successfully defend a scholarly dissertation.

#### *Departmental Presentation*

Approximately nine to twelve months after the student's advance to candidacy, the student will present a seminar, based on his or her work in progress, to the entire department.

#### *Dissertation Committee*

After becoming a candidate for the PhD, the student must choose a dissertation advisor and committee. The dissertation committee will generally, but not necessarily, comprise three members of the AAC and one member from outside the department. With the approval of the GPD and the Graduate Committee, faculty from outside the Biology Department or non-UMass Boston faculty will be permitted to co-sponsor a student's dissertation work.

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## Dissertation Defense

A final public dissertation defense will be administered by a dissertation panel comprising at least five members, including a) the Dissertation Committee; and b) the Biology GPD or (if the GPD is already on the dissertation committee) a member of the Graduate Committee. The defense will be chaired by the student's dissertation advisor; it will be scheduled after the student has submitted an advanced draft of the manuscript to the dissertation panel and after the panel has agreed that the student is ready to defend it.

## The Master of Science Degree in Biology

On admission, the student will be assigned an academic advisor, who must be a full-time member of the Biology Department faculty. Within six months, the student and academic advisor will choose an Academic Advisory Committee (AAC) and will submit this proposed committee for approval to the Biology Graduate Program Director (GPD) and the Biology Graduate Committee, which oversees all aspects of graduate study in biology.

The AAC will comprise the academic advisor and at least two additional members in the student's area of interest. The student, in consultation with the AAC, will plan an appropriate course of study. The AAC will monitor the student's progress. The academic advisor and the student will provide a yearly progress report to the GPD and the Biology Graduate Committee. With the approval of the GPD, the student may change his or her academic advisor or rearrange his or her AAC.

The MS student may choose either of two options:

- a) a program of study with a thesis, designed to provide competence for teaching, research, or further study; or
- b) a program with a library research project, designed to meet the needs of a generalist. Under either option, students can gain valuable experience through supervised participation in the teaching of undergraduate laboratory courses.

## Course Work Requirements

Thirty credits are required for the master of science degree in biology. Students may select courses at the 600 level or above, subject to the permission of the instructor. As part of the course work, all students must take BIOL 650 (Scientific Communication) (3 credits). Students choosing option "a" will have a thesis advisor and committee (often the same as the advising committee) and must enroll for at least ten credits in BIOL 699 (Thesis Research). These students are required to fulfill the remainder of their course work with electives acceptable to their AAC. Students choosing option "b" must enroll for at least six credits in BIOL 698 (Projects in Biology). All students must fulfill the remainder of their course work (17 credits for option "a" students, 21 credits for option "b" students) with electives acceptable to their academic advisory committees. All candidates for the master's degree must take a general oral examination. Each option "a" student must submit a thesis draft to his or her thesis committee for approval before taking the master's oral examination, which is not limited to the thesis topic.

## Admission Requirements

Please see the general statement of admission requirements for all graduate studies programs in the "Admissions" section of this publication, and the "Special Instructions for Applicants to Individual Programs" section at the back of this publication.

Submission of General Graduate Record Examination scores is required of applicants to the MS Program in Biology and the PhD tracks in Environmental Sciences/Environmental Biology and Environmental Sciences/Molecular, Cellular, and Organismal Biology.

An applicant is expected to have a grade point average of 3.0 in all undergraduate science and mathematics courses. The stated interests of a prospective student must coincide to an acceptable degree with faculty specialties represented in the program. The Biology Graduate Committee is responsible for reviewing applications and for recommending candidates to the dean of Graduate Studies.

## Eligibility for Courses

All 600-level courses with the exception of BIOL 698 and 699 are open to advanced undergraduates who meet prerequisites and have the permission of the instructor. All 500-level courses are available to students with a bachelor's degree who are not part of the MS or PhD program in the Biology Department. Please consult UMass Boston's undergraduate catalog for complete information about the undergraduate courses listed below as prerequisites for individual graduate-level courses.

