

MOLECULAR AND CELLULAR PHYSIOLOGY

Emeriti: (Professor) Julian M. Davidson

Chair: W. James Nelson

Professors: Richard W. Aldrich, Axel Brunger, W. James Nelson, Richard H. Scheller, Stephen J. Smith, Richard W. Tsien

Associate Professors: Brian K. Kobilka, Richard S. Lewis, V. Daniel Madison, Thomas L. Schwarz, William Weis

Courtesy Professor: Jeffrey J. Wine

Courtesy Associate Professor: Anson W. Lowe

Courtesy Assistant Professor: Michael McConnell

The Department of Molecular and Cellular Physiology is located in the Beckman Center for Molecular and Genetic Medicine.

The creation and growth of the department is a reflection of the rapid development of the field of cellular signaling as it relates to intracellular, and interorgan communication. The faculty have common interests in cellular signaling, with a special focus on molecular mechanisms controlling: synaptic transmission and memory; regulation of vesicle trafficking and targeting in neurons and epithelia; structure/function analysis of G protein coupled receptors, potassium and calcium channels; calcium signaling in activated T lymphocytes; cell-cell interactions in epithelia and neuromuscular junctions; and structural and functional polarity in neurons and epithelia. The research programs draw on a wide range of techniques including biochemistry, cell biology, electrophysiology, imaging with light or electron microscopy, and molecular genetics. The department teaches physiology to medical and graduate students.

GRADUATE PROGRAMS

The department offers required and elective courses for students in the School of Medicine and is also open to other qualified students with the consent of the instructor. Training of medical, graduate, and postdoctoral students is available. The program offers a course of study leading to the Ph.D. degree. No B.S. is offered, and an M.S. is offered only in the unusual circumstance where a student completes the course work, rotation, and the written section of the qualifying exam, but is unable to complete the requirements for the Ph.D.

DOCTOR OF PHILOSOPHY

Students with undergraduate or master's degrees who have completed a year each of college chemistry (including lectures in organic and physical chemistry), physics, calculus, and biology are considered for admission to graduate study. Applicants submit a report of scores from the Graduate Record Examination (verbal, quantitative, analytical, and an advanced subject test in one of the sciences) as part of the application.

Students who do not speak English as their native language must submit scores from TOEFL unless waived by Graduate Admissions, the Registrar's Office.

Study toward the Ph.D. is expected to occupy five years, including summers. A minimum of seven quarter-long courses are required. Students must take Molecular and Cellular Physiology 210, and a choice of two out of these three: Neurobiology 200, Biochemistry 200-201, or Molecular and Cellular Physiology 221. Students are also required to take the Molecular and Cellular Physiology seminar series. At least three of the student's courses must be more focused, advanced, graduate-level courses in areas such as molecular and cellular physiology, cellular signaling, cell biology, or pharmacology. Each student presents a journal club to the department at least every other year, starting their second year. Acceptable grades for all course work must be a minimum of 'B-', and at least two grades equal to 'A-' or above are necessary (but not sufficient) for continuation in the program.

Qualifying Examination—At the end of the second year in residence as a graduate student, each Ph.D. candidate presents a written thesis proposal to be defended at an oral comprehensive examination. General

knowledge of relevant physiology is also tested orally at a separate examination. The examinations may be taken only after all course work has been completed by the required standard. Students undertake individual research studies as early as possible after consultation with their preceptor. Upon passing this exam, the student is advanced to candidacy for the Ph.D.

Dissertation and University Oral Examination—The results of independent, original work by the students are presented in a dissertation. The oral examination is largely a defense of the dissertation.

Advisers and Advisory Committees—A graduate advisory committee, currently Professors Madison, Schwarz, and Smith, advises students during the period before the formation of their qualifying committees.

Financial Aid—Students may be funded by their advisers' research grants, by future training grants, by department funds, or by extramural funds. Students are encouraged to obtain funding from outside sources (for example, NIH, NSF, Hughes, and so on).

COURSES

Course work and lab instruction in the Department of Molecular and Cellular Physiology conform to the Policy on the Use of Vertebrate Animals in Teaching Activities as stated in the front of this catalog.

199. Undergraduate Research—Investigation sponsored by individual faculty members, available to undergraduates, hours and units arranged. Fields of research open to students are decided in consultation with sponsoring faculty member.

any quarter (Staff)

200. Physiology: Cardiovascular—Offered jointly with the Department of Medicine. Lectures, small group instruction, clinical presentations, and lab demonstrations of normal and disordered human cardiovascular physiology. Prerequisite: understanding of general biochemistry.

