

Biomedical Sciences

PROFESSORS

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Steven F. Dowdy, M.D., *Cellular and Molecular Medicine*
Mark H. Ellisman, Ph.D., *Neurosciences*
Scott D. Emr, Ph.D., *Cellular and Molecular Medicine*
Gregory F. Erickson, Ph.D., *Reproductive Medicine (Emeritus)*
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Sylvia Evans, Ph.D., *Pharmacy/Pharmacology*
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Ziwei Huang, Ph.D., *Pathology (Adjunct)*
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Thomas J. Kipps, M.D., Ph.D., *Medicine*
Richard Klemke, Ph.D., *Pathology*
Richard Kolodner, Ph.D., *Medicine*
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Ronald Kuczynski, Ph.D., *Psychiatry (In-Residence)*
Hyam L. Leftert, M.D., *Pharmacology*
Fred Levine, M.D., Ph.D., *Pediatrics (In-Residence)*
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Jamey D. Marth, Ph.D., *Cellular and Molecular Medicine*
James Andrew McCammon, Ph.D., *Chemistry and Biochemistry/Pharmacology*
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<http://biomedsci.ucsd.edu>

THE GRADUATE PROGRAM

The graduate program offered by the Group in Biomedical Sciences (BMS) is designed to lead to the Ph.D. students through a combination of didactic study, laboratory rotations, and thesis research in basic and translational biomedical sciences. Research opportunities in BMS span a wide spectrum of biological and medical sciences, permitting students the options of selecting molecular, cellular, organismal, and integrated systems approaches in their research projects. Students are encouraged to design and execute original and creative research in a self-critical and independent manner. Undergraduate preparation must include courses in mathematics (through calculus), chemistry (including organic, physical, and biochemistry), and preferably participation in research. Students whose undergraduate backgrounds are significantly different will be considered provided there is sufficient evidence of interest in cell and molecular biology, genetics, pathology, physiology, pharmacology, or other disciplines in biomedical sciences, and a strong commitment to enter a field of active research and academic excellence.

DOCTORAL DEGREE PROGRAM

During the first year, the students enroll in two core courses and specialized track courses in cell biology, molecular biology, pathology, pharmacology, physiology, genetics, and microbiology/immunology. 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. Students may differentiate into one of six advanced training tracks: genetics, microbiology/immunology, molecular cell biology, molecular pathology, molecular pharmacology, or physiology. Students can also associate with a number of focus groups in Cancer Biology, Stem Cell Biology, Developmental Biology, Bioinformatics, Neurobiology, Endocrinology, Glycobiology, and Structural-Chemical Biology. Required advanced courses and electives in subsequent years are chosen to develop students' interests and specialized knowledge in the thesis research area and chosen training tracks. BMS students are required to select their thesis advisors and begin their thesis research by the end of the first year in the program, the average matriculation time among BMS students is between five to six years. Besides course work and examinations, BMS students are required to assist in the teaching of undergraduate biology majors at UC San Diego for one academic quarter. The teaching requirement allows BMS students to learn and practice the skills of effective scientific communication, which is of critical importance to the career development of independent investigators in biomedical research.

The graduate program is interdepartmental and interdisciplinary; it includes faculty of the Departments of Cellular and Molecular Medicine, Medicine, Pathology, Pediatrics, Pharmacology, Neurosciences, Reproductive Medicine, Chemistry and Biochemistry, Biology, Bioengineering, Psychiatry, Orthopedics, Anesthesiology, the Moores UCSD Cancer Center, the Skaggs School of Pharmacy and Pharmaceutical Sciences, the Burnham Institute, and The Salk Institute.

The graduate program in biomedical sciences is also designed to educate physician-scientists through the School of Medicine's Medical Scientist Training Program, in conjunction with the School of Pharmacy and Pharmaceutical Sciences (SPPS). Students receive a Pharm.D./Ph.D. degree. Students already admitted to the School of Medicine and the SPPS are eligible for admission to the BMS program for Ph.D. training. Such students generally apply in the first or second year of their medical or pharmacy studies and enter graduate studies following completion of their second year of medical or pharmacy school. Normative time for M.D./Ph.D. or Pharm.D./Ph.D. students is seven years.

EXAMINATIONS

Students obtain letter grades in the core and track courses. Candidacy for the Ph.D. degree is granted following the successful completion of two research-oriented examinations. The first examination, the Research Proposition Exam, tests the student's preparation for his/her thesis research. Preparation for the Research Proposition Exam begins as soon as students join their thesis laboratories during the first summer quarter in the program. Students prepare a written research proposal and defend the proposal in an oral examination conducted by a program-approved exam committee. The second examination that determines the Advancement to Ph.D. candidacy takes place after the students finalize their thesis research plan, and should be completed by the end of the second summer quarter. Thereafter, the students' thesis research progress is reviewed annually by the thesis committee. The thesis committee also approves the final dissertation. After the preparation of the dissertation, a public oral defense of the thesis completes the requirement for the Ph.D. in biomedical sciences.

