

# Graduate Programs and Faculty Research Interests at Yale for MD-PhD Students

**Biomedical Engineering** Students in the Biomedical Engineering Doctoral Program explore problems of human health and biomedical science using the tools and methods of modern engineering. Faculty in the department work in three areas of biomedical engineering: biomechanics, bioimaging, and biomolecular engineering. Within the field of biomolecular engineering, Yale has particular strengths in the fields of drug delivery and tissue engineering. Faculty research interests are broad and span investigators working on the North and South campuses. The Biomedical Engineering doctoral program seeks to develop students' research independence and creativity while strengthening their technical background. The excellent student-to-faculty ratio ensures ongoing interaction between students and faculty. Research and teaching focuses on a fundamental understanding of biomedical engineering problems. Doctoral studies in Biomedical Engineering consist of two years of course work and of original research. Areas of specialization reflect the research interests of faculty members. Students participate in research starting in their first year by way of two one-term research projects called "Special Investigations." Graduate students do their research in state-of-the-art facilities at the Yale School of Medicine and the Faculty of Engineering. Course work is typically required during the first two years in residence.

## Faculty Research Interests

**Jacek Cholewicki**, Biomechanics: Simulation and modeling of the lumbar spine in regard to tissue loads during heavy lifting, low back pain, and mechanical instability of the spine; muscle mechanics and electromyography

**R. Todd Constable**, Development and application of Magnetic Resonance Imaging methods with emphasis on pulse sequence design and functional brain imaging applications

**Robin A. de Graaf**, NMR spectroscopy methods to measure metabolic pathways in animals and humans in vivo; cerebral energetics and neurotransmitter metabolism during increased neuronal activation; NMR spectroscopy and imaging methods for applications at very high magnetic fields

**Francesco d'Errico**, Development of detectors for three dimensional radiation dosimetry; ultrasound-guided drug delivery techniques for chemotherapy agents.

**James S. Duncan**, Computer vision and image processing; optimization-based and distributed computational approaches to image analysis; applications of the above to medical images.

**Fahmeed Hyder**, Development of in vivo NMR methods for measuring tissue oxygen consumption; modeling oxygen delivery in brain; high field animal models for functional MRI; biophysical basis of functional MRI image contrast

**Themis R. Kyriakides**, Analysis of the cellular and molecular events that occur at the interface between implanted biomaterials and tissues. Areas of basic research include biomaterial-induced inflammation, wound healing, tissue regeneration with a focus on angiogenesis, and extracellular matrix remodeling. In vivo work involves genetically-modified mice. Areas of applied research include gene delivery from biomaterials, development of biodegradable polymers, modification of glucose sensors, and development of artificial skin

**Erin Lavik**, Biomaterials, synthesis of new degradable polymers; tissue engineering; spinal cord repair; retinal regeneration; drug delivery for optic nerve preservation and repair

**Michael Levene**, Application of nonlinear optical techniques, including multiphoton excited

fluorescence and second harmonic generation, for in vivo microscopy; micro-optics to reach deep structures in the brain and other organs in the intact animal, including mouse models of Alzheimer's and Parkinson's disease; development of optical techniques for cancer biopsy and early cancer detection; novel nonlinear optical microscopies and single molecule techniques.

**Mark Laubach**, Learning-dependent plasticity in cortical and subcortical networks and the neurophysiological basis of psychophysical processes

**Xenophon Papademetris**, Development of image analysis methodology for the automated quantification of three-dimensional images and image sequences with applications to whole organ segmentation, fat quantification in whole body mouse imaging, non-rigid brain registration and non-rigid motion/deformation analysis.

**Douglas L. Rothman**, Development of magnetic resonance spectroscopy and magnetic resonance imaging methods to image metabolic and neurotransmitter pathways non-invasively in humans and in animal models

**W. Mark Saltzman**, Controlled drug delivery to the brain, polymers for supplementing or stimulating the immune system, cell interactions with polymers, and tissue engineering

**Steve Segal**, Microcirculation and intravital microscopy; local control of muscle blood flow and its regulation by the nervous system; cell-to-cell signaling in microvascular endothelium and smooth muscle

**Frederick J. Sigworth**, Electrical recording (patch clamp) and signal processing of ion channel currents; studies of structure and function of ion channel proteins; cryo-electron microscopy methods for macromolecular structure determination

**Lawrence Staib**, Biomedical image analysis, processing, and measurement; models for the analysis of structure and function with applications in neuroimaging

**Hemant D. Tagare**, Mathematical theory of non-rigid correspondence and non-rigid shape change with application to heart motion analysis; indexing and rapid retrieval of images based on their content; image segmentation with deformable contours; visual attention and its use in object recognition. Radiology

**Steven W. Zucker**, Computational vision, computational neuroscience, biomedical image analysis

**Cell Biology** The Graduate Program in Cell Biology offers students outstanding opportunities for research and training leading to the Ph.D. degree. Reflecting the truly multidisciplinary nature of cell biology today, students in the program engage in independent research on a broad spectrum of exciting topics concerned with cellular structure, function, development, and organization in complex systems, with particular emphasis on molecular mechanisms and relevance to human diseases. Fields include membrane biology of eukaryotic cells (molecular mechanisms of membrane biogenesis, traffic, and fusion; organelle biogenesis), intracellular transport of membrane and secretory proteins, receptor-mediated endocytosis, generation of transmembrane signals, epithelial cell polarity and the extracellular matrix, protein folding, membrane function in the nervous system (synapse formation and function), neural networks, axon guidance, developmental genetics, virus-cell interactions, cell biology of protozoan parasites and of pathogen/host interactions, cell biology of the immune response, mRNA biogenesis and localization, RNA folding, cell biology of RNA-protein particles, structural biology, cell biology of bone remodeling and of the cytoskeleton. The curriculum is rigorous and comprehensive, providing in-depth exposure to the wide range of methodological approaches used by contemporary cell biologists, from molecular genetics and structural biology to functional genomics and live cell imaging. Yet it is flexible as well to accommodate the individual interests

and needs of students. Collaborative research is fostered by a highly interactive community of students, postdocs, faculty, and staff, and by communal research facilities. The overall goal of the program is to provide students with the skills for independent, critical, and creative thinking necessary for successful future careers as scientists.

**Faculty Research Interests:**

(\*Primary Appointment) <http://info.med.yale.edu/cellbio/>

**Norma W. Andrews**, Professor of Microbial Pathogenesis and Cell Biology. Invasion, survival and signaling mechanisms of intracellular pathogens

**Roland Baron**, Professor of Orthopedics and Cell Biology. Signal transduction in skeletal development and remodeling

**Michael Caplan**, Professor of Cellular & Molecular Physiology. Ion pumps in polarized epithelia: sorting and function

**Lynn Cooley**, Professor of Genetics and Cell Biology. Cell biology of *Drosophila* oogenesis: cytoplasm transport and cytoskeleton regulation

**Peter Cresswell**, Professor of Immunobiology. Investigator, HHMI, Molecular mechanisms of antigen processing

**Pietro De Camilli**,\* Higgins Professor of Cell Biology; Investigator HHMI. Development and function of neuronal synapses

**Susan Ferro-Novick**,\* Professor of Cell Biology. Investigator, HHMI. Vesicle traffic and organelle inheritance

**Jorge Galán**, Markey Professor and Chairman of Microbial Pathogenesis. Molecular mechanisms of bacterial pathogenesis

**Fred S. Gorelick**, Professor of Medicine and Cell Biology. Cell biology of pancreatitis and protein transport in gastrointestinal epithelial cells

**Carl Hashimoto**,\* Associate Professor of Cell Biology. Cellular and developmental processes involving regulated proteolysis

**James D. Jamieson**,\* Professor of Cell Biology; Director of M.D.-Ph.D. Program.

**Thomas L. Lentz**,\* Professor of Cell Biology.

**Vincent Marchesi**, Anthony N Brady Professor of Pathology; Professor of Cell Biology and Molecular, Cellular & Developmental Biology; Director of Boyer Center for Molecular Medicine. Regulation of cell division

