AST 164. Vietnamese American Culture (4) Lecture, 3 hours; written work, 3 hours. Prerequisite(s): upper-division standing or consent of instructor. A study of the pervasive aspects of Vietnamese American culture, including shared histories, acculturation patterns, class diversity, identity struggles, community-building literary and cultural production, youth issues, and cultural survival. Introduces foundational literature, visual culture, and scholarship in the field. Cross-listed with VNM 164.

AST 165 (E-Z). Themes in Vietnamese Literature (4) Lecture, 3 hours; extra reading, 3 hours. Prerequisite(s): upper-division standing or consent of instructor. An exploration of Vietnamese literature in translation, as seen through the lens of a particular theme or issue. Segments pay particular attention to the implications of gender and sexuality on nation formation. All materials are read or viewed in English. E. Women and War. Cross-listed with VNM 165 (E-Z) and WMST 165 (E-Z).

AST 166. Vietnam and the Philippines (4) Lecture, 3 hours; written work, 3 hours. Prerequisite(s): upper-division standing or consent of instructor. Introduction to the comparative national histories of Vietnam and the Philippines by way of great literary works in various genres: poetry, short fiction, and novels. All materials are read in English. Cross-listed with CPLT 166 and VNM 166.

AST 167. Postcolonial Literature and Criticism in Southeast Asia and South Asia (4) Lecture, 3 hours; extra reading, 3 hours. Prerequisite(s): upper-division standing or consent of instructor. Explores how the theoretical concepts of postcolonial criticism inform and challenge the literature of Southeast Asia and South Asia, as the literature itself pushes the limits of the criticism. Addresses themes of nation, identity, space, gender, home, diaspora, alterity, history, sexuality, transnationalism, neocolonialism, tourism, and education. Cross-listed with CPLT 167.

AST 168. Javanese Gamelan Ensemble: Beginning (2) Prerequisite(s): upper-division standing and consent of instructor. Study and performance of the Central Javanese gamelan, consisting mainly of gongs and gong-chime instruments. Readings and discussions focus on Javanese culture. Normally graded Satisfactory (S) or No Credit (NC), but students may petition the instructor for a letter grade on the basis of assigned extra work or examination. Course is repeatable. Cross-listed with MUS 168.

AST 169. Taiko Ensemble (1) Studio, 2 hours. Prerequisite(s): upper-division standing or consent of instructor. Study and performance of Japanese drumming. Normally graded Satisfactory (S) or No Credit (NC), but students may petition the instructor for a letter grade on the basis of assigned extra work or examination. Course is repeatable. Cross-listed with MUS 169.

AST 170. Rondalla Ensemble (1-2) Studio, 2-4 hours. Prerequisite(s): upper-division standing or consent of instructor. Study and performance of the Filipino rondalla, an ensemble consisting of various sizes of lure-like and guitar-like instruments. Discussions focus on Filipino culture. Normally graded Satisfactory (S) or No Credit (NC), but students may petition the instructor for a letter grade on the basis of assigned extra work or examination. Course is repeatable. Cross-listed with MUS 170.

AST 184. Japanese Film and Visual Culture (4) Lecture, 2 hours; discussion, 1 hour; term paper, 3 hours. Prerequisite(s): upper-division standing or consent of instructor. Investigates popular visual culture in Japan primarily through film, from the early masters to contemporary directors. May draw additional material from fields such as theatre, television, visual art, architecture, and illustrated fiction. All materials are read or viewed in English. Course is repeatable to a maximum of 12 units. Cross-listed with JPN 184 and MCS 184.

AST 185. New Chinese Cinema (4) Lecture, 3 hours; screening, 3 hours. Prerequisite(s): upper-division standing or consent of instructor. A study of representative films from the People's Republic of China, with a focus on those made during the last decade. Conducted in English; most films have English subtitles. Cross-listed with CHN 185 and MCS 169.

AST 186. Hong Kong Cinema: Gender, Genre, and the "New Wave" (4) Lecture, 3 hours; screening, 3 hours. Prerequisite(s): MCS 020 or upper-division standing or consent of instructor. Examines contemporary Hong Kong films, specifically the "New Wave" genre. Particular focus is on the sociopolitical conditions of Hong Kong and its relations with Great Britain and China, the linkages of which set the stage for the films and thematic concerns. Cross-listed with MCS 168.

AST 187. Vietnamese and Overseas Vietnamese Cinema (4) Lecture, 3 hours; screening, 3 hours. Prerequisite(s): MCS 020 or upper-division standing or consent of instructor. Explores how Vietnamese people and the Vietnamese diaspora seek to imagine a sense of community in the postwar era through contemporary film and video. Examines the thematics of return, longing, and exile. Reviews some of the texts' bold expressions of gender, sexuality, and identity. Cross-listed with MCS 167.

