

COMMITTEE ON DEVELOPMENT, REGENERATION, AND STEM CELL BIOLOGY

Chair

- Urs Schmidt-Ott

Professors

- John Cunningham, Pediatrics
- Wei Du, Ben May Department for Cancer Research
- Richard Fehon, Molecular Genetics & Cell Biology
- Edwin Ferguson, Molecular Genetics & Cell Biology
- Yoav Gilad, Human Genetics
- Michael Glotzer, Molecular Genetics & Cell Biology
- William Green, Neurobiology
- Elizabeth Grove, Neurobiology
- Robert Ho, Organismal Biology & Anatomy
- Sally Horne-Badovinac, Molecular Genetics & Cell Biology
- David Kovar, Molecular Genetics & Cell Biology
- Ivan Moskowitz, Pediatrics
- Ed Munro, Molecular Genetics & Cell Biology
- Victoria Prince, Organismal Biology & Anatomy
- Clifton Ragsdale, Neurobiology
- Ilaria Rebay, Ben May Department for Cancer Research
- Urs Schmidt-Ott, Organismal Biology & Anatomy
- Nancy Schwartz, Pediatrics
- Neil Shubin, Organismal Biology & Anatomy
- Bin Zhou, Pediatrics

Associate Professors

- Robert Carrillo, Molecular Genetics & Cell Biology
- Jill de Jong, Pediatrics
- Ellie Heckscher, Molecular Genetics & Cell Biology
- Paschalis Kratsios, Neurobiology
- Jocelyn Malamy, Molecular Genetics & Cell Biology
- Xiaoyang Wu, Ben May Department for Cancer Research

Assistant Professors

- Huanhuan Chen, Pritzker School of Molecular Engineering
- Noah Mitchell, Molecular Genetics & Cell Biology
- Xiaochang Zhang, Human Genetics
- ZhuZhu Zhang, Human Genetics

Faculty

- Karen Echeverri, Associate Scientist, Marine Biological Laboratory
- Andrew Gillis, Associate Scientist, Marine Biological Laboratory
- Jennifer Morgan, Senior Scientist, Marine Biological Laboratory
- Zak Swartz, Assistant Scientist, Marine Biological Laboratory

Emeritus Faculty

- Martin Gross, Pathology
- Robert Haselkorn, Molecular Genetics & Cell Biology
- Anthony Mahowald, Molecular Genetics & Cell Biology
- Manfred Ruddat, Ecology & Evolution

PROGRAM OF STUDY

FIRST YEAR

The first year of graduate study is spent in coursework, independent reading, and exploratory research. Three courses constitute a full schedule for each quarter of the first year; the schedule typically includes three lecture courses or two lecture courses and a research rotation. Students are required to undertake laboratory rotations in at least three different laboratories before beginning their dissertation research. These rotations are performed during the first academic year, one each quarter.

Seminars given by invited speakers are regularly offered and students are strongly urged to attend. A separate series of meetings is presented in the Autumn and Winter quarters by faculty to introduce students to their research.

At the end of June, students take the Preliminary Examination as a first step toward candidacy for the Ph.D. The exam consists of the preparation of a written research proposal in the field of developmental biology and an oral defense of that proposal.

SECOND YEAR

Coursework will continue during the second year as needed to fulfill the requirements. Students choose research advisors by July 1 of the Summer Quarter after the first year and begin developing a research project. By the early Autumn Quarter, each student assembles a thesis committee. The student then prepares a written proposal for dissertation research and defends this proposal before the doctoral committee. This defense constitutes Part II of the candidacy examination. This examination must be completed by the end of the Autumn Quarter of the second academic year.

ADVANCED YEARS

After the qualifying exam, the student works full-time on thesis research, although the faculty urges students to continue to take advantage of the advanced courses and seminars that are offered. Finally, each graduating student writes a dissertation describing his or her research, presents the work in a public seminar, and defends it before their doctoral committee.

EVALUATION

Throughout their term as graduate students, students are expected to have frequent informal conversations with professors in their courses, their research advisor, and members of their doctoral committees. In this way, students can obtain frequent appraisals of their progress and constructive advice.

Formal evaluation of each student's progress continues every academic year. In the first year and a half, the evaluation is based on the student's performance in courses, laboratory rotations, the preliminary examination, and the qualifying examination. In later years, the research advisor and doctoral committee oversee the student's dissertation research progress; a report is submitted after the yearly meeting that becomes part of the student's permanent file. If there are any deficiencies in performance, the student will receive a letter describing those deficiencies and making suggestions about how to remedy them.