**Ira Mellman**,\* Sterling Professor and Chairman of Cell Biology; Professor of Immunobiology; Member, Ludwig Institute for Cancer Research. Membrane traffic in epithelial organization, the immune response and cancer

**Gero Miesenböck**,\* Associate Professor of Cell Biology. Organization and function of neural networks.

**Mark S. Mooseker**, Harrison Professor of Molecular, Cellular & Developmental Biology, Cell Biology, and Pathology. Molecular mechanisms of cytoskeletal structure, motility and assembly

**Michael H. Nathanson**, Professor of Medicine and Cell Biology, Director of the Center of Cellular and Molecular Imaging (CCMI). Second messengers and regulated secretion in polarized epithelia

**Peter Novick**,\* Professor of Cell Biology. Membrane traffic and cell polarity

**Thomas D. Pollard**, Higgins Professor of Molecular, Cellular & Developmental Biology; Professor of Cell Biology. Molecular basis of cellular motility and cytokinesis

**Karin Reinisch,\*** Assistant Professor of Cell Biology. Structural biology of RNA folding and membrane traffic

**Elke Stein,** Assistant Professor of Molecular, Cellular & Developmental Biology and Cell Biology. Neuronal development: axon guidance cues

**Peter Takizawa,\*** Assistant Professor of Cell Biology. mRNA localization in yeast and neurons

**Derek Toomre,\*** Assistant Professor of Cell Biology, Ludwig Institute for Cancer Research  
Cellular imaging and analysis of polarized membrane traffic

**Elisabetta Ullu,** Professor of Medicine and Cell Biology. Regulation of gene expression in *Trypanosoma brucei*

**Graham Warren,\*** Professor of Cell Biology, Ludwig Institute for Cancer Research, Growth and division of the Golgi apparatus

**Sandra Wolin,\*** Associate Professor of Cell Biology and Molecular Biophysics & Biochemistry; Associate Investigator, HHMI. RNA folding and its role in cellular resistance to radiation damage and in autoimmunity

**Cellular & Molecular Physiology** The Graduate Program in Cellular and Molecular Physiology at the Yale University School of Medicine is an intensive course of study leading to the Ph.D. degree. The Program is intended to prepare individuals for productive careers in research and teaching. There is a broad range of research interests with particular emphasis on membrane transport processes and on cellular and molecular aspects of cellular regulation and neurobiology. Individual laboratories specialize in the biophysics, biochemistry and/ or molecular biology of ion channels; active transport in epithelia and isolated cells; membrane protein targeting; muscle activation; hormone-receptor interaction and second messenger pathways; developmental neurobiology; organ physiology; and the neurophysiology of learning. Among the techniques currently in use are a wide range of electrophysiologic methods including single channel recording; molecular cloning and DNA transfection; transgenic mouse production; light, electron and confocal microscopy; dynamic fluorescent imaging; renal tubule perfusion; and membrane biochemistry. Resources include core facilities for tissue culture, molecular biology and biochemistry, light and electron microscopy, as well as a professionally staffed electronics and machine shop.

**Faculty Research Interests:** <http://info.med.yale.edu/cmphysiol/>

**Walter F. Boron,** Physiology of ion-transport processes Involved in the regulation of intracellular pH.

**Emile L. Boulpaep,** Membrane channels and transporters in kidney

**Cecilia Canessa,** Molecular mechanisms of renal function

**Michael Caplan,** Ion pumps in polarized epithelia: Sorting and function

**W. Knox Chandler,** Excitation-contraction coupling in skeletal muscle

**Lawrence B. Cohen,** Multi-cell optical monitoring of action potential activity during simple behaviors

**Biff Forbush,** Molecular physiology of membrane transporters

**Steven C. Hebert,** Molecular and cellular mechanisms and regulation of ion transport by epithelial cells

**P. Darrell Neuffer,** Molecular mechanisms regulating gene expression in skeletal muscles

**Michael N. Nitabach**, Genes, Clocks, and Neurons: Molecular Genetics and Systems Physiology of Animal Behavior

**Vincent A. Pieribone**, Physiological, structural and molecular analyses of vertebrate neurotransmission

**Steven S. Segal**, Microcirculation in skeletal muscle: cellular mechanisms of blood flow control

**Clifford L. Slayman**, Biophysics and molecular biology of ion movement across membranes

**Fred J. Sigworth**, Functioning of ionic channels

**David Zenisek**, Physiology and cell biology of the presynaptic terminal.

**Yufeng Zhou**, Revealing the atomic basis of ion transport

#### **Secondary Appointees:**

**Peter S. Aronson**, Molecular mechanisms of sodium chloride and bicarbonate transport in the kidney

**Henry Binder**, Regulation of colonic Na transport in apical and basolateral membranes

**Angelique Bordey**, Function of glial transporters at GABAergic synapses

**Thomas Brown**, Synaptic transmission, neuronal plasticity and mechanisms of memory

**Lloyd G. Cantley**, Epithelial morphogenesis

**Arthur B. DuBois**, Respiratory and circulatory physiology

**Marie Egan**, Regulation of ion transport across the airway epithelia

**Barbara Ehrlich**, Mechanisms of intracellular calcium release

**John P. Geibel**, Optical monitoring of ion transport mechanisms in epithelia

**Leonard K. Kaczmarek**, Long-lasting changes in neural activity

**George B. Richerson**, Role of serotonergic raphe neurons in pH homeostasis; Nonvesicular GABA release via reversal of the GABA transporter.

**Gerald I. Shulman**, Intermediary metabolism in humans

**Carolyn W. Slayman**, Molecular genetics of cation transporters

**Fred S. Wright**, Ion transport in single renal tubules

**Epidemiology and Public Health** Programs of study are offered in the areas of biostatistics, chronic disease epidemiology, environmental health sciences, genetic epidemiology, health policy and administration, and epidemiology of microbial diseases (infectious disease epidemiology, vector-borne diseases, immunology, parasitology, and virology). The Social and Behavioral Program (SBS), within the Chronic Disease Epidemiology division, offers students specialized instruction in the theory and methods of the social and behavioral sciences. All programs are under the faculty of the Department of Epidemiology and Public Health.

For detailed information visit: <http://publichealth.yale.edu/>

#### **Faculty Research Interests:**

**Serap Aksoy**, Interaction of African trypanosomes with their vector, the tsetse fly genetic modification of vector competence

**Louis Alexander**, Factors that contribute to the replication and pathogenesis of HIV-1

**Michael Bracken**, Perinatal epidemiology and asthma

**Elizabeth Bradley**, Health care needs of older adults, hospice and quality improvement efforts

**Durland Fish**, Ecology and prevention of vector borne infectious diseases

**Alison Galvani**, Modeling the evolution and epidemiology of infectious diseases

**Robert Heimer**, Hepatitis and HIV syringe exchange programs, molecular epidemiology of HIV and hepatitis

**Josephine Hoh**, Age-related macular degeneration

**Theodore Holford**, Development and application of statistical methods in public health and medicine, particularly cancer epidemiology

**Karen Hudmon**, Tobacco use and dependence, smoking, clinician education, pharmacy, medication compliance, health outcomes and poison control

**Jeannette Ickovics**, Community based longitudinal studies in HIV/AIDS

**Beth Jones**, Cancer screening and epidemiology

**Stanislav Kasl**, Psychosocial epidemiology

**Harlan Krumholz**, Cardiovascular epidemiology

**Brian Leaderer**, Research on human exposure to air contaminants; asthma

**Becca Levy**, Aging and psychosocial epidemiology

**Judith Lichtman**, Cardiovascular disease in the elderly and epidemiology

**Susan Mayne**, Cancer prevention and clinical trials

**Diane McMahon-Pratt**, Immune effector mechanisms in Leishmania

**Michael Merson**, HIV/AIDS prevention; Director, Center for Interdisciplinary Research on AIDS

**Linda Niccolai**, Behavioral aspects of HIV and STD prevention

**Melinda Pettigrew**, Molecular and epidemiological approaches to infectious diseases in infants and young children

**Harvey Risch**, Cancer etiology and prevention

**Nancy Ruddle**, Mechanism of action of cytokines: TNF in autoimmune diseases and lymphoid organ development

**David Paltiel**, Cost effectiveness studies; medical decision analysis; health policy modeling

**Mark Schlesinger**, Health Policy research, especially assessments of Federal programs for children and the elderly

**Jody Sindelar**, Applying economic principles to health issues

**Christian Tschudi**, Biology of trypanosomes, the causative agent of devastating diseases in Africa and South America

**Herbert Yu**, Molecular epidemiology and tumor markers

**Daniel Zelterman**, Categorical data analysis, goodness of fit tests; mixture models; statistical methods in cancer research

