Department of Ecology and Evolution

Chair: Joy Bergelson
Director of Graduate Studies: Stefano Allesina

Professors
- Joy Bergelson
- Jerry Coyne
- Gregory Dwyer
- Richard R. Hudson
- Martin Kreitman
- Manyuan Long
- Mercedes Pascual
- Catherine Pfister
- Trevor D. Price
- John Reinitz, Statistics
- Joseph Thornton
- Kevin White, Human Genetics
- J. Timothy Wootton
- Chung-I Wu

Associate Professors
- Marcus Kronforst
- Stephen Pruett-Jones

Assistant Professors
- Sarah Cobey

Emeritus Faculty
- Wen-Hsiung Li
- Thomas Nagylaki
- Manfred D.E. Ruddat
- Janice B. Spofford

Research Associate (Associate Professor)
- Michael Z. Ludwig

The Department of Ecology and Evolution provides training for research and teaching in the ecology, evolution and behavior of whole organisms, at the levels of the organism, the population, and the ecosystem. The research interests of our faculty include molecular evolution, population genetics, quantitative genetics, animal behavior, plant and animal ecology, evolutionary theory, systematics, paleontology, and related subjects. Individual levels of study range from molecules to communities. A common theme is the conduct of studies in a rigorous ecological and conceptual context, and the faculty share an interest in the architecture of populations, species and communities.

The department stresses scientific breadth and the interrelations between various specialized fields. Students are encouraged to approach basic biological problems with the most appropriate techniques: biophysical, biochemical, mathematical, physiological, or organismal. Departmental laboratories are equipped for a wide variety of contemporary research methods. Courses in other programs may be taken for credit in ecology and evolution for example, in the Departments of Organismal Biology and Anatomy, Biochemistry and Molecular Biology, Molecular Genetics and Cell Biology, Statistics, Geophysical Sciences, Anthropology, and Chemistry. Many students in the Department of Ecology and Evolution participate in interdepartmental programs in genetics, cell biology, developmental biology, population biology, theoretical biology, and evolutionary biology, and in these programs dissertation research may be co-sponsored by faculty from different departments. Collaboration is also maintained with the Field Museum and the Shedd Aquarium for students interested in research in systematics, taxonomy, and evolutionary biology, and with the Brookfield Zoo for basic research in conservation and behavior involving zoo animals. New opportunities are available for research and education at the Woods Hole Marine Biological Laboratory as well as the Warren Woods Ecological Field Station (http://pondside.uchicago.edu/ee/facilities/WW.shtml). Recent students in the department have performed field research in Central and South America, Asia, Australasia, Northern Europe, and other regions of the earth.
Program of Study

Most students in the Department of Ecology and Evolution complete their Ph.D. program in 5-6 years, though students entering with a master’s degree may finish in slightly less time. A student advisory committee advises all incoming and second year students on academic and research concerns. The first and second years consist largely of course work and individual reading courses, aiming toward successful completion of an oral general knowledge examination by the spring quarter of the first year, supervised by the student advisory committee. The student and faculty advisor, in consultation with the director of graduate studies, then choose a five member faculty doctoral committee, scheduling a defense of the dissertation research proposal by the end of the second year of study. Work in subsequent years shifts to dissertation-centered research and, finally, preparation and defense of the Ph.D. dissertation. All students are required to register to be a supervised teaching assistant in two approved courses during their tenure in the doctoral program. While there is no terminal master’s degree program in the department, students may elect to receive the S.M. degree upon successful completion of their dissertation proposal defense.

Entrance Requirements

Entering students are expected to have received a broad undergraduate training in biology, and a good background in related quantitative subjects, such as chemistry, statistics and calculus. Students who are admitted without having fully satisfied these requirements will be required to remedy their deficiencies by taking appropriate courses during their first two years in the graduate program.

General Knowledge Examination

Each first year student will be expected to pass an oral general knowledge examination during the first year of study, generally no later than the 10th week of the spring quarter. This examination session shall be attended by all three members of an examination committee appointed by the student advisory committee. The goal of the examination will be to assess each student’s general knowledge of key concepts, processes and issues in ecology and evolutionary biology, as covered in the courses recommended to the student by the student advisory committee during the student’s first year in the program.

