TRANSLATIONAL BIOMEDICINE

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https://medicine.yale.edu/ptb/
M.S., M.Phil., Ph.D.

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Associate Professors Titus Boggon (*Pharmacology*; *Molecular Biophysics and Biochemistry*), Demetrios Braddock (*Pathology*), Emanuela Bruscia (*Pediatric Pulmonology, Allergy, Immunology and Sleep Medicine*), Christopher Bunick (*Dermatology*), Engin Deniz (*Pediatrics*, *Critical Care*), Monique Hinchcliff (*Rheumatology*), Megan King (*Cell Biology*; *Molecular, Cellular, and Developmental Biology*; *Therapeutic Radiology*), Daryl Klein (*Pharmacology*), Liza Konnikova (*Neonatal-Perinatal Medicine*), Madhav Menon (*Kidney Transplantation, Nephrology*), Peggy Myung (*Dermatology*; *Pathology*) Don Nguyen (*Pathology*), Renato Polimanti (*Psychiatry*), Faye Rogers (*Therapeutic Radiology*), Kurt Schalper (*Medical Oncology*; *Pathology*)

Assistant Professors David Alagpulinsa (*Comparative and Cardiovascular Medicine*), David Braun (*Medical Oncology*), William Damsky (*Dermatology*; *Dermatopathology*), Sarah Fineberg (*Psychiatry*), Salil Garg (*Laboratory Medicine*), Vikas Gupta (*Internal Medicine/Endocrinology*; *Digestive Diseases*), Brian Hafler (*Ophthalmology*; *Pathology*), Won Jae Huh (*Pathology*), Mark Lee (*Laboratory Medicine*), Janitza Montalvo-Ortiz (*Psychiatry*), Ian Odell (*Dermatology*), Emily Olfson (*Child Study Center*), Richard

Pierce (*Pediatrics*), Jason Sheltzer (*Surgery Oncology*; *Genetics*), Dennis Shung (*Digestive Diseases*), Wan-Ling Tseng (*Child Study Center*), Juan Vasquez (*Pediatrics*, *Hematology/Oncology*), Daniel Vatner (*Endocrinology*)

Lecturer Agnès Vignery (*Cell Biology*)

FIELDS OF STUDY

Cancer biology: leukemogenesis, metastasis, growth control, immune checkpoint therapy. Cell biology: cytoskeleton, nuclear structure and dynamics. Cell signaling: kinases, phosphatases, growth signaling. Epithelial cell biology: epithelial patterning, skin development and disease. Immunology: autoimmune disease, immunotherapy, systems biology. Genetics: disease etiology, birth defects. Lung function: cystic fibrosis, lung disease, idiopathic lung fibrosis. Maternal-fetal medicine. Metabolism: signaling and systems biology, diabetes. Neuroscience: pathogenesis of brain disease, neurogenomics. Organ homeostasis and injury: pancreatitis, kidney injury, macular degeneration, scleroderma. Physiology.

Students seeking admission into the Ph.D. program in Translational Biomedicine (PTB) apply to the Translational Molecular Medicine, Pharmacology, and Physiology (TMMPP) track within the interdepartmental graduate program in Biological and Biomedical Sciences (BBS), https://medicine.yale.edu/bbs/molmed/.

SPECIAL REQUIREMENTS FOR THE PH.D. DEGREE

The primary mission of the PTB is to prepare the next generation of translational scientists to be forward-thinking leaders in academic research, medicine, education, industry, and society. To achieve this mission, the PTB leverages its interdepartmental structure to break down silos between disciplines and to foster a collaborative community comprising laboratories across all the departments at the Yale School of Medicine. The PTB emphasizes a flexible curriculum, personalized professional development, and a supportive environment in which all participants can reach their full potential.

The first three to four terms of graduate study are spent in formal course work, independent reading, laboratory rotations, and early thesis work. Each student's program of study is designed in consultation with the TMMPP Track director during the first year and with an advisory committee of the PTB that includes the PTB director of graduate studies once the student affiliates with the PTB, typically in the spring of the first year of study. The goal is to provide flexibility, rigor, and breadth while ensuring that students are well prepared to meet the PTB course requirements and to have a strong foundation for their thesis research. Students also participate in at least three laboratory rotations during their first two terms.

PTB coursework includes at least five graduate-level courses typically taken over the first four terms. Students must meet the graduate school requirement of a grade of Honors in two courses, taking additional courses to fulfill this requirement if necessary. The graduate school requires this requirement be met by the end of the second year.

PTB students are expected to take at least one of the following: C&MP 550a, PATH 690b, or PHAR 504a; as well as CBIO 604 and the year-long graduate seminar course in the TMMPP Track. They are also required to take one course in biostatistics (from several offered). In their second year, PTB students are required to take four

modules (one year) of the Mentored Clinical Experience (MCE) and the PTB Grant Writing Course.

A qualifying examination is given during the second year of study and consists of a written research proposal based on the proposed thesis project followed by an oral exam. Within one year after a successful qualifying exam, the student schedules the first thesis committee meeting and provides an updated summary of the thesis project (in the form of a revised Specific Aims page). At this meeting the student is considered for advancement to candidacy, which must occur prior to the end of year three. In addition to all other requirements, students must successfully complete the Responsible Conduct in Research course (PHAR 580/C&MP 650/PATH 660) prior to the end of their first year of study. In their fourth year of study, all students must successfully complete B&BS 503, the RCR Refresher for Senior BBS Students.

