GENETICS

Sterling Hall of Medicine 1313, 203.785.5846
http://medicine.yale.edu/genetics
M.S., M.Phil., Ph.D.

Chair
Antonio Giraldez

Director of Graduate Studies
Marc Hammarlund

Professors Allen Bale, Susan Baserga (Molecular Biophysics & Biochemistry), W. Roy Breg, Jr. (Emeritus), Martina Brueckner (Pediatrics/Cardiology), Keith Choate (Dermatology), Lynn Cooley, Daniel DiMaio, Patrick Gallagher (Pediatrics), Joel Gelernter (Psychiatry; Neuroscience), Antonio Giraldez, Peter Glazer (Therapeutic Radiology), Valentina Greco, Jeffrey Gruen (Pediatrics), Murat Gunel (Neurosurgery), Arthur Horwich, Kenneth Kidd (Emeritus), Haifan Lin (Cell Biology), Maurice Mahoney (Emeritus), Shrikant Mane, Arya Mani (Internal Medicine), Michael Nitabach (Cellular & Molecular Physiology), Charles Radding (Emeritus), Valerie Reinke, Margretta Seashore (Emeritus), Nenad Sestan (Neuroscience), Stefan Somlo (Internal Medicine/Nephrology), Joann Sweasy (Therapeutic Radiology), Peter Tattersall (Laboratory Medicine), Sherman Weissman, Hongyu Zhao (Public Health; Biostatistics)

Associate Professors Chris Cotsapas (Neurology), Daniel Greif (Internal Medicine/Cardiology), Marc Hammarlund, Mustafa Khokha (Pediatrics), Peining Li, Janghoo Lim, Jun Lu, Stefania Nicoli (Internal Medicine/Cardiology), James Noonan, In-Hyun Park, Curt Scharfe, Zhaoxia Sun, Andrew Xiao

Assistant Professors Kaya Bilguvar, Sidi Chen, Smita Krishnaswamy, Monkol Lek, Bluma Lesch, Mandar Muzumdar, Michele Spencer-Manzon, Sijuan Wang, Frederick Wilson (Internal Medicine/Oncology), Hui Zhang

FIELDS OF STUDY


SPECIAL ADMISSIONS REQUIREMENTS

The department welcomes applicants who have a bachelor’s or master’s degree in biology, chemistry, or a related field, with experience (from course work and/or research) in the field of genetics. The GRE General Test or a pertinent GRE Subject Test (Biochemistry and Molecular Biology, Biology, or Chemistry) is no longer required, but if you submit scores, we will take them into account in our review of your application.

To enter the Ph.D. program, students apply to the Molecular Cell Biology, Genetics, and Development (MCGD) track within the interdepartmental graduate program in Biological and Biomedical Sciences (BBS), https://medicine.yale.edu/bbs.

SPECIAL REQUIREMENTS FOR THE PH.D. DEGREE

The Ph.D. program in Genetics is designed to provide the student with a broad background in general genetics and the opportunity to conduct original research in a specific area of genetics. The student is expected to acquire a broad understanding of genetics, spanning knowledge of at least three basic areas of genetics, which include molecular, cellular, organismal, and population genetics. Normally this requirement is accomplished through the satisfactory completion of formal courses, many of which cover more than one of these areas.

Students are required to pass at least five graduate-level courses that are taken for a grade. Advanced graduate study becomes increasingly focused on the successful completion of original research and the preparation of a written dissertation under the direct supervision of a faculty adviser along with the guidance of a thesis committee.

A qualifying examination is given during the second year of study. This examination consists of a period of directed reading with the faculty followed by the submission of two written proposals and an oral examination. Following the completion of course work and the qualifying examination, the student submits a dissertation prospectus and is admitted to candidacy for the Ph.D. degree. There is no language requirement. An important aspect of graduate training in genetics is the acquisition of communication and teaching skills. Students participate in presentation seminars and two terms (or the equivalent) of teaching at the TF-10 level. Teaching activities are drawn from a diverse menu of lecture, laboratory, and seminar courses given at the undergraduate, graduate, and medical school levels. Students are not expected to teach during their first year. In addition to all other requirements, students must successfully complete...
GENE 900 and GENE 901, Research Skills and Ethics I and II, prior to the end of their first year of study. In their fourth year of study, all students must successfully complete B&BS 503, RCR Refresher for Senior BBS Students.