**Heping Zhang**, Development of biostatistical methods and applications for large complex epidemiological studies; statistical genetics and neuroimaging analysis

**Hongyu Zhao**, Applications of probability and statistics to molecular biology and genetics

**LiangBiao Zheng**, Analysis of molecular and genetic interactions between mosquitoes and malarial parasites

**Tongzhang Zheng**, Cancer epidemiology and environmental epidemiology including genetic polymorphisms and environmental factors in breast cancer

**Yong Zhu**, molecular epidemiological approach to study genetic susceptibility markers and their interactions with environmental exposures in human disease development

**Experimental Pathology** The Experimental Pathology Ph.D. Program emphasizes research on disease mechanisms, built upon a strong foundation of training in cell biology, molecular biology, pharmacology, and genetics. Students in these programs draw upon the wide range of expertise at Yale University in all areas of contemporary biology. This Program has a broad goal of educating students on the mechanistic basis of disease. Students completing this Program will have training in cell and molecular biology, genetics, and integrated aspects of disease. Members of the Experimental Pathology faculty have great strengths in areas of signal transduction, cytoskeleton, animal virology (including HIV), mouse genetics, mechanisms of carcinogenesis, and immunology. The fields of study in Experimental Pathology include molecular and cellular basis of cancer; biology, biochemistry, and pathology of the plasma membrane; cells, molecules, and response to stimuli of connective tissue; interaction of viruses with animal cells; pathology of organ systems; somatic cells genetics and birth defects; biology of endothelial cells; and assembly of viruses.

**Faculty Research Interests** - <http://www.yalepath.org/DEPT/edu/gradtraing.htm>

**Demetrios Braddock**, Molecular basis of sequence-specific single-stranded DNA recognition by KH domains of nuclear RNA

**Jose Costa**, Molecular genetics of tumor progression

**Stuart Flynn**, DNA analysis of neoplasms, thyroid pathology, neonatal cardiac function and metabolism, experimental diabetes, ischemic heart disease, and the cardiomyopathies

**Michael Kashgarian**, Renal pathology, immunology, and physiology

**Themis Kyriakides**, biomaterials engineering in wound healing and angiogenesis.

**Diane Krause**, human stem cells and hematopoiesis

**Michael Krauthammer**, bioinformatics of molecular interaction networks; text mining.

**Paul Lizardi**, Analysis of gene expression patterns in cancer

**Joseph A. Madri**, Endothelial cell biology, cell-matrix interaction, and angiogenesis

**Vincent T. Marchesi**, Skeletal proteins of mitotic apparatus

**Robert Means**, host responses to infection by Kaposi's sarcoma-associated herpesvirus (KSHV) and other herpesviruses

**Wang Min**, Cytokine signaling and angiogenesis

**Jon S. Morrow**, Structure and function of the spectrin cytoskeleton

**Archibald Perkins**, Identification and characterization of genes involved in cancer using transgenic mice and mutant mouse strains

**Jordan Pober**, Immunobiology of vascular endothelium; cytokine alterations of endothelium; signalling between T cells and endothelial cells

**Lihui Qin**, Immunosuppression in graft-host interactions

**David Rimm**, Role of cadherin in cancer and inflammatory diseases; quantitative biomarker analysis

**Michael Robek**, virus-host interactions controlling Hepatitis B and C virus-induced diseases

**John K. Rose**, Molecular aspects of virus assembly and intracellular protein transport

**Gerald Shadel**, yeast and mammalian models for mitochondrial diseases

**David F. Stern**, Transformation by growth factor and growth factor receptor oncogenes including HER2. DNA checkpoint controls

**Jeffrey Sklar**, Molecular characterization of chromosomal aberrations in cancer

**Fattaneh Tavassoli**, Molecular alterations in intraepithelial and invasive mammary carcinomas

**David Tuck**, Computational biology and informatics

**Genetics** The Department of Genetics offers broadly-based training in the molecular genetics of model systems including viruses and microorganisms, yeast, nematodes and *Drosophila*, as well as a very strong program in human genetics that includes gene mapping, diagnostics, biochemical genetics and identification of disease genes. The breadth of expertise in various aspects of genetics provides students with a unique set of research opportunities, complemented by courses that focus on human genetics and the genetics of model organisms. The Department of Genetics began with a strong focus on human genetics, and has since grown to include research programs using a wide range of model genetic organisms while continuing its emphasis on human genetics. In addition to a strong graduate program, the Department also sponsors a Medical Genetics & Genetics Residency program leading to certification by the American Board of Medical Genetics. The department is located in the Medical School in the Sterling Hall of Medicine, the Boyer Center and the Anlyan Center for Medical Research and Education.

The program of study leading to the Ph.D. degree emphasizes a broad approach to the fundamental principles of genetics, development and molecular biology combined with extensive research training. The program is designed to permit close interaction between graduate students, postdoctoral fellows, and faculty, while also encouraging full participation in the larger community of biological scientists at Yale.

**Faculty Research Interests** <http://info.med.yale.edu/genetics/>

**Terry Ashley**, Control of meiosis in mouse

**Allen Bale**, Cancer genetics, skin cancer, hedgehog pathway in flies

**Susan Baserga**, Ribosome biogenesis, rRNA processing

**Nancy Berliner**, Granulocyte differentiation, myeloid gene expression in normal and leukemic cells

**Douglas Brash**, Skin cancer, p53-dependent apoptosis

**Kei-Hoi Cheung**, Bioinformatics and Computational Biology

**Lynn Cooley**, *Drosophila* development, regulation of cytoskeleton, oogenesis, live imaging

**Daniel DiMaio**, Viral effects on cell growth, cellular senescence, virology

**Bernard Forget**, Hematopoiesis, membrane skeleton proteins, stem cells

**Peter M. Glazer**, Triple helix-mediated genome modification, genetic instability in cancer, DNA damage response

**Arthur Horwich**, Protein folding machines, chaperones

**Paula Kavathas**, Immune response to Chlamydia, T cell interaction with ligands

**Kenneth Kidd**, Genetics of complex human disorders, human genome diversity, human evolution

**Richard Lifton**, Human genetics of hypertension, stroke, heart disease

**Maurice J. Mahoney**, Clinical genetics; diagnosis and therapy of human fetal disease

**Valerie Reinke**, *C. elegans* signaling pathways, germline development

**Shirleen Roeder**, Genetic and molecular analysis of meiosis in yeast

**Margretta Seashore**, Clinical genetics; inherited metabolic disorders

**Carolyn Slayman**, Ion transport across membranes, ATPases

**Stefan Somlo**, Human polycystic kidney disease, human genetics

**Matthew State**, Childhood psychiatric disorders, human genetics

**Michael Stern**, Cell migration, FGF signaling, computational modeling of *C. elegans* development

**Hong Sun**, Cell cycle progression, PI 3-kinase signaling, *C. elegans*

**Zhaoxia Sun**, Kidney disease, zebrafish mutations, kidney development

**Joann Sweasy**, DNA polymerase function and mechanism

**Peter Tattersall**, Parvovirus infection and replication, coat protein function, virology

**Sherman Weissman**, Human genome, gene expression, mechanism of aging

**Tian Xu**, Metastasis, Drosophila cancer genes

**Hui Zhang**, Cell cycle regulation, Ubiquitin-dependent degradation

**Hongyu Zhao**, Computational genetics, linkage disequilibrium, statistical methods

**Immunobiology** The Section of Immunobiology at Yale, a multi-disciplinary group of investigators committed to understanding the cellular, genetic and molecular basis of immunological processes. The Immunology Graduate Program is designed to prepare students for independent careers in research and teaching in Immunology or related disciplines. The educational program emphasizes interdisciplinary training and collaborative and interactive research, an approach based on the idea that solving difficult problems requires the integration of individuals with common goals but differing expertise. Advanced technologies facilitate achieving those goals. Specific areas of interest in basic immunobiology include: B, T and NK cell development, activation and effector functions; the innate immune system; the role of cytokines in immunoregulation; intracellular signaling and the control of transcription in lymphocytes; antigen processing and presentation; immunoglobulin and T cell receptor gene rearrangement; B and T cell memory; the immunobiology of vascular endothelial cells; and B and T cell tolerance. Other areas of research with direct clinical relevance are: autoimmunity (i.e. arthritis, SLE, multiple sclerosis, colitis), asthma, diabetes and bone disease, infectious diseases (i.e. Herpes Simplex and West Nile viruses, Chlamydia and Legionella bacteria, Leishmania parasite), transplantation.