An important dimension of graduate training in the program in Translational Biomedicine is the acquisition of teaching skills through participation in courses appropriate for the student's academic interests. Ph.D. students are expected to participate in two terms (or the equivalent) of teaching.

M.D.-PH.D. STUDENTS

M.D.-Ph.D. students who affiliate with the Ph.D. program in Translational Biomedicine follow a different course than other incoming graduate students, resulting in some modifications 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, several rotations are done during the summer between year one and year two.) No set number of research rotations is required. M.D.-Ph.D. students officially affiliate with the Ph.D. program in Translational Biomedicine after selecting a thesis adviser and consulting with the Director of Graduate Studies (DGS). M.D.-Ph.D. students interested in affiliating with the PTB are encouraged to consult with the DGS as early as possible 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 PTB (see below) may be modified from the normal requirements for Ph.D. students with permission of the DGS. Although five graduate-level courses are still required, some medical school courses are recognized. M.D.-Ph.D. students must also meet the graduate school requirement of a grade of Honors in two courses, taking additional courses beyond the five required in the department to fulfill this requirement if necessary. Students must also maintain an average grade of High Pass in all courses. M.D./Ph.D students are also not required to take the MCE course. In addition, only one term of teaching is required.

M.D.-Ph.D. students will be admitted to candidacy once they have completed their course work, obtained two Honors grades, passed their qualifying exam, and had their dissertation prospectus accepted by their 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 PTB website at https://medicine.yale.edu/ptb.

PTB 504a / PHAR 504a, Molecular Mechanisms of Drug Actions Elias Lolis
This course provides fundamental background in core principles of pharmacology, molecular mechanisms of drug action, and important research areas in contemporary pharmacology. Material covered includes quantitative topics in pharmacology such as drug-receptor theory, multiple equilibria and kinetics, pharmacokinetics, therapeutic drug monitoring, and drug metabolism. Specific content on the mechanisms of drug action includes autonomics; ion channel blockers; endocrine agents (hormones); cardiovascular drugs (ACE inhibitors, organic nitrates, β-blockers, acetylsalicylic acid); antimicrobials (anti-bacterials, fungals, and virals); anti-cancer, anti-inflammatory, anti-asthma, and anti-allergy drugs; and immunosuppressants. Students learn how to model drug-receptor interaction parameters and how to analyze steady-state enzyme kinetics and inhibition data. Senior students serving as teaching assistants lead discussion groups covering problem sets, review topics or assigned manuscripts. The course includes a self-study component consisting of video modules produced in collaboration with Yale faculty and Merck that explore the preclinical and clinical phases of drug development.

PTB 550a / C&MP 550a / ENAS 550a / MCDB 550a / PHAR 550a, Physiological Systems W. Mark Saltzman and Stuart Campbell
The course develops a foundation in human physiology by examining the homeostasis of vital parameters within the body, and the biophysical properties of cells, tissues, and organs. Basic concepts in cell and membrane physiology are synthesized through exploring the function of skeletal, smooth, and cardiac muscle. The physical basis of blood flow, mechanisms of vascular exchange, cardiac performance, and regulation of overall circulatory function are discussed. Respiratory physiology explores the mechanics of ventilation, gas diffusion, and acid-base balance. Renal physiology examines the formation and composition of urine and the regulation of electrolyte, fluid, and acid-base balance. Organs of the digestive system are discussed from the perspective of substrate metabolism and energy balance. Hormonal regulation is applied to metabolic control and to calcium, water, and electrolyte balance. The biology of nerve cells is addressed with emphasis on synaptic transmission and simple neuronal circuits within the central nervous system. The special senses are considered in the framework of sensory transduction. Weekly discussion sections provide a forum for in-depth exploration of topics. Graduate students evaluate research findings through literature review and weekly meetings with the instructor.

PTB 610a / C&MP 610a, Medical Research Scholars Program: Mentored Clinical Experience Yelizaveta Konnikova and Richard Pierce
The purpose of the Mentored Clinical Experience (MCE), an MRSP-specific course, is to permit students to gain a deep understanding of and appreciation for the interface between basic biomedical research and its application to clinical practice. The MCE is intended to integrate basic and translational research with direct exposure to clinical medicine and patients afflicted with the diseases or conditions under discussion. The

course provides a foundation and a critically important forum for class discussion because each module stimulates students to explore a disease process in depth over four ninety-minute sessions led by expert clinician-scientists. The structure incorporates four perspectives to introduce the students to a particular disease or condition and then encourages them to probe areas that are not understood or fully resolved so they can appreciate the value and challenge inherent in using basic science to enhance clinical medicine. Students are provided biomedical resource material for background to the sessions as well as articles or other publicly available information that offers insight to the perspective from the non-scientific world. During this course students meet with patients who have experienced the disease and/or visit and explore facilities associated with diagnosis and treatment of the disease process. Students are expected to prepare for sessions, to participate actively, and to be scrupulously respectful of patients and patient facilities. Prior to one of the sessions students receive guidance as to what they will observe and how to approach the experience; and at the end of the session, the students discuss their thoughts and impressions. All students receive HIPAA training and appropriate training in infection control and decorum relating to patient contact prior to the course.

PTB 629a and PTB 630b / C&MP 629a and C&MP 630b / PATH 679a and PATH 680b / PHAR 501a and PHAR 502b, 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). Required of and open only to Ph.D. and M.D./Ph.D. students in the Molecular Medicine, Pharmacology, and Physiology track.

PTB 690a / PATH 690a, Molecular Mechanisms of Disease Demetrios Braddock

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.