AST 188 (E-Z). Topics in Chinese History (4) Lecture, 3 hours; extra reading, 3 hours. Prerequisite(s): upper-division standing; HIST 180 or HIST 181 or HIST 182; or consent of instructor. An in-depth look at important topics in Chinese history. E. Chinese Food Culture. Cross-listed with HIST 188 (E-Z).

AST 189. Encountering Vietnam (5) Lecture, 6 hours; tutorial, 6 hours; project, 6 hours. Prerequisite(s): upper-division standing or consent of instructor. Focuses on literary and historical accounts of Vietnam. Utilizes translated travel writings from different genres and eras. Proficiency in Vietnamese not required. Taught in Vietnam and offered only in summer. Cross-listed with HIST 189, SEAS 189, and VNM 189.

AST 190. Special Studies (1-5) Individual study, 3-15 hours. Prerequisite(s): upper-division standing or consent of instructor. To be taken with the consent of the Chair of the Program as a means of meeting special curricular problems. Course is repeatable.

AST 195. Senior Thesis (1-4) Thesis, 3-12 hours. Prerequisite(s): consent of instructor and senior standing. Preparation of a substantial paper based on original research. The student works independently with a faculty member. Course is repeatable to a maximum of 12 units.

Biochemistry

Subject abbreviation: BCH
College of Natural and Agricultural Sciences

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Christopher Y. Switzer, Ph.D. (Chemistry)
Linda L. Walling, Ph.D. (Botany and Plant Sciences)
Raphael Zidovetzki, Ph.D. (Cell Biology and Neuroscience)

Major

The three emphases areas within the Biochemistry major are Chemistry, Biology, and Medical Sciences. The Biology and Chemistry emphases are for students interested in post-graduate education or employment in the basic areas of the discipline of Biochemistry. The goal of the Medical Sciences emphasis is to prepare students for admission to postbaccalaureate education in the health professions. The Biology, Chemistry, and Medical Sciences emphases focus on the development of laboratory and critical thinking skills, and hands-on laboratory experience. In addition, participation in an independent research project (BCH 197) or research tutorial (BCH 190), carried out under the supervision of a faculty member, is encouraged. Internships in industry (BCH 198-I) are also available, and often lead to valuable job experience and employment opportunities.

The department offers both B.A. and B.S. degrees. The major and emphasis requirements are the same for both, and most students choose the B.S. degree. The B.A. degree requires 12 additional units of Humanities and Social Sciences courses, and 16 units or a course 4 equivalency level of a foreign language (see College Breadth Requirements).

Transfer Students

Transfer students majoring in Biochemistry must complete at least three of the following full-year sequences, which must include first-year calculus and general chemistry:

1. First-year calculus, equivalent to MATH 009A, MATH 009B, MATH 0046
2. General chemistry, equivalent to CHEM 001A, CHEM 001B, CHEM 001C, CHEM 01LA, CHEM 01LB, CHEM 01LC
3. Organic chemistry (must be completed with a minimum grade of "B" in each term)
4. General biology, equivalent to BIOL 005A, BIOL 05LA, and BIOL 005B (and BIOL 005C, if available)
5. General physics (calculus-based) equivalent to PHYS 002A, PHYS 002B, PHYS 002C or PHYS 040A, PHYS 040B, PHYS 040C

Students must have a minimum grade point average of 2.70 in transferable college courses.

University Requirements

See Undergraduate Studies section.

College Requirements

See College of Natural and Agricultural Sciences, Colleges and Programs section.

Some of the following requirements for the major may also fulfill some of the college's breadth requirements. Consult with a department advisor for course planning.

Major Requirements

The major requirements and the emphasis requirements are the same for the B.A. and the B.S. degree in Biochemistry. Choose one emphasis. All upper-division courses presume completion of the life sciences core curriculum.

