BIOCHEMISTRY

Emeriti: (Professors) Robert L. Baldwin, Paul Berg, David S. Hogness, Arthur Kornberg, A. Dale Kaiser, I. Robert Lehman
Chair: Mark A. Krasnow
Professors: Patrick O. Brown, Douglas L. Brutlag, Gilbert Chu, Ronald W. Davis, James E. Ferrell, Jr., Daniel Herschlag, Mark A. Krasnow, Suzanne R. Pfeffer, James A. Spudich
Associate Professors: Pehr A. B. Harbury, Julie A. Theriot
Assistant Professor: Aaron F. Straight
Courtesy Professors: Chaitan S. Khosla, Sharon Long
Department Offices: Beckman Center, B400
Mail Code: 94305-5307
Phone: (650) 723-6161
Web Site: http://biochemistry.stanford.edu/

Courses given in Biochemistry have the subject code BIOC. For a complete list of subject codes, see Appendix.

Biochemistry is a department within the School of Medicine, with offices and labs located in the Beckman Center for Molecular and Genetic Medicine at the Stanford Medical Center. Courses offered by the department may be taken by undergraduate, graduate, and medical school students.

Advanced courses are offered in more specialized areas and they emphasize the most recent developments in biochemistry, cell biology, and molecular biology. These courses include the physical and chemical principles of biochemistry, enzyme reaction mechanisms, membrane trafficking and biochemistry, molecular motors and the cytoskeleton, mechanisms and regulation of nucleic acid replication and recombination, the biochemistry of bacterial and animal viruses, the molecular basis of morphogenesis, the molecular and cell biology of yeast, and the structure and function of both eukaryotic and prokaryotic chromosomes.

Opportunities exist for directed reading and research in biochemistry and molecular biology, utilizing the most advanced research facilities, including those for light and electron microscopy, chromatography and electrophoresis, protein and nucleic acid purification, rapid kinetic analysis, synthesis and analysis, single molecule analyses using laser light traps, microarray generation and analysis and computer graphic workstation facilities for protein and nucleic acid structural analysis. Ongoing research utilizes a variety of organisms, from bacteria to animal cells.

GRADUATE PROGRAM

DOCTOR OF PHILOSOPHY

Requirements for the M.S. and Ph.D. degrees are described in the "Graduate Degrees" section of this bulletin. The department does not offer undergraduate degrees.

The Department of Biochemistry offers a Ph.D. program which begins in the Autumn Quarter of each year. The program of study is designed to prepare students for productive careers in biochemistry; its emphasis is training in research, and each student works closely with members of the faculty. In addition to the requirement for a Ph.D. dissertation based on original research, students are required to complete six advanced courses in biochemistry and related areas. Selection of these courses is tailored to fit the background and interests of each student. A second requirement involves the submission of two research proposals which are presented by the student to a small committee of departmental faculty members who are also responsible for monitoring the progress of student curricular and research programs, and a journal club presentation. All Ph.D. students are expected to participate actively in the department's seminar program, and students are encouraged to attend and to present papers at regional and national meetings in cellular biochemistry and molecular biology. Teaching experience is an integral part of the Ph.D. curriculum and is required for the degree.

The Department of Biochemistry offers an M.S. degree only to students already enrolled in the Ph.D. program. Students should contact the Graduate Studies adviser for more details.

Those applying for graduate study should have at least a baccalaureate degree and should have completed work in cell and developmental biology, basic biochemistry and molecular biology, and genetics. Also required are: at least one year of university physics; differential and integral calculus; and analytical, organic, inorganic, and physical chemistry. The department is especially interested in those applicants who have research experience in biology or chemistry. Students must submit an application, including transcripts and letters of recommendation, by December 12.

Applications should be submitted at http://gradadmissions.stanford.edu/. Applicants are notified by March 24 of decisions on their applications. Stanford University requires scores from the Graduate Record Examination (GRE) (verbal, quantitative, and analytical), and applicants are encouraged to submit scores from the GRE Subject Test in either biochemistry, biology, or chemistry. Applicants should take the October GRE exam.

All applicants are urged to compete for non-Stanford fellowships or scholarships, and U.S. citizens should complete an application for a National Science Foundation Predoctoral Traineeship. Students are provided with financial support to cover normal living expenses; Stanford tuition costs are paid.

