**Microbiology**

Boyer Center for Molecular Medicine 354F, 203.737.1087
http://medicine.yale.edu/micropath
M.S., M.Phil., Ph.D.

**Director of Graduate Studies**
Walther Mothes

**Professors** Serap Aksoy (Epidemiology), Susan Baserga (Molecular Biophysics & Biochemistry; Genetics; Therapeutic Radiology), Ronald Breaker (Molecular, Cellular, & Developmental Biology; Molecular Biophysics & Biochemistry), Richard Bucala (Internal Medicine; Epidemiology; Pathology), Michael Cappello (Pediatrics; Epidemiology; Microbial Pathogenesis), Yung-Chi Cheng (Pharmacology), Daniel DiMaio (Genetics; Molecular Biophysics & Biochemistry; Therapeutic Radiology), Erol Fikrig (Internal Medicine; Epidemiology; Microbial Pathogenesis), Durland Fish (Emeritus, Microbial Diseases), Richard Flavell (Immunobiology), Jorge Galán (Microbial Pathogenesis; Cell Biology), Eduardo Groisman (Microbial Pathogenesis), Akiko Iwasaki (Immunobiology; Molecular, Cellular, & Developmental Biology), Christine Jacobs-Wagner (Molecular, Cellular, & Developmental Biology; Microbial Pathogenesis), Albert Ko (Epidemiology; Internal Medicine), Ruslan Medzhitov (Immunobiology), I. George Miller (Pediatrics; Epidemiology; Molecular Biophysics & Biochemistry), Walther Mothes (Microbial Pathogenesis), Melinda Pettigrew (Epidemiology), John Rose (Pathology), Craig Roy (Microbial Pathogenesis; Immunobiology), Nancy Ruddle (Emerita, Epidemiology), Dieter Söll (Molecular Biophysics & Biochemistry; Chemistry), William Summers (Emeritus, Molecular Biophysics & Biochemistry), Joann Swoesy (Therapeutic Radiology; Genetics), Peter Tattersall (Laboratory Medicine; Genetics), Jeffrey Townsend (Biostatistics; Ecology & Evolutionary Biology), Christian Tschudi (Epidemiology), Paul Turner (Ecology & Evolutionary Biology)

**Associate Professors** Murat Acar (Molecular, Cellular, & Developmental Biology; Physics), Choukri Ben Mamoun (Internal Medicine; Microbial Pathogenesis), Jason Crawford (Chemistry; Microbial Pathogenesis), Andrew Goodman (Microbial Pathogenesis), Farren Isaacs (Molecular, Cellular, & Developmental Biology), Barbara Kazmierczak (Internal Medicine; Microbial Pathogenesis), Priti Kumar (Internal Medicine; Infectious Diseases), Brett Lindenbach (Microbial Pathogenesis), Jun Liu (Microbial Pathogenesis), John MacMicking (Microbial Pathogenesis; Immunobiology), Kathryn Miller-Jensen (Biomedical Engineering; Molecular, Cellular, & Developmental Biology), Carla Rothlin (Immunobiology), Christian Schlieker (Molecular Biophysics & Biochemistry; Cell Biology), Richard Sutton (Internal Medicine; Microbial Pathogenesis), Yong Xiong (Molecular Biophysics & Biochemistry)

**Assistant Professors** Stavroula Hatzios (Molecular, Cellular, & Developmental Biology), Ya-Chi Ho (Microbial Pathogenesis; Internal Medicine; Infectious Diseases), Nikhil Malvankar (Molecular Biophysics & Biochemistry), Noah Palm (Immunobiology), E. Hesper Rego (Microbial Pathogenesis), Aaron Ring (Immunobiology)

**Fields of Study**

The Graduate Program in Microbiology is a multidisciplinary Ph.D. program in training and research in the study of microorganisms and their effects on their hosts. The faculty of the program share the view that understanding the biology of microorganisms requires a multidisciplinary approach; therefore, the Microbiology graduate program emphasizes the need for strong multidisciplinary training. The program is designed to provide individualized education in modern microbiology and to prepare students for independent careers in research and teaching. Students can specialize in various areas, including bacteriology, virology, microbe-host interactions, microbial pathogenesis, cell biology and immunobiology of microbial infections, microbial genetics and physiology, structural biology, parasitology, microbiome, and microbial ecology and evolution.

**Special Admissions Requirements**

To enter the Ph.D. program, students apply to the Microbiology track within the interdepartmental graduate program in the Biological and Biomedical Sciences (BBS), http://bbs.yale.edu. An undergraduate major in biology, biophysics, biochemistry, microbiology, or molecular biology is recommended; the GRE General Test or MCAT is no longer required, and scores will not be considered if submitted.

