

Biomedical Sciences

OFFICE: 5008 Basic Science Building,
School of Medicine
<http://biomedsci.ucsd.edu>

Professors

Kim E. Barrett, Ph.D., *Medicine*
Roland C. Blantz, M.D., *Medicine*
Colin M. Bloor, M.D., *Pathology*
Richard C. Boland, M.D., *Medicine*
Gerry R. Boss, M.D., *Medicine*
Robert A. Brace, Ph.D., *Reproductive Medicine*
Joan Heller Brown, Ph.D., *Pharmacology*
Laurence L. Brunton, Ph.D., *Pharmacology/*
Medicine
Dennis A. Carson, M.D., *Medicine*
Webster K. Cavenee, Ph.D., *Medicine*
Cecilia Y. Cheung, Ph.D., *Reproductive Medicine*
Kenneth R. Chien, M.D., Ph.D., *Medicine*
Shu Chien, M.D., Ph.D., *Bioengineering/Medicine*
Mario Chojkier, M.D., *Medicine*
Don W. Cleveland, Ph.D., *Medicine*
James W. Covell, M.D., *Medicine*
Edward Dennis, Ph.D., *Chemistry and*
Biochemistry
Wolfgang H. Dillmann, M.D., *Medicine*
Daniel Donoghue, Ph.D., *Chemistry and*
Biochemistry
Mark H. Ellisman, Ph.D., *Neurosciences*
Scott D. Emr, Ph.D., *Cellular and Molecular*
Medicine
Gregory F. Erickson, Ph.D., *Reproductive Medicine*
Jeffrey Esko, Ph.D., *Cellular and Molecular*
Medicine
Ronald M. Evans, Ph.D., *Biology (Adjunct)*
Marilyn G. Farquhar, Ph.D., *Cellular and*
Molecular Medicine
James R. Feramisco, Ph.D., *Medicine/*
Pharmacology
Theodore Friedmann, M.D., *Pediatrics*
Gordon N. Gill, M.D., *Medicine*
Christopher K. Glass, M.D., Ph.D., *Cellular and*
Molecular Medicine
Lawrence S. B. Goldstein, Ph.D., *Cellular and*
Molecular Medicine
Philip M. Groves, Ph.D., *Psychiatry/ Neurosciences*
Vivian Hook, Ph.D., *Medicine (Adjunct)*
Stephen B. Howell, M.D., *Medicine*
Paul A. Insel, M.D., *Pharmacology/ Medicine*
Martin F. Kagnoff, M.D., *Medicine*