HONORS REQUIREMENT
Students must meet the Graduate School's Honors requirement by the end of the fourth term of full-time study.

M.D./PH.D. STUDENTS
M.D./Ph.D. students affiliate with the Department of Genetics graduate program. They may be admitted for a Ph.D. degree in the Department, resulting in some modification of the academic requirements for the Ph.D. portion of the M.D./Ph.D. degree. Typically, one or more research rotations are done during the first two years of medical school (in many cases, the first rotation is done during the summer between years one and two). No set number of research rotations is required. M.D./Ph.D. students officially affiliate with the Department of Genetics after selecting a thesis advisor and consulting with the director of graduate studies (DGS). M.D./Ph.D. students interested in Genetics are required to consult with the DGS prior to formal affiliation to determine an appropriate set of courses tailored to the student's background and interests.

The courses, rotations, and teaching requirements for M.D./Ph.D. students entering the Genetics graduate program (see below) are modified from the normal requirements for Ph.D. students. Besides the modifications in these three requirements, M.D./Ph.D. students in the Department of Genetics are subject to all of the same requirements as the other graduate students in the department.

Courses Four graduate-level courses taken for a grade are required. Two graduate-level courses taken for a grade during medical school may be counted toward this requirement at the discretion of the DGS. Course work is aimed at providing a firm basis in genetics and in cellular molecular mechanisms, with graduate-level proficiency in genetics, cell biology, and biochemistry.

Required courses: In addition to the four graduate-level courses, all M.D./Ph.D. students must take: Genomic Methods for Genetic Analysis (GENE 760); Graduate Student Seminar: Critical Analysis and Presentation of Scientific Literature (2 terms; GENE 675 and GENE 676, graded Satisfactory/Unsatisfactory); Responsible Conduct of Research (B&BS 501, graded Satisfactory/Unsatisfactory); and, in their fifth year of study, RCR Refresher for Senior BBS Students (B&BS 503).

Recommended courses: Advanced Eukaryotic Molecular Biology (GENE 743); Biochemical and Biophysical Approaches in Molecular and Cellular Biology (MCDB 630); Molecules to Systems (CBIO 502); Frontiers in Medicine (CBIO 601).

Electives: Other courses may be taken in a wide variety of fields relevant to the biological and biomedical sciences.

Laboratory rotations One or more rotations are necessary to identify a thesis advisor. No set number of research rotations is required.

Teaching One term of teaching is required. Previous teaching while enrolled at the Yale School of Medicine may count toward this requirement at the discretion of the DGS.

Qualifying exam M.D./Ph.D. students take their qualifying exam in the term following the completion of their coursework. They will be admitted to candidacy once they have completed their course work, obtained two Honors grades, passed their qualifying exam, and submitted their dissertation prospectus.

Thesis committee M.D./Ph.D. students are required to have one thesis committee meeting per year, beginning the term after passing their qualifying exam. However, students are strongly encouraged to consider having additional meetings if they feel their project could benefit from the assistance of members of the thesis committee.

MASTER’S DEGREES
M.Phil. See Degree Requirements under Policies and Regulations.

M.S. Students are not admitted for this degree. They may receive this recognition if they leave Yale without completing the qualifying exam but have satisfied the course requirements as described above, as well as the Graduate School's Honors requirement. Students who are eligible for or who have already received the M.Phil. will not be awarded the M.S.

Prospective applicants are encouraged to visit the BBS website (https://medicine.yale.edu/bbs), MCGD Track.

COURSES
GENE 625a / MB&B 625a / MCDB 625a, Basic Concepts of Genetic Analysis  
Jun Lu

The universal principles of genetic analysis in eukaryotes are discussed in lectures. Students also read a small selection of primary papers illustrating the very best of genetic analysis and dissect them in detail in the discussion sections. While other Yale graduate molecular genetics courses emphasize molecular biology, this course focuses on the concepts and logic underlying modern genetic analysis.
GENE 645b / CB&B 647b, Statistical Methods in Human Genetics  Hongyu Zhao
Probability modeling and statistical methodology for the analysis of human genetics data are presented. Topics include population genetics, single locus and polygenic inheritance, linkage analysis, quantitative trait analysis, association analysis, haplotype analysis, population structure, whole genome genotyping platforms, copy number variation, pathway analysis, and genetic risk prediction models. Offered every other year. Prerequisites: genetics; BIS 505; S&DS 541 or equivalent; or permission of the instructor.