## 500-Level Courses

Students who possess a bachelor's degree from an institution of recognized standing and meet individual course prerequisites are eligible to enroll in 500-level graduate courses offered by the Biology Department. This option may be especially useful for UMass Boston MEd students or science teachers completing coursework as non-matriculated students. Full course descriptions for these dual-level courses may be consulted in the undergraduate catalog. Available courses are:

BIOL 313/513	Developmental Biology and Embryology (lecture only)
BIOL 318/518	Neurobiology (lecture only)
BIOL 319/519	Endocrinology (lecture only)
BIOL 323/523	Plant Physiology (lecture only)
BIOL 329/529	Plant Life (lecture only)
BIOL 333/533	Biology of Marine Invertebrates (lecture only)
BIOL 334/534	Microbiology
BIOL 338/538	Insect Life
BIOL 339/539	Comparative Animal Physiology (lecture only)
BIOL 340/540	Marine Mammal Biology
BIOL 342/542	Ecology
BIOL 344/544	Ornithology
BIOL 348/548	Animal Behavior
BIOL 352/552	Evolution (lecture only)
BIOL 360/560	Bioinformatics
BIOL 372/572	Molecular Biology (lecture only)
BIOL 380/580	Immunology (lecture only)
BIOCHM 383/583	Biochemistry I
BIOCHM 384/584	Biochemistry II

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## Courses

### BIOL 601

#### Marine Ecosystems

The structure and function of coastal marine habitats, including rocky intertidal areas, sandy beaches, tidal and mud flats, estuaries, salt marshes, soft bottom areas, and plankton. The course reviews the physical regime, flora, and fauna of these environments and case histories of community organization.

*Prerequisites: Undergraduate course in ecology and permission of instructor.*

3 Lect-Disc Hrs, 3 Credits

### BIOL 602

#### Plant Molecular Biology and Physiology

This course focuses on molecular mechanisms of gene regulation, gene expression patterns during development and differentiation, molecular responses to light, plant genetics, the evolution of genomes, plant biotechnology, and the molecular biology of the regulation of physiological processes in plants. Lecture topics integrate molecular biology, plant genetics, plant physiology, and plant evolution. The syllabus includes a core of basic lectures introducing students to the field of plant molecular biology.

*Prerequisites: BIOL 320, 321, 322, or 323 or equivalent; and 675 or 676.*

3 Lect Hrs, 3 Credits

### BIOL 603

#### Theories of Community Structure

Theoretical aspects of community development and organization, including demography, competition, predation, life history strategies, trophic structure, community stability, and equilibrium and non-equilibrium models of species diversity. The course emphasizes rigorous mathematical and graphical approaches.

*Prerequisite: BIOL 342 or equivalent, or permission of instructor.*

3 Lect Hrs, 3 Credits

### BIOL 605

#### Field Sampling Methods and Data Analysis

Statistical principles of research design integrated with field techniques, to measure parameters of community structure. Field exercises involve application of the principles learned in lectures and the use of typical sampling equipment to solve environmental questions. Laboratory and field work.

*Prerequisites: BIOL 342 and 343, or equivalent, or permission of instructor.*

3 Lect Hrs, 6 Lab Hrs, 5 Credits

### BIOL L608 (PHYSIC L608)

#### Biophysical Instrumentation

A lecture and laboratory course on the application of microcomputers and microprocessor-based electronics to laboratory experiments in the biological and physical sciences. Emphasis is on techniques for interfacing the microcomputer with laboratory experiments for automated data acquisition, data reduction and analysis, information display, and real-time control of experiments. (Course offered in the spring only.)

*Prerequisite: Graduate standing or permission of instructor.*

2 Lect Hrs, 4 Lab Hrs, 4 Credits

### BIOL 612

#### Advanced Cell Biology

The analysis of gene transfer and expression at the cellular level, including the nature of metabolic systems and the factors governing their regulation.

*Prerequisite: Permission of instructor.*

Hrs by arrangement, 3-5 Credits

### BIOL 614

#### Advanced Cell Chemistry

The methodology of cell analysis, with emphasis on macromolecules and intermediary metabolites.

*Prerequisite: Permission of instructor.*

Hrs by arrangement, 3-5 Credits

### BIOL 615

#### Immunology

Selected topics in immunology are studied in depth, using the current literature. Topics are chosen for relevance and current interest, or for their challenging, even controversial, nature.

*Prerequisite: BIOL 378 or 380 or equivalent, or permission of instructor.*

3 Lect Hrs, 3 Credits

Mr Beck

### BIOL 622

#### Concepts and Methods in Cytology

The structural basis of cellular and subcellular functions, with practical experience in methods of visualizing cellular structure.

*Prerequisite: Permission of instructor.*

Hrs by arrangement, 1-5 Credits

### BIOL 626

#### Molecular Genetics of Bacteria

In-depth examination of genetic and molecular processes in bacteria and their associated viruses. Coverage of classical bacterial-genetics as well as modern molecular genetic analysis. Topics include genetic transfer processes, gene regulation, mutagenesis and repair, plasmids, transposons, gene fusion methodologies, and protein secretion. Emphasis is given to current experimental approaches and research design.

