BIOCHEMISTRY

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

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. A basic series in biochemistry is taught by the entire staff and requires a good background in organic chemistry and cell biology.

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 three research proposals, which are presented by the student to a small sy committee of departmental faculty members who are also responsible for monitoring the progress of student curricular and research programs. 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 15.

Beginning September 1, applications are available and can be requested by mail from Graduate Admissions, Registrar's Office, Old Union, Stanford University, Stanford CA 94304-3005, by phone (650) 723-4291, or email at ck.gaa@forsythe.stanford.edu. Applications may also be submitted electronically at http://www.stanford.edu/dept/registrar/admissions/index.html and http://www.med.stanford.edu/school/biosciences/. Applicants are notified by April 1 of decisions on their applications. Stanford University requires scores from the Graduate Record Examination (GRE) (verbal, quantitative, and analytical), and applicants must 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 and a Howard Hughes Medical Institute Predoctoral Traineeship. Students are provided with financial support to cover normal living expenses; Stanford tuition costs are paid.

All 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, Bioinformatics, and Medicine—Stanford Introductory Seminar. Preference to sophomores. The kind of 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. The ethical implications of genetic information. The use of genome and disease databases to determine the function of genes involved in disease. Recommended: BIOSCI 52 or HUMBIO 2A. GER:2b

3 units, Spr (Brutlag)

BIOC 199. Undergraduate Research—Prerequisite: consent of instructor.

1-18 units (Staff)

BIOC 200. Biochemical Structure, Metabolism, Energetics—The structure and function of biological molecules, enzyme kinetics and mechanisms, bioenergetics, pathways of intermediary metabolism and their control, and membrane structure and function. Lectures on special topics. Prerequisites: organic chemistry, cell biology.

4-5 units, Win (Harbury, Pfeffer, Spudich, Theriot)

BIOC 201. Advanced Molecular Biology—Lectures on rapidly developing frontiers in DNA structure and metabolism, chromosome structure and function, gene expression and its control, regulation of transcription,

RNA processing and translation, genomics, and bioinformatics. Prerequisite: 200 and an understanding of basic molecular biology.

5 units, Win (Brutlag, Davis) not given 2002-03

BIOC 203. Molecular Biology—Enrollment limited to medical students or by consent of instructors. DNA structure, DNA replication, repair and recombination, chromosome structure and function, gene expression and its control, regulation of transcription, RNA processing, and translation. Prerequisite: 200 or equivalent.

4 units, Spr (Brown, Chu, Krasnow, Lehman)

BIOC 204. Medical Biochemistry—(Enrollment limited to M.D. candidates). Structure and function of biological molecules, enzyme kinetics and mechanisms, bioenergetics, pathways of intermediary metabolism and their control, and membrane structure and function. Lectures on special topics. This course is taught with clinical correlations. Prerequisites: organic chemistry, cell biology or exemption for 204 received by placement examination.

5 units, Win (Harbury, Pfeffer, Spudich, Theriot)

BIOC 210. Advanced Topics in Membrane Biochemistry—The structure, function, and biosynthesis of cellular membranes and organelles. Based on current literature, with extensive student participation. Prerequisites: 200, 203, or equivalents, and consent of instructor.

4 units (Pfeffer) not given 2002-03

BIOC 211. Development in Microorganisms—Cell differentiation and multicellular development in microorganisms. Microbes are attractive subjects for molecular studies of the regulation of development and morphogenesis because they can be manipulated easily by genetic and biochemical techniques. Moreover, their genome sequences are known. Topics: sporulation; organelle morphogenesis; bacterial cell cycle; cell-cell communication; pattern formation; multicellular development. Tutorial format/readings and discussion of current literature.

2 units, Aut (Kaiser, Shapiro) not given 2002-03

BIOC 214. Physical and Chemical Principles of Biochemistry—Physical chemistry of proteins, nucleic acids and their complexes, and the chemistry underlying biological reactions; principles of enzymatic catalysis. The physical and chemical concepts that are fundamental to biological processes. Appraisal of experimental and conceptual approaches and analysis of classic and current papers in the literature. Areas: interactions involved in protein and nucleic acid structure and folding; energetic, chemical, and structural principles of enzymatic catalysis and control. Prerequisites: 200 and 203 or equivalent, a course in physical chemistry, and a course in organic chemistry.

3 units (Herschlag) not given 2002-03

BIOC 215. Frontiers in Biological Research—(Same as DBIO 215, GENE 215.) Literature discussion on how to critically evaluate biological research. Held in conjunction with a seminar series, hosted in alternate weeks by Biochemistry, Developmental Biology, and Genetics. Each Wednesday, distinguished investigators present their current work at the Frontiers in Biological Research seminar. Before the seminar, students and course faculty meet and discuss in depth one or more papers from the speaker's primary research literature on a related topic. After the seminar, students meet informally with the speaker to discuss their research and future direction, the techniques most commonly used to study problems in biology, and a comparison between the genetic and biochemical approaches in biological research.

1 unit, Aut, Win (Harbury, Kingsley, Baker)

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 under the guidance of advanced graduate students and postdoctoral fellows.