Michael Karin, Ph.D., *Pharmacology*
Carolyn J. Kelly, M.D., *Medicine (In-Residence)*
Thomas J. Kipps, M.D., Ph.D., *Medicine*
Richard Kolodner, Ph.D., *Medicine*
Elizabeth A. Komives, Ph.D., *Chemistry and*
Biochemistry
Ronald Kuczenski, Ph.D., *Psychiatry (In-Residence)*
Hyam L. Leffert, M.D., *Pharmacology*
Richard Lieber, Ph.D., *Orthopaedics*
Jamey D. Marth, Ph.D., *Cellular and Molecular*
Medicine
Carol L. MacLeod, Ph.D., *Medicine (In-Residence)*
James Andrew McCammon, Ph.D., *Chemistry and*
Biochemistry/Pharmacology
Odile Mathieu-Costello, Ph.D., *Medicine*
(In-Residence)
Pamela L. Mellon, Ph.D., *Reproductive Medicine/*
Neurosciences
Marc Montminy, M.D., Ph.D., *Biology (Adjunct)*
Sanjay Nigam, M.D., *Medicine/Pediatrics*
Daniel T. O'Connor, M.D., *Medicine (In-Residence)*
Jerrold M. Olefsky, M.D., *Medicine*
George Palade, M.D., *Cellular and Molecular*
Medicine
Frank L. Powell Jr., Ph.D., *Medicine*
Morton P. Printz, Ph.D., *Pharmacology*
Douglas D. Richman, M.D., *Pathology/Medicine*
(In-Residence)
Michael G. Rosenfeld, M.D., *Medicine*
Geert Schmid-Schoenbein, Ph.D., *Bioengineering*
David S. Segal, Ph.D., *Psychiatry*
Shunichi Shimasaki, Ph.D., *Reproductive Medicine*
Stephen A. Spector, M.D., *Pediatrics*
Daniel Steinberg, M.D., Ph.D., *Medicine*
Charles F. Stevens, Ph.D., *Pharmacology (Adjunct)*
Palmer W. Taylor, Ph.D., *Pharmacology*
Lynn F. TenEyck, Ph.D., *Pharmacology (Adjunct)*
Roger Y. Tsien, Ph.D., *Pharmacology/*
Chemistry and Biochemistry
Robert H. Tukey, Ph.D., *Pharmacology*
(In-Residence)/Chemistry and Biochemistry
Wylie W. Vale, Ph.D., *Medicine (Adjunct)*
Ajit P. Varki, M.D., *Medicine*
Peter D. Wagner, M.D., *Medicine*
John F. Ward, Ph.D., *Radiology (Emeritus)*
John B. West, M.D., Ph.D., *Medicine*
Joseph L. Witzum, M.D., *Medicine*
Flossie Wong-Staal, Ph.D., *Biology/Medicine*
Tony L. Yaksh, Ph.D., *Anesthesiology/Pharmacology*
Maurizio Zanetti, M.D., *Medicine (In-Residence)*

Associate Professors

Timothy D. Bigby, M.D., *Clinical Medicine*

Philip Bourne, Ph.D., *Pharmacology*
Jerold J. M. Chun, M.D., Ph.D., *Pharmacology*
Nazneen Dewji, Ph.D., *Medicine (Adjunct)*
Xiang-Dong Fu, Ph.D., *Cellular and Molecular*
Medicine
Richard Gallo, M.D., Ph.D., *Medicine (In-Residence)*
Michael Gribskov, Ph.D., *Biology (Adjunct)*
John C. Guatelli, M.D., *Medicine*
Michael C. Hogan, Ph.D., *Medicine (Adjunct)*
John Kelsoe, M.D., *Psychiatry*
Fred Levine, M.D., Ph.D., *Pediatrics (In-Residence)*
Gerrit Los, Ph.D., *Surgery (Adjunct)*
Diana L. Marquardt, M.D., *Medicine (In-Residence)*
Alexandra Newton, Ph.D., *Pharmacology*
Renate B. Pilz, M.D., *Medicine (In-Residence)*
Oswald Quehenberger, Ph.D., *Medicine (Adjunct)*
Gregg J. Silverman, M.D., *Medicine (In-Residence)*
Francisco Villarreal, M.D., Ph.D., *Medicine (Adjunct)*
Nicholas J.G. Webster, Ph.D., *Medicine*
(In-Residence)
David S. Williams, Ph.D., *Pharmacology/*
Neurosciences (Adjunct)
Virgil L. Woods, Jr., M.D., *Medicine*
Jason X. Yuan, M.D., Ph.D., *Medicine*

Assistant Professors

Joseph A. Adams, Ph.D., *Pharmacology*
Bogi Andersen, M.D., *Medicine (In-Residence)*
Joseph G. Gleeson, M.D., *Neurosciences*
Bruce Hamilton, Ph.D., *Medicine*
Steffan Ho, M.D., Ph.D., *Pathology*
Paul T. Martin, Ph.D., *Neurosciences*
Peter Van der Geer, Ph.D., *Chemistry and*
Biochemistry
Judith A. Varner, Ph.D., *Medicine*
Anthony Wynshaw-Boris, M.D., Ph.D., *Pediatrics/*
Medicine

The Graduate Program

The graduate program offered by the Group in Biomedical Sciences is designed to lead to the Ph.D. degree through a combination of didactic study, laboratory rotations, and thesis research in basic biomedical sciences. Research experiences are wide and varied, permitting students the options of selecting molecular, cellular, or organ and integrated systems approaches in their research programs. Students are encouraged to design and execute investigation in a self-critical and independent manner. Under-graduate preparation must include courses in mathematics (through calculus), chemistry (including organic,

physical, and biochemistry), and if possible, participation in undergraduate research. Students whose undergraduate backgrounds are significantly different will be considered provided there is sufficient evidence of interest in cell and molecular biology, physiology, pharmacology, or eukaryotic regulatory biology, and a desire to enter a field of active research and academic excellence.