Applicants for admission to the department are considered without regard to race, color, creed, religion, sex, age, national origin, or marital status.

Postdoctoral research training is available to graduates who hold a Ph.D. or an M.D. degree. Qualified individuals may write to individual faculty members for further information.

At present, the primary research interests of the department are the structure and function of proteins and nucleic acids, the biochemistry and control of development processes, molecular motors and the cytoskeleton, the trafficking of proteins between membrane-bound organelles, the control and regulation of gene expression, bioinformatics/protein structure design, and the application of microarrays to problems in human health and disease.

COURSES

BIOC 118Q. Genomics and Medicine—Stanford Introductory Seminar. Preference to sophomores. Knowledge gained from sequencing the human genome and the implications of such knowledge for medicine and biomedical research. Novel diagnostic methods and treatment of diseases, including gene therapy and drug design. Ethical implications of genetic information. Use of genome and disease databases to determine the function of genes involved in disease. See http://biochem118.stanford.edu/. Recommended: BIOSCI 42 or HUMBIO 2A. GER:DB-EngrAppSci
3 units, Spr (Brutlag, D)

BIOC 199. Undergraduate Research—Allows for qualified students to undertake investigations sponsored by individual faculty members. Prerequisite: consent of instructor.
1-18 units, Aut, Win, Spr, Sum (Staff)

BIOC 201. Advanced Molecular Biology—Literature-based lectures and discussion on rapidly developing frontiers in chromosome structure and function and modern insights into the control of gene expression. Emphasis on experimental approaches and insights that have lead to breakthroughs. Topics include chromosome organization, novel modes of transcriptional control, RNA based mechanisms for controlling gene expression and emerging translational regulatory mechanisms. Prerequisite: Undergraduate Molecular Biology.
5 units, not given this year

BIOC 202. Metabolic Biochemistry: Structure, Metabolism, and Energetics—(Review course for medical students only.) Structure and function of biological molecules, enzyme kinetics and mechanisms, bioenergetics, pathways of intermediary metabolism and their control, and membrane structure and function. Course offered via online lectures and problem sets, with weekly small-group review sessions.
1-3 units, Aut (Brutlag, D)

BIOC 205. Molecular Foundations of Medicine—Topics include: DNA structure, replication, repair, and recombination; chromosome structure and function; gene expression including mechanisms for regulating transcription and translation; and methods for manipulating DNA, RNA, and proteins. Patient presentations illustrate how molecular biology affects the practice of medicine.

3 units, Aut (Brown, P; Chu, G; Krasnow, M)

BIOC 210. Advanced Topics in Membrane Trafficking—The structure, function, and biosynthesis of cellular membranes and organelles. Current literature. Prerequisite: consent of instructor.

3 units, not given this year

BIOC 214. Physical and Chemical Principles of Enzyme Function—Enzymatic mechanisms, with emphasis on the fundamental behavior of biochemical systems and the properties that emerge due to the complex nature of these systems. Student presentations on specific enzymes based on classic and current literature, developed in consultation with the instructor. Prerequisites: BIOC/SBIO 241 and a course in organic chemistry.

3-5 units, not given this year

BIOC 215. Frontiers in Biological Research—(Same as DBIO 215, GENE 215.) Literature discussion in conjunction with the Frontiers in Biological Research seminar series hosted by Biochemistry, Developmental Biology, and Genetics in which distinguished investigators present current work. Students and faculty meet beforehand to discuss papers from the speaker's primary research literature. Students meet with the speaker after the seminar to discuss their research and future direction, commonly used techniques to study problems in biology, and comparison between the genetic and biochemical approaches in biological research.

1 unit, Aut (Harbury, P; Brunet, A; Kingsley, D),
Win (Kingsley, D; Harbury, P; Brunet, A)

BIOC 217. Advanced Tutorial in Special Topics—Readings and tutorial in membrane biochemistry, enzyme mechanisms, chromosome structure, biochemical genetics, bacterial and animal viruses, and nucleic acid enzymology. Conducted by advanced graduate students and postdoctoral fellows.