6 units, Spr (Schwarz)

201. Physiology: Endocrine—Offered jointly with the Department of Medicine. Lectures, clinical presentations, and demonstrations on normal and disordered function in the endocrine system. Prerequisite: understanding of general biochemistry.

4 units, Win (Hoffman, Scheller)

202,203,204. Physiology: 202-Gastrointestinal; 203-Renal; 204-Respiratory—Offered jointly with the Department of Medicine. Lectures, clinical presentations, and demonstrations on normal and disordered function in the respiratory, renal, fluid and electrolyte, and acid-base systems. Prerequisite: understanding of general biochemistry.

6 units, Aut (202, 1 unit; 203, 3 units; 204, 2 units)

(Gastrointestinal: Lowe; Renal: Meyer; Respiratory: Raffin)

206. Pathophysiology—Offered jointly with the Department of Medicine. The physiology of disease, emphasizing clinical situations where two or more organ systems come together at the molecular, cellular, and organ level. The physiology of individual organ systems and the genetics and physiology of diseases such as cystic fibrosis, muscular dystrophy, and hypertension.

2 units, Win (Tsien)

210. Principles of Cell Physiology—Required for all MCP graduate students; open to graduate, medical, and advanced undergraduate students (with consent of instructor). Examines the basic biophysical principles that govern cell physiology and applies these principles to aid in understanding a wide range of physiological processes. Energy transduction, diffusion, membrane properties, and electrical potentials and gradients are discussed and related to current problems in ionic and electrical signaling, solute and solvent transport and cellular homeostasis. Lecture/discussions introduce basic concepts; students use these principles to solve specific physiological problems.

4 units, Spr (Aldrich, Lewis)

213. Special Topics in Molecular and Cellular Physiology—Seminar of guided reading/discussion in introductory and advanced physiological topics agreed on by an individual instructor and interested students. Prerequisite: consent of instructor.

(Staff)

215. Synaptic Transmission—Primarily for graduate students with an interest in synaptic function; interested medical students and advanced undergraduates may enroll. The anatomical, physiological, and biochemical basis of synaptic function in the peripheral and central nervous system. Lectures and discussions of relevant research papers.

5 units, Aut (Smith, Schwarz, Madison)

alternate years, not given 2000-01

216. Ion Channels and Membrane Physiology—(Same as Neurobiology 216.) For students with some background in neurobiology who wish to learn the basic mechanisms of signaling in nerve cells. Reading/discussion of original research papers, emphasizing concepts, quantitative analysis of experimental results, and critical evaluation of evidence. Topics: gating mechanisms in voltage sensitive and chemosensitive ion channels and ionic mechanisms in sensory transduction. Student presentations and small group discussions.

3 units (Aldrich, Baylor) alternate years, not given 2001-02

218. Transmembrane Signal Transduction—The molecular mechanisms of signal transduction for a variety of structurally and functionally different plasma membrane receptors. Topics: the structure of receptors and the interaction of the receptor protein with the lipid bilayer; ligand binding and ligand mediated changes in receptor structure; and cytosolic, cytoskeletal, and membrane proteins that interact with receptors. Seminar/discussion emphasizes recent research developments and examines the value of various experimental approaches for the study of receptors.

2 units, Win (Kobilka)

221. Cell Biology of Physiological Processes—(Same as Biological Sciences 214.) The basic mechanisms of membrane and cellular biogenesis in relation to physiological processes. Emphasis is on the regulatory and signaling mechanisms involved in coordinating complex cellular phenomena, such as cellular organization, function, and differentiation. Topics: cellular compartmentalization, transport and trafficking of macromolecules, organelle biogenesis, cell division, motility and adhesion, and multicellularity. Must be taken concurrently with 214A-H. Prerequisites: Biological Sciences core, Biochemistry 201.

4 units, Win (Rexach, Nelson, Frydman, Jackson, Theriot, Fang)

222. Imaging: Biological Light Microscopy—Survey of instruments which use light and other radiation for analysis of cells in biological and medical research. Topics: basic light microscopy through confocal fluorescence and video/digital image processing. Lectures on physical principles; involves partial assembly and extensive use of lab instruments. Lab. Prerequisites: some college physics, Biological Sciences core.

3 units, Spr (S. Smith)

299. Directed Reading—Prerequisite: consent of instructor.

any quarter (Staff)

399. Advanced Research—Investigation sponsored by individual faculty members undertaken by interested, qualified medical or graduate students. Research fields include endocrinology, neuroendocrinology, and topics in molecular and cellular physiology.

any quarter (Staff)