Doctoral Degree Program

During the first year, the students take basic courses in cell biology, molecular biology, pharmacology, and physiology. In a required laboratory rotation program, students develop laboratory skills and the ability to formulate scientific hypotheses and become familiar with the research activities of the faculty. Required advanced courses and electives in subsequent years are chosen to develop the students' interest and specialized knowledge in the thesis research area. The thesis laboratory is usually selected by the end of the first year of graduate study.

The graduate program is interdepartmental and interdisciplinary; it involves faculty of the Departments of Medicine, Pharmacology, Neurosciences, Reproductive Medicine, Chemistry, Pathology, Bioengineering, Cellular and Molecular Medicine, and the Cancer Center. Physiological studies include molecular to whole animal approaches to cardiovascular, microcirculatory, respiratory, renal, gastrointestinal and fetal physiology and their neural and hormonal control. Pharmacologic studies of drug action at the molecular and biochemical levels include studies of receptor structure and function, genetic and recombinant DNA methods to analyze ligand-receptor interactions, regulation of gene expression and signal transduction, and biophysical approaches to defining neurotransmitter and hormone action. Molecular and cell biological approaches are being applied to the study of major issues in cell biology, including the regulation of protein targeting and intracellular membrane traffic, hormone and growth factor receptors, endothelial cell biology, molecular motors, RNA splicing, and mitosis, among others. Eukaryotic regulatory biologists are using the most advanced molecular biological techniques to study developmental and homeostatic regulation of gene expression in primarily mammalian systems. As evidence of the research strength of the group, faculty within the program are the

directors of four specialized centers of research at the university focusing on cancer, myocardial ischemia, hypertension, and atherosclerosis. Other faculty are directors of training grants for programs in pulmonary physiology, oncogenes, cardiovascular physiology, cellular and molecular pharmacology, hypertension, metabolic diseases, cell and molecular biology, genetics, digestive diseases, and cancer cell biology.

The graduate program in biomedical sciences is also designed to educate physician-scientists through the School of Medicine's Medical Scientist Training Program. Students already admitted to the School of Medicine are eligible for admission to our program for Ph.D. training. Such students generally apply in the first or second year of their medical studies and enter graduate studies following completion of their second year of medical school. Normative time for M.D./Ph.D. students is seven years.

Examinations

Students obtain letter grades in the program's basic courses. Candidacy for the Ph.D. degree is determined by a two-part examination. The first part, the minor proposition examination, tests the student's competence and ability to design a pertinent research problem in an area unrelated to his or her major interest. The second part, the major proposition examination, deals with the dissertation problem and should be completed between the spring of the third year and the beginning of the fourth year of residence in the program. After the preparation of the dissertation, an oral defense of the thesis completes the requirement for the Ph.D. degree.

COURSES

202. Carcinogenesis and Drug Metabolism (3)

This elective will explore relationships between drug metabolism and carcinogenesis at cellular, molecular and etiological levels. Guided by faculty, students will research and present key papers and principles underlying the biochemistry, genetics, biophysics, and computer-assisted aspects of several assigned topics. *Prerequisites:* biology and chemistry. Cell biology, biochemistry, and molecular biology may be taken concurrently

204. Evolution of Modern Concepts in Pharmacology (2)

This course details the evolution of modern principles of pharmacology from first evidences to the present level of knowledge. The course will be independent of but complement general principles of pharmacology courses for medical and graduate students. *Prere-*

quisites: prior or concurrent Principles of Pharmacology, or equivalent course.

