

## BIOCHEMISTRY AND MOLECULAR BIOLOGY (Div III)

Chair: Associate Professor Pei-Wen Chen

### Advisory Committee

- Lois M. Banta, Halvorsen Professor for Distinguished Teaching and Research of Biology; on leave Fall 2024
- Pei-Wen Chen, Associate Professor of Biology, Chair of Biochemistry & Molecular Biology Program; affiliated with: Biology, BIMO (Biochemistry and Molecular Biology)
- Amy Gehring, Philip and Dorothy Schein Professor of Chemistry, Director of the Science Center; on leave Spring 2025
- Katie M. Hart, Assistant Professor of Chemistry
- Tim J. Lebestky, Associate Professor of Biology; affiliated with: Biology, Neuroscience; on leave 2024-2025
- David W. Loehlin, Assistant Professor of Biology; on leave Fall 2024
- Luana S. Maroja, Professor of Biology; on leave Spring 2025
- Robert M. Savage, Chair of Biology and Charles L. MacMillan Professor in Natural Sciences
- Steven J. Swoap, Howard B. Schow '50 and Nan W. Schow Professor of Biolog; on leave Spring 2025
- Claire S. Ting, 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: [B. Thuronyi](#)  
[Catalog details](#)

[BIMO 322 / BIOL 322 / CHEM 322\(S\) LEC Biochemistry II: Metabolism](#)

Taught by: [Caitlyn Bowman-Cornelius](#)  
[Catalog details](#)  
[BIMO 401\(S\) SEM Topics in Biochemistry and Molecular Biology](#)

Taught by: [Katie Hart](#)  
[Catalog details](#)  
[BIOL 101\(F\) LEC The Cell](#)

Taught by: [Pei-Wen Chen](#), [Caitlyn Bowman-Cornelius](#), [Robert Savage](#)  
[Catalog details](#)  
[BIOL 102\(S\) LEC The Organism](#)

Taught by: [Robert Savage](#), [Claire Ting](#)  
[Catalog details](#)  
[BIOL 202\(F\) LEC Genetics](#)

Taught by: [Luana Maroja](#)  
[Catalog details](#)  
[CHEM 101\(F, S\) LEC Concepts of Chemistry](#)

Taught by: [Bob Rawle](#), [Lee Park](#), [Ben Augenbraun](#)  
[Catalog details](#)  
[CHEM 200\(S\) LEC Advanced Chemical Concepts](#)

Taught by: [Enrique Peacock-López](#)  
[Catalog details](#)  
[CHEM 201\(F\) LEC Organic Chemistry: Introductory Level](#)

Taught by: [Kerry-Ann Green](#), [Amanda Turek](#)  
[Catalog details](#)  
[CHEM 242\(S\) LEC Organic Chemistry: Intermediate Level](#)

Taught by: [Thomas Smith](#), [B. Thuronyi](#)  
[Catalog details](#)

## Elective Courses

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

[BIOL 303\(F\) LEC Pharmacology](#)

Taught by: [Cynthia Holland](#)  
[Catalog details](#)  
[BIOL 305\(S\) LEC Evolution](#)

Taught by: TBA  
[Catalog details](#)  
[BIOL 308\(F\) LEC Integrative Plant Biology: Fundamentals and New Frontiers](#)

Taught by: [Claire Ting](#)  
[Catalog details](#)  
[BIOL 312 / NSCI 312 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 LEC Cellular Assembly and Movement](#)

Taught by: [Pei-Wen Chen](#)  
[Catalog details](#)  
[BIOL 330 LEC Genomes: Structure, Function, Evolution](#)

Taught by: [David Loehlin](#)  
[Catalog details](#)  
[BIOL 407 / NSCI 347 SEM Neurobiology of Emotion](#)

Taught by: [Tim Lebestky](#)  
[Catalog details](#)  
[BIOL 408\(S\) SEM RNA Worlds](#)

Taught by: [David Loehlin](#)  
[Catalog details](#)  
[BIOL 419\(S\) SEM Secrets of Enzymes: Fidelity, Promiscuity, and Disease](#)

Taught by: [Cynthia Holland](#)  
[Catalog details](#)

[BIOL 436 SEM Metabolites as Messengers](#)

Taught by: [Caitlyn Bowman-Cornelius](#)

[Catalog details](#)

[BIOL 440\(S\) TUT Cell Signaling and Tissue Engineering: A Potential Fountain of Youth?](#)

Taught by: [Pei-Wen Chen](#)

[Catalog details](#)

[CAOS 414 Life at Extremes: Molecular Mechanisms](#)

Taught by: [Claire Ting](#)

[Catalog details](#)

[CHEM 324 LEC Enzyme Kinetics and Reaction Mechanisms](#)

Taught by: [Amy Gehring](#)

[Catalog details](#)

[CHEM 326 SEM Chemical and Synthetic Biology](#)

Taught by: [B Thuronyi](#)

[Catalog details](#)

[CHEM 342 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\(S\) LEC Polymer Chemistry](#)

Taught by: [Sarah Goh](#)

[Catalog details](#)

[CHEM 364 / ENVI 364 LEC Instrumental Methods of Analysis](#)

Taught by: Stephanie Christau, [Christopher Goh](#)

[Catalog details](#)

[CHEM 366\(F\) LEC Thermodynamics and Statistical Mechanics](#)

Taught by: [Enrique Peacock-López](#)

[Catalog details](#)

[CHEM 367\(S\) 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:** 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 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 times per week and laboratory, four hours per week

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

**Prerequisites:** BIOL 101, CHEM 200 and CHEM 201; or either CHEM 155 or 256 and CHEM 251

**Enrollment Limit:** 12/lab

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

**Expected Class Size:** 36

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

**Unit Notes:** 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 321(D3) BIMO 321(D3) CHEM 321(D3)

**Quantitative/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 2024

LEC Section: 01 MWF 10:00 am - 10:50 am B Thuronyi

LAB Section: 02 T 1:00 pm - 5:00 pm B Thuronyi

LAB Section: 03 W 1:00 pm - 5:00 pm Jenna L. MacIntire

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

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

**Cross-listings:** CHEM 322 / BIOL 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 three 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, plus either: CHEM 156 and CHEM 256, or CHEM 155 and CHEM 156, or CHEM 200 and CHEM 201, or permission of instructor

**Enrollment Limit:** 48

**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:** 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 322(D3) CHEM 322(D3) BIOL 322(D3)

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

**Attributes:** BIGP Courses BIMO Required Courses

Spring 2025

LEC Section: 01 TR 11:20 am - 12:35 pm Caitlyn E. Bowman-Cornelius

LAB Section: 02 M 1:00 pm - 3:50 pm Caitlyn E. Bowman-Cornelius

LAB Section: 03 W 1:00 pm - 3:50 pm Caitlyn E. Bowman-Cornelius

LAB Section: 04 R 1:00 pm - 3:50 pm Caitlyn E. Bowman-Cornelius

**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 2025

SEM Section: 01 W 1:10 pm - 3:50 pm Katie M. Hart

**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 2025

IND Section: 01 TBA Pei-Wen Chen