Biochemistry (BS)

The Bachelor of Science degree in Biochemistry

Biochemistry is an interdisciplinary science focused on chemical processes that occur in living systems. The mission of the Biochemistry undergraduate program is to prepare and inspire students for the discovery and dissemination of knowledge to the greater life sciences community through research and instruction. The faculty believe in a balance of interdependent formal classroom instruction with innovative laboratory training and experience in inquiry-based research methods. Classroom and lab training emphasize chemistry, physics, and biology of metabolism, molecular biology, macromolecular structure, function and synthesis. The ultimate goal is to infuse each student with sufficient breadth and depth of understanding that they are conversant in the rigors of life at the molecular level, and capable of contributing to a wide variety of future career paths that require detailed understanding of physical and chemical principles in living systems. Our program is accredited by the American Society for Biochemistry and Molecular Biology.

Accelerated Bachelors/Masters programs in Biochemistry and Biochemistry/Biomanufacturing

Advanced, academically qualified undergraduate students have the opportunity to participate in the Accelerated Bachelor's/Master's (ABM) programs in Biochemistry or in Biochemistry & Biomanufacturing. These programs allow students to earn both the BS and the MS degrees in Biochemistry or the combined disciplines within five years.

For more information about Biochemistry, visit our program website (https://cals.ncsu.edu/molecular-and-structural-biochemistry/)

Program Requirements

Code	Title	Hours
Orientation		
BCH 103	Introduction to Biochemistry [1]	1
or ALS 103	First-year Success in Agriculture and Life Sciences	
or ALS 303	Transfer Success in Agriculture and Life Sciences	
or LSC 103	Exploring Opportunities in the Life Sciences	
English & Advanced Writing		
ENG 101	Academic Writing and Research (C- or better) [1]	4
ENG 331	Communication for Engineering and Technology [1]	3
or ENG 333	Communication for Science and Research	
Mathematical Science & Physics		
Choose one of the following Math sequences:		12
MA 141	Calculus I [1,2]	
MA 241	Calculus II [1,2]	
MA 242	Calculus III [1,2]	
OR		
MA 131	Calculus for Life and Management Sciences A [1,2]	
MA 231	Calculus for Life and Management Sciences B [1,2]	
ST 311	Introduction to Statistics [1,2]	
Advised Elective MA, ST or CSC [1,2,5]		
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory [1,3]	4
or PY 211	College Physics I	
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory [1,3]	4
or PY 212	College Physics II	
Chemistry/Lab Analysis		
CH 101 & CH 102	Chemistry - A Molecular Science and General Chemistry Laboratory [1,8]	4
CH 201 & CH 202	Chemistry - A Quantitative Science and Quantitative Chemistry Laboratory [1,8]	4
CH 221 & CH 222	Organic Chemistry I and Organic Chemistry I Lab [1,8]	4
CH 223 & CH 224	Organic Chemistry II and Organic Chemistry II Lab [1,8]	4
Select one of the following Physical Chemistry sequences:		6
CH 331	Introductory Physical Chemistry [1,7]	
or BCH 330	Physical Biochemistry	
Sciences Advised Elective [1,7]		
OR		
CH 431 & CH 433	Physical Chemistry I and Physical Chemistry II [1,7]	
Laboratory Analysis Elective (p. 2) [1,6]		3
Life Sciences		
LSC 101	Critical and Creative Thinking in the Life Sciences	2
BIO 181	Introductory Biology: Ecology, Evolution, and Biodiversity [1]	4
BIO 183	Introductory Biology: Cellular and Molecular Biology [1]	4
Advised Elective [1,4]		3
BCH 451	Principles of Biochemistry [1]	4
BCH 453	Biochemistry of Gene Expression [1]	3
or BCH 553	Biochemistry of Gene Expression	
BCH 455	Proteins and Molecular Mechanisms [1]	3
or BCH 555	Proteins and Molecular Mechanisms	
Biochemistry Laboratory Elective		5-6
BCH 452	Introductory Biochemistry Laboratory [1]	
and one of the following:		
BCH 454	Advanced Biochemistry Laboratory [1,6]	
ALS 499	Honors Research or Teaching II [1]	
BCH 492	External Learning Experience [1]	
BCH 493	Special Problems in Biochemistry [1]	
MB 351	General Microbiology [1]	3
MB 352	General Microbiology Laboratory [1]	1
or MB 354	Inquiry-Guided Microbiology Lab	
GN 311	Principles of Genetics [1]	4
Cell Biology/Physiology: Select one of the following:		3
BIO 240	Principles of Human Anatomy & Physiology (A): Nervous, Skeletal, Muscular, & Digestive Systems [1]	
BIO 245	Principles of Human Anatomy & Physiology (B): Endocrine, Cardiovascular, Respiratory & Renal Systems [1]	
BIO 414	Cell Biology [1]	
PB 421	Plant Physiology [1]	
GEP Courses		

GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)	6
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)	6
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)	2
GEP Elective (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)	3
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)	3
GEP Global Knowledge (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-global-knowledge/) (verify requirement)	
GEP Foundations of American Democracy (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-fad/) (verify requirement)	
World Language Proficiency (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/world-language-proficiency/) (verify requirement)	
Free Electives	
Free Electives (12 Hr S/U Lmt) [2]	8
Total Hours	**120-121**

[1] A grade of C- or higher is required.

[2] There are two sequences for mathematics: MA 131, MA 231, ST 311, and a math/ST/CSC elective OR MA 141, MA 241, and MA 242. The three semester sequence (MA 141, 241 and 242) is a prerequisite for PY 205 and 208 and for CH 431 and 433 (CH 431/433 also requires MA 341). This sequence is recommended for those students who plan on graduate studies in Biophysics or a related specialty in Biochemistry, and is required for Biochemistry Honors Option 1. If a student elects to start with MA 141, the sequence of 241 and 242 should be taken. If a student elects to start with MA 131 and MA 231, the sequence of ST 311 and a math/ST/CSC elective should be taken. ST 311 is not a substitute for MA 242.

[3] The calculus based physics sequence (PY 205 and 208) is recommended for those students who plan on graduate studies in Biophysics or a related specialty in Biochemistry; and is required for Biochemistry Honors Option 1. If a student chooses PY 205, PY 208 should be taken.

[4] This course is an advised elective in the life sciences. BIO 240 or BIO 245 is recommended for those students who are interested in applying to the health related professions. This requirement can also be satisfied by an advised elective from upper level life science courses (life science course, 200 level or above; verify with advisor).

[5] If a student has chosen the Math sequence of MA 131, MA 231, and ST 311, another course (200 level or above; verify with advisor) in computer science, mathematics or statistics must be chosen.

[6] If BCH 454 is not selected as an option for the Biochemistry Laboratory elective it may be used as an option for the Laboratory Analysis elective.

[7] The two semester Physical Chemistry course sequence (CH 431 and 433) is recommended for those students who plan on graduate studies in Biophysics or a related specialty in Biochemistry, and is required for Biochemistry Honors Option 1. If CH 431 is chosen, CH 433 must be taken. If CH 331 or BCH 330 is chosen, a student must choose an advised elective from upper level courses offered in the sciences, math or computer science (200 level or above; verify with advisor).

[8] The corresponding courses for chemistry majors may be substituted (CH 103,104 for CH 101,102; CH 203,204 for CH 201,202; CH 225,226 for CH 221,222; CH 227,228 for CH 223,224).

Laboratory Analysis Elective

Code	Title	Hours
BCH 454	Advanced Biochemistry Laboratory	4
BEC 463/563	Fermentation of Recombinant Microorganisms	2
BIT 463	Fermentation of Recombinant Microorganisms	2
BIT 464	Protein Purification	2
BIT 465	Real-time PCR Techniques	2
BIT 466	Animal Cell Culture Techniques	2
BIT 467	PCR and DNA Fingerprinting	2
BIT 471	RNA Interference and Model Organisms	2
BIT 473	Protein Interactions	2
BIT 474	Plant Genetic Engineering	2
BIT 476	Applied Bioinformatics	2
BIT 477	Metagenomics	2
BIT 479	High-Throughput Discovery	2
BIT 480	Yeast Metabolic Engineering	2
BIT 481	Plant Tissue Culture and Transformation	2
BIT 563	Fermentation of Recombinant Microorganisms	2
BIT 564	Protein Purification	2
BIT 565	Real-time PCR Techniques	2
BIT 566	Animal Cell Culture Techniques	2
BIT 567	PCR and DNA Fingerprinting	2
BIT 571	RNA Interference and Model Organisms	2
BIT 573	Protein Interactions	2
BIT 574	Plant Genetic Engineering	2
BIT 577	Metagenomics	2
BIT 579	High-Throughput Discovery	2
BIT 580	Yeast Metabolic Engineering	2
CH 315	Quantitative Analysis	3
CH 316	Quantitative Analysis Laboratory	1
CHE 463	Fermentation of Recombinant Microorganisms	2
CHE 563	Fermentation of Recombinant Microorganisms	2
PB 481	Plant Tissue Culture and Transformation	2
PO 466	Animal Cell Culture Techniques	2
PO 566	Animal Cell Culture Techniques	2

Semester Sequence

This is a sample.