206. Organ Physiology (9)

Building on the student's basic knowledge of cellular biology and biochemistry, this course develops fundamental concepts of organ physiology. Major areas include autonomic, cardiovascular, gastrointestinal, renal, and respiratory physiology. Clinical correlation sessions relate physiological principles to clinical situations. *Prerequisites:* BMS 210, 211, 212, 213 or equivalent background in biology and chemistry. For students not in the School of Medicine, consent of instructor. (W)

206L. Organ Physiology and Pharmacology, Laboratory Course (3)

Selected laboratory exercises demonstrating basic principles of pharmacology and organ physiology. Subjects covered include electrocardiography, hemodynamics, myocardial control mechanisms, pulmonary function, dose-response relationships in pharmacology, autonomic mechanisms, and other aspects of physiology and pharmacology. *Prerequisites:* cell biology and biochemistry or equivalent, and consent of instructor. (W)

207. Using Internet Resources in Molecular Biology (2)

Increasing the Internet is a source both of data and analysis tools in molecular biology. A hands-on series of instructional lectures is proposed that uses these resources to work through problems found in many molecular biology research situations. Topics include: DNA and protein sequence analysis, genome analysis, constructing and using phylogenetic trees, RNA structure prediction, protein structure, analysis, classification, and prediction. *Prerequisite:* consent of instructor.

208A-B. Topics in Medical Therapeutics (1-2)

Students attend pharmacology (medical therapeutics) lectures given in conjunction with those presented in core courses. Correlation with pathophysiology of diseases will be stressed including organ malfunction as causes of drug toxicity. Other topics will include chemotherapeutic agents and cardiovascular drugs. (W,S)

210. Cellular Biology (6)

The course focuses on fundamentals of the biology of eukaryotic cells. Topics include: Cell structure and cytoskeleton, biosynthesis of macromolecules, transport across cell membranes, receptors and signal transduction, regulation of the cell growth cycle, early development and differentiation. (F)

211. Molecular Biology (6)

The course covers concepts and techniques of molecular biology. Topics include: DNA and chromosome structuring, the eukaryotic genome, gene transcription units and their regulation, RNA processing, RNA and DNA viruses, development and methodologies of molecular biology. (W)

212. Cellular and Molecular Pharmacology (6)

Topics include: Analysis of ligand-macromolecule interactions, biochemistry and pharmacology of chemical transmission and signal transduction, cellular responses to environmental stress (cyto P-450, P-glycoprotein, etc.), and bases of selective toxicity (viruses, bacteria, insects, mammalian tumor cells). Emphasis is on basic principles, on analysis of recent experimental data, and on integration in mammalian systems. (W)

213. Systemic Physiology (6)

General principles of organ physiology including mass transport, tissue and fluid mechanics, membrane trans-

port, energetics, structure-function relations, and homeostasis applied to cardiovascular, gastrointestinal, muscle, renal, and respiratory systems. Emphasis on integrative properties of cells in organs and organismic responses. (F)

219. Ethics in Scientific Research (1)

Overview of ethical issues in scientific research, conflicts of interest, national, statewide and campus issues and requirements, ethical issues in publications, authorship, retention of research records, tracing of research records, attribution, plagiarism, copyright considerations primary, archival and meeting summary publications, ethical procedures and policies, NIH, NSF, California and UCSD, case studies and precedents in ethics. *Prerequisites:* permission of instructor. (S)

220A-B. Principles of Pharmacology (3)

Building on the student's knowledge in cell biology and biochemistry, this course examines the principles of pharmacology and therapeutics and relates them to clinical practice. The portion of the course given in the winter quarter is closely integrated with the organ physiology course. *Prerequisites:* same as 206. (W,S)

222. Essentials of Glycobiology (2)

Advanced elective for graduate/medical students who have had core courses in cell biology or biochemistry. Expert faculty will present a coordinated overview of the field of glycobiology, which explores the structure, synthesis and functions of sugar chains in biological systems.

