

Molecular & Cellular Biochemistry

College of Medicine

Graduate study in biochemistry is designed to prepare candidates for research careers in academics, industry, and government laboratories. Admission to the graduate program is competitive and is based upon academic background, professional recommendations, performance on the Graduate Record Examination (GRE), experience and, when possible, personal interviews. Students should have completed an undergraduate degree in chemistry, biology, biochemistry, engineering, mathematics, physics, or pharmacy. It is recommended that students have completed undergraduate courses in organic chemistry, physical chemistry, calculus, physics and biological sciences.

Students will have the opportunity to join faculty research programs studying a spectrum of topics including: signal transduction, protein structure and function, transcriptional regulation, the cytoskeleton, secretion and vesicular fusion, disease mechanisms (atherosclerosis, cancer, infectious disease, diabetes, Alzheimer's), drug design, computational biology, development, nucleic acid dynamics, and membrane biogenesis & function. The program of study stresses an interdepartmental approach both in the selection of courses and in the pursuit of research. Students are expected to participate in graduate seminars, journal clubs, and research seminars; to interact with visiting scholars; and to present the results of their research at local and national meetings. Financial aid is available to all students in the program.

Admission Requirements

Admission to the Ph.D. program in Molecular and Cellular Biochemistry is through the Integrated Biomedical Sciences (IBS) Curriculum.

Inquiries regarding admission should be directed to the Director of Graduate Studies, Department of Biochemistry, University of Kentucky College of Medicine. Information regarding the Ph.D. program in Biochemistry may also be obtained at <http://biochemistry.med.uky.edu/>.

Course Descriptions

BCH 395 INDEPENDENT WORK IN BIOCHEMISTRY. (3-12)

Students will carry out a laboratory research project and related reference reading. Laboratory: 9-36 hours per week. May be repeated to a maximum of 12 credits. Prereq: Permission of instructor.

BCH 401G FUNDAMENTALS OF BIOCHEMISTRY. (3)

Descriptive chemistry of amino acids and proteins, carbohydrates, lipids, and nucleic acids. Discussion of structure and function; metabolism and bioenergetics; and biological information flow. At the undergraduate level, understanding is demonstrated through hour examinations; at the graduate level, understanding is demonstrated through hour examinations and a brief paper. Lecture, three hours; one optional conference. Prereq: CHE 107, CHE 236 and BIO 152 or equivalent.

BCH 419G MOLECULAR BASIS OF HUMAN DISEASE. (3)

The goal of this course is to provide students with an understanding of the defining characteristics of the major human diseases, the molecular mechanisms responsible for causing these diseases, and some of the molecular technologies used to diagnose and treat them. Prereq: BCH 401G.

BCH 517 EXPERIMENTAL METHODS IN BIOCHEMISTRY. (4)

A laboratory course dealing with the instrumentation and procedures of biochemical research. Because many of the materials used are labile, the course is given in a block during a four-week period at the end of the spring semester. Five days per week during four-week intersession, or summer session. Prereq: BCH 401G, 502 or 811 and consent of instructor.

BCH 556 PRINCIPLES OF DRUG DESIGN. (3)

Introduction to medicinal chemistry will be explored through rational biochemical and physical organic chemical approaches to drug design, action and development. Structural features, physical properties, mechanism of action and metabolism of drug like molecules, forces that govern interaction of drug-like molecules with their targets, enzyme mechanisms and inhibition and xenobiotic metabolism will be illustrated with specific examples showing how drugs function at the molecular level. Prereq: CHE 230, CHE 232, BIO 148, BIO 152. (Same as PHS 556.)

BCH 601 SPECIAL TOPICS IN MOLECULAR AND CELLULAR GENETICS. (1)

Each semester five distinguished scientists visit the UK campus to deliver a series of three formal lectures each and participate in numerous informal contacts with graduate students. The emphasis is on the presentation of the most current advances (often unpublished) in selected topics in molecular and cellular genetics. May be repeated to a maximum of six credits. (Same as BIO/MI/PLS/PPA 601.)

BCH 604 STRUCTURAL BIOLOGY. (3)

An advanced course on the structure and function of proteins and nucleic acids. Topics include: the physical determinants of protein structure, classification of protein architecture, protein-nucleic acid and protein-protein interactions, sequence dependence of nucleic acid structure, ribozymes, dynamics and evolutionary relationships. Prereq: IBS 601-602/BCH 607-608 or equivalent.