COURSES

For course descriptions not found in the UC San Diego General Catalog, 2010–11, please contact the department for more information.

200A. Molecules to Organisms: Concepts (6)

This course provides a systematic approach to current biomedical research, using analysis of selected topics to focus on the process of research discovery and its critical evaluation. The course progresses through five thematic modules that cover genes, building a cell, cellular responses, organogenesis, and the processes that allow survival in the world. **Prerequisite:** limited to BMS graduate students except by consent of instructor.

200B. Molecules to Organisms: Approaches (2)

Students will critically evaluate classic and current research papers in biomedical research, in addition to being exposed to state-of-the-art technologies in research. **Prerequisite:** limited to BMS graduate students except by consent of instructor.

201. Seminars in Biomedical Research (4)

This course includes attendance at seminars in the biomedical sciences and is designed to provoke critical discussion of the presented findings and scientific approaches in a small-group setting. **Prerequisite:** limited to BMS graduate students except by consent of instructor.

202. Carcinogenesis (3)

This elective will explore carcinogenesis at cellular, molecular, and etiological levels. Guided by faculty, students will research and present papers and principles underlying the biochemistry, genetic, biophysics, and computer-assisted aspects of several assigned topics. **Prerequisites:** Equivalent background in biology and chemistry. May be concurrent in biology, chemistry plus cell biology, biochemistry, molecular biology. Corequisites as above.

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 compliment general principles of pharmacology courses for medical and graduate students. **Prerequisite:** prior or concurrent Principles of Pharmacology, or equivalent course.

219. Ethics in Scientific Research (1)

Overview of ethical issues in scientific research, conflicts of interest; national, statewide and campus issues and requirement; 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. **Prerequisite:** consent of instructor.

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.

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:** limited to senior undergraduates, graduate students, and medical students. (W, S)

226. Hormone Action (3)

The course covers recent advances in research into hormone action, molecular endocrinology, lipid, lipoprotein, and carbohydrate metabolism, and reproductive medicine. **Prerequisites:** BIOM 200, 201. Limited to BMS graduate students, except by consent of instructor.

228. Modern Drug Discovery Technologies (2)

Drug discovery is an emerging science available to academic investigators. This course provides an overview of these drug discovery techniques, including high throughput screening, cell-based screening, computational methods of lead compound discovery, and chemical methods of optimization. **Prerequisite:** Graduate student status or consent of graduate program director.

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. Structural and Quantitative Pharmacology (4)

This course is essentially biophysical pharmacology. Two-thirds will be didactic, covering protein structure, thermodynamic stability, receptor-ligand binding, enzyme kinetics, biophysical methods, visualization of structures/docking, mathematical analysis of data. The last section will involve student presentations of topics in biophysical pharmacology. **Prerequisite:** knowledge of graduate or undergraduate biochemistry is recommended.

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)

232. In vivo Cellular and Molecular Imaging (1)

Strategies such as positron emission tomography, magnetic resonance imaging, and ultrasound for nondestructively imaging molecular and cell biological events inside living animals and eventually human patients. Emphasis on detecting angiogenesis, apoptosis, and expression of tumor-specific genes. **Prerequisites:** upper-division or graduate courses in molecular and cell biology.

233. Molecular Biology of Human Retroviruses (3)

Replication cycle and gene regulation of HIV. Molecular approaches to therapy and vaccines. **Prerequisites:** undergraduate lower-division courses in BMM 100.

234. Practical Histopathology and Mouse Models of Human Diseases (2)

The course is designed to introduce or reintroduce histology and histopathology of the various organ systems to those who need to analyze mouse tissues as an essential part of their research. **Prerequisites:** standard undergraduate biology courses.

235. Pharmacogenomics (3)

The pharmacogenetics course is designed to introduce graduate students, medical students, and pharmacy students to this emerging area of interest, indicating how hereditary mechanisms influence drug responses in humans. The lectures, examples, discussions, and journal presentations will provide the students with a working knowledge of the domains of pharmacology, how heredity influences any response traits, and the ways that advances in genome technologies support our emerging understanding of how polymorphic genetic variants determine inter-individual differences in drug responses. The course will include lectures, discussions, and journal article presentations by students. **Prerequisite:** admission to a UCSD graduate program, School of Medicine, or School of Pharmacy and Pharmaceutical Sciences.

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.

246. Current Literature in Glycobiology (1)

Informal presentations on topics of current interest in glycobiology as represented in the current scientific literature. **Prerequisite:** consent of instructor.