223. Genetics, Metabolism, and Inherited Disease (2)

Detailed discussions of the molecular aspects of certain inborn errors of intermediary metabolism selected to illustrate principles of biochemical genetics applicable to a wider variety of clinically important genetic diseases. Individual sessions will include faculty presentations followed by student-led discussions of the particular principles illustrated by the disorders reviewed. (S)

224. Topics in Cancer Research (2)

Each quarter will focus on an important area of cancer research such as immunology (fall), growth regulation (winter), and cancer genetics (spring). One-hour lecture coordinated with a one-hour seminar with the opportunity to meet with the invited speaker. *Prerequisites:* senior undergraduates, graduate students, medical students. (W,S)

226. Frontiers in Endocrinology and Metabolism (3)

The course covers recent advances of research in lipid, lipoprotein metabolism, carbohydrate metabolism, reproductive medicine, diabetes mellitus, and atherosclerosis. (F)

228. Basic Science Research Seminar (1)

The objective is to provide an opportunity for cardiology research fellows, postgraduate students and undergraduate students to interact with faculty in the Division of Cardiology in a faculty-sponsored basic research seminar. This will take place once a month for ten sessions at a faculty member's home. It will be in the format of a journal club where a faculty member or a faculty-sponsored individual will present and discuss one recent article deemed to have considerable scientific importance. The content of the course will be determined by the faculty member who is assigned the session. *Prerequisite:* bachelor's degree in a science discipline. (F,W,S)

229. Methods in Pharmacology (3)

A combination of lecture and lab exercises presented by the faculty of the Group in Biomedical Sciences, designed to introduce biomedical science graduate students to the essential techniques employed in molecular and cellular pharmacology. *Prerequisites:* BMS 212, OP, CBB, biochemistry, molecular biology, biomedical sciences or consent of instructor. (S)

230. Receptors and Signal Transduction (3)

An examination of the molecular and biochemical bases of drug and neurotransmitter action. Topics include molecular basis of drug specificity, receptor mechanisms, neuropharmacology, signal transduction from the cell surface to the nucleus, and drug action on excitable tissues. *Prerequisite:* course in biochemistry. (F)

231. Contemporary Topics in Pharmacology (2)

A selection of short courses in the biomedical and pharmacological sciences offered by resident experts. Topics will vary annually. Each short course will last one to two weeks, meeting five hours a week. *Prerequisite:* consent of instructor. (F,W,S) (Not offered in fall 1997.)

233. Molecular Biology of Human Retroviruses (3)

Replication cycle and gene regulation of HIV. Molecular approaches to therapy and vaccines. *Prerequisites:* undergraduates lower-division courses in Biology, BIMM 100, BICD 100, BIBC 100, BIBC 102.

236. Maternal and Placental Physiology (2)

This course provides a broad based coverage of the physiology of maternal changes during pregnancy as well as physiology of the placenta. Included are endocrine, cardiovascular, respiratory, fluid balance, metabolism, nutrition, lactation, immune and postpartum aspects as well as problems of pregnancy. *Prerequisites:* Med. 206 (OPP) and Med. 209 (ERM), or equivalent. (F)

237. Fetal Physiology (2)

This course provides a broad based coverage of the physiology of the fetus, including growth and development, metabolism, neurologic and endocrine development, regulation of the cardiovascular, endocrine, renal, and gastrointestinal systems, development of the lungs, immune system, abnormal development genetic problems, and diseases. *Prerequisites:* same as 236. (W)

240. Critical Reading in Cell Biology (3)

This course will focus on critical reading and understanding current areas in Cell and Molecular Biology. The exact topic will vary, but will include such topics as Protein Trafficking, Cell Division, Intracellular Movement, Cell Interaction, and Cell Cycle.

242. Seminar in Genetics (1)

Intended for graduate students interested in principles of classical and molecular genetics. Will attend weekly genetics seminar and participate in didactic/discussion preparatory session. *Prerequisite:* consent of instructor.

