BIOCHEMISTRY AND MOLECULAR BIOLOGY

Edmiston, Ch., Biochemistry and Molecular Biology Curriculum Committee: Amburgey-Peters, Fraga, T. Johnson, Morgan, Snider

Both biochemists and molecular biologists ask how the multitude of molecules found in biological systems interact to confer the amazing properties of living organisms. In fact, the disciplines of biochemistry and molecular biology are the two sides of the boundary between the classical disciplines of biology and chemistry. Both chemistry and biology continue to grow and draw inspiration from each other as investigators at this boundary learn more about how molecules interact to convert energy, build complex structures, maintain order, catalyze reactions, and convey information spatially and over time.

Requirements for a **major** in Biochemistry and Molecular Biology:

Biochemistry and Molecular Biology: 303, 331, 332
Chemistry: 111, 112, 211, 212
Biology: 210, 220, 305, 306.
Mathematics: 111 (or 107, 108)
Physics: 203 (or 101)
Independent Study: 401, 451, 452

The required courses listed above represent a strong and diversified major that will serve the needs of a liberally educated science major. Students interested in going to graduate school in chemistry, biochemistry, pharmacology, molecular biology, and related fields or intending to pursue careers in biotechnology or the pharmaceutical industry should also take as many as possible of the following courses:

Suggested courses:

Chemistry: 215, 318
Biology: One other upper-level biology course
Physics: 204 (or 102)
Mathematics: 112

Students who are more interested in meeting requirements for graduate work in a department with a strong biological emphasis (such as molecular, cellular, developmental or physiological biology) are advised to take additional biology courses that reflect their specific interests, such as Evolution, Development, Neurobiology, Plant Biology, or Microbiology. Majors who wish to meet all of the requirements that are recommended by the American Society of Biochemistry and Molecular Biology in its guidelines for a biochemistry major should take all of the suggested courses listed above.

The major is administered by a committee composed of equal numbers of faculty from the departments of Biology and Chemistry, of whom one is the chair for purposes of administration. Interested students should direct any questions about the major to the chair or his/her designee. A double major in either Biology or Chemistry and Biochemistry and Molecular Biology is not an option; neither is a minor offered in Biochemistry and Molecular Biology.

Courses in the major

CHEMISTRY 111. GENERAL CHEMISTRY I Emphasis is placed on the structure of the atom, chemical bonding, behavior of matter in the various pure states, solutions, stoichiometry, equilibria, energetics, and chemical reactivity. During the latter half of the second course, well-qualified students may apply to undertake special laboratory projects. [Q, +]

Course 111: Three class hours and one three-hour laboratory period per week. One and one-fourth course credits. Annually. Fall. [Q, +]

CHEMISTRY 112. GENERAL CHEMISTRY II Emphasis is placed on the structure of the atom, chemical bonding, behavior of matter in the various pure states, solutions, stoichiometry, equilibria, energetics, and chemical reactivity. During the latter half of the second course, well-qualified students may apply to undertake special laboratory projects. [Q, +]

Course 112: Three class hours and one three-hour laboratory period per week. Prerequisite: Chemistry 111. One and one-fourth course credits. Annually. Spring. [Q, +]

CHEMISTRY 211. ORGANIC CHEMISTRY I This course introduces students to the fundamental principles of organic chemistry. The structure, bonding, and reactivity of organic compounds will be studied. Functional groups, reaction mechanisms, spectroscopic techniques, data interpretation, and synthetic methods will be emphasized. The course particularly emphasizes critical thinking, application of general concepts to new examples, and problem-solving skills. This course includes three class hours and one three-hour laboratory period per week. Laboratory experiments are designed to teach students about key synthetic organic laboratory skills, reactions, techniques, and instrumentation. The experiments promote student independence and competency in the laboratory. Informational literacy, safety awareness, and scientific writing skills will also be developed. Prerequisite: Chemistry 112. One and one-fourth credits. Annually. Fall. [+]

CHEMISTRY 212. ORGANIC CHEMISTRY II This course builds on the fundamental principles of organic chemistry introduced in Chemistry 211. The study of organic structure, bonding, and reactivity continues with more complex molecules including aromatics, carbonyl compounds, amino acids, and carbohydrates. Advanced spectroscopic data analysis and multi-step syntheses of complex molecules will challenge students to be creative, critical thinkers. This course includes three class hours and one three-hour laboratory per week. The laboratory allows students to use skills learned in Chemistry 211, become more independent, and learn new synthetic techniques through multi-week projects involving synthesis and spectroscopic identification. Information literacy, safety, and scientific writing (notebooks, technical reports, summaries, and experimental plans) continue to be emphasized. This is a Writing Intensive (W) Course. It fulfills part of the College's writing requirement for graduation. Scientific writing is a distinct form of written communication that has its own conventions and idiosyncrasies. This course will build on scientific writing developed in Chemistry 211 to communicate research ideas, data, and scientific arguments. The subtleties of several forms of scientific writing (including notebooks, reports, data summaries, and experimental plans) will be addressed. Students will complete at least six writing assignments. Two of these assignments will be extensive formal laboratory reports. Time will be allotted during the laboratory for peer review of notebooks and reports, discussion of the writing process, and revision. The *ACS Style Guide* and *Writing in the Sciences* will serve as resources for understanding the prevailing conventions in scientific writing. Prerequisite: Chemistry 211. One and one-fourth credits. Annually. Spring. [W, +]