Dissertation Proposal Defense

This examination consists of the submission of a written Ph.D. research proposal and an oral presentation of the proposal in a public or closed/private seminar format, followed by a closed discussion and examination on the proposal presentation with the faculty committee chosen by the student and the chair of the department. Students are expected to schedule the dissertation proposal defense before the end of their second year.

Doctor of Philosophy

Upon successful completion of the dissertation proposal defense and admission into candidacy for the Ph.D., students work closely with the faculty advisor and dissertation committee on the dissertation project. During the period of two to three years in which students do primary original research, they also participate in seminars, discussion groups, and professional meetings and conferences, leading to the completion of the written Ph.D. dissertation. The Ph.D. in ecology and evolution is awarded based upon:

- Submission of a written dissertation based on original research, which must be approved by the faculty adviser and dissertation committee.
- Presentation of a public seminar based on the dissertation research.
- Following the public seminar, successful performance during an oral examination by the dissertation committee and other relevant faculty.
- Acceptance of the approved written dissertation by the university Dissertation Office in compliance with that office’s regulations.

Application

We strongly advise students considering application to the department to begin preparation of their application early in the autumn quarter, so that all materials will arrive by the December 1 deadline. The department requires GRE General Test scores from all applicants, and recommends submission of GRE subject test scores in biology. Foreign applicants whose first language is not English also must submit TOEFL test scores with their application materials.

Further information also may be obtained from the department’s home page at http://pondside.uchicago.edu/ee/
Ecology and Evolution Courses

**ECEV 31100. Evolution of Biological Molecules. 100 Units.**
The course connects evolutionary changes imprinted in genes and genomes with the structure, function and behavior of the encoded protein and RNA molecules. Central themes are the mechanisms and dynamics by which molecular structure and function evolve, how protein/ RNA architecture shapes evolutionary trajectories, and how patterns in present-day sequence can be interpreted to reveal the interplay data of evolutionary history and molecular properties. Core concepts in macromolecule biochemistry (folding and stability of proteins and RNA, structure-function relationships, kinetics, catalysis) and molecular evolution (selection, mutation, drift, epistasis, effective population size, phylogenetics) will be taught, and the interplay between them explored.
Instructor(s): A. Drummond, J. Thornton Terms Offered: Winter
Prerequisite(s): Comfort with basic computer programming (course will use Python and R); undergraduate biology, chemistry, calculus, and introductory statistics.
Equivalent Course(s): HGEN 31100, BCMB 31100

**ECEV 32000. Introduction to Scientific Computing Skills for Biologists. 100 Units.**
The course will cover basic concepts in computing for an audience of biology graduate students. The students will receive basic training in the use of version control systems, databases and regular expressions. They will learn how to program in python and R and how to use R to produce publication-grade figures for their manuscripts, and how to typeset scientific manuscripts and theses using LaTeX. All the examples and exercises will be biologically motivated and will make use of real data. The approach will be hands-on, with lecturing followed by exercises in class.
Instructor(s): S. Allesina Terms Offered: Winter

**ECEV 32900. Plant Development and Molecular Genetics. 100 Units.**
Genetic approaches to central problems in plant development will be discussed. Emphasis will be placed on embryonic pattern formation, meristem structure and function, reproduction, and the role of hormones and environmental signals in development. Lectures will be drawn from the current literature; experimental approaches (genetic, cell biological, biochemical) used to discern developmental mechanisms will be emphasized. Graduate students will present a research proposal in oral and written form; undergraduate students will present and analyze data from the primary literature, and will be responsible for a final paper.
Instructor(s): J. Greenberg Terms Offered: Spring
Prerequisite(s): For undergraduates only: Three quarters of a Biological Sciences Fundamentals sequence.
Equivalent Course(s): DVBI 36100, MGCB 36100, BIOS 23299