*Prerequisite: BIOL 252 or equivalent.*

3 Lect Hrs, 3 Credits

Ms Skvirsky

### BIOL 627

#### Bacterial Physiology

A rigorous biochemical examination of the bacterial cell. Lectures focus on bacterial cytology, growth, and metabolism. Areas of current research are emphasized. Students are expected to read primary and secondary scientific literature and to discuss course material.

*Prerequisite: BIOL 334 and BIOCHM 383, or equivalent.*

3 Lect Hrs, 3 Credits

Mr Shiaris

### BIOL 628

#### Microbial Ecology

The functions, roles, and ecology of microorganisms in the environment, emphasizing biogeochemical cycling of elements. Topics for special concentration are chosen from the following: microbial diversity, evolution, interactions, aquatic or soil microbiology, and sewage microbiology. The course focuses on relating molecular and biochemical mechanisms to ecological principles. Readings are assigned from classical and current scientific literature for class discussion. An in-depth review paper on a special topic is required.

*Prerequisites: BIOL 334 or 342, and permission of instructor.*

3 Lect Hrs, 3 Credits

Mr Shiaris

### BIOL 632

#### Advanced Evolution

An inquiry into the modern synthetic theory of evolution with emphasis on population genetics, ecological genetics, evolution of dominance, genetic homeostasis, canalization, and genetic theory of polymorphism.

*Prerequisite: Permission of instructor.*

Hrs by arrangement, 3 Credits

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## **BIOL 635**

### **Population Genetics and Diversity**

A quantitative approach to the concept of populations and the evolutionary forces affecting them. The course analyzes the interactions among forces and the resulting dynamics of population structure. Toward the end of the semester, the course shifts its primary emphasis from lecture to discussion in order to cover current topics in population genetics. Topics include the theory and application of tools necessary for assaying genetic variation in natural populations, DNA fingerprinting in forensics, the evolution of sex, and the genetics of rare and endangered species.

*Prerequisites: BIOL 252 and 352 or equivalent.*

3 Lect Hrs, 3 Credits

Mr Kesseli

## **BIOL 638**

### **Advanced Ecology**

Concepts of population and community ecology. Topics covered may include population dynamics, life history strategies, theory of r- and K-selection, competition, predation, community organization, and species diversity. Particular emphasis is placed on the relationship between theoretical and empirical ecology. A weekly tutorial provides the opportunity for greater discussion of material covered in lecture. Emphasis changes from year to year.

*Prerequisite: BIOL 342 or permission of instructor.*

2 Lect Hrs, 1 Disc Hr, 3 Credits

## **BIOL 639**

### **Conservation Biology**

The principles of conservation biology are drawn from such various subdisciplines of biology as ecology, genetics, evolution, and biogeography. The course begins with an analysis of the distribution of biodiversity, proceeds to examine the patterns of biodiversity loss at all levels, from genes to ecosystems, and finishes with a discussion of the causes, consequences, and solutions of the crisis. Topics include assessment and monitoring of species diversity, conservation genetics, the theory of island biogeography, habitat loss and forest fragmentation, human impacts on biodiversity, the design of nature reserves, economic valuation of biodiversity, and sustainable use of biodiversity.

*Prerequisites: BIOL 342 and 352 or equivalent.*

3 Lect-Disc Hrs, 3 Credits

Mr Bawa

## **BIOL 640**

### **Principles of Qualitative Modeling in Biology**

A mathematical analysis of biological systems, with emphasis on qualitative rather than quantitative approaches. Signed digraphs (Loop Analysis), matrices, and computer programming will be used. In addition, notions of feedback, stability, and other global properties of systems will be presented. During the work section, students will be grouped to solve problems. At the completion of the course, students will be competent to distinguish the various methods, assess their strengths and limitations, and apply them to biological systems of interest.

3 Lect-Disc Hrs, 3 Credits

## **BIOL 641**

### **Quantitative Population Modeling**

Fundamentals of mathematical models of population dynamics. The course examines single-species models, including stability analysis, life tables, and analysis of matrix models, as well as competition and predation model forms. More advanced topics include spatial structure, stochasticity, harvesting models, individual-based models, and population viability analysis. The course combines lectures, discussions, and hands-on model development.