BIOLOGY 210. INTRODUCTION TO THE BIOLOGY OF ORGANISMS This introductory course considers the organismic level of biological organization. Representatives from all five kingdoms are studied, with emphasis on plants and animals. The course examines how organisms meet the demands of living, including the basic requirements of nutrition, gas exchange, internal transport, osmoregulation, excretion, integration, and reproduction. Biology 210, 220, and 230 may be taken in any order. Three class hours and one laboratory period weekly. One and one-quarter credits. Annually. Fall and Spring. [Q, +]

BIOLOGY 220. INTRODUCTION TO THE BIOLOGY OF CELLS This introductory course considers the cellular level of biological organization. Topics include cellular structure, bioenergetics, metabolism, biosynthesis, photosynthesis, cell division and growth, and molecular genetics. Biology 210, 220, and 230 may be taken in any order. Three class hours and one laboratory period weekly. One and one-quarter credits. Prerequisite: Previous or concurrent registration in Chemistry 112. Annually. Fall and Spring. [Q, +]

303. TECHNIQUES IN BIOCHEMISTRY AND MOLECULAR BIOLOGY This laboratory-based course will give students hands-on experience with experimental methods used in biochemistry and molecular biology. It is organized around a semester-long project in which students will design and work towards specific

research goals. This course counts for major credit in Biology and Chemistry. Prerequisites: Chemistry 112 and Biology 220. BMB majors are encouraged to have prior or concurrent enrollment in BMB 331. Annually. Fall.

BIOLOGY 305. CELL PHYSIOLOGY This course will focus on cellular processes including signal transduction, cellular organization, cell motility, the cytoskeleton, gene expression, and membrane processes. The class will emphasize the cellular and molecular basis of disease. Student-led investigations will be performed in the laboratory. Three lectures and one laboratory/discussion section a week. One and one-fourth course credits. Prerequisites: Biology 220 and Chemistry 112 or permission of the instructor. Annually. Fall and Spring. [W†]

BIOLOGY 306. GENETICS Introduction to the mechanisms of heredity as elucidated in prokaryotes and eukaryotes, using classical and molecular techniques. Advanced topics include the use of genetic analysis as a powerful tool for studying complex biological systems and the regulation of gene expression. The laboratory provides experience in basic and advanced methods of genetic analysis. Three classroom meetings and one laboratory/recitation period weekly. Prerequisites: Chemistry 112 and Biology 220. One and one-fourth course credits. Annually. Fall and Spring.

331. BIOCHEMISTRY I (See Biology and Chemistry) The main goal of this course is to analyze the structural properties of the four main groups of biological molecules — amino acids, nucleic acids, carbohydrates and lipids — with a goal of understanding the function of complex biological macromolecules and cellular processes. Structure, equilibria, thermodynamics and reactivity of biological macromolecules, with emphasis on proteins, are the course cornerstones. Principles of bioeneregetics and intermediary metabolism (glycolysis, citric acid cycle, and oxidative phosphorylation) also discussed. It is highly recommended that students concurrently take BMB 303: Techniques in Biochemistry and Molecular Biology. This course counts for major credit in Biology and Chemistry. Prerequisite: Chemistry 212. Suggested previous courses: Biology 210 and 220, and Chemistry 215 and 318. One course credit. Annually. Fall. [+]

332. BIOCHEMISTRY II (See Biology and Chemistry) A continuation of Biochemistry I with molecular and mechanistic emphasis on advanced cellular metabolism, signal transduction, as well as DNA, RNA and protein metabolism. Special topics in areas of biochemical genetics and recombinant DNA methodologies discussed. This course counts for major credit in Biology and Chemistry. Prerequisite: BMB 331 or permission of instructor. One course credit. Annually. Spring. [+]

401. INTRODUCTION TO INDEPENDENT STUDY This course focuses on scientific writing, experimental design, and informational retrieval systems, including accessing and evaluating the growing collection of molecular databases. Students will explore the literature related to their proposed I.S. thesis through a series of structured writing assignments. In addition, students will give a short presentation on their proposed project in class. The final major paper is a detailed proposal for a senior research project. Annually. Spring.

451, 452. INDEPENDENT STUDY THESIS An original investigation is conducted, culminating in a thesis and oral defense of the thesis. During the year each student will give at least one research poster and/or presentation on his or her Independent Study research topic. Normally a student will have one research advisor and the thesis will be read by the research advisor and one other professor. The evaluation of the thesis will be determined by these two readers in consultation with the other members of the Biochemistry and Molecular Biology Curriculum Committee. Prerequisite BMB 401.