BIOCHEMISTRY AND MOLECULAR BIOLOGY (Div III)

Chair: Associate Professor Luana S. Maroja

Advisory Committee

- Lois M. Banta, Chair and Halvorsen Professor for Distinguished Teaching and Research of Biology
- Pei-Wen Chen, Assistant Professor of Biology
- Amy Gehring, Philip and Dorothy Schein Professor of Chemistry; on leave Fall 2021
- Katie M. Hart, Assistant Professor of Chemistry; on leave 2021-2022
- Tim J. Lebestky, Associate Professor of Biology, Chair of Neuroscience Program; affiliated with: Neuroscience Program
- David W. Loehlin, Assistant Professor of Biology
- Luana S. Maroja, Associate Professor of Biology, Chair of Biochemistry & Molecular Biology Program; affiliated with: Biochemistry&Molecular Bio Pgr; on leave Fall 2021
- Robert M. Savage, Charles L. MacMillan Professor in Natural Sciences
- Steven J. Swoap, Howard B. Schow '50 and Nan W. Schow Professor of Biology and Director of the Williams-Exeter Programme at Oxford University; affiliated with: Williams-Exeter Prg at Oxford
- Claire S. Ting, Professor of Biology
- Damian Turner, Assistant Professor of Biology

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(F) LEC Biochemistry I: Structure and Function of Biological Molecules

Taught by: Ben Thuronyi
Catalog details

BIMO 322 / BIOL 322 / CHEM 322(S) LEC Biochemistry II: Metabolism

Taught by: Cynthia Holland
Catalog details

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

Taught by: Amy_Gehring
Catalog details

BIOL 101(F) LEC The Cell

Taught by: Damian_Turner, Cynthia Holland
Catalog details

BIOL 102(S) LEC The Organism

Taught by: Robert Savage, Allison Gill, Ron Bassar
Catalog details

BIOL 202(F) LEC Genetics

Taught by: David Loehlin
Catalog details

CHEM 151(F) LEC Introductory Chemistry

Taught by: Sarah Goh
Catalog details

CHEM 153(F) LEC Concepts of Chemistry

Taught by: Lee Park
Catalog details

CHEM 155(F) LEC Principles of Modern Chemistry

Taught by: Christopher_Goh
Catalog details

CHEM 156(S) LEC Organic Chemistry: Introductory Level

Taught by: Ben Thuronyi, Kerry-Ann_Green
Catalog details

CHEM 251(F) LEC Organic Chemistry: Intermediate Level

Taught by: Thomas Smith, Amanda Turek
Catalog details

CHEM 256(S) LEC Advanced Chemical Concepts

Taught by: Lee Park
Catalog details

Elective Courses

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

BIOL 305(S) LEC Evolution

Taught by: Luana Maroja
Catalog details

BIOL 308(S) LEC Integrative Plant Biology: Fundamentals and New Frontiers

Taught by: Claire Ting
Catalog details

BIOL 312 / NSCI 312(F) LEC Sensory Biology

Taught by: Heather_Williams
Catalog details

BIOL 313 LEC Immunology

Taught by: Damian_Turner
Catalog details

BIOL 315(S) LEC Microbiology: Diversity, Cellular Physiology, and Interactions

Taught by: Lois Banta
Catalog details

BIOL 319 / CHEM 319 / CSCI 319 / MATH 319 / PHYS 319 SEM Integrative Bioinformatics, Genomics, and Proteomics Lab