**Faculty Research Interests** <http://info.med.yale.edu/immuno/>

**Alfred Bothwell**, Professor of Immunobiology and Interdepartmental Program in Vascular Biology and Transplantation. T-cell receptor recognition and signaling properties

**Kim Bottomly**, Professor of Immunobiology and Molecular, Cellular & Developmental Biology. Activation requirements and effector functions of CD4+ T lymphocytes

**Tian Chi**, Assistant Professor of Immunobiology. Use of the immune system especially T cell development as a model to attack fundamental problems in signal transduction, chromatin dynamics and epigenetic memory

**Joe Craft**, Professor of Medicine (Rheumatology) and Immunobiology. Propagation and regulation of systemic autoimmunity by T cells and the role of gd T cells in host defenses

**Peter Cresswell**, Professor of Immunobiology and Cell Biology. Molecular mechanisms of antigen processing; assembly and intracellular transport of CD1 molecules, class I and class II MHC molecules; functions and mechanisms of action of antiviral and antibacterial interferon-induced proteins

**Richard Flavell**, Professor and Chairman of Immunobiology, Professor of Molecular, Cellular & Developmental Biology. T cell tolerance and activation in immunity and autoimmunity. Apoptosis; regulation of T cell differentiation

**Sankar Ghosh**, Professor of Immunobiology, Molecular Biophysics and Biochemistry, and Molecular, Cellular & Developmental Biology. Regulation and function of NF-KB and related proteins

**Margaret Hostetter**, Professor of Immunobiology, Understanding how pathogenic organisms evade host defenses to cause infection and injury

**Akiko Iwasaki**, Associate Professor of Immunobiology. Mechanism of generation of antiviral mucosal immunity by dendritic cells

**Susan Kaech**, Assistant Professor of Immunobiology and Microbial Pathogenesis. Mechanisms of memory T cell development

**Paula Kavathas**, Professor of Laboratory Medicine, Genetics and Immunobiology Human Immune response to Chlamydia Trachomatis and host-pathogen interaction, structural biology CD8-MHC class I interaction, Significance CD8 signaling isoforms

**Joseph Madri**, Professor of Immunobiology and Pathology. Endothelial cell biology, cell matrix interaction, and angiogenesis

**Diane McMahon-Pratt**, Professor of Immunobiology and Epidemiology and Public Health. Membrane biochemistry and developmental biochemistry of the parasitic protozoa, Leishmania

**Robert Means**, Assistant Professor of Immunobiology and Pathology. Viral coping mechanisms and their importance to pathogenicity

**Ruslan Medzhitov**, Professor of Immunobiology. Innate immunity and control of adaptive immune responses by innate immune recognition.

**Ira Mellman**, Professor of Immunobiology and Cell Biology. Intracellular transport and function of MHC class II molecules

**I. George Miller**, Professor of Immunobiology and Infectious Diseases. Mechanisms underlying viral persistence and reactivation. Two related human tumor viruses: 1) Epstein Barr virus (EBV), and 2) Kaposi's sarcoma (KSHV)

**Wang Min**, Assistant Professor of Immunobiology and Pathology. Dissection of signal pathways during inflammatory responses and developing therapeutic targets for treatment of vascular diseases

**Jordan S. Pober**, Professor of Pathology, Immunobiology, and Dermatology. Immunobiology of vascular endothelial cells: cytokine actions and mechanisms; transplantation immunology; contributions of immunity to arteriosclerosis; tissue engineering

**Michael Robek**, Assistant Professor of Immunobiology and Pathology. Understanding the virus host interactions that mediate the control of HBV, as it may be possible to exploit them therapeutically for the treatment of chronic infections

**John Rose**, Professor of Immunobiology and Pathology. Molecular aspects of virus assembly and intracellular protein transport

**Craig Roy**, Professor of Immunobiology and Microbial Pathogenesis. Understanding the molecular and cellular events that enable microbial pathogens to evade host defense mechanisms

**Nancy Ruddle**, Professor of Epidemiology and Public Health (Microbial Diseases) and Immunobiology. Lymphotoxin (LT, TNF-b, LT-a), LT-b and tumor necrosis factor-a (TNF-a): molecular regulation and roles in autoimmunity and lymphoid organ development.

**David Schatz**, Professor of Immunobiology. Biochemical mechanism and developmental regulation of V(D)J recombination and somatic hypermutation; lymphocyte development; genomic instability and lymphoid malignancies

**Mark Shlomchik**, Professor of Laboratory Medicine and Immunobiology. Regulation and pathogenesis of autoantibody-producing B cells in normal and auto-immune mice; Toll-like receptors in autoimmune disease; molecular basis of B-cell memory; mechanism of graft vs host/leukemia

**Warren Shlomchik**, Assistant Professor of Internal Medicine and Immunobiology Mechanisms of antigen presentation, T cell effector function and regulation of Graft vs. Host Disease and Graft vs. Leukemia

**Robert Tigelaar**, Professor of Dermatology and Immunobiology. Immunobiology of gd T cells; immune system-skin interactions; immunopathogenesis of contact dermatitis, atopic dermatitis, and cutaneous T-cell lymphoma

**Interdepartmental Computational Biology and Bioinformatics** The Interdepartmental Ph.D. Program in Computational Biology and Bioinformatics provides opportunities for research and training in this rapidly growing multi-disciplinary field. The systematic acquisition of data made possible by genomics and proteomics technologies has created a tremendous gap between available data and their biological interpretation. Given the rate of data generation, it is well recognized that this gap will not be closed with direct individual experimentation. Computational and theoretical approaches to understanding biological systems provide an essential vehicle to help close this gap. These activities include computational modeling of biological processes, computational management of large-scale projects, database development and data-mining, algorithm development and high-performance computing, as well as statistical and mathematical analyses.

**Faculty Research Interests:** <http://cbb.yale.edu/faculty.html>

**James Aspnes** Distributed algorithms

**Joseph Chang** Probability, stochastic processes, sequential analysis, quality control, genetics, evolution, and bioinformatics

**Kei-Hoi Cheung** Bioinformatics; interoperation of genomic databases

**Ronald Coifman** Analysis tools for spectrometric diagnostics and hyperspectral imaging

**Lynn Cooley** Drosophila development, regulation of cytoskeleton, oogenesis, live imaging

**Donald Engelman** Developing a chemical understanding of membrane protein folding and oligomerization to use in interpreting evolution and function

**Mark Gerstein** Bioinformatics, large-scale analysis of genome sequences, macromolecular structures, and gene expression data

**William Jorgensen** Computational chemistry

**Douglas Kankel** Genetic and molecular analysis of visual system development in Drosophila

**Kenneth Kidd** Genetics of complex human disorders, human genome diversity, human evolution

**Steven Kleinstein** Disease/tissue/pathway/process modeling and simulation

**Michael Krauthammer** Bioinformatics of molecular interaction networks; text mining

**Paul Lizardi** Experimental and computational studies of cancer biology

**Elias Lolis** Structural biology of proteins involved in inflammation and cancer

**Andrew Miranker** Molecular mechanisms of protein folding, misfolding and pathological assembly into amyloid fibers

**Willard Miranker** Consciousness studies and neural networks

**Perry Miller** Biomedical informatics

**Annette Molinaro** Statistical genetics and computational biology

**Anna Pyle** Computational biology on RNA

**Martin Schultz** High performance computing

**Gordon Shepherd** Experimental and computational studies of sensory transduction, synapses, dendrites, and microcircuits using the olfactory pathway as a model system

