BIOCHEMISTRY

Overview and Contact Information

The major in biochemistry is intended to provide a strong background in the fundamentals of both biology and chemistry and to develop an awareness of the unique principles of biochemistry.

Biochemistry is the study of reactions that underpin the living system. These include the vital metabolic reactions that provide cells with energy to perform myriad activities and functions, and the biosynthetic reactions that enable cells to renew, repair, grow, and divide. The linkage of biochemistry with molecular biology for the past 30 years has brought revolutionary advances in our understanding of the living world, the human organism, disease etiology, and medicine.

The interdisciplinary major in biochemistry offers a rigorous course of study that builds on two years of fundamental course work in biology and chemistry. With this broad preparation, students engage with biochemistry and molecular biology at a very high level, allowing them to integrate their knowledge in molecular and cellular biology, and to think and address issues occurring at the forefront of the biochemical/biomedical sciences. Majors are also encouraged to participate in academic-year and/or summer research and majors usually have more than one research internship experience before graduation.

See Also

- Chemistry (http://catalog.mtholyoke.edu/areas-study/chemistry/)
- Biological Sciences (http://catalog.mtholyoke.edu/areas-study/biological-sciences/)

Contact Information

Amy Camp, Co-chair
Darren Hamilton, Co-chair
Dina Bevivino, Academic Department Coordinator

G04 Carr Laboratory
413-538-2214
https://www.mtholyoke.edu/acad/biochemistry (https://www.mtholyoke.edu/acad/biochemistry/)

Learning Goals

Knowledge-Based Learning Goals

- Use energy, kinetics, and thermodynamics to develop a quantitative and mechanistic view of biological systems.
- Explain the structures, functions, and interactions of biomolecules.
- Describe the flow of information within a cell and between cells.
- Use chemical and biological logic to interpret metabolic pathways and their regulation.
- Apply biochemical knowledge to human health, technology, and society.

Skill-Based Learning Goals

- Employ responsible and ethical practices in data collection and analysis, reporting, and attribution.
- Critically evaluate primary scientific literature.
- Interpret and critically analyze data.
- Design and conduct independent experiments in biochemistry, using modern instrumentation.
- Effectively communicate scientific information in oral, written and visual formats to scientific and broader audiences.
- Collaborate to pursue common goals.
- Assess safety concerns in the laboratory and employ best practices.

Faculty

This area of study is administered by the Biochemistry Committee:
Craig Woodard, Christianna Smith Professor of Biological Sciences, Teaching Fall Only

Jason Andras, Associate Professor of Biological Sciences

Kyle Broaders, Associate Professor of Chemistry, Teaching Spring Only

Amy Camp, Associate Professor of Biological Sciences

Kathryn McMenimen, Associate Professor of Chemistry, On Leave 2021-2022

Alan Van Giessen, Associate Professor of Chemistry, Teaching Fall Only

Katie Berry, Clare Boothe Luce Assistant Professor of Biochemistry

Rebeccah Lijek, Assistant Professor of Biological Sciences, Teaching Spring Only

Tommy Tashjian, Visiting Lecturer in Biochemistry

Requirements for the Major

A minimum of 49 credits:

Code	Title	Credits
CHEM-150	General Chemistry: Foundations of Structure and Reactivity	4
or CHEM-160	Integrated Introduction to Biology and Chemistry	
CHEM-202	Organic Chemistry I	4
CHEM-302	Organic Chemistry II	4
CHEM-231	Inorganic Chemistry	4
As a prerequisite for CHEM-308 or CHEM-346:		
MATH-203	Calculus III	
CHEM-308	Chemical Thermodynamics with Lab	4
or CHEM-346	Physical Chemistry of Biochemical Systems With Lab	
BIOL-145	Introductory Biology [2]	4
or BIOL-160	Integrated Introduction to Biology and Chemistry	
BIOL-200	Introductory Biology II: How Organisms Develop	4
BIOL-230	Molecular Genetics and Cell Biology	4
BIOCH-311	Protein Biochemistry and Cellular Metabolism	4
BIOCH-318	Laboratory Techniques in Protein Biochemistry	1
BIOCH-314	Nucleic Acids Biochemistry and Molecular Biology	4
8 additional credits elected from 300-level courses in biochemistry, biology, or chemistry [1]		8
Total Credits		**49**

1 This requirement is intended to increase the breadth and depth of your knowledge and application of biochemistry through related 300-level course work.

2 Students may select any BIOL-145 topic, such as BIOL-145AB, BIOL-145BN, BIOL-145GW and BIOL-145RG.

Other Requirements

- Senior Symposium. All seniors must give an oral presentation on a biochemical topic in the Senior Symposium.

Additional Specifications

- Students who are interested in taking the biochemistry core courses (BIOCH-311 and BIOCH-314) in their junior year are encouraged to complete at least CHEM-150 (or CHEM-160) and BIOL-145 (or BIOL-160) and BIOL-200 during the first year.
- A student coming to the College with advanced credits from IB or A-level course work or Advanced Placement examinations, in accordance with the number of advanced credits received, should consult with the program chair or other members of the Biochemistry Program Committee to determine the appropriate placement for introductory courses in both biology and chemistry.
- The committee further recommends CHEM-325 to students planning graduate work in biochemistry.
- Independent study 295 or 395 does not count towards the minimum of 49 required credits.
- Students who declare a biochemistry major automatically fulfill the College's "outside the major" requirement.