252. Genetics and Genomics (3)

This course will examine the basic principles of genetics and genomics. We will focus on classic discoveries and examples of approaches to current experimental problems. Emphasis areas will vary but general topics include Mendelian inheritance, imprinting, cytogenetics, genome structure, genetic variation, linkage and recombination, complex traits, statistical genetics, population genetics, genomic tools and methodology, medical genetics, model organisms. **Prerequisites:** BIOM 200, 201. Limited to BMS graduate students except by consent of instructor.

253. Pathogens and Host Defense (3)

This course will examine the innate and adaptive immune responses of humans to microbial infection. In parallel, we will explore the virulence mechanisms through which certain medically important viruses, bacteria, fungi, and parasites subvert host defense to produce infectious disease. Emphasis will be placed on basic molecular genetic and cellular approaches to understanding microbial pathogenesis and host susceptibility, including progress toward novel antibiotic and immune stimulatory therapies. **Prerequisites:** BIOM 200, 201.

254. Molecular and Cell Biology (3)

This course will examine the basic principles of molecular and cellular biology and their impact on medicine focusing on classic discoveries and examples of approaches to current experimental problems. Emphasis areas will vary but will include genes and genomics, chromosome biology and nuclear structure, transcriptional regulation, RNA processing, cell cycle control, cell growth and death, cell differentiation and stem cell biology, molecular motors and motility, membrane trafficking and signaling. **Prerequisites:** BIOM 200, 201. Limited to BMS graduate students except by consent of instructor.

255. Drugs and Disease (3)

Examines physiological and pathological basis for diseases by exploring normal and dysregulated molecular mechanisms controlling tissue and organ functions. Considers how alterations can be translated into therapeutic interventions and probe unexplored questions regarding human disease etiology and novel drug targets. **Prerequisites:** BIOM 200A-B, 201. Limited to BMS graduate students except by consent of instructor (BS 75, BS 77).

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 consent 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 nuclear receptors in disease, signal transduction by oncogenes in cancer cells, AIDS, human diseases affecting glycosylation pathways, rheumatoid arthritis, and arteriosclerosis. **Prerequisite:** graduate students. (W)

266. Environmental and Molecular Toxicology (4)

Molecular and cellular mechanisms underlie the actions of environmental toxicants. This course will investigate approaches to study the impact of environmental toxicants on human health. Other modern approaches that are being implemented to detect and remediate environmental toxicants will also be examined. BGGN 256, BIOM 266 and Chem. 266 students will be required to complete an additional paper and/or exam beyond that expected of students in Chem. 166 and BMM 166. **Prerequisites:** Chem. 114A and 114B required for Chem. 166 and BIBC 100 and BIBC 102 required for BMM 166. (S)

272. Seminars in Genetics (2)

This course includes attendance at seminars in genetics and is designed to provoke critical discussion of the presented findings and scientific approaches in a small group setting. **Prerequisite:** limited to BMS graduate students except by consent of instructor.

273. Seminars in Microbiology (2)

This course includes attendance at seminars in microbiology and is designed to provoke critical discussion of the presented findings and scientific approaches in a small group setting. **Prerequisite:** limited to BMS graduate students except by consent of instructor.

274. Seminars in Molecular and Cell Biology (2)

This course includes attendance at seminars in molecular and cell biology and is designed to provoke critical discussion of the presented findings and scientific approaches in a small group setting. **Prerequisite:** limited to BMS graduate students except by consent of instructor.

275. Seminars in Pharmacology (2)

This course includes attendance at seminars in pharmacology and is designed to provoke critical discussion of the presented findings and the scientific approaches in a small group setting. **Prerequisite:** limited to BMS graduate students except by consent of instructor.

276. Seminars in Physiology (2)

This course includes attendance at seminars in physiology and is designed to provoke critical discussion of the presented findings and scientific approaches in a small group setting. **Prerequisite:** limited to BMS graduate students except by 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)

283 Supramolecular Structure Determination Laboratory (4)

A laboratory course combining hands-on mass spectrometry and bioinformatics tools to explore the relationship between structure and function in macromolecules. Tools for peptide sequencing, analysis of post-translational modification, and fragmentation analysis by mass spectrometry are examples of experiments students will run. (F,W,S) **Prerequisite:** consent of instructor.

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.

287. Tissue Engineering Laboratory (4)

Students will learn to conduct tissue engineering and developmental biology experiments, microfabricate cell culture systems, engineer biopolymer materials, and develop and analyze quantitative models of transport, cell fate, and growth mechanics. The understanding and manipulation of multi-cellular processes that comprise development and growth involves specialized areas of biomechanics, developmental biology, biomaterials, and the tools of molecular biology, as well as the integration of theory and experiment. To fabricate functional tissues, it is important to establish underlying molecular and physical mechanisms, and then control and integrate these. (F,W,S) **Prerequisite:** consent of instructor.

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)