**Avi Silberschatz** Bioscience database systems

**Michael Snyder** Molecular analysis of genomes, proteomes and cell division

**Dieter Söll** Biochemical and genomic studies of the evolution of protein synthesis

**Michael Stern** Computational modeling of *C. elegans* development; cell migration; FGF signaling  
**Valerie Reinke** *C. elegans* signaling pathways, germline development  
**David Tuck** Computational biology and informatics  
**Gunter Wagner** Developmental evolution of morphological characters; conceptual and mathematical work on the theory of evolution  
**Heping Zhang** Statistical genetics and neuroimaging analysis  
**Hongyu Zhao** Statistical genomics and proteomics  
**Steven Zucker** Computational vision, biological perception, artificial intelligence, and robotics

## **Interdepartmental Neuroscience Program**

### **Faculty Research Interests**

**Meenakshi Alreja**, In vitro electrophysiological studies on the neurobiology of the septohippocampal pathway, a brain pathway that is involved in cognitive functions and degenerates in Alzheimer's disease and other neurodegenerative disorders  
**Amy Arnsten**, Examination of the catecholamine and second messenger mechanisms influencing the cognitive functioning of the prefrontal and entorhinal cortices, brain regions commonly dysfunctional in mental illness  
**Thomas Biederer**, Molecular analysis of synapse formation in the developing central nervous system of vertebrates  
**Hal Blumenfeld**, Neuroimaging and electrophysiology studies of corticothalamic mechanisms causing impaired consciousness in epilepsy  
**Angelique Bordey**, Glial influence on postnatal neurogenesis in the subventricular zone and cerebellum  
**Charles Bruce**, Neurophysiology of information processing in cerebral cortex  
**Benjamin Bunney**, Neurobiology of schizophrenia and movement disorders, especially as related to central dopaminergic systems  
**John Carlson**, Function and development of the *Drosophila* olfactory system  
**Wei Chen**, Functional organization of olfactory neuronal circuits  
**Marvin Chun**, Functional MRI studies of visual perception, memory, and executive control  
**Lawrence Cohen**, Imaging the input and output of the olfactory bulb  
**R. Todd Constable**, Technical aspects of functional MRI with particular emphasis in fMRI for neurosurgical planning, and the application of fMRI and ERP to better understand language and memory systems in the human brain and the response to injury  
**Pietro De Camilli**, Membrane traffic at the neuronal synapse; phosphoinositide metabolism and neuronal function  
**Sabrina Diano**, Role of thyroid hormones, steroid hormones, neuropeptides and UCPs in the homeostatic mechanisms of CNS in physio-pathological conditions  
**Ronald Duman**, Molecular, cellular, and anatomical sites which mediate the adaptive responses of mammalian neurotransmitter signal transduction pathways to psychotropic drugs, hormones, and environmental stimuli  
**Barbara Ehrlich**, Regulation of intracellular calcium signaling using electrophysiological, biochemical and molecular techniques  
**Paul Forscher**, Molecular mechanisms of neuronal growth and guidance  
**Karyn Frick**, Neurobiology of learning and memory  
**Jeremy Gray**, fMRI studies of human emotion-cognition interactions

**Charles Greer**, Mechanisms that influence axonal and dendritic growth and specificity of targeting in sensory systems

**Lise Heginbotham**, Structure-function studies of ion channel proteins

**Tamas Horvath**, Determine the signaling flow and regulatory relationship within and between neuronal circuits that underlie the maintenance of physiological and pathological homeostatic conditions

**James Howe**, Glutamate receptors

**Marcia Johnson**, Cognitive neuroscience studies of human cognition and memory and of the relation between emotion and cognition

**Sven-Eric Jordt**, Molecular neurobiology of sensory transduction and pain

**Len Kaczmarek**, Long-lasting changes in neuronal activity

**Haig Keshishian**, Factors governing the formation of synaptic connections during development

**Ken Kidd**, Molecular and genetic mapping of genes of neuropsychiatric relevance; searching for genetic causes of neuropsychiatric diseases

**Jeffery Kocsis**, Pathophysiology of axons and neurons

**Michael Koelle**, Mechanism of signaling by G protein-coupled neurotransmitter receptors using a combination of *C. elegans* genetics and biochemical experiments

**Anthony Koleske**, Regulation of neuronal differentiation and morphogenesis by nonreceptor tyrosine kinases

**Hür Köser**, Creation of miniature microfluidic chambers to study cellular chemotaxis in real-time

**Robert LaMotte**, Neurobiology of pain and tactile sensations

**Mark Laubach**, Neurophysiological studies of associative learning, sensorimotor integration, and the effects of aging using chronic neuronal ensemble recording in frontal cortex, basal ganglia, and other brain areas in rodents

**David LaVan**, Micro- and nano-fabrication. Development of polymer based electrodes. Development of novel materials for biomedical applications

**Erin Lavik**, Developing new therapeutic approaches for the treatment of spinal cord injury and retinal degeneration

**Michael Levene**, Nonlinear optical techniques and micro-optics for in vivo microscopy; single molecule spectroscopy

**James Mazer**, Neurophysiological basis of natural vision

**David McCormick**, Cellular basis for cortical and thalamic function

**Gero Miesenböck**, Neuronal circuits and behavior

**Mark Mooseker**, Molecular and functional analysis of the cytoskeleton, with current emphasis on myosin superfamily of actin-based molecular motors

**Angus Nairn**, Dopaminergic signal transduction in the central nervous system

**Dhasakumar Navaratnam**, Molecular aspects of inner ear function

**Michael Nitabach**, Behavioral and physiological genetics in the fly, with goal of dissecting neural circuit function

**Marina Picciotto**, Use of mouse genetics and molecular biological approaches to study the role of neuromodulatory systems in behavior

**Maria Mercedes Piñango**, Language-brain relations: cortical dissociations in language localization, time-course of language processing during real-time sentence comprehension

**Pasko Rakic**, Developmental neurobiology, genetic and epigenetic regulation of neural interactions

**George Richerson**, Sensitivity to changes in pH of CNS respiratory neurons; Electrophysiological effects of nonvesicular GABA release

**Robert Roth**, Biochemistry, pharmacology, and function of midbrain dopamine systems

**Gary Rudnick**, Structure and function of biogenic amine transporters, which are targets for antidepressants and psychostimulants

**W. Mark Saltzman**, Biomaterials for drug delivery in the central nervous system, particularly in the development of controlled release systems for treating brain tumors

**Laurie Santos**, Social and physical cognition in non-human primates

**Joseph Santos-Sacchi**, Auditory biophysics, hair cell physiology, role of outer hair cells in cochlear amplification

**Glenn Schafe**, Neural organization of the brain's fear system; emotional learning & memory

**Michael Schwartz**, Development and organization of connectivity in the mammalian cerebral cortex

**Nenad Sestan**, Molecular control of neuronal identity and connectivity in the cerebral cortex

**Gordon Shepherd**, Experimental and computational studies of sensory transduction, synapses, dendrites, and microcircuits using the olfactory pathway as a model system

**Fred Sigworth**, Ion channel structure and gating mechanisms

**Dana Small**, Affective sensory neuroscience with an emphasis in multisensory integration of taste and smell and in brain representation of feeding and food reward in health and in addiction. Behavioral and neuroimaging approaches are used in humans

**Matthew State**, Gene discovery and characterization in childhood neuropsychiatric and developmental disorders

**Elke Stein**, Axon guidance in the developing nervous system.

**Stephen Strittmatter**, Molecular determinants of axonal guidance during development and regeneration

**Jane Taylor**, Neurobiology of addiction, depression and other neuropsychiatric disorders involving motivation, learning and cognition. Behavior and molecular approaches in mice, rats and monkeys

**Ning Tian**, The development of synaptic pathways and the activity-dependent synaptic plasticity in mammalian retina

**Susumu Tomita**, Revealing molecular mechanisms for synaptic strength regulation

**Vinzenz Unger**, Structure and function of metal transporters; Structure of scaffolding complexes in the postsynaptic density; Structure of membrane associated proteins

