MOLECULAR AND CELLULAR PHYSIOLOGY

Courses offered by the Department of Molecular and Cellular Physiology are listed under the subject code MCP on the Stanford Bulletin's ExploreCourses web site .

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 in Molecular and Cellular Physiology

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 in Molecular and Cellular Physiology

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.

Study toward the Ph.D. is expected to occupy five years, including summers. The course requirements for the program are as follows:

- MCP 221 Advanced Cell Biology
- MCP 207 MCP Bootcamp
- MCP 256 How Cells Work: Energetics, Compartments, and Coupling in Cell Biology
- BIOS 200 Foundations in Experimental Biology
- Advanced graduate courses or mini-courses for a minimum of 6 units total. These courses do not need to be MCP courses but must be in relevant scientific topic and approved by the Director of Graduate Studies.
- Two of the following courses:
  - BIOC 241 Biological Macromolecules
  - GENE 205 Advanced Genetics
  - MCP 222 Imaging: Biological Light Microscopy
  - MED 255 The Responsible Conduct of Research, if funded on NSF or NIH training grants

Students are also required to participate in the Molecular and Cellular Physiology Seminar Series and attend the department scientific meeting. Grades for course work and mini-courses must be a minimum of 'B', and students must maintain a grade point average (GPA) of at least 3.3 for their required courses as a whole. Courses may be retaken once to improve an unsatisfactory grade. Failure to maintain the required grades and grade point average ia taken as evidence of unsatisfactory progress in the program.

Qualifying Examination

At the beginning 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 examination should be taken prior of all course work 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 Feng, Lewis, Nachury and Madison, 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 such as NIH and NSF.

Chair: Axel T. Brunger

Professors: Axel T. Brunger, K. Christopher Garcia, Miriam B. Goodman, Brian K. Kobilka, Richard S. Lewis, Thomas C. Sudhof

Associate Professors: V. Daniel Madison, Merritt C. Maduke

Assistant Professors: Liang Feng, Maxence V. Nachury, Lucy E. O'Brien

Joint Professors: Steve Chu, W. James Nelson, William Weis

Courtesy Professors: John Huguenard, Beth Pruitt, Anthony J. Ricci

Courtesy Associate Professor: Ron Dror, Michael McConnell, Richard J. Reimer

Courtesy Assistant Professor: Gregory Scherrer

Emeritus Faculty: Stephen J. Smith, Richard W. Tsie

Courses

MCP 126. Neurons and Disease. 4 Units.
Diseases of the nervous system. First lecture of each week focuses on the clinical, epidemiological and behavioral aspects of a selected disease or syndrome. Second lecture exposes the cell biological, electrophysiological, biochemical and/or molecular biological processes that underlie each disease presented. Instructors maintain some flexibility in the diseases chosen for elucidation, but students can expect those covered to range from the relatively straightforward, for example Multiple Sclerosis (MS) or Amyotrophic Lateral Sclerosis (ALS), to the more complex, for example, Schizophrenia or Obsessive Compulsive Disorder (OCD). Prerequisite: Biology or Human Biology core.

MCP 156. How Cells Work: Energetics, Compartments, and Coupling in Cell Biology. 4 Units.
Open to graduate and medical students, and advanced undergraduates. Dynamic aspects of cell behavior and function, including cellular energetics, homeostasis, heterogeneity of membranes, structure and function of organelles, solute and water transport, signaling and motility. Emphasis is on the principles of how coupling of molecular processes gives rise to essential functions at the cellular level. Mathematical models of cell function. Student presentations.
Same as: MCP 256

MCP 199. Undergraduate Research. 1-18 Unit.
Students undertake investigations sponsored by individual faculty members. Prerequisite: consent of instructor.

MCP 202. Advanced Immunology II. 3 Units.
Readings of immunological literature. Classic problems and emerging areas based on primary literature. Student and faculty presentations. Prerequisite: IMMUNOL 201/MI 211.
Same as: IMMUNOL 202

MCP 207. MCP Bootcamp. 3 Units.
Hands-on, week-long immersion in methods and concepts related to the physiology of cell signaling. Required of all first-year MCP students; other PhD students may enroll with consent of instructor.

MCP 221. Advanced Cell Biology. 4 Units.
For Ph.D. students. Current research on cell structure, function, and dynamics. Topics include complex cell phenomena such as cell division, apoptosis, compartmentalization, transport and trafficking, motility and adhesion, and differentiation. Weekly reading of current papers from the primary literature. Preparation of an original research proposal. Prerequisite for advanced undergraduates: BIO 129A,B, and consent of instructor.
Same as: BIO 214, BIOC 224

MCP 222. Imaging: Biological Light Microscopy. 3 Units.
Biological light microscopy: from theory to practice. This intensive laboratory and lecture course will provide participants with the theoretical and practical knowledge to utilize emerging imaging technologies. Students will learn the principles of light microscopy, as well as use of different types of cameras, laser scanning systems, functional fluorophores, probe delivery techniques. Topics include microscope optics, resolution limits, Koehler illumination, confocal fluorescence, two-photon, TIRF, FRET, photobleaching, super-resolution (SIM, STED, STORM/PALM), and live-cell imaging and cell tracking approaches. Discussion of physical principles; involves partial assembly and extensive use of lab instruments. Lab. Prerequisites: some college physics.
Same as: BIO 152, CSB 222

MCP 256. How Cells Work: Energetics, Compartments, and Coupling in Cell Biology. 4 Units.
Open to graduate and medical students, and advanced undergraduates. Dynamic aspects of cell behavior and function, including cellular energetics, homeostasis, heterogeneity of membranes, structure and function of organelles, solute and water transport, signaling and motility. Emphasis is on the principles of how coupling of molecular processes gives rise to essential functions at the cellular level. Mathematical models of cell function. Student presentations.
Same as: MCP 156

MCP 287. Connectomes. 1-3 Unit.
(Same as PSYCH 287) Neural circuitry can be measured over a huge range of spatial scales, from sub-synaptic to whole brain connectomes. The methods used to measure these scales differ enormously, and scientists working at one scale should be able to understand and communicate with those measuring at other scales. Reviews methods, principal results, and ideas for integrating findings across scales by large-scale computation modeling.

MCP 299. Directed Reading in Molecular and Cellular Physiology. 1-18 Unit.
Prerequisite: consent of instructor.

MCP 300. Neuroscience Journal Club and Professional Development Series. 1-2 Unit.
Neuroscience Journal Club and Professional Development Series New description: Required of Neurosciences Ph.D. students in Autumn, Winter, and Spring of the first three years of study. Recent papers in neuroscience literature presented by graduate student.
Same as: NEPR 280

MCP 370. Medical Scholars Research. 4-18 Units.
Provides an opportunity for student and faculty interaction, as well as academic credit and financial support, to medical students who undertake original research. Enrollment is limited to students with approved projects.

MCP 399. Graduate Research. 1-18 Unit.
Students undertake investigations sponsored by individual faculty members. Research fields include endocrinology, neuroendocrinology, and topics in molecular and cellular physiology. Prerequisite: consent of instructor. (Staff).

MCP 801. TGR Project. 0 Units.
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MCP 802. TGR Dissertation. 0 Units.
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