243. Human Genetics (3)

Advanced aspects of human genetics and human genetics disease, including principles of Mendelian and non-Mendelian inheritance, monogenic and polygenic traits, anticipation, penetrance, and genomics. Course will consist of alternating didactic sessions and seminars in which students will present papers.

245. Cancer Genetics (3)

Intended for graduate students interested in genetics. Course will cover genetic basis for cancer related dis-

eases. *Prerequisites:* graduate-level course in cell biology and molecular biology.

250. Molecular and Modern Methodologies in Physiological Sciences (2)

This course emphasizes modern approaches and methodologies for investigating physiological processes in normal and pathological conditions. This includes the application of transgenic, knockout, adenovirus gene therapy, antisense, and cellular imaging technologies in animal models.

260. Immune Regulation (3)

This course will cover most of today's key aspects in the organization and dynamics of the immune system and its regulation. It will provide students with a basis for understanding the physiology and functioning of the immune system in normal and pathological states. *Prerequisites:* core courses in Biomedical Sciences Ph.D. Program, or permission of instructor.

262. Neurophysiology (4)

An overview of neurophysiological systems, emphasizing mammalian neurophysiology and related model vertebrate systems and concepts. (W)

264. Molecular and Cellular Basis of Disease (2)

Lectures on the molecular and cellular mechanisms of pathogenesis. Topics will include Alzheimer's disease, cell surface and unclear receptors in disease, signal transduction by oncogenes in cancer cells, AIDS, human diseases affecting glycosylation pathways, rheumatoid arthritis, and arteriosclerosis. *Prerequisite:* graduate students. (W)

271. Cardiovascular Physiology (4)

Physical concepts of behavior of heart, large blood vessels, vascular beds in major organs, and the microcirculation. Physical and physiological principles of blood flow, blood pressure, cardiac work, electrophysiology of the heart. Special vascular beds, including their biological and hemodynamic importance. Integration through nervous and humoral controls. *Prerequisites:* BIPN 100, 102 and BE 231A, or consent of instructor.

282. Microbial Pathogenesis (3)

Topics covered in this course include molecular and cellular mechanisms of viral, bacterial, and protozoan pathogenesis. Host response and microbial mechanisms of evasion of host defense will also be discussed. Sessions will consist of faculty and student presentations of current literature. *Prerequisite:* graduate standing or consent of instructor. (S)

285. Statistical Inference in the Medical Sciences (2)

An introduction to basic techniques used in biomedical literature: t tests, ANOVA, chi-square, linear and nonlinear regression. Emphasis will be on understanding the appropriate use and interpretation of the tests, rather than on the calculations.

294. Pharmacology and Molecular Biology Journal Club (0-1)

Current literature in molecular pharmacology and molecular biology is reviewed. Two papers are chosen per week for oral presentation by students. Faculty critique the student presentations. *Prerequisite:* enrollment in Ph.D. program at year two and above. (F,W,S)

295. Pharmacology Research Discussions (0-1)

Student, faculty, and fellow discussion groups on research projects. Students are expected to present research findings to fellows, other Ph.D. students, and faculty. Written critiques are provided by the faculty.

Prerequisites: completion of minor proposition examination and two years of graduate work. (F,W,S)

296. Directed Reading (1-4)

Reading of special topics under the direction of a faculty member. Exact subject matter to be arranged in individual cases. *Prerequisite: consent of instructor.*

297. Progress in Signal Transduction (1)

Papers describing recent progress in signal transduction from the cell-surface to the nucleus will be chosen from recent research literature. Two papers will be discussed and criticized in detail each week for one hour.

Prerequisites: graduate level Biochemistry, Cell Biology, and Molecular Biology; registered as second year and above graduate student in Biomedical Sciences, Biology, or Chemistry. (F,W,S)

298. Directed Study (1-12)

Reading and laboratory study of special topics under the direction of a faculty member. Exact subject matter to be arranged in individual cases. (F,W,S)

299. Independent Study or Research (1-12)

Independent study or research. *Prerequisite: consent of instructor. (F,W,S)*