**Flora Vaccarino**, Regulation of progenitor cell differentiation in normal development and after injury

**Xiao-Jing Wang**, Dynamical aspects of neural computation and memory in cortex

**Stephen Waxman**, Molecular neurobiology of disease, with emphasis on ion channel function and dysfunction in spinal cord injury, multiple sclerosis, and stroke

**David Wells**, Molecular mechanisms of synaptic plasticity; role of local protein synthesis

**Robert Wyman**, Molecular biology and neurophysiology of gap junctions; genetic control of neural circuit development

**Tian Xu**, Mechanisms underlying neurodegeneration in Drosophila model

**Mark Yeckel**, Cellular and systems characterization of cortical neurons involved in learning and memory

**David Zenisek**, Presynaptic mechanisms of retinal neurons

**Weimin Zhong**, Asymmetric cell division and the development of the mammalian neocortex

**Yufeng Zhou**, Structure and function of ion channels  
**Steven Zucker**, Computational neuroscience

**Affiliated faculty – these faculty do not have an appointment in a Basic Science Department**

**Patrick Allen**, Molecular mechanisms of synaptic communication

**Robert Beech**, Roles of transcription factors and adult neurogenesis in the neurobiology of psychiatric disorders

**Hilary Blumberg**, Understanding the neural systems that underlie emotional processing.

**Nicholas T. Carnevale**, Development of a theoretical framework for understanding the functional consequences of the mechanisms that underlie the origin, propagation, and interaction of electrical and chemical signals in neurons

**Ralph DiLeone**, Understanding the molecular and neuronal circuits that are responsible for controlling reward-related behavior

**Albert Lo**, Pathobiology of demyelinating disease, neuronal injury and repair, neuroprotection, MS epidemiology, robotic neurorehabilitation, clinical trial design and methodology

**Laura Manuelidis**, Experimental models of Creutzfeldt Jakob Disease and variants; mechanisms of dementia & infectious agents

**Rory McCrimmon**, Glucose-sensing mechanisms used by specific brain regions; metabolic adaptations in brain following recurrent exposure to low glucose

**Vincent Pieribone**, Information encoding in somatosensory cortex and optical probes of membrane potential

**Sam Sathyanesan**, Regulation of angiogenesis in adult rodent brain and contribution to cellular and behavioral effects

**Robert Sherwin**, How the brain senses changes in blood glucose and the effect of decrements in blood glucose on brain function

**James Swain**, Combining psychological assessments and functional magnetic resonance brain imaging to study thoughts and behaviors of parents in the early postpartum

**Michael Westerveld**, Memory disorders associated with epilepsy and development of cognitive function across the lifespan

**Anne Williamson**, Physiological changes seen in the chronically epileptic brain

**Microbiology** The Microbiology Graduate Program is an interdisciplinary PhD program of training and research in the study of microorganisms and the effects on their hosts. The faculty of the Program share the view that understanding the biology of microorganisms requires a multidisciplinary approach and therefore the Microbiology Graduate Program emphasizes the need for strong multidisciplinary training, including the study of cellular mechanisms for host pathogen interaction in the Sections of Molecular Pathogenesis and the Emerging Microbial Diseases division of EPH. The faculty is composed of microbiologists in several academic departments, shares a commitment to understanding the biology of microorganisms through employing cellular, molecular, and genetic approaches. 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 and parasitology; and microbial genetics, ecology, evolution, and physiology.

**Hervé Agaisse**, Assistant Professor, Microbial Pathogenesis

**Louis Alexander**, Assistant Professor, Epidemiology & Public Health  
**Sidney Altman**, Sterling Professor, Molecular, Cellular & Developmental Biology and Chemistry,  
**Norma W. Andrews**, Professor, Microbial Pathogenesis & Cell Biology  
**Serap Aksoy**, Associate Professor, Epidemiology & Public Health  
**Susan J. Baserga**, Associate Professor, Therapeutic Radiology & Genetics,  
**H. Kim Bottomly**, Professor, Immunobiology and Dermatology  
**Michael Cappello**, Associate Professor, Pediatrics and Epidemiology & Public Health  
**Yung-Chi Cheng**, Henry Bronson Professor, Pharmacology  
**Donald M. Crothers**, Sterling Professor Chemistry, Chemical Engineering, Molecular Biophysics  
 & Biochemistry  
**Daniel DiMaio**, Waldemar Von Zedtwitz Professor and Vice-Chairman of Genetics  
**Savithramma P. Dinesh-Kumar**, Assistant Professor, Mol Cell & Dev Biology  
**Erol Fikrig**, Associate Professor, Medicine and Epidemiology & Public Health  
**Durland Fish**, Associate Professor Epidemiology & Public Health  
**Jorge E. Galán**, Lucille P Markey Professor, Microbial Pathogenesis  
**Nigel D.F. Grindley**, Professor, Molecular Biophysics & Biochemistry  
**Margaret K. Hostetter**, Professor, Pediatrics & Microbial Pathogenesis  
**Akiko Iwasaki**, Assistant Professor Epidemiology & Public Health  
**Christine Jacobs-Wagner**, Assistant Professor, Mol Cell & Dev Biology  
**Susan Kaech**, Assistant Professor, Immunobiology  
**Barbara Kazmierczak**, Assistant Professor, Infectious Diseases  
**Brooks Low**, Professor (Adj-Rsrch) Therapeutic Radiology  
**Diane McMahon-Pratt**, Professor, Epidemiology & Public Health  
**John MacMicking**, Assistant Professor, Microbial Pathogenesis  
**May Macnab**, Research Associate, Molecular Biophysics & Biochemistry  
**Robert Means**, Assistant Professor, Pathology  
**I. George Miller, Jr.**, John F. Enders Professor Pediatrics, MB&B, & EPH  
**Walther Mothes**, Assistant Professor of Microbial Pathogenesis  
**L. Nicholas Ornston**, Professor, MCDB  
**Michael Robek**, Assistant Professor, Pathology  
**Craig R. Roy**, Associate Professor, Microbial Pathogenesis  
**Nancy Hartman Ruddle**, Professor, Epidemiology & Public Health and Immunobiology  
**W. Dean Rupp, Jr.**, Professor, Therapeutic Radiology  
**Clifford Slayman**, Professor, Physiology  
**John K. Rose**, Professor, Pathology and Cell Biology  
**William C. Summers**, Professor, Therapeutic Radiology, Molecular Biophysics & Biochemistry  
**Joann B. Sweasy**, Associate Professor, Therapeutic Radiology and Genetics  
**Peter John Tattersall**, Professor, LabMedicine & Genetics  
**Christian Tschudi**, Associate Professor, LEPH & Internal Medicine, Infectious Diseases  
**Paul Turner**, Associate Professor, Ecology & Evolutionary Biology  
**Elisabetta Ullu**, Associate Professor, Internal Medicine, Infectious Diseases & Cell Biology  
**Sandra Wolin**, Associate Professor, Cell Biology & MB&B  
**Liangbiao Zheng**, Assistant Professor, LEPH

**Molecular Biophysics & Biochemistry** The Molecular Biophysics and Biochemistry (MB&B) Graduate Program is designed to prepare students for careers as independent investigators in the broad areas of molecular and structural biology.

Foci of faculty interest include the study of DNA dynamics, including replication, recombination, transposition and functional genomics; transcriptional regulation, from individual transcription factors to the control of lymphocyte activation, the interferon response and organismal development; RNA catalysis and ribonucleoprotein machines, including self-splicing introns and spliceosomes, mRNA stability, RNA editing and modification, ribosome structure and function, tRNA recognition and biosynthesis, and HIV reverse transcriptase; protein folding and degradation, including chaperone structure and function, protein design, ubiquitin-mediated proteolysis, amyloid fibril formation; and membrane biology and motion, including transmembrane signaling, growth factor receptors, and membrane channels. Additional faculty study neurotransmission in *C. elegans*, control of the cell cycle, and signal transduction. Structural and computational biology is a strong component of many of the research areas outlined above. The department is located in the Bass Center for Molecular and Structural Biology and the Gibbs Laboratory on the main campus, and in the Sterling Hall of Medicine and the Boyer Center at the Medical School. MB&B draws strength from the fact that its physical presence is split between Science Hill (close to MCDB, and the Departments of Chemistry, Physics and Geology) and the Medical School. Courses cover the molecular genetics of prokaryotes and eukaryotes, macromolecular structure and function, enzyme mechanisms, genetic analysis, molecular cell biology, membrane structure and function, electron cryo-microscopy, X-ray diffraction, and genomics & bioinformatics.