Biology Emphasis

1. Lower-division requirements (56-57 units)
   a) BCH 095 or equivalent
   b) BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C
   c) CHEM 001A, CHEM 001B, CHEM 001C, CHEM 01LA, CHEM 01LB, CHEM 01LC
   d) MATH 008B or MATH 009A, MATH 009B, MATH 046
   e) PHYS 002A, PHYS 002B, PHYS OO2C, PHYS 02LA, PHYS 02LB, PHYS 02LC
2. Statistics requirement (5 units): STAT 100A
3. Upper-division requirements (49–65 units)
   a) BCH 101, BCH 102, BCH 110A, BCH 110B, BCH 110C, BCH 184
   b) At least 7 units from BCH 120, BCH 153/BIOL 153/BPSC 153, BCH 162, BCH 180A, BCH 180B, BCH 180C, BCH 183, BCH 186, BCH 187, BCH 210, BCH 211, BCH 212, BCH 241/CHEM 241
   c) BIOL 102
   d) CHEM 109 or CHEM 110A; CHEM 112A, CHEM 112B, CHEM 112C
   e) Choose three biological science courses from the following:
      (1) BCH 120, BCH 153/BIOL 153/ BPSC 153, BCH 162, BCH 180A, BCH 180B, BCH 180C, BCH 183, BCH 186, BCH 187, BCH 210, BCH 211, BCH 212, BCH 241/CHEM 241
      (2) BIOL 105, BIOL 108, BIOL 114, BIOL 117, BIOL 121/MCBL 121, BIOL 121L/MCBL 121L, BIOL 123/MCBL 123/PLPA 123, BIOL 124/MCBL 124, BIOL 128/CBNS 128, BIOL 151, BIOL 155/BPSC 155, BIOL 157, BIOL 159/NEM 159, BIOL 160, BIOL 161A, BIOL 161B, BIOL 171, BIOL 171L, BIOL 173/ENTM 173, BIOL 175
      (3) BIOL 104/BPSC 104, BIOL 132/ BPSC 132, BIOL 143/BPSC 143, BIOL 148/BPSC 148, BIOL 155/ BPSC 155, BPSC 135
      (4) BIOL 100/ENTM 100, BIOL 173/ENTM 173, ENTM 128
      (5) CBNS 101, CBNS 106, CBNS 116, CBNS 120/PSYC 120, CBNS 120L/ PSYC 120L, CBNS 124/PSYC 124, CBNS 125/PSYC 125, CBNS 150/ ENTX 150, CBNS 169
      (6) ENSC 100, ENSC 155
      (7) ENTX 101, CBNS 150/ENTX 150
4. BCH 190 or BCH 197 are available as elective courses to juniors who have completed BCH 102 and to seniors. No more than 9 units of courses numbered 190-199 may be counted towards the major.

Chemistry Emphasis

1. Lower-division requirements (61-62 units)
   a) BCH 095 or equivalent
   b) BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C
   c) CHEM 001A, CHEM 001B, CHEM 001C, CHEM 01LA, CHEM 01LB, CHEM 01LC, CHEM 005
   d) MATH 008B or MATH 009A, MATH 009B, MATH 046
   e) PHYS 002A, PHYS 002B, PHYS 002C, PHYS 02LA, PHYS 02LB, PHYS 02LC
2. Statistics requirement (5 units): STAT 100A
3. Upper-division requirements (49–59 units)
   a) BCH 101, BCH 102, BCH 110A, BCH 110B, BCH 110C, BCH 184
   b) At least 7 units from BCH 120, BCH 153/BIOL 153/BPSC 153, BCH 162, BCH 180A, BCH 180B, BCH 180C, BCH 183, BCH 186, BCH 187, BCH 210, BCH 211, BCH 212, BCH 241/CHEM 241
   c) BIOL 102
   d) CHEM 109 or CHEM 110A; CHEM 112A, CHEM 112B, CHEM 112C
   e) Two courses from CHEM 110B, CHEM 113, CHEM 125, CHEM 150A, CHEM 150B, CHEM 166 (BCH 241/CHEM 241 and other graduate courses may be substituted by students with a GPA of 3.00 or better with permission of the instructor and the faculty advisor.)
4. BCH 190 or BCH 197 are available as elective courses to juniors who have completed BCH 102 and to seniors. No more than 9 units of courses numbered 190-199 may be counted towards the major.

Medical Sciences Emphasis

1. Lower-division requirements (54-55 units)
   a) BCH 095 or equivalent
   b) BCH 096, BCH 098-I
   c) BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C
   d) CHEM 001A, CHEM 001B, CHEM 001C, CHEM 01LA, CHEM 01LB, CHEM 01LC
   e) MATH 008B or MATH 009A, MATH 009B
   f) PHYS 002A, PHYS 002B, PHYS 002C, PHYS 02LA, PHYS 02LB, PHYS 02LC

2. Statistics requirement (5 units): STAT 100A
3. Upper-division requirements (51 units)
   a) BCH 101, BCH 102, BCH 110A, BCH 110B, BCH 110C, BCH 120, BCH 184
   b) BIOL 102
   c) CHEM 109 or CHEM 110A; CHEM 112A, CHEM 112B, CHEM 112C
   d) CBNS 101
4. Highly recommended (15 units): BIOL 161A, BIOL 161B, BIOL 171

Graduate and upper-division courses can be substituted with permission of the instructor and the faculty advisor. Graduate courses require a GPA of 3.0 or greater in the sciences.

Students should be aware that CHEM 005 is often a requirement for admission to professional schools.

Note A maximum of 12 units of 190-199 courses may be counted toward the 180 unit graduation requirement. All courses used towards the Biochemistry major requirements must be taken for letter grades.

Graduate Program

The Department of Biochemistry offers a graduate program leading to the M.S. or Ph.D. degree in Biochemistry and Molecular Biology. This program emphasizes basic biochemistry with research specializations in the areas of molecular biology, physical biochemistry, molecular endocrinology, plant biochemistry and molecular biology, signal transduction, and biomedical research. It is designed for students who are planning a career of research and teaching in biochemistry at colleges and universities or who wish to engage in biochemical investigations of fundamental or applied nature in private, governmental or commercial laboratories.