First Year		
Fall Semester		**Hours**
BCH 103	Introduction to Biochemistry	1
BIO 181	Introductory Biology: Ecology, Evolution, and Biodiversity [1]	4
CH 101	Chemistry - A Molecular Science [1,8]	3
CH 102	General Chemistry Laboratory [1,8]	1
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1

LSC 101	Critical and Creative Thinking in the Life Sciences	2
MA 141 or MA 131	Calculus I [1,2] or Calculus for Life and Management Sciences A	3-4
	Hours	**15**
Spring Semester		
BIO 183	Introductory Biology: Cellular and Molecular Biology [1]	4
CH 201	Chemistry - A Quantitative Science [1,8]	3
CH 202	Quantitative Chemistry Laboratory [1,8]	1
ENG 101	Academic Writing and Research	4
MA 241 or MA 231	Calculus II [1,2] or Calculus for Life and Management Sciences B	3-4
	Hours	**15**
Second Year		
Fall Semester		
CH 221	Organic Chemistry I [1,8]	3
CH 222	Organic Chemistry I Lab [1,8]	1
Select one of the following:		
MA 242 or ST 311 or ST 380	Calculus III [1,2] or Introduction to Statistics or	4
Select one of the following:		4
PY 211	College Physics I [1,3]	
PY 205 & PY 206	Physics for Engineers and Scientists I and Physics for Engineers and Scientists I Laboratory [1,3]	
Life Science Elective [1,4]		3-4
GEP Health and Exercise Studies (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-health-exercise-studies/)		1
	Hours	**16**
Spring Semester		
CH 223	Organic Chemistry II [1,8]	3
CH 224	Organic Chemistry II Lab [1,8]	1
MB 351	General Microbiology [1]	3
MB 352 or MB 354	General Microbiology Laboratory [1] or Inquiry-Guided Microbiology Lab	1
Select one of the following:		4
PY 212	College Physics II [1,3]	
PY 208 & PY 209	Physics for Engineers and Scientists II and Physics for Engineers and Scientists II Laboratory [1,3]	
Select one of the following:		3
Computer Elective [1,5]		
Math Elective [1,5]		
Statistics Elective [1,5]		
Free Elective		
	Hours	**15**
Third Year		
Fall Semester		
BCH 451	Principles of Biochemistry [1]	4
BCH 452	Introductory Biochemistry Laboratory [1]	2
GN 311	Principles of Genetics [1]	4
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		3
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		3
	Hours	**16**
Spring Semester		
BCH 453	Biochemistry of Gene Expression [1]	3
Select one of the following: [1]		3-4
BCH 454	Advanced Biochemistry Laboratory [1,6]	
Research Elective (BCH 492, BCH 493, ALS 499) [1]		
ENG 331 or ENG 333	Communication for Engineering and Technology or Communication for Science and Research	3
GEP Social Sciences (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-social-sciences/)		3
GEP Interdisciplinary Perspectives (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-interdisciplinary-perspectives/)		3
	Hours	**15**
Fourth Year		
Fall Semester		
Cell Biology or Physiology Elective [1]		3
Select one of the following:		3-4
CH 431 or CH 331 or BCH 330	Physical Chemistry I [1,7] or Introductory Physical Chemistry or Physical Biochemistry	
Free Elective		3
GEP Humanities (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/gep-humanities/)		6
	Hours	**15-16**
Spring Semester		
Select one of the following:		3-4
CH 433	Physical Chemistry II [1,7]	
Advised Elective [1,7]		
BCH 455	Proteins and Molecular Mechanisms [1]	3
GEP Elective (http://catalog.ncsu.edu/undergraduate/gep-category-requirements/)		3
Lab Analysis (p.) [1,6]		3-4
Free Elective		2
	Hours	**14**
	Total Hours	**121-122**

1 A grade of C- or higher is required.

2 There are two sequences for mathematics: MA 131, MA 231, ST 311 [ST 380], and a math/ST/CSC elective OR MA 141, MA 241, and MA 242. The three semester sequence (MA 141,241 and 242) is a prerequisite for PY 205 and 208 and for CH 431 and 433 (CH 431/433 also requires MA 341). This sequence is recommended for those students who plan on graduate studies in Biophysics or a related specialty in Biochemistry, and is required for Biochemistry Honors Option 1. If a student elects to start with MA 141, the sequence of 241 and 242 should be taken. If a student elects to start with MA 131 and

MA 231, the sequence of ST 311 [ST 380] and a math/ST/CSC elective should be taken. ST 311 or ST 380 is not a substitute for MA 242.