**Faculty Research Interests:** [http://www.mbb.yale.edu/gp/gp\\_home.htm](http://www.mbb.yale.edu/gp/gp_home.htm)

**Susan Baserga**, Associate Professor; Elucidation of the mechanisms underlying ribosome biogenesis in eukaryotes

**Thomas Biederer**, Assistant Professor; Molecular Mechanisms of Synapse Formation in the Central Nervous System.

**Gary Brudvig**, Professor; Photosynthetic water oxidation, metalloproteins, biological electron-transfer reactions, EPR spectroscopy

**João Cabral**, Associate Professor; Membrane proteins that mediate ion transport with the aim of developing a molecular understanding of the mechanisms of transport

**Enrique De La Cruz**, Associate Professor; Molecular basis of free-energy coupling and subunit cooperatively in non-muscle myosins

**Donald Engelman**, Professor; Developing a chemical understanding of membrane protein folding and oligomerization to use in interpreting evolution and function

**Alan Garen**, Professor; Cell surface molecules involved in tumorigenesis and normal development

**Mark Gerstein**, Professor; Bioinformatics, large-scale analysis of genome sequences, macromolecular structures, and gene expression data

**Sankar Ghosh**, Professor; Regulation of the transcription factor NF- $\kappa$ B in immune responses

**Nigel Grindley**, Professor; Structure-function studies of the gamma-delta resolves site-specific recombination system and of DNA polymerases

**Andrew Hamilton**, Professor; Design, synthesis, and evaluation of synthetic agents that recognize protein surfaces and block protein-protein interactions

**Lise Heginbotham**, Associate Professor; Structure-function studies of ion transport proteins

**Mark Hochstrasser**, Professor; Mechanisms and functions of the ubiquitin-proteasome system

**Michael Koelle**, Associate Professor; Mechanism and regulation of neurotransmission through G protein coupled receptors

**Anthony Koleske**, Associate Professor; Biochemical mechanisms that regulate neuronal motility and morphogenesis

**William Konigsberg**, Professor; Structure/function relationships with respect to a pol alpha class DNA polymerase from bacteriophage RB69

**Richard Lifton**, Professor; Molecular genetic mechanisms underlying human cardiovascular and renal disease

**I. George Miller**, Professor; Molecular biology and immunology of the oncogenic human gamma herpes viruses, Epstein-Barr virus (EBV) and Kaposi Sarcoma-Associated Herpesvirus (KSHV)

**Andrew Miranker**, Associate Professor; Molecular mechanisms of protein folding, misfolding and pathological assembly into amyloid fibers

**Yorgo Modis**, Assistant Professor; Structural biology of host-pathogen recognition and innate immunity.

**Peter B. Moore**, Professor; Structure and function of RNAs and ribonucleoproteins, especially the ribosome

**Thomas Pollard**, Professor; Molecular basis of cellular motility and cytokinesis

**Anna Pyle**, Professor; RNA tertiary structure, RNA helicase enzymes and computational biology on RNA

**Lynne Regan**, Professor; Protein structure, function, and design

**Michael Snyder**, Professor; Molecular analysis of genomes, proteomes and cell division

**Dieter Söll**, Professor; Biochemical and genomic studies of the evolution of protein synthesis

**Mark Solomon**, Associate Professor; Biochemistry and genetics of cell cycle regulation in yeast and mammalian systems

**Joan A. Steitz**, Professor; Structure and function of small RNPs in vertebrate cells

**Thomas A. Steitz**, Professor; Structural explanations at the atomic level for the mechanisms of replication, recombination, transcription, and protein synthesis using the tools of X-ray crystallography and molecular biology

**Scott Strobel**, Professor; The structural and functional basis of RNA catalyzed biological reactions

**Patrick Sung**, Professor; Mechanisms of homologous recombination and DNA repair in eukaryotes

**Vinzenz Unger**, Associate Professor; Structure and function of integral membrane proteins by electron crystallography, biochemical, genetic, and biophysical approaches

**Sandra Wolin**, Associate Professor; How RNAs fold and assemble into functional RNA-protein complexes within cells

**Yong Xiong**, Assistant Professor; Structural and functional studies of human anti-HIV proteins

**Molecular, Cellular & Developmental Biology** Yale's Department of Molecular, Cellular and Developmental Biology offers a wide-ranging program of study and research leading to the Ph.D. degree. The program is supervised by approximately thirty-five faculty members working in seven areas: Biochemistry, molecular biology, and chemical biology; Genetics; Cell and developmental biology; Neurobiology; Plant sciences; Biotechnology; Genomics, Proteomics, and Bioinformatics. Students whose interests overlap two or more of these areas are encouraged to develop a special program of study for themselves. In addition, students may develop programs of

study in conjunction with other University departments such as Molecular Biophysics and Biochemistry, Chemistry, Ecology and Evolutionary Biology, or with other schools within the University such as the School of Medicine. The Department is located primarily in the twelve-story Kline Biology Tower and in the Osborn Memorial Laboratories. These are located on Yale's Science Hill.

**Faculty Research Interests:** <http://www.biology.yale.edu/>

**Sidney Altman**, Professor; Post-transcriptional RNA processing as a means of gene regulation

**Ronald Breaker**, Professor; Enzymatic DNA and in vitro evolution

**John Carlson**, Professor; Molecular and genetic analysis of olfactory system in *Drosophila*

**Craig Crews**, Associate Professor; Biochemical and molecular analyses of natural products

**Stephen Dellaporta**, Professor; Molecular biology and genetic utility of transposons in plants

**Xing-Wang Deng**, Professor; Molecular mechanisms involved in light-triggered regulation of growth and development in higher plants

**S.P. Dinesh-Kumar**, Associate Professor; Molecular basis of host-pathogen interactions in plants

**Paul Forscher**, Professor; Molecular dynamics of guided axon growth

**Martín García-Castro**, Assistant Professor; The origin of neural crest cells

**Scott Holley**, Assistant Professor; Genetic analysis of vertebrate segmentation in the zebrafish, *Danio rerio*

**Vivian Irish**, Professor; Mechanisms that govern pattern formation during plant development

**Christine Jacobs-Wagner**, Associate Professor; Bacterial cytoskeleton and cell cycle regulation

**Douglas Kankel**, Professor; Genetic and molecular analysis of visual system development in *Drosophila*

**Haig Keshishian**, Professor; Analysis of neuromuscular development in *Drosophila*

**Mark Mooseker**, Professor; Molecular underpinnings of cytoskeletal structure, motility and assembly

**Timothy Nelson**, Professor; Development of leaves

**L. Nicholas Ornston** Professor; Evolutionary relationships among a set of genes which have coevolved within a single cell line

**Thomas Pollard**, Professor; Molecular basis of cellular motility and cytokinesis.

**Shirleen G. Roeder**, Professor; Genetic and molecular analysis of meiosis in yeast

**Joel Rosenbaum**, Professor; Assembly of cell organelles using the flagella of *Chlamydomonas* as a model

**Frank Slack**, Associate Professor; MicroRNAs in Development and Disease

**Michael Snyder**, Professor; Molecular, cellular and genetic analysis of cell structure and division in eukaryotes

**Elke Stein**, Assistant Professor; The molecular mechanism that underlies neuronal growth cone guidance

**David Wells**, Assistant Professor; Examination of the process of experience dependent modification (or plasticity) of synapses at the cellular and molecular levels

**Robert Wyman**, Professor; Analysis of genes which control the specificity of neuronal connectivity in *Drosophila*

**Weimin Zhong**, Associate Professor; Regulation of neural stem cells and development of the mammalian neocortex

**Pharmacology** Research in pharmacology involves a multi-disciplinary approach to understand the interaction of various molecular entities with biological systems. These molecules may be as simple as electrons or ions, or as complex as phospholipids, nucleic acids, proteins, or clinically relevant drugs. The biological systems may be as simple as a protein, or as complicated as a virus particle to a whole organism – from bacteria to humans. Historically, the Department of Pharmacology at Yale was renowned for its contributions to neuropharmacology and cancer and viral chemotherapy. More recently, the department has broadened its scope to include strengths in signal transduction mechanisms, vascular biology, structural biology (of proteins involved in cell signaling, inflammation, cancer, and Alzheimer's disease), mechanisms of pain, enzyme and ion channel kinetics, and mechanisms of neurotransmitter transport and hormone storage release. New programs in the department include high throughput rational drug design using techniques ranging from X-ray crystallography and modern image analysis. The ultimate goal is not only to gain insights into various biomedical mechanisms or diseases, but also to use this information to generate new therapies for use in the clinic. The faculty members listed below have been successful in generating both insights into biomedical mechanisms and in developing clinically approved drugs for human use.