*Prerequisites: MATH 130 or 135 or equivalent, MATH 342, BIOL 342 or equivalent, or permission of instructor.*

3 Lect Hrs, 3 Credits

Ms Brault

## **BIOL 642**

### **Biogeography**

A study of the distribution of organisms in space and time. Includes comparative and experimental tests of island biogeographic theory; the significance of spatial and temporal scale; the roles of dispersal and vicariance; phylogenetic implications; geographic patterns of species diversity in marine and terrestrial ecosystems; contemporary analytical methods; mass extinctions and the fossil record; historical biogeography; macroecology; and the importance of biogeography for understanding conservation strategies and the global biodiversity crisis. Conducted in seminar format with student discussions.

*Prerequisite: BIOL 342 or 35 or equivalent, or permission of instructor.*

Hrs by arrangement, 3 Credits

Mr Rex

## **BIOL 643**

### **The Behavior and Ecology of Seabirds**

Adaptations of seabirds to the marine environment, with particular reference to breeding biology and feeding strategies; other topics of current interest in behavioral ecology. Lectures or lecture and field work.

*Prerequisite: Permission of instructor.*

Hrs by arrangement, 2-5 Credits

Mr Hatch

## **BIOL 645**

### **Ecological and Evolutionary Aspects of Plant-Animal Interactions**

Coevolution of plants and animals is examined in an ecological context. Interactions to be examined include pollination, seed predation, herbivory, and grazing. Topics of discussion include the role of these interactions in the regulation of community structure. Although the main emphasis is on tropical communities, there is also some discussion of alpine, temperate, and desert communities.

*Prerequisites: BIOL 290 or equivalent and 342 or 352 or equivalent, or permission of instructor.*

3 Lect Hrs, 3 Credits

Mr Bawa

## **BIOL 646**

### **Pollutants in Marine Food Chains**

Examination in depth of the entry of selected pollutants into the oceans, their movements, distribution and effects within marine organisms. Where possible, case studies from New England will be used.

*Prerequisites: CHEM 253, BIOL 210, BIOL 342, or equivalents, and permission of instructor.*

## **BIOL 650**

### **Scientific Communication**

Required of all biology master's and doctoral students; usually taken in the second year. The course covers the storage and retrieval of scientific information (including searching of computerized data bases), the design of tables, figures, and other graphics, the writing of technical reports and papers, and the preparation of posters and publications. Writing, oral presentations and other assignments, and attendance at the weekly departmental seminar are required.

*Prerequisite: Admission to graduate study in biology at either the master's or the doctoral level.*

3 Credits

# Biology

## **BIOL 652**

### **Biological Diversity and Evolution**

This course is an inquiry into the origin and evolution of patterns of biological diversity. It begins with an overview of the biogeochemical history of the Earth, theories of origin of life, diversification of metazoans during the Phanerozoic, and the nature and causes of periodic mass extinction events. Biological diversity is considered at molecular, population, and community levels. This course counts toward the required core in the Environmental Sciences/Environmental Biology PhD track. (Course offered in the fall only.)

*Prerequisite:* Permission of instructor.

3 Lect Hrs, 3 Credits

Mr Etter, Mr Rex

## **BIOL 653**

### **Current Literature in Biology**

A series of one-credit seminar courses focusing on subfields of environmental biology, to help students develop the habit of keeping up with recent developments through reading scientific journals. The seminars also provide a forum for oral presentations where students can get comment and critique on their scientific progress. Students must take a minimum of five seminars, for a total of five credits. This course is part of the required core in both the Environmental Sciences/Environmental Biology and MCOB PhD tracks.

*Prerequisite:* Permission of instructor.

Hrs by arrangement, 1 Credit

## **BIOL L658 (ECOS L658)**

### **Environmental Physiology**

A discussion course exploring in detail the mechanisms by which organisms adapt to their environment, and highlighting the interplay among cellular function, physiological function, and the ecology of the organism.

*Prerequisites:* BIOL 210 or 212 or equivalent, and BIOL 337; or permission of instructor.

3 Lect Hrs, 3 Credits

## **BIOL 662**

### **Photobiology**

The photochemical reactions that occur in biological systems. Major topic areas are properties of light energy, utilization of light energy by photosynthetic organisms, mechanism of visual transduction, photochemical triggering mechanisms for developmental processes.

*Prerequisite:* Permission of instructor.