ADMISSIONS

For information about applying to our graduate program, please visit our website at <http://molbio.bsd.uchicago.edu>.

REQUIREMENTS FOR THE PH.D. DEGREE

A Ph.D. candidate must fulfill certain formal coursework requirements, pass the preliminary and qualifying examinations, and present a satisfactory dissertation describing the results of original research.

The committee expects a knowledge of and proficiency in contemporary developmental biology as well as auxiliary fields of molecular biology, cell biology, and genetics. This requirement will normally be met by fulfilling the formal coursework listed below. However, courses taken at other institutions, in other departments, or as part of the medical school curriculum may substitute for required committee courses with the approval of the curriculum committee.

FORMAL COURSE WORK

The Biological Sciences Division requirement of nine graded course units may be met by registering for a combination of formal courses and up to two graded laboratory rotations. During the first year of graduate work students ordinarily complete one course in molecular biology, one in cell biology, one in genetics, and three courses in developmental biology.

DEVELOPMENTAL BIOLOGY COURSES

DVBI 33850. Evolution and Development. 100 Units.

The course will provide a developmental perspective on animal body plans in phylogenetic context. The course will start with a few lectures, accompanied by reading assignments. Students will be required to present a selected research topic that fits the broader goal of the course and will be asked to submit a referenced written version of it after their oral presentation. Grading will be based on their presentation (oral and written) as well as

their contributions to class discussions. Prerequisite(s): Advanced undergraduates may enroll with the consent of the instructor.

Instructor(s): U. Schmidt-Ott Terms Offered: Spring

Prerequisite(s): Advanced undergraduates may enroll with the consent of the instructor.

Note(s): E.

Equivalent Course(s): ORGB 33850, EVOL 33850, BIOS 22306

DVBI 36100. 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 including BIOS 20187 or BIOS 20235.

Note(s): E.

Equivalent Course(s): BIOS 23299, ECEV 32900, MGCB 36100

DVBI 36200. Stem Cells and Regeneration. 100 Units.

The course will focus on the basic biology of stem cells and regeneration, highlighting biomedically relevant findings that have the potential to translate to the clinic. We will cover embryonic and induced pluripotent stem cells, as well as adult stem cells from a variety of systems, both invertebrate and vertebrates.

Instructor(s): H. Marlow, E. Ferguson, V. Prince, J. Cunningham, Terms Offered: Spring

Prerequisite(s): For undergraduates only: Three quarters of a Biological Sciences fundamentals Sequence

Equivalent Course(s): BIOS 21416

DVBI 36400. Developmental Mechanisms. 100 Units.

This course provides an overview of the fundamental questions of developmental biology, with particular emphasis on the genetic, molecular and cell biological experiments that have been employed to reach mechanistic answers to these questions. Topics covered will include formation of the primary body axes, the role of local signaling interactions in regulating cell fate and proliferation, the cellular basis of morphogenesis, and stem cells.

Instructor(s): E. Ferguson, R. Fehon Terms Offered: Winter

Prerequisite(s): For undergraduates only: Three quarters of a Biological Sciences Fundamentals Sequence including BIOS 20189, or BIOS 20235. AND CONSENT OF INSTRUCTOR

Equivalent Course(s): MGCB 36400, BIOS 21237

DISTRIBUTION COURSES

DVBI 31200. Molecular Biology I. 100 Units.

Nucleic acid structure and DNA topology; methodology; nucleic-acid protein interactions; mechanisms and regulation of transcription in eubacteria, and of replication in eubacteria and eukaryotes; mechanisms of genome and plasmid segregation in eubacteria.

Instructor(s): Bishop, D, Fei, J, Lee H.C., Rice, P, Ruthenburg, A Terms Offered: Winter

Equivalent Course(s): MGCB 31200, BCMB 31200

DVBI 31300. Molecular Biology-II. 100 Units.

The content of this course covers the mechanisms and regulation of eukaryotic gene expression at the transcriptional and post-transcriptional levels. Our goal is to explore research frontiers and evolving methodologies. Rather than focusing on the elemental aspects of a topic, the lectures and discussions highlight the most significant recent developments, their implications and future directions.