Admission Students who have completed a bachelor's degree in physical, biological, chemical, or agricultural sciences are invited to apply to the program. Regardless of the area of their major for the baccalaureate degree, students should have taken the following courses prior to beginning graduate study in biochemistry or plan to make up deficiencies soon after entering graduate school:

1. One year of calculus
2. One year of general physics
3. One year of organic chemistry
4. An introductory course in physical chemistry
5. At least two courses in biology at the upper-division level, including genetics

Students should arrange to take the GRE General Test in time for their scores to be submitted with their application.

Doctoral Degree

The Department of Biochemistry offers the Ph.D. degree in Biochemistry and Molecular Biology.

Course Work Students' course requirements are determined in consultation with a three-member advisory committee appointed for them upon their arrival. The advisory committee suggests an individualized course program involving classes in biochemistry and subsidiary fields of study, chosen from any of the physical, biological, or agricultural sciences. Although an adequate course preparation is a requisite part of the training program, the department encourages early involvement of the students in research directed toward their dissertations.

At the end of the second quarter, students select major professors and are ready to initiate a research project. At the end of the first year, students submit a written report describing their research efforts and relating them to current biochemical work in related areas.

Written and Oral Qualifying Examinations After the second year, students take a comprehensive written qualifying examination, then submit and orally defend a research report in which they describe the research they have performed thus far and develop a plan for their complete dissertation research project. This fulfills the Graduate Division's requirement for an oral qualifying examination; Students completing these requirements are advanced to candidacy for the Ph.D. degree.

Dissertation and Final Oral Examination Following completion of their research, students submit a written dissertation and conclude their studies with an oral defense of the dissertation. As part of the program, each student is required to serve at least two quarters as a teaching assistant.

Normative Time to Degree 15 quarters

Master's Degree

In addition to the Ph.D. program, the department offers two plans for the master's degree (Plan I, Thesis; Plan II, Comprehensive Examination). Both plans require completion of at least 36 course units; for Plan I, a maximum of 12 units may be for thesis research.

Lower-Division Courses

BCH 010. Introduction to Nutrition (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): none. Introduction to the biological basis of human nutrition in the context of plant-animal-microorganism cycles and the characteristics of different food classes. The effects of nutritional needs, food availability, and the expanding human population are discussed. Students record and evaluate their own diet.

BCH 095. Topics in Biochemistry for Career Planning (1) Seminar, 1 hour. Prerequisite(s): lower-division standing in Biochemistry. Topics include analysis of academic aspects of career goals and options; curriculum planning; undergraduate research opportunities; preparation for postgraduate education; laboratory experiences and evaluation of data; ethics in education and research; research problems in contemporary biochemistry; and modern experimental approaches in biochemistry. Graded Satisfactory (S) or No Credit (NC). Credit is awarded for only one of BCH 095, NASC 091, or NASC 093.

BCH 096. Introduction to Humanitarian and Healthcare Service (1) Lecture, 8 hours per quarter; consultation, 2 hours per quarter. Prerequisite(s): a major in Biochemistry with an emphasis in Medical Sciences. Acquaints students with opportunities for volunteer activities in the humanitarian and healthcare arenas in southern California. Provides students with the opportunity to validate their commitment to a career in the healthcare arena. Requires a term paper. Graded Satisfactory (S) or No Credit (NC).

BCH 097. Research Tutorial in Biochemistry (1) Laboratory, 3 hours. Prerequisite(s): lower-division standing, minimum grade point average of 3.5, approval of undergraduate advisor and consent of instructor. Laboratory tutorial in Biochemistry. To provide biochemistry laboratory experience for exceptional lower-division students. A written report is required at the end of each quarter. Graded Satisfactory (S) or No Credit (NC). Course is repeatable to a maximum of 3 units.

BCH 098-I. Individual Internship in a Humanitarian or Healthcare Arena (1) Internship, 3 hours; term paper, 10 hours per quarter. Prerequisite(s): a major in Biochemistry with an emphasis in Medical Sciences; BCH 096. Gives Biochemistry majors with a Medical Sciences emphasis real-world experience providing community service in a humanitarian or healthcare arena. Requires a written report. Graded Satisfactory (S) or No Credit (NC). Course is repeatable to a maximum of 2 units.

Upper-Division Courses

BCH 100. Elementary Biochemistry (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005C, CHEM 112C (BIOL 005C and CHEM 112C may be taken concurrently). An introduction to the chemistry and molecular biology of living organisms based on a study of the structure, function, and metabolism of small molecules and macromolecules of biological significance. Examines selected animals, plants, and microorganisms to develop a general understanding of structure-function relationships, enzyme action, regulation, bioenergetics, intermediary metabolism, and molecular biology. Credit is not awarded for BCH 100 if it has already been awarded for BCH 110A, BCH 110B, or BCH 110C.