3 Lect Hrs, 3 Credits

Mr Hagar, Mr White

## **BIOL 664**

### **Computer Analysis of DNA and Protein Sequences**

A lecture and laboratory course focusing on using computers to predict the structure of RNA and protein, to search DNA and protein sequence databases, to align protein and DNA sequences, to deduce the structure and mechanism of regulation of a gene from DNA sequences, to design cloning strategies, and to choose oligonucleotide primers for DNA sequencing and polymerase chain reactions. The course emphasizes the significance and limitations of computer analyses in biological research.

*Prerequisites:* An advanced undergraduate course or a graduate course in molecular genetics (BIOL 370 or equivalent, BIOL 675, or BIOL 626), and permission of instructor.

1 1/2 Lect Hrs, 3 Disc Hrs, 3 Credits

Mr Kleene

## **BIOL 666**

### **Mammalian Toxicology**

This course provides a background in principles of toxicology in mammalian systems. It is an alternative to Environmental Toxicology, ECOS 635, as a core requirement for the Molecular, Cellular, and Organismal Biology doctoral track.

Coverage includes: basic concepts of poisons and their commonalities with drugs and hormones; toxicant exposure routes, uptake, sites and mechanisms of action, storage, metabolism, activation, and clearance; toxicant roles in carcinogenesis, development, endocrine, and reproductive functions; roles of diet, lifestyle, and concurrent exposures; methods of toxicant evaluation emphasizing multigeneration and high-throughput testing; and environmental and medical implications of toxicant/toxin exposure on individual and ecological health.

*Prerequisites:* General chemistry and organic chemistry, general biology and one advanced course in cell biology, biochemistry, or physiology.

3 Credits

Mr Campbell

## **BIOL 668**

### **Cellular and Molecular Endocrinology**

A laboratory and seminar course on selected aspects of endocrinology, emphasizing laboratory investigations of such topics of current interest in endocrinology as molecular control of the synthesis of hormones, complete elucidations of the mechanisms of hormone action, and methods of modulating fertility and development.

*Prerequisites:* CHEM 253, BIOL 317 or BIOCHM 383, or equivalents, and permission of instructor.

2 Lect-Seminar Hrs, 6 Lab Hrs, 4 Credits

Mr Campbell

## **BIOL 670**

### **Tissue Culture**

A seminar and laboratory course on the principles and methods of culturing cells, tissues, and organs of animals and plants. Topics include growth factors, differentiation and morphogenesis in vitro, cell cloning, protoplast fusion, and the production of hybridomas for monoclonal antibodies. Students also apply tissue culture methods to individual research projects.

*Prerequisite:* BIOL 313 or permission of instructor.

2 Sem Hrs, 6 Lab Hrs, 4 Credits

Ms Davis, Mr Kleene

## **BIOL 672-673**

### **Directed Readings in Biology**

Selected readings in advanced areas of biology with guidance and regular discussion.

*Prerequisite:* Permission of instructor.

Hrs by arrangement, 1-3 Credits

## **BIOL 675**

### **Advanced Molecular Biology**

A lecture and laboratory course covering the biosynthesis and regulation of RNA, DNA, and proteins in eukaryotic organisms. The course examines the importance of gene regulation in oncogenesis, levels of gene expression, and development; as well as regulation by structure and function (chromosome structure and translational regulation); basic research techniques; and current recombinant DNA methodology.

Please note: Labs meet every other week, for a total of seven hours every two weeks.

*Prerequisites:* BIOL 370 or 372 or equivalent, and permission of instructor.

*Prerequisite or Corequisite:* BIOL 670.

3 Lect Hrs, 3 1/2 Lab Hrs, 4 Credits

Mr Ackerman, Mr Kleene

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## **BIOL 676**

### **Advanced Molecular Biology**

#### **Lecture**

A lecture-only course covering the same material as BIOL 675; no lab work is required.

*Prerequisites: BIOL 370 or 372 or equivalent, and permission of instructor.*

3 Lect Hrs, 3 Credits

## **BIOL 677**

### **Advanced Eukaryotic Genetics**

A broad spectrum of readings in plant, animal, and fungal genetics on such topics as segregation distortion, the control of sex determination, modes of asexual reproduction, inheritance of cytoplasmic genomes, self-incompatibility systems, transposable elements, and genetic mapping.

*Prerequisite: BIOL 252 or equivalent.*

3 Lect Hrs, 3 Credits

Mr Kesseli

## **BIOL 678**

### **Protein Chemistry and Enzymology**

A lecture and laboratory course on various aspects of protein chemistry and enzymology. Emphasis is on purification, characterization, structure, function, mechanism of action, kinetics, and regulatory aspects of enzymes. Topics also include the practical and theoretical aspects of affinity chromatography and other separation techniques, immobilization of enzymes and other biomolecules, enzyme kinetics, and the analytical and industrial use of soluble and insoluble enzymes.

