MOLECULAR AND CELLULAR PHYSIOLOGY

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Courses given in Molecular and Cellular Physiology have the subject code MCP. For a complete list of subject codes, see Appendix B.

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

A central goal of physiology in the post-genomic era is to understand how thousands of encoded proteins serve to bring about the highly coordinated behavior of cells and tissues. Research in the department approaches this goal at many levels of organization, ranging from single molecules and individual cells to multicellular systems and the whole organism. The faculty share common interests in the molecular mechanisms of cell signaling and behavior, with a special focus on structure/function analysis of ion channels and G-protein coupled receptors, and their roles at the cellular, organ, and whole-organism levels; the molecular basis of sensory transduction, synaptic transmission, plasticity and memory; the role of ion channels and calcium in controlling gene expression in neural and immune cells; and the regulation of vesicle trafficking and targeting, cell polarity, and cell-cell interactions in the nervous system and in epithelia. Research programs employ a wide range of approaches, including molecular and cell biology, biochemistry, genetics, biophysics, x-ray crystallography and solution NMR, electrophysiology, and *in vitro* and *in vivo* imaging with confocal and multi-photon microscopy.

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 six quarter-long courses are required. These include four graduate-level courses (200-300 series) and a choice of two out of these three courses: MCP 221, MCP 255, and MCP 256. Students are also required to take the Molecular and Cellular Physiology seminar/Research In Progress series. Each student presents a talk on research in progress 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. 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 Lewis and Aldrich, advises students during the period before the formation of their qualifying committees.

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

COURSES

Course and lab instruction in the Department of Molecular and Cellular Physiology conforms to the "Policy on the Use of Vertebrate Animals in Teaching Activities," the text of which is available at http://www.stanford.edu/dept/DoR/rph/8-2.html.

MCP 100Q. The Hippocampus as a Window to the Mind—Stanford Introductory Seminar. Preference to sophomores.
3 units, Spr (Madison)

MCP 199. Undergraduate Research—Fields of research open to students decided in consultation with sponsoring faculty member.
1-18 units, Aut, Win, Spr, Sum (Staff)

MCP 200-204. Physiology—Offered jointly with the Department of Medicine. Lectures, small group instruction, clinical presentations, and lab demonstrations of normal and disordered human cardiovascular physiology, normal and disordered function in the endocrine, respiratory, renal, fluid and electrolyte, and acid-base systems. Prerequisite: understanding of general biochemistry.

MCP 200. Cardiovascular Physiology
6 units, Spr (Kobilka)

MCP 201. Endocrine Physiology
1-4 units, Win (Hoffman)

MCP 202. Gastrointestinal Physiology
1-3 units (Lowe)

MCP 203. Renal Physiology
1-3 units (Meyer)

MCP 204. Respiratory Physiology
1-2 units (Kao, Peter)

MCP 213. Special Topics in Molecular and Cellular Physiology—Seminar. Introductory and advanced physiological topics agreed on by an individual instructor and interested students. Prerequisite: consent of instructor.
1-18 units (Staff)

MCP 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. Relevant research papers.

5 units, Aut (Smith, Madison)

MCP 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. Recent research developments and the value of experimental approaches for the study of receptors.

2 units, Win (Kobilka)

MCP 221A,C,E,F,G,H. Cell Biology of Physiological Processes Discussion—Required course taken with 221, taught by medical school faculty, to expand on the topics covered in 221. Students register for only one section. Prerequisites: Biological Sciences core, BIOCHEM 201.

2 units, Win (Staff)

MCP 222. Imaging: Biological Light Microscopy—(Same as BIOSCI 152.) 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, Meyer)

MCP 255. Molecular Physiology of Membranes—Recommended for all MCP graduate students; open to graduate and medical students; advanced undergraduates with consent of instructor. Structure and mechanisms of the molecules underlying transmembrane processes. Topics include structure of membrane proteins, energetics of membranes, transmembrane signaling (receptors and channels), transport (transporters and pumps), single molecule methods and theory, and membrane complexes. Lectures introduce concepts; student activities and small group discussion emphasize application of concepts to research the literature. Recommended: BIOC/SBIO 214 or equivalent.

4 units, Win (Maduke, Aldrich)

MCP 256. Molecular Physiology of Cells—Recommended for all MCP graduate students; open to graduate and medical students; advanced undergraduates with consent of instructor. Dynamic aspects of cell function, including cellular energetics, gas exchange, solute transport, absorption and secretion in epithelia, ionic and electrical signaling in nerve and muscle, and sensory physiology. Emphasis is on the cellular function of ion channels and transporters, joining experimental and analytical approaches. Lectures, in-class readings, discussions, student presentations, and the use of mathematical models of cell function. Recommended: MCP 255; basic cell and molecular biology.

4 units, Spr (Lewis, Goodman)

MCP 299. Directed Reading—Prerequisite: consent of instructor. See faculty list for section numbers.

1-18 units, Aut, Win, Spr, Sum, by arrangement

MCP 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.

1-18 units, Aut, Win, Spr, Sum (Staff)

MCP 459. Frontiers in Interdisciplinary Biosciences—(Crosslisted in multiple departments in the schools of Humanities and Sciences, Engineering, and Medicine. Students should enroll through their affiliated department; otherwise enroll in CHEMENG 459.) See CHEMENG 459 or http://biox.stanford.edu/chemeng_index.html for description.

1 unit, Aut, Win, Spr (Robertson)