BCH 101. Biochemical Laboratory: Fundamentals (3) Laboratory, 3 hours; lecture, 1 hour; discussion, 1 hour. Prerequisite(s): CHEM 112A (may be taken concurrently) or consent of instructor. Introduces basic biochemistry wet laboratory techniques for biological samples, including micropipetting, volumetric relationships, dilutions, pH measurement, buffer preparation, spectrophotometry, gel permeation chromatography, and ion-exchange chromatography as well as use of molecular graphics for investigation of macromolecular structure-function relationships.

BCH 102. Introductory Biochemistry Laboratory (4) Lecture, 2 hours; laboratory, 8 hours. Prerequisite(s): BCH 100 with a grade of "C-" or better or BCH 110A with a grade of "C-" or better; BCH 101 with a grade of "C-" or better or CHEM 005 with a grade of "C-" or better; or consent of instructor. Introduction to biochemistry laboratory techniques including spectrophotometry, pH and buffer preparation, methods of protein determination, principles and uses

of chromatography, enzyme assay, theory and measurement of radioisotopes (liquid scintillation counting), SDS gel electrophoresis, and theory of centrifugation. Most experiments include a "quantitative component" upon which the student's performance is graded.

BCH 110A. General Biochemistry (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005B; CHEM 112C. Consideration of the structure and function of biological molecules including proteins, carbohydrates, lipids, and nucleic acids.

BCH 110B. General Biochemistry (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BCH 110A with a grade of "C-" or better or consent of instructor. Consideration of metabolic pathways including mechanisms and regulation of catabolism, anabolism, and bioenergetics in living organisms.

BCH 110C. General Biochemistry (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BCH 100 with a grade of "C-" or better or BCH 110B with a grade of "C-" or better or consent of instructor; BIOL 102 or concurrent enrollment in BIOL 115 or consent of instructor. Consideration of regulation of gene expression, genome replication, recombination, and repair.

BCH 120. Topics in Human Biochemistry (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BCH 100 with a grade of "C+" or better or BCH 110B with a grade of "C-" or better or consent of instructor. Lectures on biochemical and molecular aspects of modern endocrinology, nutrition, metabolic diseases, and blood chemistry. Emphasis is on relation of the above topics to medicine. The discussion sections are used for presentations on topical medical problems.

BCH 153. Plant Genomics and Biotechnology Laboratory (4) Lecture, 1 hour; discussion, 1 hour; laboratory, 6 hours. Prerequisite(s): BCH 110C or BIOL 107A; upper-division standing; consent of instructor. A study of modern techniques in plant genome modification. Topics include nucleic acid cloning and sequencing; plant tissue culture and genetic transformation; controlled-environment plant growth; gene mapping; and germplasm collections. Also explores the history of plant biotechnology; economic, agricultural, nutritional, medicinal, and societal relevance; and regulatory issues. Cross-listed with BIOL 153 and BPSC 153.

BCH 162. Biochemistry and Molecular Biology Laboratory (5) Lecture, 1 hour; discussion, 1 hour; laboratory, two 4.5-hour laboratories. Prerequisite(s): BCH 102; BCH 110A, BCH 110B, BCH 110C all with grades of "C+" or better (BCH 110C may be taken concurrently); consent of instructor. Purification, quantitation, and analysis of DNA, RNA, protein, and lipid. Molecular techniques include DNA cloning, *in situ* hybridization, restriction mapping, PCR, and DNA sequencing. Biochemical techniques include *in vitro* transcription and translation, immunochemistry, phase extraction, affinity chromatography, and gel shift assays.

BCH 180A. Methods in Gene Regulation (2) Lecture, 1 hour; seminar, 1 hour; extra reading, 2 hours; term paper, .5 hours. Prerequisite(s): upper-division standing, concurrent enrollment in BCH 197 or equivalent or BCH 110C or BIOL 107A; or consent of instructor. Introduction and discussion of experimental approaches and modern techniques in the study of gene regulation in eukaryotes.

BCH 180B. Methods in Chromatin Research (2) Lecture, 1 hour; seminar, 1 hour; extra reading, 2 hours; term paper, .5 hours. Prerequisite(s): upper-division standing, concurrent enrollment in BCH 197 or equivalent or BCH 110C or BIOL 107A; or consent of instructor. Introduction and discussion of the experiments and methods in studying DNA-dependent processes in the context of chromatin.

BCH 180C. Methods in Cell Signaling (2) Lecture, 1 hour; seminar, 1 hour; extra reading, 2 hours; term paper, .5 hours. Prerequisite(s): upper-division standing, concurrent enrollment in BCH 197 or equivalent or BCH 110C or BIOL 107A; or consent of instructor. Introduction and discussion of the experimental approaches and modern techniques in the study of cell growth regulation, signal transduction, and cell death in cancer.

BCH 183. Plant Biochemistry (3) Lecture, 3 hours. Prerequisite(s): BCH 110A, BCH 110B; or BCH 100. The course is designed for the student interested in plant biochemistry who wishes to become informed about biochemical structures, systems and metabolic pathways which are unique to plants; for example, photosynthesis, nitrogen fixation, cell walls, and seed development and germination.