**Special Requirements for the Ph.D. Degree**

Course work generally occupies the first two years of study. Each student, together with a faculty committee, outlines a course of study tailored to the individual's background and career goals. A program of course work may include general microbiology, virology, parasitology, and/or microbial genetics, as well as complementary courses in such areas as epidemiology, cell biology, immunology, biochemistry, and genetics. Students must take a minimum of four courses, three of which have to be in microbiology. Students must receive a grade of Honors in two full-term courses. All students participate in three laboratory rotations (MBIO 670, MBIO 671, and MBIO 672), with different faculty members, in their area of interest. Laboratory rotations ensure that students quickly become familiar with the variety of research opportunities available in the program. A qualifying proposal, defended in an exam on the student's thesis project, is given before the end of the second year. Students then undertake an original research project under the direct supervision of a faculty member. In the third year, students organize their thesis committee and prepare a dissertation prospectus, which is submitted to the Graduate School after approval by their committee. The student is then admitted to candidacy. Upon completion of the student's research project, the Ph.D. requirements conclude with the writing of a dissertation and its oral defense.
An important aspect of graduate training in microbiology is the acquisition of teaching skills through participation in courses appropriate for the student's scientific interests. These opportunities can be drawn from a diverse menu of lecture, laboratory, and seminar courses given at the undergraduate, graduate, and medical school levels. Ph.D. students are expected to participate in two terms (or the equivalent) of teaching. Students are not permitted to teach during their first year.

In addition to all other requirements, students must successfully complete IBIO 601, Fundamentals of Research: Responsible Conduct of Research, prior to the end of their first year of study. This requirement must be met prior to registering for a second year of study. In their fourth year of study, all students must successfully complete B&B 503, RCR Refresher for Senior BBS Students.

MASTER’S DEGREES

M.Phil. The M.Phil. degree can be awarded to Ph.D. students who have been admitted to candidacy. See Degree Requirements under Policies and Regulations.

M.S. This degree may only be granted to students who are withdrawing from the Ph.D. program prior to advancing to candidacy. To be eligible for this degree, a student must have completed at least four graduate-level term courses at Yale, chosen from a number of main courses including, but not limited to: MBIO 685, MBIO 686, MBIO 530, MBIO 734, MBIO 680, and CBIO 602. Two of these four courses must be related to microbiology. Students must have received at least one Honors or two High Pass grades. In addition, students must have received a Satisfactory grade in the following courses: IBIO 601, MBIO 701, MBIO 702, MBIO 670, MBIO 671, and MBIO 672. Students who are eligible for or who have already received the M.Phil. will not be awarded the M.S.

COURSES

MBIO 530a / IBIO 530a / MCDB 530a, Biology of the Immune System Eric Meffre, David Schatz, Peter Cresswell, Jordan Pober, Joao Pedro Pereira, Ruslan Medzhitov, Craig Roy, Nikhil Joshi, Aaron Ring, Noah Palm, Kevan Herold, Carla Rothlin, and Carrie Lucas
The development of the immune system. Cellular and molecular mechanisms of immune recognition. Effector responses against pathogens. Immunologic memory and vaccines. Human diseases including allergy, autoimmunity, cancer, immunodeficiency, HIV/AIDS.

MBIO 601b, Fundamentals of Research: Responsible Conduct of Research Staff
A weekly seminar presented by faculty trainers on topics relating to proper conduct of research. Required of first-year Immunobiology students, first-year CB&B students, and training grant-funded postdocs. Pass/Fail. 0 Course cr

MBIO 670a and MBIO 671b and MBIO 672b, Laboratory Rotations Walther Mothes
Rotation in three laboratories. Required of all first-year graduate students.

MBIO 680b, Molecular and Cellular Processes of Parasitic Eukaryotes Christian Tschudi
An introductory topic-based course in modern parasitology. For each topic there is an introductory lecture followed by a journal club-like discussion session of relevant papers selected from the literature. The course provides an introduction to basic biological concepts of parasitic eukaryotes causing diseases in humans. Topics include strategies used by parasitic eukaryotes to establish infections in the host and approaches to disease control, through either chemotherapy, vaccines, or genomics. In addition, emphasis is placed on evaluating the quality and limitation of scientific publications and developing skills in scientific communication. Also EMD 680. Prerequisite: permission of the instructor.

MBIO 685b, The Biology of Bacterial Pathogens II Andrew Goodman
This interdisciplinary course focuses on current topics related to host-pathogen interactions. Each week a lecture is given on the topic, followed by student presentations of seminal papers in the field. All participants are required to present a paper.

MBIO 686a, The Biology of Bacterial Pathogens I Eduardo Groisman
The course provides an introduction to basic principles in bacterial pathogenesis. Topics focus on the bacterial determinants mediating infection and pathogenesis, as well as strategies to prevent and treat diseases. Each week a lecture is given on the topic, followed by student presentations of seminal papers in the field. All participants are required to present a paper.

MBIO 701a and MBIO 702b, Research in Progress Walther Mothes
All students, beginning in their third year, are required to present their research once a year at the Graduate Student Research in Progress. These presentations are intended to give each student practice in presenting the student's own work before a sympathetic but critical audience and to familiarize the faculty with the research.

MBIO 703a and MBIO 704b, Microbiology Seminar Series Walther Mothes
All students are required to attend all Microbiology seminars scheduled throughout the academic year. Microbiologists from around the world are invited to describe their research.

MBIO 705b, Evasion of Host Defense by Viruses, Bacteria, and Eukaryotic Parasites Staff
The course, in student seminar format, is required of all first- and second-year Microbiology graduate students. Subjects include strategies employed by viruses, bacteria, or eukaryotic parasites to evade either cell intrinsic defenses, such as programmed cell death or innate immune sensing, or responses operating at the level of the organism, such as the adaptive immune response.

MBIO 734b / GENE 734b / MB&B 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.