BCH 607 BIOMOLECULES AND METABOLISM. (3)

An introductory graduate-level biochemistry course designed to provide a basic knowledge of molecular and biochemical principles necessary for advanced graduate study. Protein structure and function, enzyme catalysis, the generation and storage of metabolic energy, amino acid, nucleotide, and lipid metabolism and biological membranes and transport will be covered. Prereq: CHE 105, 107, 230 and 232; BIO 150 and 152; or equivalents. (Same as IBS 601.)

BCH 608 BIOMOLECULES AND MOLECULAR BIOLOGY. (3)

An introductory graduate-level biochemistry course focused on the cellular mechanisms that underlie the regulated expression of genes, including transcription and translation, as well as basic mechanisms of DNA replication/repair and recombination. Genetic engineering and other experimental approaches critical to molecular biology research will be reviewed. Prereq: CHE 105, 107, 230 and 232; BIO 150 and 152; or equivalents.

BCH 609 PLANT BIOCHEMISTRY. (3)

The course will consider the chemical constituents of plants (with emphasis on biologically or nutritionally significant compounds unique to plants), their biosynthesis, contribution to key metabolic and defense processes and the regulation of their synthesis. Included will be discussions of photosynthesis, carbohydrates, lipids, isoprenoids and phenylpropanoids, nitrogen fixation, nitrogen and sulfur reduction and assimilation, alkaloids and additional secondary compounds, frontiers in plant biochemistry. Prereq: BCH 607 or equivalent or consent of instructor. (Same as PLS/PPA 609.)

BCH 610 STRUCTURE AND FUNCTION OF BIOMEMBRANES. (3)

A lecture and seminar course that discusses primary literature focused on the structures, assembly, and functions of biologically important membranes. Prereq: CHE 232; CHE 442G; BCH 401G, 811, or IBS 601.

BCH 611 BIOCHEMISTRY AND CELL BIOLOGY OF NUCLEIC ACIDS. (3)

A lecture and seminar course devoted to a study of the principles of nucleic acid chemistry and to the role of nucleic acids in cellular function. Prereq: BCH 401G, 502 or 811.

BCH 612 STRUCTURE AND FUNCTION OF PROTEINS AND ENZYMES. (3)

Primarily a lecture course devoted to the relationship of the structure of protein molecules to their biological roles. Proteins will be discussed in terms of their size, shape, conformation, primary structure, catalytic mechanism and regulatory properties. Prereq: BCH 401G, 502 or 811; CHE 444G or consent of instructor. May be taken concurrently with BCH 502.

- BCH 615 MOLECULAR BIOLOGY.** (3)
 This course will develop the student's ability to critically read and evaluate the primary literature in selected areas of molecular biology; various experimental systems and techniques are discussed. While there is some lecture, the time will be predominately spent in class discussions of the primary literature. Prereq: An advanced course in molecular biology and genetics (e.g. IBS 602) or consent of instructor. (Same as BIO/MI 615.)
- BCH 618 SEMINAR IN BIOCHEMISTRY.** (1)
 A weekly seminar, required of all students majoring in biochemistry, devoted to discussions of areas not covered in other courses and to recent developments in the field. May be repeated to a maximum of five credits.
- BCH 619 SEMINAR IN BIOCHEMISTRY.** (1)
 A weekly seminar, required of all students majoring in biochemistry, devoted to discussions of areas not covered in other courses and to recent developments in the field. May be repeated to a maximum of five credits.
- BCH 620 BIOSYNTHESIS OF NATURAL PRODUCTS.** (3)
 An overview of the biochemical pathways leading to compounds called natural products/secondary metabolites. Prereq: Two semesters of organic chemistry. (Same as PHR 620/PLS 642.)
- BCH 625 SCIENTIFIC COMMUNICATIONS.** (2)
 To be useful, scientific research needs to be explained clearly to others – to colleagues, to administrators, to foundations and governmental bodies, and to the public. This course will give students the tools to effectively present their data, their ideas, and themselves to the scientific community. Through a series of directed exercises the students will learn how to write an abstract, a scientific paper, and a grant, and to prepare a poster and to give an oral presentation. The class will draw examples, topics, and exercises from current literature. Prereq: Good standing in a graduate program in the physical, chemical or biomedical sciences.
- BCH 640 RESEARCH IN BIOCHEMISTRY.** (1-9)
 Prereq: Consent of instructor.
- BCH 748 MASTER'S THESIS RESEARCH.** (0)
 Half-time to full-time work on thesis. May be repeated to a maximum of six semesters. Prereq: All course work toward the degree must be completed.
- BCH 749 DISSERTATION RESEARCH.** (0)
 Half-time to full-time work on dissertation. May be repeated to a maximum of six semesters. Prereq: Registration for two full-time semesters of 769 residence credit following the successful completion of the qualifying exams.
- BCH 767 DISSERTATION RESIDENCY CREDIT.** (2)
 Residency credit for dissertation research after the qualifying examination. Students may register for this course in the semester of the qualifying examination. A minimum of two semesters are required as well as continuous enrollment (Fall and Spring) until the dissertation is completed and defended.
- BCH 768 RESIDENCE CREDIT FOR MASTER'S DEGREE.** (1-6)
 May be repeated to a maximum of 12 hours.
- BCH 769 RESIDENCE CREDIT FOR THE DOCTOR'S DEGREE.** (0-12)
 May be repeated indefinitely.
- BCH 779 MEMBRANE SCIENCES COLLOQUIUM.** (1)
 Outstanding membrane scientists present their current research on biological and/or synthetic membranes. Students read a pertinent paper by the speaker prior to his/her talk and write a short paper on the talk; especially important is relevance of the main points of the talk to membrane science in general and the student's own research in particular. May be repeated to a maximum of six credits. (Same as CHE/ CME/

