BIOCHEMISTRY, BA

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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 provide a platform for understanding life, from the study of individual proteins and nucleic acids to control of gene expression in entire tissues. This research contributes directly to the development of therapies for health issues such as metabolic disorders, cancer, and infectious diseases.

The Biochemistry Department 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).

Research in faculty laboratories is required and is a strength of the major. Both majors require BIOC 391 and students present their research during their last semester in **BIOC 393** as a written thesis 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.

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	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 SAGES Seminar	3
BIOC 391	Research Project	3
BIOC 393	Senior Capstone Experience	3
or BIOC 393H	Biochemistry Honors Senior Capstone	
Choose two of the following:		*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 & 214L	Genes, Evolution and Ecology and Genes, Evolution and Ecology Lab	4
BIOL 215 & 215L	Cells and Proteins and Cells and Proteins Laboratory	4
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 Hours		**78-80**

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. A grade point average of at least 3.6
b. A minimum of 6 credit hours of undergraduate research (BIOC 391) in one laboratory
c. 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:
   i. Should follow a standard journal format
   ii. Should demonstrate the student's understanding of the research area, experimental techniques, goals and implications of the project
   iii. Should show that the student has advanced their knowledge of the applicable techniques and the underlying scientific concepts.
d. 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.

Concentrations

Cancer Biology Concentration Requirements:

Code	Title	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 Hours		**9**

Infectious Disease Concentration Requirements:

Code	Title	Hours
BIOC 310	Microbial Physiology and Therapeutic Opportunities	3
BIOC 311	Antimicrobial Therapies and Resistance	3
BIOC 334	Structural and Computational Biology	3
Total Hours		**9**

Metabolism Concentration Requirements:

Code	Title	Hours
BIOC 312	Proteins and Enzymes	3
Choose two of the following:		6
BIOC 315	Biological Membranes and Their Proteins	
BIOC 344	Molecular Endocrinology	
BIOC 345	Metabolic Dysregulation and Human Disease	
Total Hours		**9**

Computational Health Science Concentration Requirements:

Code	Title	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 Hours		**9**

Honors Research Concentration Requirements:

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

Sample Plan of Study

First Year		
Fall		**Hours**
BIOC 101	Frontiers in Biochemistry	1
BIOL 214	Genes, Evolution and Ecology	3
BIOL 214L	Genes, Evolution and Ecology Lab	1
CHEM 105 or CHEM 111	Principles of Chemistry I or Principles of Chemistry for Engineers	3
MATH 125 or MATH 121	Math and Calculus Applications for Life, Managerial, and Social Sci I or Calculus for Science and Engineering I	4
Academic Inquiry Seminar, Breadth, or Elective course [a]		3
	Hours	**15**
Spring		
BIOL 215	Cells and Proteins	3
BIOL 215L	Cells and Proteins Laboratory	1
CHEM 106 or ENGR 145	Principles of Chemistry II or Chemistry of Materials	3
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
	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
Select 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
Breadth, or Elective course [a]		3
	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
Select 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
Breadth, or Elective course [a]		3
	Hours	**15**
Third Year		
Fall		
BIOC 307	Introduction to Biochemistry: From Molecules To Medical Science	4
Breadth, or Elective course [a]		3
BIOC technical elective		3
Electives		3
	Hours	**13**
Spring		
BIOC 308	Molecular Biology	4
BIOC 391	Research Project	3
Breadth, or Elective course [a]		3
BIOC core course [d]		3
Elective		3
	Hours	**16**
Fourth Year		
Fall		
BIOC 373	Biochemistry SAGES Seminar	3
BIOC 391	Research Project [e]	3
BIOC core course [d]		3
Breadth, or Elective course [a]		3
Elective		3
	Hours	**15**
Spring		
BIOC 393	Senior Capstone Experience	3
BIOC technical elective		3
Elective courses		9
	Hours	**15**
	Total 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. Students should consult their academic advisers about the elective parts of the curriculum.