[3] The calculus based physics sequence (PY 205 and 208) is recommended for those students who plan on graduate studies in Biophysics or a related specialty in Biochemistry; and is required for Biochemistry Honors Option 1. If a student chooses PY 205, PY 208 should be taken.

[4] This course is an advised elective in the life sciences. BIO 240 or BIO 245 is recommended for those students who are interested in applying to the health related professions. This requirement can also be satisfied by an advised elective from upper level life science courses (life science course, 200 level or above; verify with advisor).

[5] If a student has chosen the Math sequence of MA 131, MA 231, and ST 311, another course (200 level or above; verify with advisor) in computer science, mathematics or statistics must be chosen.

[6] If BCH 454 is not selected as an option for the Biochemistry Laboratory elective it may be used as an option for the Laboratory Analysis elective.

[7] The two semester Physical Chemistry course sequence (CH 431 and 433) is recommended for those students who plan on graduate studies in Biophysics or a related specialty in Biochemistry, and is required for Biochemistry Honors Option 1. If CH 431 is chosen, CH 433 must be taken. If CH 331 or BCH 330 is chosen, a student must choose an advised elective from upper level courses offered in the sciences, math or computer science (200 level or above; verify with advisor).

[8] The corresponding courses for chemistry majors may be substituted (CH 103,104 for CH 101,102; CH 203,204 for CH 201,202; CH 225,226 for CH 221,222; CH 227,228 for CH 223,224).

Career Opportunities

The Biochemistry program provides B.S. graduates with the scientific background and skills required for employment in biochemistry, molecular biology, biotechnology, and genetics and for the health professions of medicine, dentistry, veterinary medicine, pharmacology and related fields.

Career Titles

- Agricultural Engineer
- Agricultural Technician
- Agronomist
- Allergists and Immunologists
- Anesthesiologist (MD)
- Animal Scientist
- Biochemist
- Bioinformatics Scientists
- Biological Technician
- Biologist
- Biology Professor
- Biophysicist
- Chemical Engineer
- Chemical Technicians
- Chemist
- Chemistry Professor
- Conservation Scientist
- Criminalist
- Dairy Technologist
- Environmental Disease Analyst
- Environmental Research Analyst
- Environmental Science and Protection Technician
- Environmental Science Professor
- Environmental Technician
- Family Practitioner (MD)
- Food Science Technicians
- Food Technologist
- Forensic Science Technicians
- General Internists (MD)
- Geneticist
- Gynecologist (MD)
- Hazardous Waste Management Analyst
- High School Teacher
- Horticulturist
- Marine and Aquatic Biologist
- Microbiologist
- Middle School Teacher
- Molecular and Cellular Biologists
- Pathologist (MD)
- Perfumer
- Petroleum Laboratory Assistant
- Petroleum Technician
- Pharmacist
- Pharmacologist
- Physical Medicine and Rehabilitation Physicians
- Plant Breeder
- Radiation Protection Engineer
- Sales Representative (Chemicals & Drugs)
- Sales Representative (Medical Equipment)
- Technical & Scientific Publications Editor
- Technical Publications Writer
- Toxicologist
- Wildlife Biologist

Learn More About Careers

NCcareers.org (https://nccareers.org/)
Explore North Carolina's central online resource for students, parents, educators, job seekers and career counselors looking for high quality job and career information.

Occupational Outlook Handbook (https://www.bls.gov/ooh/)
Browse the Occupational Outlook Handbook published by the Bureau of Labor Statistics to view state and area employment and wage statistics. You can also identify and compare similar occupations based on your interests.

Career One Stop Videos (https://www.careeronestop.org/)
View videos that provide career details and information on wages, employment trends, skills needed, and more for any occupation. Sponsored by the U.S. Department of Labor.

Focus 2 Career Assessment (https://careers.dasa.ncsu.edu/explore-careers/career-assessments/) (NC State student email address required)
This career, major and education planning system is available to current NC State students to learn about how your values, interests, competencies, and personality fit into the NC State majors and your

future career. An NC State email address is required to create an account. Make an appointment with your career counselor (https://careers.dasa.ncsu.edu/about/hours-appointments/) to discuss the results.

Focus 2 Apply Assessment (https://www.focus2career.com/Portal/Register.cfm?SID=1929) (Available to prospective students)
A career assessment tool designed to support prospective students in exploring and choosing the right major and career path based on your unique personality, interests, skills and values. Get started with Focus 2 Apply and see how it can guide your journey at NC State.