EXPERIMENTAL PATHOLOGY

140 Brady Memorial Laboratory, 203.785.3624
https://medicine.yale.edu/pathology/training/graduateprogram
M.S., M.Phil., Ph.D.

Chair
Jon Morrow

Director of Graduate Studies
Themis Kyriakides (10 Amistad St., Rm. 301C, 203.737.2214)

Professors
Richard Bucala,* Sandy Chang,* Young Choi (Emeritus), José Costa (Emeritus), Gary Friedlaender,* Patrick Gallagher,* Earl Glusac, Robert Homer, S. David Hudnall, Pei Hui, Peter Humphrey, Dhanpat Jain, Michael Kashgarian (Emeritus), Jung Kim (Emeritus), Diane Krause,* Gary Kupfer,* Francis Lee,* Patty Lee,* Janina Longtine, Joseph Madri (Emeritus), Vincent Marchesi, Jennifer McNiff,* Wang Min, Gilbert Moecckel, Mark Mooskeer,* Raffaella Morotti, Jon Morrow, Jordan Pober,* Manju Prasad, David Rimm, Marie Robert, John Rose, Marcus Rosenberg,* John Sinard, Jeffrey Sklar, David Stern, A. Brian West (Emeritus), Wendall Yarbrough*

Associate Professors

Assistant Professors

* A secondary appointment with primary affiliation in another department or school.

FIELDS OF STUDY
Fields include molecular and cellular basis of diseases, including cancer; biology, biochemistry, genetics, and pathology of molecules, cells, tissues, and organ systems, including plasma membrane dynamics, mitochondrial dysfunction, signal transduction, and response to stimuli of connective tissue; assembly of viruses and their interactions with animal cells; somatic cell genetics and birth defects; biology of endothelial cells; and computational and high-throughput approaches to understanding disease pathology.

SPECIAL ADMISSIONS REQUIREMENTS
A strong background in basic sciences is recommended for applicants to the program, including biology, chemistry through organic and physical chemistry, mathematics through calculus, biochemistry, genetics, or immunology. GRE General Test or MCAT is required.

To enter the Ph.D. program, students apply to an interest-based track, usually the Molecular Medicine, Pharmacology, and Physiology track, within the interdepartmental graduate program in Biological and Biomedical Sciences (BBS), http://bbs.yale.edu.

SPECIAL REQUIREMENTS FOR THE PH.D. DEGREE
Course requirements
Experimental Pathology students must pass PATH 640, Developing and Writing a Scientific Research Proposal; PATH 650, Cellular and Molecular Biology of Cancer; and PATH 690, Molecular Mechanisms of Disease. Passes in three additional graduate-level, one-term courses are required, which can include courses in biochemistry, genetics, immunology, cell biology, and pathology, to be chosen in consultation with the director of graduate studies (DGS), according to the student's background and interest. All requirements of the Graduate School of Arts and Sciences, including the Honors requirement, must be met. In year one, students must also take a seminar course (one in each term) and do three laboratory rotations. Prior to registering for a second year of study, students must successfully complete PATH 660, The Responsible Conduct of Research. In their fourth year of study, all students must successfully complete B&B5 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. Students must also maintain an overall High Pass average. Student progress toward these goals is reviewed at the end of the second term.

Qualifying examination
The qualifying examination of the Experimental Pathology graduate program comprises: (1) enrollment in the BBS/Pathology course Developing and Writing a Scientific Research Proposal (PATH 640) in the fall term of year two and preparation of a proposal on the topic of the student's research; student will receive assistance from a faculty member who will later be part of the qualifying committee; (2) two literature reading periods in the spring term of year two that are specifically related to the grant proposal; and (3) an oral exam in which the student is examined by the qualifying exam committee on the research proposal, the reading periods,
and general knowledge of experimental pathology. This exam is usually taken in the second term of the second year and is described below.

1. The qualifying examination committee, consisting of three faculty members, will be chosen to examine the student. At least one of the committee members must have a primary appointment in the Department of Pathology, and the thesis adviser is not on the exam committee. The student will read with two committee members. The faculty member who assisted the student during the proposal writing period will serve as the third person on the committee. At the oral exam itself, one member of the committee will be selected as the chairperson responsible for documenting the results of the exam for submission to the DGS. Members of the exam committee should have expertise in areas chosen for reading.

2. All oral exams will follow the same general format. The oral examination will focus on the student’s ability to present and defend the research proposal. The student should come to the exam with a short (30–40 minute) presentation of the thesis-related proposal, with visual aids. The actual presentation will take longer since exam committee faculty will interrupt with questions. The committee can also ask questions on topics covered during the reading period and general topics in experimental pathology that will have been covered in courses. The final evaluation by the exam committee faculty takes into account the student’s performance on the examination and performance in lab (based on the adviser’s evaluation, solicited by the DGS). A written summary of the qualifying examination evaluation will be prepared by the examination committee chairperson and submitted to the DGS. If the student does not pass the exam, the committee has the option of recommending an additional course of reading and/or written work. The DGS has final discretion in approving or modifying the recommendations of the committee.

Prospectus Upon successful completion of the qualifying examination, the student will constitute a dissertation committee including at minimum three members in addition to the dissertation/thesis adviser. At least two of the committee members must be Pathology department faculty. The membership of the committee must be approved by the DGS. The student will prepare a written thesis prospectus, consisting of a summary of background information in the field of interest, the specific questions to be answered, a rationale for choosing those questions, and a research plan for addressing those questions. Upon completing the course requirement with at least two terms of Honors, passing the qualifying examination, and submitting a thesis prospectus, students will be admitted to candidacy. This should take place by the end of the third year, and preferably in the second year. Students must then submit a written thesis describing the research and present a thesis research seminar.

