

BIOCHEMISTRY, BA

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Degree: Bachelor of Arts (BA)

Field of Study: Biochemistry

Program Overview

The field of biochemistry encompasses an extremely broad and ever-growing variety of topics focused on studying biomedically-relevant problems from a molecular point of view. Biochemists make fundamental discoveries that enhance understanding of human health and disease, and contribute to the development of therapeutics.

The Department of Biochemistry in the School of Medicine offers majors leading to BA and BS degrees, as well as a minor. Biochemical studies prepare students well: for medical or other professional schools; for top graduate programs; for research or technical positions in industry (e.g. biotechnology, pharmaceutical) or academia; and for a variety of careers in which biomedical knowledge is crucial (e.g. finance, consulting, media, intellectual property, education).

Biochemistry courses are taught from a biomedical point of view. Research in faculty laboratories is a strength of the major. Students are expected to be engaged in biochemical research multiple semesters and required to complete BIOC 391 in at least one semester. Graduating seniors present their research during their last semester in BIOC 393 as a written paper and a presentation at the Biochemistry Capstone Retreat.

Both the BA and BS programs offer five optional concentrations which are defined by their required courses: Cancer Biology, Infectious Disease, Metabolism, Computational Health Science, and Research Honors.

The primary differences between the Biochemistry BA and BS curricula are that the BA accepts the less rigorous MATH, PHYS, and STAT courses, and requires completion of two technical electives compared to three for the BS.

Learning Outcomes

- Students will understand the central biochemical mechanisms that are important in human biology and medicine.
- Students will learn biochemical approaches that align with the understanding of normal physiology and disease.
- Students will understand that macromolecular structure determines function and regulation.
- Students will learn that energy is required by and transformed in biological systems.
- Students will understand the molecular basis of information storage and flow within and between cells.
- Students will learn that scientific discovery requires objective measurement, quantitative analysis and clear communication.
- Students will learn the value and application of experiential learning to the practice of research.

Undergraduate Policies

For undergraduate policies and procedures, please review the Undergraduate Academics section of the General Bulletin.

Accelerated Master's Programs

Undergraduate students may participate in accelerated programs toward graduate or professional degrees. For more information and details of the policies and procedures related to accelerated studies, please visit the Undergraduate Academics section of the General Bulletin.

Program Requirements

Students seeking to complete this major and degree program must meet the general requirements for bachelor's degrees and the Unified General Education Requirements. Students completing this program as a secondary major while completing another undergraduate degree program do not need to satisfy the school-specific requirements associated with this major.

Code	Title	Credit Hours
Required Courses:		
BIOC 101	Frontiers in Biochemistry	1
BIOC 307	Introduction to Biochemistry: From Molecules To Medical Science	4
BIOC 308	Molecular Biology	4
BIOC 373	Biochemistry Senior Seminar	3
BIOC 391	Capstone Research	3
BIOC 393	Senior Capstone Communication	3
or BIOC 393H	Biochemistry Honors Senior Capstone	
<i>Choose two of the following:</i>		6
BIOC 312	Proteins and Enzymes	
BIOC 334	Structural and Computational Biology	
BIOC 350	Molecular Basis of Cancer	
Two BIOC Technical Electives		6
Additional Required Courses:		
BIOL 214	Genes, Evolution and Ecology	3
BIOL 215	Cells and Proteins	3
<i>Choose two of the following:</i>		2-3
BIOL 214L	Genes, Evolution and Ecology Lab	
BIOL 215L	Cells and Proteins Laboratory	
BIOL 216L	Development and Physiology Lab	
BIOL 222L	Introductory Research Lab in Biology	
CHEM 105	Principles of Chemistry I	3-4
or CHEM 111	Principles of Chemistry for Engineers	
CHEM 106	Principles of Chemistry II	3-4
or ENGR 145	Chemistry of Materials	
CHEM 113	Principles of Chemistry Laboratory	2
CHEM 223	Introductory Organic Chemistry I	3
or CHEM 323	Organic Chemistry I	
CHEM 224	Introductory Organic Chemistry II	3
or CHEM 324	Organic Chemistry II	
CHEM 233	Introductory Organic Chemistry Laboratory I	2
CHEM 234	Introductory Organic Chemistry Laboratory II	2
CSDS 132	Programming in Java	3
or ENGR 131	Elementary Computer Programming	
MATH 125	Math and Calculus Applications for Life, Managerial, and Social Sci I	4
or MATH 121	Calculus for Science and Engineering I	

MATH 126	Math and Calculus Applications for Life, Managerial, and Social Sci II	4
or MATH 122	Calculus for Science and Engineering II	
or MATH 124	Calculus II	
PHYS 115	Introductory Physics I	4
or PHYS 121	General Physics I - Mechanics	
or PHYS 123	Physics and Frontiers I - Mechanics	
PHYS 116	Introductory Physics II	4
or PHYS 122	General Physics II - Electricity and Magnetism	
or PHYS 124	Physics and Frontiers II - Electricity and Magnetism	
STAT 201	Basic Statistics for Social and Life Sciences	3
or STAT 312	Basic Statistics for Engineering and Science	
or STAT 312R	Basic Statistics for Engineering and Science Using R Programming	
or STAT 313	Statistics for Experimenters	
Total Credit Hours		78-81

Departmental Honors

Biochemistry majors who have excellent academic records may be awarded Biochemistry Undergraduate Honors. To graduate with departmental honors in biochemistry, a student must satisfy the following requirements:

- A grade point average of at least 3.6
- A minimum of 6 credit hours of undergraduate research (BIOC 391) in one laboratory
- A BIOC 393 capstone report approved by the Undergraduate Education Committee of the department on the basis of the quality of the research, the written report, and an oral presentation. An acceptable report:
 - Should follow a standard journal format
 - Should demonstrate the student's understanding of the research area, experimental techniques, goals and implications of the project
 - Should show that the student has advanced their knowledge of the applicable techniques and the underlying scientific concepts.
- Using all or part of the capstone research, the student must be a co-author on a manuscript either submitted, in press, or published in a peer reviewed journal.