BCH 184. Topics in Physical Biochemistry (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BCH 100 with a grade of "C-" or better or BCH 110A with a grade of "C-" or better; CHEM 112C and either CHEM 109 or CHEM 110A; or consent of instructor. Lectures on the application of spectroscopy, imaging, and other physical methods in biochemistry including study of macromolecular structure, nucleic acid-protein interactions, subcellular structures, bioenergetics, mechanisms of enzymatic catalysis, enzyme kinetics, and metabolism.

BCH 186. Topics in Molecular Bioenergetics (3) Lecture, 3 hours. Prerequisite(s): BCH 100 with a grade of "C-" or better or BCH 110B with a grade of "C-" or better; BCH 184 with a grade of "C-" or better; or consent of instructor. Introduction to biological energy transduction. Describes the coupling of oxidative phosphorylation and photosynthesis to adenosine triphosphate (ATP) synthesis and the coupling of ATP hydrolysis to ion transport, chemotaxis, molecular motors, biomimetics, and other biological processes on the basis of recent structural and mechanistic studies of the protein complexes involved.

BCH 187. Fundamentals of Enzymology (3) Lecture, 3 hours. Prerequisite(s): BCH 100 or BCH 110A with a grade of C- or better. An introduction to the fundamental principles of enzymology. Specific topics include, acid-base catalysis, strain effects, transition state theory, enzyme kinetics (including isotope effects), enzyme dynamics and enzyme regulation. Considers in detail the reactions of several representative enzymes.

BCH 188. Introduction to Oral Presentations (2) Seminar, 1 hour; discussion, 1 hour. Prerequisite(s): upper-division standing; consent of instructor. Prepares science students for oral presentations and formal research talks. Includes student presentations and discussions. Also covers the electronic preparation of figures and tables.

BCH 189. Reading and Analysis of Scientific Articles (1) Lecture, 1 hour. Prerequisite(s): junior or senior standing or consent of instructor. Introduces students to the analysis of scientific articles. Students read current research papers, present the data, and learn to critique papers.

BCH 190. Special Studies (2-4) Individual study, 6-16 hours. Prerequisite(s): upper-division standing and consent of instructor. Literature review and tutorial in select modern biochemical topics. Course is repeatable.

BCH 197. Research for Undergraduate Students (1-4) Prerequisite(s): junior status and consent of the instructor. Directed research and preparation of written report. Course is repeatable.

BCH 198-I. Internship in Biochemistry (1-12) Internship, 3-36 hours. Prerequisite(s): BCH 102, consent of instructor, upper-division standing. An internship to provide students with on-the-job biochemical experience in government, industrial or clinical laboratories. Each individual project must be approved by the Biochemistry Department and the laboratory director where the internship is to be carried out. A written report is required. Graded Satisfactory (S) or No Credit (NC). May be repeated for a total of 12 units.

Graduate Courses

BCH 204. Genome Maintenance and Stability (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BCH 110C or BIOL 107A; BIOL 113 or BIOL 114 or CBNS 101; BIOL 102 is strongly recommended. Emphasizes chromosome-based processes that maintain genome integrity and ensure accurate genome transmission during cell division. Topics are drawn from the primary literature and include chromatin structure and composition, DNA repair and recombination, telomere function and chromosome maintenance, mitotic chromosome segregation, and checkpoint surveillance mechanisms. May be taken Satisfactory (S) or No Credit (NC) with consent of instructor and graduate advisor. Cross-listed with CMDB 204 and ENTX 204.

BCH 205. Signal Transduction Pathways in Microbes and Plants (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): graduate standing in the biological sciences, BIOL 107A or BIOL 113 or BIOL 114 or CBNS 101; or consent of instructor. Advanced topics in signal transduction pathways that regulate growth and development in plants and prokaryotic and eukaryotic microbes. Areas covered include two-component regulatory systems; quorum sensing; signaling via small and heterotrimeric G proteins; mitogen-activated protein kinase cascades; cAMP signaling; photoreceptors; plant hormone signaling; responses to low-oxygen stress; calcium signaling; and plant pathogenesis. Cross-listed with BPSC 205, CMDB 205, GEN 205, MCBL 205, and PLPA 205.

BCH 210. Biochemistry of Macromolecules (4) Lecture, 4 hours. Prerequisite(s): BCH 110A, BCH 110B, BCH 110C or equivalents; BCH 184 (may be taken concurrently); CHEM 109; graduate standing or consent of instructor. Discussion of recent advances in the knowledge of the molecular architecture of proteins and nucleic acids, especially with respect to new experimental approaches for analyzing their structure and function. Chemistry of the active site of enzymes.