GENE 655a / CBIO 655a, Stem Cells: Biology and Application  In-Hyun Park and Haifan Lin
This course is designed for first-year or second-year students to learn the fundamentals of stem cell biology and to gain familiarity with current research in the field. The course is presented in a lecture and discussion format based on primary literature. Topics include stem cell concepts, methodologies for stem cell research, embryonic stem cells, adult stem cells, cloning and stem cell reprogramming, and clinical applications of stem cell research. Prerequisites: undergraduate-level cell biology, molecular biology, and genetics.

GENE 675a and GENE 676b, Graduate Student Seminar: Critical Analysis and Presentation of Scientific Literature  Valentina Greco
Students gain experience in preparing and delivering seminars and in discussing presentations by other students. A variety of topics in molecular, cellular, developmental, and population genetics are covered. Required of all second-year students in Genetics. Graded Satisfactory/Unsatisfactory.

GENE 734b / MB&B 734b / MBIO 734b, Molecular Biology of Animal Viruses  Brett Lindenbach and Daniel DiMaio
Lecture course with emphasis on mechanisms of viral replication, oncogenic transformation, and virus-host cell interactions.

GENE 743b / MB&B 743b / MCDB 743b, Advanced Eukaryotic Molecular Biology  Mark Hochstrasser, Matthew Simon, and Karla Neugebauer
Selected topics in transcriptional control, regulation of chromatin structure, mRNA processing, mRNA stability, RNA interference, translation, protein degradation, DNA replication, DNA repair, site-specific DNA recombination, somatic hypermutation. Prerequisite: biochemistry or permission of the instructor.

GENE 749a / MB&B 749a, Medical Impact of Basic Science  Joan Steitz, I. George Miller, David Schatz, Sandy Chang, Karla Neugebauer, and Seyyedtaghi Takyar
Consideration of examples of recent discoveries in basic science that have elucidated the molecular origins of disease or that have suggested new therapies for disease. Emphasis is placed on the fundamental principles on which these advances rely. Reading is from the primary scientific and medical literature, with emphasis on developing the ability to read this literature critically. Aimed primarily at undergraduates. May not be taken by MB&B B.S./MS. students for graduate course credit. Prerequisite: biochemistry or permission of the instructor.

GENE 777b / MCDB 677b, Mechanisms of Development  Zhaoxia Sun
An advanced course on mechanisms of animal development focusing on the genetic specification of cell organization and identity during embryogenesis and somatic differentiation. The use of evolutionarily conserved signaling pathways to carry out developmental decisions in a range of animals is highlighted. Course work includes student participation in critical analysis of primary literature and a research proposal term paper.

GENE 800a / E&EB 800a, Seminar in Molecular Evolution  Jeffrey Powell and Bluma Lesch
This weekly seminar, a continuation of the highly successful Colloquium on Molecular Evolution, covers topics in the general area of molecular evolution. Past topics have included evolution of transcription factors, the role of epigenetics in evolutionary processes, and detecting selection in DNA sequences. Speakers generally come from Yale: faculty, postdocs, and graduate students. We solicit speakers as the term progresses, and we invite volunteers to let us know if they want to present ongoing research for input from other participants. Graduate students may take the course for credit, but it is not graded. Credit is given for attendance at at least two-thirds of meetings; sign-in for students taking the course for credit is held at each session.

GENE 911a / CBIO 911a / MCDB 911a, First Laboratory Rotation  Valerie Horsley
First laboratory rotation for Molecular Cell Biology, Genetics, and Development track students.

GENE 912a / CBIO 912a / MCDB 912a, Second Laboratory Rotation  Valerie Horsley
Second laboratory rotation for Molecular Cell Biology, Genetics, and Development track students.

GENE 913b / CBIO 913b / MCDB 913b, Third Laboratory Rotation  Valerie Horsley
Third laboratory rotation for Molecular Cell Biology, Genetics, and Development track students.