

BIOCHEMISTRY AND MOLECULAR BIOLOGY (DIV III)

Chair: Professor DANIEL LYNCH

Advisory Committee: Professors: L. BANTA, A. GEHRING, L. KAPLAN***, C. LOVETT**, D. LYNCH, R. SAVAGE***, S. SWOAP**, C. TING. Associate Professor: L. MAROJA. Assistant Professors: J. BLAIR, P. CHEN, T. LEBESTKY, D. TURNER.

Biochemistry and molecular biology are dynamic fields that lie at the forefront of science. Through elucidation of the structure and function of biologically important molecules (such as nucleic acids, lipids, proteins, and carbohydrates) these disciplines have provided important insights and advances in the fields of molecular engineering (recombinant DNA technology, “intelligent” drug design, “in vitro evolution”), genomics and proteomics, signal transduction, immunology, developmental biology, and evolution.

The Biochemistry and Molecular Biology Program is designed to provide students with an opportunity to explore living systems in molecular terms. Biochemistry and molecular biology are at the interface between the chemical and biological methods of looking at nature; therefore, the program draws heavily from these disciplines. While chemistry is concerned with the relationship between molecular structure and reactions, and biology focuses on cells and organisms, biochemistry and molecular biology probe the details of the structures and interactions of molecules in living systems in order to provide the foundation for a better understanding of biological molecules both individually and as members of more complex structures.

PROGRAM

While aspects of biochemistry and molecular biology can be very diverse, a common set of chemical and biological principles underlie the more advanced topics. With this in mind, the program has been structured to provide the necessary background in chemistry and biology and the opportunity to study the many facets of the modern areas of the biochemical sciences. Students interested in the Biochemistry and Molecular Biology Program should plan their course selection carefully. Since it is expected that Biochemistry 321 and 322 would be taken in the junior year, students are advised to take the prerequisites for those courses in both chemistry and biology during their first two years at Williams. While the program is open to all students, it is expected that it will appeal primarily to majors in biology and chemistry because of the number of courses required in those fields. In addition to taking the required courses, students planning to complete the Biochemistry and Molecular Biology Program are strongly encouraged to elect courses in mathematics and physics.

The following interdepartmental courses serve as the core of the Biochemistry and Molecular Biology Program. BIMO 321 and 322 provide a comprehensive introduction to biochemistry. BIMO 401, the capstone course for the concentration, provides students the opportunity to examine the current scientific literature in a wide variety of BIMO-related research areas.

To complete the concentration in Biochemistry and Molecular Biology, a student must complete all of the required courses listed below, take at least one elective in biology and one elective in chemistry from the list below, and attend at least eight Biology and/or Chemistry Department colloquia. Since the Chemistry Department counts two biology courses and the Biology Department counts two chemistry courses toward the majors (each of which can be completed with only eight other courses), a student majoring in either chemistry or biology would have to take only two or three additional courses to complete the program.

Required Courses

BIMO 321/BIOL 321/CHEM 321 Biochemistry I: Structure and Function of Biological Molecules
BIMO 322/BIOL 322/CHEM 322 Biochemistry II: Metabolism
BIMO 401 Topics in Biochemistry and Molecular Biology
BIOL 101 The Cell
BIOL 102 The Organism
BIOL 202 Genetics
CHEM 151 Introductory Chemistry *or*
CHEM 153 Concepts of Chemistry *or*
CHEM 155 Principles of Modern Chemistry
CHEM 156 Organic Chemistry: Introductory Level
CHEM 251 Organic Chemistry: Intermediate Level
CHEM 256 Advanced Chemical Concepts (not required if CHEM 155 was taken)

Students can check with the program chair to see if other courses not listed here might count as electives.

Elective Courses

BIOL 301 Developmental Biology
BIOL 306 Cellular Regulatory Mechanisms
BIOL 308 Integrative Plant Biology: Fundamentals and New Frontiers
BIOL 310/NSCI 310 Neural Development and Plasticity
BIOL 313 Immunology
BIOL 315 Microbiology: Diversity, Cellular Physiology, and Interactions
BIOL 319/MATH 319/CHEM 319/PHYS 319/CSCI 319 Integrative Bioinformatics, Genomics, and Proteomics Lab
BIOL 326 Cellular Assembly and Movement
BIOL 406 Dynamics of Membrane Systems
BIOL 407/NSCI 347 Neurobiology of Emotion
BIOL 408 RNA Worlds
BIOL 410 Nanomachines in Living Systems
BIOL 414 Life at Extremes: Molecular Mechanisms
BIOL 416 Epigenetics
BIOL 418 Signal Transduction to Cancer