BCH 211. Molecular Biology (3) Lecture, 3 hours. Prerequisite(s): BCH 110A, BCH 110B, BCH 110C or equivalents; graduate standing or consent of instructor. Advanced topics in molecular biology of the biosynthesis and regulation of DNA, RNA, and proteins. Some topics covered include the following: molecular anatomy of genes and chromosomes; DNA repair and recombination; regulation of genes in the cell cycle; telomerase; RNA processing and splicing; RNA editing; regulation of normal genes and oncogenes; chaperones and protein targeting.

BCH 212. Signal Transduction and Biochemical Regulation (3) Lecture, 2 hours; discussion, 1 hour. Prerequisite(s): BCH 110A, BCH 110B, BCH 110C or equivalents; graduate standing or consent of instructor. Advanced topics in signal transduction and biochemical regulation. Some topics covered include the following: protein kinases and protein phosphorylation; phosphatases and their role in regulation; function of

phosphorylation events in regulation of metabolism and growth; calcium and other ion channels as signal transduction mechanisms, steriod hormones receptor super family; immune system signal transduction events.

BCH 230 (E-Z). Advanced Topics in Biochemistry (2) Lecture, 1 hour; discussion, 1 hour. Prerequisite(s): BCH 100 or both BCH 110A and BCH 110B or consent of instructor. Addresses advances in a particular field of biochemistry by analysis of the recent literature. E. Structure of Biological Molecules; F. Enzyme Catalysis; G. Glycobiochemistry; H. Membrane Biochemistry; I. Cytoskeleton and Extracellular Matrix; J. Metabolism; K. Regulation of Chromatin Structure and Transcription; M. Genome Stability; N. Regulation of Protein Synthesis; O. Signal Transduction; Q. Cell Cycle Regulation; R. Biochemistry of Stress Responses; S. Biochemistry of Development and Aging; T. Molecular Basis of Genetic Diseases; U. Genomics and Proteomics; V. Emerging Topics in Biochemistry and Molecular Biology; W. Stem Cell Biology.

BCH 231. The Plant Genome (4) Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BCH 100, BIOL 107A; or BCH 110A, BCH 110B, BCH 110C; or consent of instructor. Gives students an appreciation for the structure of the plant nuclear, chloroplast, and mitochondrial genomes. Gene structure, regulation of gene expression, transposons, and methods of gene introduction are also emphasized. Cross-listed with BPSC 231.

BCH 240. Special Topics in Biochemistry (2) Lecture, 2 hours. Prerequisite(s): BCH 110A, BCH 110B, BCH 110C or equivalents (may be taken concurrently); graduate standing in Biochemistry or consent of instructor. Oral presentations and intensive small-group discussion of selected topics in the area of specialization of each faculty member. Course content emphasizes recent advances in the special topic area and varies accordingly. Transposable Elements and Insect Molecular Biology. **Atkinson**. Chromosome Segregation and Stability. **Bachant**. Mechanisms of Translational Control. **Bailey-Serres**. Biochemical Host—Parasite Relationships. **Beckage**. Signal Transduction in Fungi. **Borkovich**. Biochemical Pharmacology. **Byus**. Plant Stress Genomics. **Close**. Protein Expression and Plasticity of Brain Glutamate Receptors. **Curras-Collazo**. Photosynthesis: Electron Transfer and 0_2 Evolution. **Debus**. Specificity in Mitogen-Activated Kinase Cascades. **DeFea**. Enzymatic and Nonenzymatic Reactions. **Dunn**. Molecular Basis of Learning and Memory. **Ethell, I**. Plant Gene Expression. **Gallie**. Mutagenesis, Recombination, and Genomic Instability. **Grosovsky**. Steroid and Cyclic Nucleotide Metabolism. **Henry**. Molecular Farming. **Huang**. Mechanisms of Signal Transduction in Plants. **Larsen**. Tumor Suppressor and Cell Cycle Regulation. **Liu**. Research Topics in Endocrinology. **Luben**. Structure and Function of Transport Proteins. **Lytle**. Regulation of Eukaryotic Gene Transcription. **Martinez**. Chemokines in Healing and Disease. **Martins-Green**. Biosensors. **Mulchandani**. Mechanisms of Steroid Hormones. **Norman**. Insect Innate Immunity. **Raikhel, A**. Nutrient-Activated Gene Expression. **Raikhel, A**. Regulation of Primary Metabolism. **Roberts**. Stem Cell Biology. **Sato**. Chromatin. **Sauer.** Regulation of Tissue-Specific Gene Expression. **Sladek**. Regulation of Gene Expression. **Spindler**. Endothelial Cell Perturbation. **Stemerman**. Signal Transduction. **Traugh**. Plant Defense Mechanisms. **Walling**. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

BCH 241. Bioorganic Chemistry (3) Lecture, 3 hours. Prerequisite(s): BCH 100 or BCH 110A; BCH 184 or CHEM 110B; CHEM 112A, CHEM 112B, CHEM 112C; graduate standing or consent of instructor. Biochemical reactions discussed from a chemical standpoint, including reactions associated with bioenergetics, biosynthesis, and enzyme catalysis. Emphasis on reaction mechanisms. Cross-listed with CHEM 241.