1-3 units, any quarter (Staff)

BIOC 221. The Teaching of Biochemistry—To be taken by all teaching assistants in 200, 203, 204, or 217. Emphasizes practical experience in teaching on a one-to-one basis, and problem set design and analysis. Familiarization with current lecture and text materials is expected, along with evaluations of class papers and examinations. Prerequisite: enrollment in the Biochemistry Ph.D. program or consent of instructor.

3 units, any quarter (Staff)

BIOC 225. Molecular Motor Proteins and the Cytoskeleton—(Same as DBIO 225.) The molecular basis of energy transduction leading to movements generated by microfilament-based and microtubule-based motors. Analysis of forms of myosin, dynein, and kinesin and their roles in the cell, as a model for understanding the structural, biochemical, and functional properties of biological machines in general. Topics: structure of the molecular motors and their accessory proteins; regulation of the function of motile assemblies; functions of molecular motors in cells; spatial and temporal controls on the formation of motile assemblies in cells. Experimental approaches: genetic analysis, DNA cloning and expression, reconstitution of functional assemblies from purified proteins, x-ray diffraction, three-dimensional reconstruction of electron microscope images, spectroscopic methods, and high-resolution light microscopy. Focus is on how a complex cellular process is analyzed at the molecular level by a multifaceted approach using biochemical, biophysical, and genetic techniques. Prerequisites: knowledge of basic biochemistry and cell biology.

3 units (Spudich) not given 2002-03

BIOC 241. Biological Macromolecules—(Enroll in SBIO 241.)

3-5 units, Aut (Puglisi, Block, Herschlag, Kirkegaard, McKay)

BIOC 242. Methods in Molecular Biophysics—(Same as SBIO 242.) Introduces students from diverse backgrounds to the potential utility of physical approaches to research and helps prepare them to evaluate literature that incorporates these methods. Experimental methods in molecular biophysics are from a theoretical and practical standpoint. Emphasis is on x-ray diffraction and nuclear and nuclear magnetic resonance spectroscopy. Fluorescence spectroscopy, circular diochroism, calorimetry, separation methods.

3 units, Win (McKay, Puglisi) alternate years, not given 2003-04

BIOC 294. DNA Repair, Recombination, and Replication—Enzymes and molecular mechanisms and how some physiological aspects of DNA transactions may be explained at the molecular level. Prerequisites: 200 and 203 (or equivalent).

2 units (Lehman) not given 2002-03

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

1-18 units, any quarter (Staff)

BIOC 399. Research and Special Advanced Work—Register by section numbers by arrangement with faculty. Prerequisite: consent of instructor.

1-18 units, any quarter (Staff)

BIOC 450. Introduction to Biotechnology—(Same as CHEMENG 450, CEE 237, DBIO 237, SBIO 450.) Stanford faculty from the schools of Medicine, Humanities and Sciences, Engineering and invited industrial speakers review the interrelated elements of modern biotechnology. Topics: development of recombinant protein pharmaceuticals, bacterial fermentation and scale-up, mammalian cell culture and scale-up, transgenic animals, transgenic protein production in plants, isolation and purification of protein pharmaceuticals, formulation and delivery of pharmaceutical proteins, environmental biotechnology, metabolic engineering, industrial enzymes, diagnostic devices, transciptomics and proteomics, drug delivery systems. Prerequisite: graduate student or upper-division undergraduate in the sciences or engineering.

3 units, Spr (Robertson, Swartz)

BIOC 459. Frontiers in Interdisciplinary Biosciences—(Crosslisted in multiple departments in the schools of Humanities and Sciences, Engineering, and Medicine; students should enroll directly through their affiliated department, otherwise enroll in CHEMENG 459.) An introduction to cutting-edge research involving interdisciplinary approaches to bioscience and biotechnology; for specialists and non-specialists. Organized and sponsored by the Stanford BioX Program. Three seminars each quarter address a broad set of scientific and technical themes related to interdisciplinary approaches to important issues in bioengineering, medicine, and the chemical, physical, and biological sciences. Leading investigators from Stanford and throughout the world present the latest breakthroughs and endeavors that cut broadly across many core disciplines. Pre-seminars introduce basic concepts and provide background for non-experts. Registered students attend all pre-seminars in advance of the primary seminars, others welcome. Prerequisite: keen interest in all of science, engineering, and medicine with particular interest in life itself. Recommended: basic knowledge of mathematics, biology, chemistry, and physics.

1 unit, Aut, Win, Spr (Robertson)

OVERSEAS STUDIES

Courses approved for the Biochemistry major and taught overseas can be found in the "Overseas Studies" section of this bulletin, or in the Overseas Studies office, 126 Sweet Hall.

PARIS

BIOC 118F. Genomics, Bioinformatics, and Medicine—See OSPPARIS 84.

3 units, Aut (Brutlag)

BIOC 218. Computational Molecular Biology—(Same as BIOMEDIN 231.) See OSPPARIS 83.

3 units, Aut, Win, Spr, via Internet (Brutlag)

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