BIOL 426 Frontiers in Muscle Physiology: Controversies
BIOL 430 Genome Sciences: At the Cutting Edge
CHEM 324 Enzyme Kinetics and Reaction Mechanisms
CHEM 326 Chemical Biology: Discoveries at the Interface
CHEM 338 Bioinorganic Chemistry
CHEM 341/ENVI 341 Toxicology and Cancer
CHEM 342 Synthetic Organic Chemistry
CHEM 343 Medicinal Chemistry
CHEM 344 Physical Organic Chemistry
CHEM 348 Polymer Chemistry
CHEM 364/ENVI 364 Instrumental Methods of Analysis
CHEM 366 Thermodynamics and Statistical Mechanics
CHEM 367 Biophysical Chemistry

Colloquium Requirement

Concentrators must attend at least eight Biology and/or Chemistry Department colloquia. The Biology and Chemistry Departments hold colloquia on Friday afternoons during the fall and spring semesters. Scientists from other academic or research institutions are invited to present their research to students and faculty. There are approximately a dozen colloquia offered each semester among which BIMO concentrators may choose. Attendance at the honors student research presentations and the Biology/BIMO Alumni Reunion poster session also count toward the colloquium requirement. Concentrators may receive credit for colloquia attended during any of their semesters at Williams College.

BIMO 321(F) Biochemistry I: Structure and Function of Biological Molecules (Q)

Crosslistings: BIMO 321/BIOL 321/CHEM 321

This course introduces the basic concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The laboratory provides a hands-on opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays.

Class Format: lecture, three hours per week; laboratory, four hours per week

Requirements/Evaluation: evaluation is based on quizzes, a midterm exam, a final exam, problem sets and performance in the laboratories including lab reports

Extra Info: may not be taken on a pass/fail basis

Prerequisites: BIOL 101 and CHEM 251/255 and CHEM 155/256

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Enrollment Limit: 48

Expected Class Size: 48

Dept. Notes: does not satisfy the distribution requirement in the Biology major

Distributional Requirements:

Division 3

Quantitative/Formal Reasoning

Other Attributes:

BGNP Related Courses

BIMO Required Courses

Fall 2016

LEC Section: 01 MWF 10:00 AM 10:50 AM Instructor: Lawrence Kaplan

LAB Section: 02 M 01:00 PM 05:00 PM

LAB Section: 03 W 01:00 PM 05:00 PM

LAB Section: 04 R 01:00 PM 05:00 PM

BIMO 322(S) Biochemistry II: Metabolism (Q)

Crosslistings: BIMO 322/BIOL 322/CHEM 322

This lecture course provides an in-depth presentation of the complex metabolic reactions which are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: lecture, three hours per week; laboratory, three hours per week

Requirements/Evaluation: evaluation is based on several exams and performance in the laboratories including lab reports that emphasize conceptual and quantitative and/or graphic analysis of the data generated

Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option

Prerequisites: BIOL 101 and CHEM 251/255 or permission of instructor

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Enrollment Limit: 64

Expected Class Size: 64

Dept. Notes: does not satisfy the distribution requirement in the Biology major

Distributional Requirements:

Division 3

Quantitative/Formal Reasoning

Other Attributes:

BGNP Related Courses

BIMO Required Courses

Spring 2017

LEC Section: 01 MWF 10:00 AM 10:50 AM Instructor: Daniel Lynch

LAB Section: 02 T 01:00 PM 04:00 PM

LAB Section: 03 W 01:00 PM 04:00 PM

LAB Section: 04 R 01:00 PM 04:00 PM

BIMO 401(S) Topics in Biochemistry and Molecular Biology (W)

This seminar course involves critical reading, analysis, and discussion of papers from the current biochemistry and molecular biology literature. Specific topics vary from year to year but are chosen to illustrate the importance of a wide range of both biological and chemical approaches to addressing important questions in the biochemical and molecular biological fields. To facilitate discussion, students will prepare written critiques analyzing the data and conclusions of the chosen literature.

Class Format: seminar, three hours per week

Requirements/Evaluation: evaluation will be based on class presentations and discussions, frequent short papers, and a final paper

Extra Info: may not be taken on a pass/fail basis; not available for the fifth course option

Prerequisites: BIOL 202 and BIMO 321

Enrollment Preferences: those completing the BIMO program; open to others with permission of instructor

Enrollment Limit: 12

Expected Class Size: 10

Distributional Requirements:

Division 3

Writing Intensive

Other Attributes:

BIMO Required Courses

Spring 2017

SEM Section: 01 W 01:10 PM 03:50 PM Instructor: Amy Gehring

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