*Prerequisites: BIOCHM 383 and BIOL 372, and permission of instructor.*

3 Lect Hrs, 6 Lab Hrs, 5 Credits

Mr Sugumaran

## **BIOL 679**

### **Protein Chemistry and Enzymology Lecture**

A lecture-only course covering the same material as BIOL 678; no lab work is required.

*Prerequisites: BIOCHM 383 and BIOL 372, and permission of instructor.*

3 Lect Hrs, 3 Credits

Mr Sugumaran

## **BIOL L680/ CHEM L680**

### **PHYSICAL BIOCHEMISTRY**

This course serves as an introduction to analytical methods and instrumentation available to the interdisciplinary scientist. While no course can be comprehensive in this field, this course will examine a broad base of analytical methods through introductory theory and will highlight applications and recent developments in these methods through current primary literature.

## **BIOL 685**

### **Biomedical Tracers**

A seminar and laboratory course describing the types and uses of physical tracers in the biomedical sciences. Covers theory and application of various tracers (immunoglobins, radioisotopes, lectins, enzymes, chromogen labels, spin labels, heavy isotopes, and particles), instrumentation for their detection, and general methods. The laboratory includes demonstrations and short projects chosen by the students and the instructor.

*Prerequisites: CHEM 253, BIOCHM 383 (or BIOL 317 or 319) or equivalents, and permission of instructor.*

2 Lect-Seminar Hrs, 6 Lab Hrs, 4 Credits

Mr Campbell

## **BIOL 690**

### **Advanced Ethology**

Examination in depth of topics in the biological study of behavior-ethology with particular reference to communication and the evolution of social behavior. Lecture-discussions, occasional lab exercises and field trips.

*Prerequisites: Graduate or senior standing; BIOL 348 and permission of instructor.*

Hrs by arrangement, 3 Credits

Mr Hatch

## **BIOL 691**

### **Seminar in Developmental Biology**

Current problems in developmental biology. Topics include molecular and cellular differentiation, and pattern determination.

*Prerequisites: BIOL 312 or 314 or equivalent, and permission of instructor.*

3 Sem-Disc Hrs, 3 Credits

## **BIOL 692**

### **Advanced Physiology**

In-depth experimental studies of two or three selected areas of organismal and cellular physiology, focusing on sensory and nervous systems and membrane transport. Provisions will be made for independent projects during the course. One weekly seminar plus one weekly lab meeting.

*Prerequisites: BIOL 337, BIOCHM 383, PHYSIC 107, or equivalents; and permission of instructor.*

1 Sem Hr; 3-4 Lab Hrs, 3-4 Credits

## **BIOL 693**

### **Seminar in Neurobiology**

Discussion of current literature in neuropharmacology and drug and behavior interactions. Combination of lectures and student presentations.

*Prerequisites: BIOL 316 or 318 or equivalent, and permission of instructor.*

3 Lect Hrs, 3 Credits

Ms Pollack

## **BIOL 697**

### **Special Topics in Biology**

A field of current interest in biology is examined in detail.

*Prerequisite: Permission of instructor.*

Hrs by arrangement, 2-5 Credits

## **BIOL 698**

### **Projects in Biology**

A substantial written report based on library research or an original project such as curriculum design, design of teaching aids and exercises, or critique of a book or theory. No more than 6 credits of this course may be applied to the master's degree. The credits may be applied over more than one semester. BIOL 698 and BIOL 699 are mutually exclusive.

Hrs by arrangement, 1-6 Credits

## **BIOL 699**

### **Thesis Research**

Substantial laboratory or field research resulting in a master's thesis. No more than 10 credits of this course may be applied to the master's degree. The credit may be applied over more than one semester. Students may not receive credit for both BIOL 698 and BIOL 699.

Hrs by arrangement, 1-10 Credits

## **BIOL 720**

### **Cell Ultrastructure**

Concepts of cell ultrastructure and methods of electron microscopy.

*Prerequisite: Graduate standing and permission of instructor.*

Hrs by arrangement, 3-5 Credits

## **BIOL 899**

### **Dissertation Research**

Research conducted under Biology Department faculty supervision which leads to the presentation of a doctoral dissertation in Environmental Sciences for students in the Environmental Biology or Molecular, Cellular, and Organismal Biology tracks of that program.

*Prerequisite: Permission of the instructor.*