Taught by: Lois Banta
Catalog details

BIOL 326(F) LEC Cellular Assembly and Movement

Taught by: Pei-Wen_Chen
Catalog details

BIOL 330(S) LEC Genomes: Structure, Function, Evolution

Taught by: David Loehlin
Catalog details

BIOL 407 / NSCI 347(S) SEM Neurobiology of Emotion

Taught by: Tim Lebestky
Catalog details

BIOL 410 SEM Nanomachines in Living Systems

Taught by: Pei-Wen Chen
Catalog details

BIOL 411 TUT Developmental Biology: From Patterning to Pathogenesis

Taught by: Robert Savage
Catalog details

BIOL 414(F) SEM Life at Extremes: Molecular Mechanisms

Taught by: Claire Ting
Catalog details

BIOL 418 SEM Signal Transduction to Cancer

Taught by: Robert Savage
Catalog details

BIOL 419 SEM Secrets of Enzymes: Fidelity, Promiscuity, and Disease

Taught by: Cynthia Holland
Catalog details

BIOL 430 TUT Genome Sciences: At the Cutting Edge

Taught by: Claire Ting
Catalog details

CHEM 324(S) LEC Enzyme Kinetics and Reaction Mechanisms

Taught by: Amy Gehring
Catalog details

CHEM 326 SEM Chemical and Synthetic Biology

Taught by: Ben Thuronyi
Catalog details

CHEM 338 TUT Bioinorganic Chemistry: Metals in Living Systems

Taught by: Christopher Goh
Catalog details

CHEM 341 / ENVI 341 LEC Toxicology and Cancer

Taught by: David Richardson
Catalog details

CHEM 342(S) LEC Synthetic Organic Chemistry

Taught by: Thomas Smith
Catalog details

CHEM 344(S) LEC Physical Organic Chemistry

Taught by: Amanda Turek
Catalog details

CHEM 348 LEC Polymer Chemistry

Taught by: Sarah Goh
Catalog details

CHEM 364 / ENVI 364(S) LEC Instrumental Methods of Analysis

Taught by: Christopher Goh
Catalog details

CHEM 366(S) LEC Thermodynamics and Statistical Mechanics

Taught by: Enrique Peacock-López
Catalog details

CHEM 367 LEC Biophysical Chemistry

Taught by: Bob Rawle
Catalog details

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 (QFR)

Cross-listings: BIMO 321 BIOL 321 CHEM 321

Primary Cross-listing

This course introduces the foundational 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 in-person laboratory provides further opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays. A laboratory section will also be provided for remote students, which will examine similar topics and techniques through literature and data analysis.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: quizzes, two midterm exams, a final exam, problem sets and performance in the laboratories including lab reports

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

Enrollment Limit: 16/lab

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

Expected Class Size: 48

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIMO 321 (D3) BIOL 321 (D3) CHEM 321 (D3)

Quantative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular problem sets in which quantitative/formal reasoning skills are practiced.

Attributes: BIGP Courses BIMO Required Courses

Fall 2021

LEC Section: 01 MWF 10:00 am - 10:50 am Ben W. Thuronyi

LAB Section: 02 M 1:00 pm - 5:00 pm Ben W. Thuronyi

LAB Section: 03 T 1:00 pm - 5:00 pm Ben W. Thuronyi

LAB Section: 04 R 1:00 pm - 5:00 pm Jenna L. MacIntire

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

Cross-listings: BIOL 322 CHEM 322 BIMO 322

Primary Cross-listing

This lecture course provides an in-depth presentation of the complex metabolic reactions that 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 and laboratory two hours per week.

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

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

Enrollment Limit: 60

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

Expected Class Size: 60

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 322 (D3) CHEM 322 (D3) BIMO 322 (D3)

Quantative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Attributes: BIGP Courses BIMO Required Courses

Spring 2022

LEC Section: 01 TR 9:55 am - 11:10 am Cynthia K. Holland

LAB Section: 02 T 1:00 pm - 4:00 pm Janis E. Bravo

LAB Section: 03 W 1:00 pm - 4:00 pm Janis E. Bravo

LAB Section: 04 R 1:00 pm - 4:00 pm Janis E. Bravo

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

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: three hours per week

Requirements/Evaluation: class presentations and discussion, frequent short papers, and a final paper

Prerequisites: BIOL 202 and BIMO 321

Enrollment Limit: 12

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

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (WS)

Writing Skills Notes: The critical analysis of published papers in the biochem literature, as expressed in clear and succinct writing, is a key learning goal for the course. The students write seven literature critiques (typically 5-6 pages long) throughout the semester. While the specific topic each week differs, the parameters of the assignment are the same each time, allowing students to progressively improve their writing. I provide extensive written feedback on each critique, returned before the next due date

Attributes: BIMO Required Courses

Spring 2022

SEM Section: 01 W 1:10 pm - 3:50 pm Amy Gehring

Winter Study ----------

BIMO 99 (W) Independent Study: Biochemistry and Molecular Biology

Open to upperclass students. Students interested in doing an independent project (99) during Winter Study must make prior arrangements with a faculty sponsor. The student and professor then complete the independent study proposal form available online. The deadline is typically in late September. Proposals are reviewed by the pertinent department and the Winter Study Committee. Students will be notified if their proposal is approved prior to the Winter Study registration period.

Class Format: independent study

Grading: pass/fail only

Winter 2022

IND Section: 01 TBA Luana S. Maroja