Instructor(s): J. Staley, A. Ruthenburg, H.C. Lee Terms Offered: Spring

Prerequisite(s): Molecular Biology I (MGCB 31200) or by special permission of an instructor

Equivalent Course(s): MGCB 31300, BCMB 31300

DVBI 31400. Genetic Analysis of Model Organisms. 100 Units.

Fundamental principles of genetics discussed in the context of current approaches to mapping and functional characterization of genes. The relative strengths and weaknesses of leading model organisms are emphasized via problem-solving and critical reading of original literature.

Instructor(s): Pincus, D, Ferguson, E, Lee, H.C, Zhang, X Terms Offered: Autumn

Equivalent Course(s): HGEN 31400, BCMB 31400, MGCB 31400

DVBI 31600. Cell Biology I. 100 Units.

Eukaryotic protein traffic and related topics, including molecular motors and cytoskeletal dynamics, organelle architecture and biogenesis, protein translocation and sorting, compartmentalization in the secretory pathway, endocytosis and exocytosis, and mechanisms and regulation of membrane fusion.

Instructor(s): A. Turkewitz, B. Glick Terms Offered: Autumn

Equivalent Course(s): HGEN 31600, MGCB 31600, BCMB 31600

DVBI 31700. Cell Biology II. 100 Units.

This course covers the mechanisms with which cells execute fundamental behaviors. Topics include signal transduction, cell cycle progression, cell growth, cell death, cancer biology, cytoskeletal polymers and motors, cell motility, cytoskeletal diseases, and cell polarity. Each lecture will conclude with a dissection of primary literature with input from the students. Students will write and present a short research proposal, providing excellent preparation for preliminary exams.

Instructor(s): M. Glotzer, D. Kovar Terms Offered: Spring

Prerequisite(s): For undergraduates: Three quarters of a Biological Sciences Fundamentals Sequence.

Equivalent Course(s): BIOS 21238, BCMB 31700, MGCB 31700

DVBI 38500. Comparative Developmental Biology @ MBL. 100 Units.

This intensive comparative developmental biology course is designed for graduate students in their second or later year of Ph.D studies. The two-week-long course will provide exposure to a combination of well-established and emerging developmental systems. Students will develop advanced experimental embryology skills—many of which are transferable across organisms—in the handling and cellular/genetic manipulation of embryos, including microinjection, lineage tracing, microdissection, cell transplantation, in situ hybridization, CRISPR/Cas mutagenesis, and 3D in vivo imaging. Students will develop an enhanced appreciation of the advantages each species offers, will be trained to think more comparatively (in a phylogenetic context), and will gain an appreciation of how best to select the appropriate species to address a specific question. They will be exposed to classic, recent, and developing methodologies and techniques and will learn about exciting ongoing research using these approaches. Developing and completing a short independent or team-based research project will enhance skills in hypothesis generation and experimental design.

Instructor(s): Victoria Prince, Nipam Patel, Karen Echeverri, Clifton Ragsdale Terms Offered: Autumn

Equivalent Course(s): BCMB 38500, MGCB 38500

DVBI 39500. UChicago Microscopy Course. 100 Units.

The UChicago Microscopy Course is a residential research course hosted at the Marine Biological Laboratory in Woods Hole, MA. The course is designed for graduate students in year two or beyond. Travel and lodging costs will be covered in full. This intensive two-week boot camp course will teach both conceptual foundations and practical approaches to modern light microscopy, using a variety of microscopes and specimens. The central goal is to empower students to identify and master imaging strategies that are best suited to address their specific experimental problems of interest, now and in the future. Core topics will include: (a) fundamentals of microscope design, image formation, contrast, and resolution; (b) common approaches to transmitted light (e.g. phase contrast, DIC, and polarization) and fluorescence microscopy (e.g. laser scanning or spinning disk confocal, light sheet and TIRF), (c) fluorescent probes and multispectral imaging; and (d) cameras and detectors, signal: noise and strategies for optimal sampling in space and time. More advanced topics will include single-molecule approaches, super-resolution, and photokinetics (e.g. FRAP, photoactivation, and optogenetics). In the first half of the course, daily lectures will introduce basic concepts, followed by intensive hands-on experience with different specimens, microscopes, and imaging modalities. In the second half, students will explore more advanced topics of interest through a set of modular projects.

Instructor(s): Ed Munro, Rick Fehon, Abishek Kumar Terms Offered: Autumn

Equivalent Course(s): MICR 39500, BCMB 39500, MGCB 39500