Additional requirements There is no foreign language requirement. In accordance with the BBS program, Ph.D. students are expected to participate in two terms (or the equivalent) of teaching. Students are not expected to teach during their first year. Teaching assignments in fulfillment of the requirement must be approved in advance by the DGS.

M.D./PH.D. STUDENTS

M.D./Ph.D. students must satisfy the requirements listed above for the Ph.D. with the following modifications: Two laboratory rotations are required. Assisting in teaching of one course is required. Five courses are required for the Ph.D., including PATH 640, Developing and Writing a Scientific Research Proposal; PATH 650, Cellular and Molecular Biology of Cancer; and PATH 690, Molecular Mechanisms of Disease. In addition, students are required to register for School of Medicine courses in OCS (Online Course Selection), https://students.yale.edu/ocs.

MASTER’S DEGREES

M.Phil. See Degree Requirements under Policies and Regulations. Awarded only to students who are continuing for the Ph.D. Students are not admitted for this degree.

M.S. Students are not admitted for this degree. On a case-by-case basis and subject to faculty vote, students who are not continuing for the Ph.D. may be considered for this degree if they have successfully completed the course requirements for the Ph.D. degree (three laboratory rotations, PATH 640, PATH 650, PATH 660, PATH 690, three elective courses, and two seminar courses), and received a grade of Honors in at least one core course (i.e., excluding rotations and seminar courses). Students who are eligible for or who have already received the M.Phil. will not be awarded the M.S.

Program materials are available upon request to the Director of Graduate Studies, Department of Experimental Pathology, Yale University, PO Box 208023, New Haven CT 06520-8023; website, https://medicine.yale.edu/pathology/training/graduateprogram.

COURSES

PATH 620a, Laboratory Rotations in Experimental Pathology  Staff
Laboratory rotations for first-year graduate students.

PATH 622b, Laboratory Rotations in Experimental Pathology  Themis Kyriakides
Laboratory rotations for first-year graduate students.

PATH 640a / B&BBS 640a, Developing and Writing a Scientific Research Proposal  Katarina Politi
The course covers the intricacies of scientific writing and guides students in the development of a scientific research proposal on the topic of their research. All elements of an NIH fellowship application are covered, and eligible students submit their applications for funding. Enrollment limited to twelve. Required of second-year graduate students in Experimental Pathology. Registration allowed by prior authorization from course directors only.
PATH 650b, Cellular and Molecular Biology of Cancer  David Stern
A comprehensive survey of cancer research from the cellular to the clinical level. The relation of cancer to intracellular and intercellular regulation of cell proliferation is emphasized, as are animal models for cancer research. Background in molecular genetics and cell biology is assumed. Open to advanced undergraduates with permission of the organizers.

PATH 660b / C&MP 650b / PHAR 580b, The Responsible Conduct of Research  Barbara Ehrlich
Organized to foster discussion, the course is taught by faculty in the Pharmacology, Pathology, and Physiology departments and two or three senior graduate students. Each session is based on case studies from primary literature, reviews, and two texts: Francis Macrina’s *Scientific Integrity* and Kathy Barker’s *At the Bench*. Each week, students are required to submit a reaction paper discussing the reading assignment. Students take turns leading the class discussion; a final short paper on a hot topic in bioethics is required.

PATH 670b, Biological Mechanisms of Reaction to Injury  S. David Hudnall, Jon Morrow, Anita Huttner, Jeffrey Sklar, and Gilbert Moeckel
An introduction to human biology and disease as a manifestation of reaction to injury. Topics include organ structure and function, cell injury, circulatory and inflammatory responses, disordered physiology, and neoplasia.

PATH 680a or b / C&MP 630a or b / PHAR 502a or b, Seminar in Molecular Medicine, Pharmacology, and Physiology  Staff
Readings and discussion on a diverse range of current topics in molecular medicine, pharmacology, and physiology. The class emphasizes analysis of primary research literature and development of presentation and writing skills. Contemporary articles are assigned on a related topic every week, and a student leads discussions with input from faculty who are experts in the topic area. The overall goal is to cover a specific topic of medical relevance (e.g., cancer, neurodegeneration) from the perspective of three primary disciplines (i.e., physiology: normal function; pathology: abnormal function; and pharmacology: intervention).

PATH 681a / B&BBS 681a, Advanced Topics in Cancer Biology  Ryan Jensen
This advanced course focuses on readings and discussion on three or four major topics in cancer biology, such as targeted therapy, tumor immunology, tumor metabolism, and genomic evolution of cancer. For each topic, the class starts with an interactive lecture, followed by critical analysis of primary research literature. Recent research articles are assigned, and a student leads discussions with input from faculty who are experts in the topic area. Prerequisite: PATH 650 or permission of the instructor. Open to all Ph.D., M.D./Ph.D., and M.P.H. students and to advanced undergraduates at the discretion of the instructor.

PATH 690a, Molecular Mechanisms of Disease  Narendra Wajapeyee
This course covers aspects of the fundamental molecular and cellular mechanisms underlying various human diseases. Many of the disorders discussed represent major forms of infectious, degenerative, vascular, neoplastic, and inflammatory disease. Additionally, certain rarer diseases that illustrate good models for investigation and/or application of basic biologic principles are covered in the course. The objective is to highlight advances in experimental and molecular medicine as they relate to understanding the pathogenesis of disease and the formulation of therapies.