**Faculty Research Interests:** <http://info.med.yale.edu/pharm/faculty/>

**Karen S. Anderson**, Associate Professor; Enzyme mechanisms and biorational design of inhibitors, including HIV reverse transcriptase and tryptophan synthase; protein structure-function relationship at a molecular level using a combination of structural techniques, including rapid transient kinetics, NMR, and X-ray crystallography

**Anton M. Bennett**, Associate Professor; Signal transduction by protein tyrosine phosphatase

**Titus Boggon**, Assistant Professor; Mechanisms of regulation and activation for protein tyrosine kinases using X-ray crystallography

**David Calderwood**, Assistant Professor; Integrin-mediated cell adhesion, signaling and cytoskeletal regulation

**Yung-chi Cheng**, Professor; Cancer and viral chemotherapy; molecular biology and biochemistry of virus and cancer

**Jack R. Cooper**, Professor; Neurochemical investigations of regulatory factors in acetylcholine metabolism and presynaptic modulation

**Priscilla S. Dannies**, Professor; Mechanisms of dopaminergic inhibition of hormone release; mechanisms regulating hormone storage

**Barbara Ehrlich**, Professor of Pharmacology. Cell regulation in intracellular calcium concentration

**Ya Ha**, Assistant Professor; Mechanism of Alzheimer's disease

**James R. Howe**, Associate Professor; Structure and function of glutamate receptor ion channels

**Sven Jordt**, Assistant Professor; Molecular neuropharmacology of pain and somatosensation; Role of sensory neuron and their receptors in environmental toxicity and chronic inflammatory conditions

**Leonard K. Kaczmarek**, Professor; Modulation of electrical activity in neurons that control long-lasting changes in behavior; the role of neuropeptides and protein phosphorylation, as well as messenger RNA and protein synthesis, in the control of neuronal ion channels

**Irit Lax**, Assistant Professor; Signal transduction mechanisms

**Elias Lolis**, Associate Professor; Structural (crystallographic and NMR) and mechanistic studies of proteins involved in inflammation and cancer

**William Prusoff**, Professor; Anticancer, antiviral, and radiation sensitizing agents.

**J. Murdoch Ritchie**, Professor; Mode of action of drugs on excitable membranes, particularly when suggesting clues for the molecular basis of the action potential

**Gary Rudnick**, Professor; Mechanism of neurotransmitter transport; interaction of cocaine, ecstasy, and other drugs with neurotransmitter transporters

**Joseph Schlessinger**, Professor; Signal transduction and crystallographic studies of ligand-dependent tyrosine kinases, downstream effectors, and development of inhibitors

**Alan C. Sartorelli**, Professor; Development and evaluation of mechanisms of action of new drugs to treat cancer and studies of multidrug resistance

**William C. Sessa**, Professor; Biochemistry and molecular biology of angiogenesis; regulation of nitric oxide production by signaling and protein-protein interactions. forces

**Benjamin E. Turk**, Assistant Professor; Mechanisms of substrate recognition by protein kinases and proteolytic enzymes in cancer and infectious disease; small molecule and peptide library screening

### **Anthropology** <http://www.yale.edu/anthro/>

The purpose of the Graduate Program in Anthropology at Yale is the development of creative scholars and scientists who will teach or otherwise apply their knowledge and skills within one or more of the traditionally recognized fields of anthropology. This goal is realized by encouraging and stimulating students to do original and creative research as early as possible in their careers. Anthropology's effort is to study the human condition broadly, comparatively, and holistically has spawned four fields of interest within the discipline:

Archaeology focuses on ritual complexes and writing, ceramic analysis, warfare, ancient civilizations, origins of agriculture, and museum studies.

Sociocultural anthropology provides a range of courses: classics in ethnography and social theory, religion, myth and ritual, kinship and descent, historical anthropology, culture and political economy, agrarian studies, ecology, environment and social change, medical anthropology, emotions, public health, sexual meanings and gender, postcolonial development, ethnicity, identity politics and diaspora, urban anthropology, global mass culture, and alternate modernity.

Linguistic anthropology includes language, nationalism, and ideology, structuralism and semiotics, feminist discourse.

Physical anthropology focuses on paleoanthropology, evolutionary theory, human functional anatomy, race and human biological diversity, primate ecology. There is strong geographical coverage in Africa, the Caribbean, East Asia (China and Japan), Latin America and South America, Southeast Asia (Indonesia), South Asia and the Indian Ocean, the Near East, Europe, and the United States.

### **History of Medicine** <http://info.med.yale.edu/histmed/>

Yale University offers an interdepartmental M.A. and Ph.D. Program in the History of Medicine and Science. The Program's full-time faculty are members of the Department of History in the Faculty of Arts and Sciences and of the Section of History of Medicine in the School of Medicine. The Program offers opportunities for students to pursue degrees in concentrations that span the full range of the history of science and history of medicine, from antiquity to modern times. The Yale Program aims to sustain an integrative, eclectic response to methodological issues that have been intensely debated in recent years. It equips students with a critical appreciation of the diverse

approaches now practiced in the history of science and medicine. It offers training in the close reading of texts, instruments, artifacts, and analysis of ideas and practices, and instruction in social, cultural, political and economic modes of interpretation. Special advantages offered by the program include library resources that are among the best in North America. The historical medical library contains renowned collections and rare works in the history of medicine and related sciences.

**Psychology/Philosophy** <http://www.yale.edu/psychology/>; <http://www.yale.edu/philos/>

The Psychology Department organizes itself into five programs representing the major substantive domains of psychology at Yale.

Behavioral Neuroscience: A course of study in Behavioral Neuroscience emphasizes an understanding of the basic mechanisms of behavior through the knowledge of their physiological substrates, and an appreciation of their varying or similar forms in different organisms. Training in Behavioral Neuroscience is generally integrated with study in related areas within the Psychology Department and enriched by affiliation with other Yale departments and associated research centers, including the Interdepartmental Neuroscience Program.

Clinical Psychology: We emphasize integration of research and clinical work to develop innovators who will advance the theoretical and empirical bases of knowledge in clinical psychology. From a basic core of general psychology, psychopathology, and psychotherapy, three main themes may be pursued: (1) psychotherapy and psychopathology assessment and research, (2) clinical child psychology, and (3) health psychology.

Cognitive Psychology: This program is concerned with basic research in perception, human learning and memory, consciousness, thinking and problem solving, language, and intelligence, as well as with applications of this basic research to everyday settings. The cognitive group bridges across various fields of specialization, including cognitive neuroscience, computer science, linguistics, philosophy, and statistics.

Developmental Psychology: The program offers advanced training in understanding children of all ages. Instruction is available within the Department of Psychology and with other scholars in other areas of the University. Topics of special interest to developmental faculty and students include infancy, adolescence, cognitive development, applications of developmental psychology to education, developmental psychopathology, social policy, intelligence, language and thought, and children in other cultures.

Social/Personality Psychology: This program at Yale University focuses on training students in diverse methodologies such as field experimentation, survey techniques, computer simulation, and case studies (where the "case" might be an individual, group, or organization).