BCH 250. Oral Presentations in Biochemistry (2) Seminar, 1 hour; discussion, 1 hour. Prerequisite(s): graduate standing. Training and practice in the presentation of biochemical concepts in both short and long seminar formats, using blackboard, overhead projector, and slides. Presentations are immediately and critically evaluated by both faculty and staff. Limited to 10 students.

BCH 251. Graduate Seminar in Biochemistry (2) Seminar, 1 hour; discussion, 1 hour. Prerequisite(s): BCH 250. Oral reports by graduate students on current research topics in biochemistry.

BCH 252. General Seminar in Biochemistry (1) Seminar, 1 hour. Prerequisite(s): graduate standing. Oral reports by faculty, graduate students, and visiting scholars on current research topics in biochemistry. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

BCH 261. Seminar in Genetics, Genomics, and Bioinformatics (1) Seminar, 1 hour. Prerequisite(s): graduate standing or consent of instructor. Oral reports by visiting scholars, faculty, and students on current research topics in Genetics, Genomics, and Bioinformatics. Graded Satisfactory (S) or No Credit (NC). Course is repeatable. Cross-listed with BIOL 261, BPSC 261, ENTM 261, GEN 261, and PLPA 261.

BCH 289. Special Topics in Neuroscience (2) Seminar, 2 hours. Prerequisite(s): graduate standing or consent of instructor. An interdisciplinary seminar consisting of student presentations and discussion of selected topics in neuroscience. Content and instructor(s) vary each time course is offered. Students who present a seminar receive a letter grade; other students receive a Satisfactory (S) or No Credit (NC) grade. Course is repeatable. Cross-listed with BIOL 289, CHEM 289, ENTM 289, NRSC 289, and PSYC 289.

BCH 290. Directed Studies (1-4) Outside research, 3-12 hours. Prerequisite(s): graduate standing in Biochemistry; consent of instructor and graduate advisor. Experimental or literature studies on specifically selected topics undertaken under the direction of a staff member. With prior approval of the graduate advisor, M.S. students may be assigned a letter grade; other students are graded Satisfactory (S) or No Credit (NC). Course is repeatable.

BCH 291. Individual Study in Biochemistry (1-6) Prerequisite(s): graduate standing in Biochemistry or consent of instructor. A program of studies designed to advise and assist candidates who are preparing for examinations. Open to M.S. and Ph.D. candidates; does not count toward the unit requirement for the M.S. degree. Graded Satisfactory (S) or No Credit (NC). Repeatable up to 6 units for pre-Master's students and up to 12 units for Ph.D. students prior to successful completion of the qualifying examination.

BCH 297. Directed Research (1-6) Prerequisite(s): graduate status in Biochemistry or consent of instructor. Directed research in preparation for dissertation projects performed prior to advancement to candidacy. Graded Satisfactory (S) or No Credit (NC).

BCH 299. Research for Thesis or Dissertation (1-12) Prerequisite(s): graduate status in Biochemistry or consent of instructor. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

Professional Courses

BCH 301. Teaching of Biochemistry at the College Level (1) Seminar, 1 hour. Prerequisite(s): graduate standing and consent of instructor. A program of weekly meetings and individual formative evaluations required of new biochemistry teaching assistants. Covers instructional methods and classroom/section activities most suitable for teaching Biochemistry. Conducted by the TA Development Program. Credit not applicable to graduate unit requirements. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

BCH 302. Apprentice Teaching (1-4) variable hours. Prerequisite(s): graduate standing; limited to departmental teaching assistants. Supervised teaching in lower- and upper-division Biochemistry courses. Required for all Biochemistry teaching assistants. Fulfills portion of the teaching requirements for Ph.D. Graded Satisfactory (S) or No Credit (NC). May be repeated for credit.

Bioengineering

Subject abbreviation: BIEN
The Marlan and Rosemary Bourns College of Engineering

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Jerome S. Schultz, Ph.D.

Assistant Professors
Jiayu Liao, Ph.D.
Julia Lyubovitsky, Ph.D.
Boris Hyle Park, Ph.D.
Valentine Vullev, Ph.D.
**

Adjunct Professor
Paul Citron, Ph.D.

Major

The major in Bioengineering allows students to complete a B.S. degree that provides a basic education to enter the fields of bioengineering and biotechnology.

Bioengineering is rooted in physics, mathematics, chemistry, biology, and the life sciences. It is the application of a systematic, quantitative, and integrative way of thinking about and approaching the solutions of problems important to biology, health, and clinical practice.

Bioengineers develop processes and products that are important for health and treatment of diseases, new materials, protecting environments, and food production. They are employed by the pharmaceutical, biotechnology, medical device, and environmental and food industries. For students interested in medicine, the bioengineering program provides the basic courses to prepare for application to medical schools.