Course Offerings

BIOCH-295 Independent Study
Fall and Spring. Credits: 1 - 4
Independent work in biochemistry can be conducted with any member of the biochemistry committee and, upon approval, also with other members of the biological sciences and chemistry departments and program in neuroscience and behavior.
The department
Instructor permission required.
Notes: Students conducting an independent lab research project for credit in a department, program, or lab covered by the College's chemical hygiene plan must participate in a safety training session before beginning research.

BIOCH-311 Protein Biochemistry and Cellular Metabolism
Fall. Credits: 4
This course is a rigorous introduction to the study of protein molecules and their role as catalysts in the cell. Topics include general principles of protein folding, protein structure-function correlation, enzyme kinetics and mechanism, carbohydrate and lipid biochemistry, and metabolic pathways (catabolic and anabolic) and their interaction and cross-regulation. Biological transformation of energy is considered in light of the principles of thermodynamics.
Crosslisted as: BIOL-311, CHEM-311
Applies to requirement(s): Math Sciences
K. Berry
Restrictions: This course is limited to Biochemistry majors only.
Prereq: BIOL-230, and CHEM-302, and CHEM-231. Coreq: BIOCH-318.

BIOCH-312 Chemistry of Biomolecules
Fall. Credits: 4
An examination of the major ideas of biochemistry from the point of view of the chemical sciences rather than the life sciences. The focus will be on structure and reactivity of important biomolecules and the role of energetics and reaction dynamics in biochemical processes. Major metabolic pathways are covered, including those of proteins, carbohydrates, lipids, and nucleic acids.
Crosslisted as: CHEM-312
Applies to requirement(s): Math Sciences
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Prereq: CHEM-202 with a grade of C or better.
Advisory: This course is NOT intended for biochemistry majors, who must take BIOCH-311 and BIOCH-314. BIOCH-312 students may take BIOCH-318 concurrently.

BIOCH-314 Nucleic Acids Biochemistry and Molecular Biology
Spring. Credits: 4
This course is an in-depth examination of DNA and RNA structures and how these structures support their respective functions during replication, transcription, and translation of the genetic material. Emphasis is on the detailed mechanisms associated with each step of gene expression. Discussions incorporate many recent advances brought about by recombinant DNA technology.
Crosslisted as: BIOL-314, CHEM-314
Applies to requirement(s): Math Sciences
K. Berry
Restrictions: This course is limited to Biochemistry majors only.
Prereq: BIOCH-311. Coreq: BIOCH-314L.

BIOCH-318 Laboratory Techniques in Protein Biochemistry
Fall. Credits: 1
This course covers fundamental laboratory techniques in protein biochemistry and data analysis. The aims of this course are: 1) to provide students with practical knowledge and hands-on experience with some of the most common experimental methods used in biochemical research, and 2) to develop the skills in written and oral scientific communication. The course focuses on protein overexpression and purification and also includes reagent preparation, proper use of instrumentation, SDS-PAGE gel analysis, enzyme activity assays, protein structure viewing, experimental design and utilizing computers to analyze and present data. Laboratory safety is also emphasized.
Applies to requirement(s): Meets No Distribution Requirement
The department
Coreq: BIOCH-311 students must co-enroll in this lab course. CHEM-312/ BIOCH-312 students may co-enroll.

BIOCH-330 Topics in Biochemistry and Molecular Biology
This course each year examines a number of important and exciting topics in biochemistry, molecular biology, and other related fields of biology. The intellectual and research development that formulated these fundamental concepts is traced through extensive readings of the primary literature. Discussions emphasize the critical evaluation of experimental techniques, data analysis, and interpretation. This is a seminar-style course in which students will bear responsibility for the synthesis and presentation of assigned papers; substantial student participation in the form of oral presentation is expected.

BIOCH-330RN Topics in Biochemistry and Molecular Biology: 'The RNA World: The Origin of Life to Modern Cells'
Spring. Credits: 4
RNA is believed by many to have been the first macromolecule to evolve. In a hypothesized "RNA world," RNA would have simultaneously served the roles of carrying genetic information and catalyzing chemical reactions within early cells. The past three decades have been a renaissance for RNA biology, as researchers have uncovered the critical role RNA plays in eukaryotic and bacterial gene regulation and defense, as well as the potential for RNAs to perform catalysis. This seminar will introduce students to modern approaches to study the structure and function of RNA and will explore the chemical and biological roles RNA plays in modern cells as well as its role in the origin of life.
Crosslisted as: CHEM-330RN
Applies to requirement(s): Math Sciences
Other Attribute(s): Speaking-Intensive
K. Berry
Prereq: BIOCH-311, or BIOCH-314, or CHEM-312.

BIOCH-395 Independent Study
Fall and Spring. Credits: 1 - 8
Independent work in biochemistry can be conducted with any member of the biochemistry committee and, upon approval, also with other members of the biological sciences and chemistry departments and program in neuroscience and behavior.
The department
Instructor permission required.
Notes: See safety training restrictions in the course description for Biochemistry 295