**ECEV 33365. Evolutionary and Genomic Medicine I. 100 Units.**
Evolution is regularly investigated in free-living organisms, but some of its most fascinating and important examples occur in the interface between free-living and non-free-living states. In this course, we will use evolutionary and ecological principles to study the dynamics of viruses, unicellular organisms and cells in multi-cellular organisms relevant to human medicine. In EGM I, the emphasis will be on the evolution of pathogens, the evolution of cells of the immune system in response to pathogen invasion, the basis of autoimmune disorders, and the population genetics of cancerous cells in light of recent cancer genomic studies. EGM II will cover more general topics including Darwinian medicine, aging, and systems biology/medicine.
Instructor(s): S. Cobey, C-I. Wu Terms Offered: Winter
Prerequisite(s): Three quarters of a Biological Sciences Fundamentals sequence.
Equivalent Course(s): DVBI 36100, MGCB 36100, BIOS 23299

**ECEV 33365. Evolutionary and Genomic Medicine I. 100 Units.**
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Instructor(s): S. Cobey, C-I. Wu Terms Offered: Winter
Prerequisite(s): Three quarters of a Biological Sciences Fundamentals sequence. Background in evolution and population genetics.
Equivalent Course(s): DVBI 36100, MGCB 36100, BIOS 23299

**ECEV 34500. Advanced Topics in Evolution. 100 Units.**
While evolution by natural selection is an elegantly simple phenomenon, modern research in evolutionary biology contains a variety of controversial, and sometimes confusing, topics. In this course, we will explore, as a group, a select list of controversial or confusing topics in evolutionary biology through a mix of student-led presentations and discussion of the primary literature. Each student will also write a review paper about his or her selected topic.
Instructor(s): M. Kronforst Terms Offered: Spring
Equivalent Course(s): EVOL 34500

**ECEV 35600. Principles of Population Genetics-I. 100 Units.**
Examines the basic theoretical principles of population genetics, and their application to the study of variation and evolution in natural populations. Topics include selection, mutation, random genetic drift, quantitative genetics, molecular evolution and variation, the evolution of selfish genetic systems, and human evolution.
Instructor(s): C.-I. Wu and M. Kreitman Terms Offered: Winter
Equivalent Course(s): EVOL 35600

**ECEV 35800. Classics in Evolutionary Genetics. 100 Units.**
Major classic papers in evolutionary genetics that had great impact on the development of the field are reviewed.
Instructor(s): M. Long, J. Reinitz, C-I Wu Terms Offered: Winter
Equivalent Course(s): EVOL 35800
ECEV 35901. Genomic Evolution. 100 Units.
Canalization, a unifying biological principle first enunciated by Conrad Waddington in 1942, is an idea that has had tremendous intellectual influence on developmental biology, evolutionary biology, and mathematics. In this course we will explore canalization in all three contexts through extensive reading and discussion of both the classic and modern primary literature. We intend this exploration to raise new research problems which can be evaluated for further understanding. We encourage participants to present new ideas in this area for comment and discussion.
Instructor(s): M. Long and J. Reinitz Terms Offered: Autumn
Equivalent Course(s): STAT 35410,EVOL 35901

ECEV 36100. Evolution by Gene Interaction: The Data and Graphic Theories. 100 Units.
This course is a summary and analysis for a general problem in molecular evolution: how does gene interaction evolve? With the advent of various genomic techniques, gigantic amount of gene interaction data have been published. We will be focused on the gene expression networks, summarizing the technology to decipher the gene networks and major findings of evolution of gene networks. Theoretical problems will be emphasized on how topology is defined and interpreted and how the stability of gene networks is maintained. The application of theoretical results to the problems of molecular evolution will be discussed. The relevant basic elements of graph theory and quantitative description of interaction systems will be introduced and discussed. A particular interest is the discussion of how new genes are integrated into an ancestral gene network and rewire the networks.
Instructor(s): M. Long, C-I. Wu Terms Offered: Spring

ECEV 36300. Speciation. 100 Units.
A review of the literature on the origin of species beginning with Darwin and continuing through contemporary work. Both theoretical and empirical studies will be covered, with special emphasis on the genetics of speciation.
Instructor(s): C-I Wu, S. Pruett-Jones Terms Offered: Winter. in alternate (odd) years
Note(s): not offered in 2016-17
Equivalent Course(s): EVOL 36300