PHA/PHR 779.)

BCH 780 TOPICS IN BIOCHEMISTRY. (1-3)

A lecture and seminar course offered on topics of special interest to graduate students. May be repeated to a maximum of six credits.

***BCH 812 DENTAL BIOCHEMISTRY. (6)**

This is a comprehensive course in biochemistry designed to fulfill the specific needs of student dentists. Course content is generally as outlined in the American Association of Dental Schools suggested curriculum guidelines for biochemistry. Part I acquaints students with the chemical constituents of prokaryotic and eukaryotic cells; topics include the chemistry of lipids, carbohydrates, proteins, vitamins and coenzymes, and the nature of enzyme action. Part II integrates the chemical principles learned from Part I with concepts of cell dynamics, structure, function, subcellular organization, and metabolism. Topics include intermediary metabolism, bioenergetics, DNA replication, protein synthesis, and cellular regulatory and control mechanisms. Course content, where possible, is related to current concepts concerning the etiology of oral diseases, their treatment, and prevention to assist student dentists in attaining institutional goals and objectives for clinical competency. Prereq: Admission into the College of Dentistry and/or consent of course director. (Same as OBI 812.)

BCH 815 FIRST-YEAR ELECTIVE, BIOCHEMISTRY. (1-3)

With the advice and approval of his or her faculty adviser, the first-year student may choose approved electives offered by the Department of Biochemistry. The intent is to provide the student an opportunity for exploration and study in an area which supplements and/or complements required course work in the first-year curriculum. Pass-fail only. Prereq: Admission to first year, College of Medicine.

BCH 819 CELLULAR STRUCTURE AND FUNCTION/BIOCHEMISTRY. (7)

The course combines lecture, small group activities, clinical correlations, problem-based learning, and problem-solving sessions in providing an understanding of the relationship of biochemical principles to human health and disease. Close integration with genetics topics provides a better picture of how biochemistry, molecular biology and genetics contribute to normal human development and medicine. Lecture, 20 hours per week. Prereq: Admission to Medical School (first year).

BCH 825 SECOND-YEAR ELECTIVE, BIOCHEMISTRY. (1-4)

With the advice and approval of his or her faculty advisor, the second-year student may choose approved electives offered by the Department of Biochemistry. The intent is to provide the student with an opportunity for exploration and study in an area which supplements and/or complements required course work in the second-year curriculum. Pass/Fail only. Prereq: Admission to second year medical curriculum and approval of advisor.

BCH 850-899 FOURTH-YEAR ELECTIVE FOR MEDICAL STUDENTS. (1-6)

With the advice and approval of the faculty adviser and the Student Progress and Promotions Committee, the fourth-year student may choose approved electives offered by the various departments in the College of Medicine. The intent is to provide the student an opportunity to develop his fund of knowledge and clinical competence. Prereq: Admission to the fourth year, College of Medicine and/ or permission of the Student Progress and Promotions Committee.

Approved elective:

***BCH 850 ELECTIVE: RESEARCH IN BIOCHEMISTRY**