1-3 units, Aut, Win, Spr (Staff)

BIOC 218. Computational Molecular Biology—For molecular biologists and computer scientists. Major issues, existing methods, and future directions concerning biological sequences and structure. Topics: accessing molecular databases, pattern search, classification of sequence and structure, alignment of sequences, rapid similarity searching, phylogenies, automated pattern learning, representing protein structure, gene expression profiling, clustering expressed genes, and discovering transcription factor binding sites. Lecture/lab. Final project. Via internet; see http://biochem218.stanford.edu. Enrollment limited to 40. Prerequisite: BIOSCI 52 or equivalent, or consent of instructor.

3 units, Win (Brutlag, D)

BIOC 220. Chemistry of Biological Processes—(Same as MPHA 220.) The principles of organic and physical chemistry as applied to biomolecules. Goal is a working knowledge of chemical principles that underlie biological processes, and chemical tools used to study and manipulate biological systems. Prerequisites: organic chemistry and biochemistry, or consent of instructor.

4 units, Aut (Wandless, T; Herschlag, D; Chen, J; Bogyo, M)

BIOC 221. The Teaching of Biochemistry—Required for teaching assistants in Biochemistry. Practical experience in teaching on a one-to-one basis, and problem set design and analysis. Familiarization with current lecture and text materials; evaluations of class papers and examinations. Prerequisite: enrollment in the Biochemistry Ph.D. program or consent of instructor.

3 units, Aut, Win, Spr, Sum (Staff)

BIOC 224. Cell Biology of Physiological Processes—(Same as BIOSCI 214.) Mechanisms of membrane and cellular biogenesis in relation to physiological processes. Emphasis is on 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. Prerequisites: Biological Sciences core. Open to graduate and medical students. Undergraduates may enroll with consent of instructor and prerequisites Biological Science core and Biochemistry 205.

2-5 units, Win (Theriot, J; Kopito, R; Straight, A; Nelson, W)

BIOC 230. Molecular Interventions in Human Disease—For M.D. students who intend to declare a concentration in molecular basis of medicine, M.S.T.P. students, and Ph.D. students with a strong interest in medicine. Advanced medical biochemistry focusing on cases where molecular-level research has led to new medical treatments or changes in the understanding of important diseases. The underlying molecular basis of diseases and the reasons for success and failure in molecular approaches to treatment. Studen-led discussions on primary medical and scientific literature.

2-3 units, Aut (Theriot, J; Harbury, P)

BIOC 241. Biological Macromolecules—(Same as BIOPHYS 241, SBIO 241.) The physical and chemical basis of macromolecular function. The forces that stabilize biopolymers with three-dimensional structures and their functional implications. Thermodynamics, molecular forces, and kinetics of enzymatic and diffusional processes, and relationship to their practical application in experimental design and interpretation. Biological function and the level of individual molecular interactions and at the level of complex processes. Case studies. Prerequisites: introductory biochemistry and physical chemistry or consent of instructor.

3-5 units, Aut (Herschlag, D; Puglisi, J; McKay, D; Garcia, K.C.; Ferrell, J; Block, S; Pande, V; Weis, W)

BIOC 299. Directed Reading in Biochemistry—Prerequisite: consent of instructor.

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

BIOC 399. Graduate Research and Special Advanced Work—Allows for qualified students to undertake investigations sponsored by individual faculty members.

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

BIOC 459. Frontiers in Interdisciplinary Biosciences—(Same as BIOE 459, BIOSCI 459, CHEMENG 459, CHEM 459, PSYCH 459.) (Cross-listed in departments in the schools of H&S, Engineering, and Medicine; students register through their affiliated department; otherwise register for CHEMENG 459.) For specialists and non-specialists. Sponsored by the Stanford BioX Program. Three seminars per quarter address scientific and technical themes related to interdisciplinary approaches in bioengineering, medicine, and the chemical, physical, and biological sciences. Leading investigators from Stanford and the world present breakthroughs and endeavors that cut across core disciplines. Pre-seminars introduce basic concepts and background for non-experts. Registered students attend all pre-seminars; others welcome. See http://www.stanford.edu/group/biox/courses/459.html. Recommended: basic mathematics, biology, chemistry, and physics.

1 unit, Aut, Win, Spr (Robertson, C)

COGNATE COURSES

See respective department listings for course description. See degree requirements above or the program's student services office for applicability of these courses to a major or minor program.

SBIO 242. Methods in Molecular Biophysics—(Same as BIOPHYS 242.)

3 units, Win (Weis, W; Puglisi, J)