ECEV 36700. Advanced Topics in Behavioral Ecology. 100 Units.
This is a reading course covering advanced topics in behavioral ecology. The list of topics to be covered will be based in part on student interests, but may include: behavior and conservation, communication, mating systems, sexual conflict, and sperm competition. This course is designed as a graduate course, but advanced undergraduates may enroll with the permission of the instructor.
Instructor(s): S. Pruett-Jones, T. Price Terms Offered: Winter
Equivalent Course(s): EVOL 46700

ECEV 36900. Topics in Paleobiology. 100 Units.
In this seminar we investigate paleobiological or multidisciplinary topics of current interest to students and faculty. Previous subjects include the origin of phyla, historical and macro-ecology, the stratigraphic record and evolutionary patterns, and climate and evolution.
Instructor(s): D. Jablonski, S. Kidwell, T. Price Terms Offered: Autumn
Equivalent Course(s): EVOL 31900,GEOS 36900

ECEV 40100. Grants, Publications and Professional Issues. 100 Units.
Covers professional topics in evolutionary biology, primarily strategies in grant writing and review. Each student will work towards the submission of an application of their choice. The course meets weekly and involves extensive writing and discussion.
Instructor(s): J. Bergelson, R. Ho, M. Coates Terms Offered: Autumn
Note(s): Open to first and second year graduate students in the Darwinian Sciences Cluster
Equivalent Course(s): EVOL 40100,ORGB 40100

ECEV 40200. Advanced Topics in Ethics for the Darwinian Sciences. 100 Units.
This course covers advanced topics in ethics relevant to senior Ph.D. students in the Darwinian Sciences. CEB students are required to successfully complete this course before being awarded the Ph.D.
Instructor(s): M. Coates, P. Herendeen, S. Hackett Terms Offered: Winter. offered in alternate (even) years
Prerequisite(s): Open to Ph.D. students in the Darwinian Sciences
Note(s): not offered in 2016-17
Equivalent Course(s): ORGB 40200,EVOL 40200

ECEV 42600. Community Ecology. 100 Units.
Lectures and readings cover advanced topics in multi-species systems, and include an introduction to basic theoretical approaches.
Instructor(s): J.T. Wootton Terms Offered: Autumn
Equivalent Course(s): EVOL 42600

ECEV 42800. Population Ecology. 100 Units.
A lecture course on the empirical and theoretical approaches to the study of natural populations, including field methodologies and quantitative approaches. Includes computer assignments.
Instructor(s): C. Pfister Terms Offered: Winter
Equivalent Course(s): EVOL 42800
ECEV 42900. Theoretical Ecology. 100 Units.
An introduction to mathematical modeling in ecology. The course will begin with linear growth and Lotka-Volterra models, and proceed to partial differential equations. The course's perspective will emphasize numerical computations and fitting models to data.
Instructor(s): G. Dwyer, S. Cobey Terms Offered: Winter
Equivalent Course(s): EVOL 42900

ECEV 44001. Molecular Evolution I: Fundamentals and Principles. 100 Units.
The comparative analysis of DNA sequence variation has become an important tool in molecular biology, genetics, and evolutionary biology. This course covers major theories that form the foundation for understanding evolutionary forces that govern molecular variation, divergence, and genome organization. Particular attention is given to selectively neutral models of variation and evolution, and to alternative models of natural selection. The course provides practical information on accessing genome databases, searching for homologous sequences, aligning DNA and protein sequences, calculating sequence divergence, producing sequence phylogenies, and estimating evolutionary parameters.
Instructor(s): M. Kreitman Terms Offered: Winter
Prerequisite(s): Three quarters of a Biological Sciences Fundamentals sequence and two quarters of calculus, or consent of instructor.
Equivalent Course(s): EVOL 44001, BIOS 23258
Font Notice
This document should contain certain fonts with restrictive licenses. For this draft, substitutions were made using less legally restrictive fonts. Specifically:

Times was used instead of Trajan.
Times was used instead of Palatino.

The editor may contact Leepfrog for a draft with the correct fonts in place.