Concentration Requirements

Concentrations

Cancer Biology Concentration Requirements:

Code	Title	Credit Hours
BIOC 350	Molecular Basis of Cancer	3
BIOC 353	Biochemical Pathways in Cancer Therapeutics	3
BIOC 360	Advanced Technologies for Cancer Research	3
Total Credit Hours		9

Infectious Disease Concentration Requirements:

Code	Title	Credit Hours
BIOC 310	Microbial Physiology and Therapeutic Opportunities	3

BIOC 311	Antimicrobial Therapies and Resistance	3
BIOC 334	Structural and Computational Biology	3
Total Credit Hours		9

Metabolism Concentration Requirements:

Code	Title	Credit Hours
BIOC 312	Proteins and Enzymes	3
<i>Choose two of the following:</i>		6
BIOC 315	Lipids, Membranes, and Membrane Proteins	
BIOC 344	Molecular Endocrinology	
BIOC 345	Metabolic Regulation, Dysregulation, and Disease	
Total Credit Hours		9

Computational Health Science Concentration Requirements:

Code	Title	Credit Hours
BIOC 334	Structural and Computational Biology	3
PQHS 431	Statistical Methods I	3
PQHS 457	Current Issues in Genetic Epidemiology: Design and Analysis of Sequencing Studies	3
Total Credit Hours		9

Research Honors Concentration Requirements:

Code	Title	Credit Hours
BIOC 285	Honors Readings in Biochemistry	1
BIOC 391	Capstone Research	6
BIOC 393H	Biochemistry Honors Senior Capstone	3
Total Credit Hours		10

Sample Plan of Study

First Year

Fall		Credit Hours
BIOC 101	Frontiers in Biochemistry	1
BIOL 214	Genes, Evolution and Ecology	3
BIOL 214L	Genes, Evolution and Ecology Lab	1
CHEM 105	Principles of Chemistry I	3
or CHEM 111	or Principles of Chemistry for Engineers	
MATH 125	Math and Calculus Applications for Life, Managerial, and Social Sci I	4
or MATH 121	or Calculus for Science and Engineering I	
Academic Inquiry Seminar, Breadth, or Elective course ^a		3
Credit Hours		15

Spring

BIOL 215	Cells and Proteins	3
BIOL 215L	Cells and Proteins Laboratory	1
CHEM 106	Principles of Chemistry II	3
or ENGR 145	or Chemistry of Materials	
CHEM 113	Principles of Chemistry Laboratory	2

Choose one of the following:	4
MATH 126 Math and Calculus Applications for Life, Managerial, and Social Sci II	
MATH 122 Calculus for Science and Engineering II	
MATH 124 Calculus II	
Academic Inquiry Seminar, Breadth, or Elective course ^a	3

Credit Hours 16

Second Year

Fall

CHEM 223 or CHEM 323 Introductory Organic Chemistry I ^b or Organic Chemistry I	3
CHEM 233 Introductory Organic Chemistry Laboratory I	2

Choose one of the following: ^c 4

PHYS 115 Introductory Physics I	
PHYS 121 General Physics I - Mechanics	
PHYS 123 Physics and Frontiers I - Mechanics	

ENGR 131 or CSDS 132 Elementary Computer Programming or Programming in Java	3
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Breadth, or Elective course ^a 3

Credit Hours 15

Spring

CHEM 224 or CHEM 324 Introductory Organic Chemistry II ^b or Organic Chemistry II	3
CHEM 234 Introductory Organic Chemistry Laboratory II	2

Choose one of the following: ^c 4

PHYS 116 Introductory Physics II	
PHYS 122 General Physics II - Electricity and Magnetism	
PHYS 124 Physics and Frontiers II - Electricity and Magnetism	

STAT 201 or STAT 312 or STAT 312R or STAT 313 Basic Statistics for Social and Life Sciences or Basic Statistics for Engineering and Science or Basic Statistics for Engineering and Science Using R Programming or Statistics for Experimenters	3
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Breadth, or Elective course ^a 3

Credit Hours 15

Third Year

Fall

BIOC 307 Introduction to Biochemistry: From Molecules To Medical Science	4
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Breadth, or Elective course ^a 3

BIOC technical elective 3

Electives 3

Credit Hours 13

Spring

BIOC 308 Molecular Biology	4
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BIOC 391 Capstone Research	3
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Breadth, or Elective course ^a 3

BIOC core course ^d 3

Elective 3

Credit Hours 16

Fourth Year

Fall

BIOC 373 Biochemistry Senior Seminar	3
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BIOC 391 Capstone Research ^e	3
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BIOC core course ^d 3

Breadth, or Elective course ^a 3

Elective 3

Credit Hours 15

Spring

BIOC 393 Senior Capstone Communication	3
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BIOC technical elective 3

Elective courses 9

Credit Hours 15

Total Credit Hours 120

a Unified General Education Requirement.

b Selected students may be invited to take CHEM 323 or CHEM 324

c Selected students may be invited to take PHYS 123 and PHYS 124 in place of PHYS 121 and PHYS 122

d BA students must take 2 of the 3 Biochemistry core courses: BIOC 312, BIOC 334, or BIOC 350. For BA students who take all 3 courses, one course can serve as a technical elective.

e 3 credit hours of BIOC 391 are required; an additional 3 credit hours of BIOC 391 are highly recommended and are required for the Research Honors Concentration. Students should consult their academic advisers about the elective parts of the curriculum.