BIOCHEMISTRY

Program Overview

Students in the biochemistry major will find themselves taking part in small classes that encourage close and frequent interaction between students and professors, helping to create a stimulating learning environment.

Students in this major are offered abundant research opportunities (https://www.rider.edu/academics/colleges-schools/college-arts-sciences/science-technology-math/faculty-departments/earth-chemical-sciences/student-research/) both during the academic year and during the summer months. Faculty are engaged in research projects which lend themselves to undergraduate participation. In tackling the challenge of advanced and independent laboratory work, students begin to understand the nature of science and the scientific method. Participation in research by all students is strongly encouraged, as it builds a greater appreciation of the nature of their chosen field. The opportunity to perform independent research has motivated many students to continue their education either in an accredited graduate program or in a professional school in a number of medical fields.

Often, faculty and students jointly present their research results at national professional meetings, the Rider Independent Scholarly Research & Creative Activities Presentations (ISCAP) Day, or as written research papers submitted to scholarly journals.

Curriculum Overview

Core chemistry classes include one year of general chemistry, one year of organic chemistry, one year of biochemistry, three semesters of general biology and courses in quantitative analysis, physical chemistry and genetics.

Students also must earn advanced course credits at the 300 level or above in chemistry, biochemistry, biology or behavioral neuroscience. Independent research, BCH 490, is also a requirement of the biochemistry major.

Student Learning Outcomes

Graduates of the Biochemistry major will demonstrate the ability to:

1. Apply their chemical knowledge and make predictions about the outcome of fundamental chemical processes.
2. Generate and interpret raw data from standard research instrumentation and computational tools.
3. Utilize databases to locate relevant primary literature articles and evaluate the validity of resources.
4. Communicate data and advanced chemical concepts via meaningful and effective representations in both oral and written forms.

Degree Offered:

- B.S. in Biochemistry

Contact

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Program Website: Biochemistry (https://www.rider.edu/academics/colleges-schools/college-arts-sciences/science-technology-math/undergraduate/biochemistry/)
Associated Department: Earth & Chemical Sciences (https://www.rider.edu/academics/colleges-schools/college-arts-sciences/science-technology-math/faculty-departments/earth-chemical-sciences/)

Related programs:

- Chemistry (http://catalog.rider.edu/undergraduate/colleges-schools/arts-sciences/majors-minors-certificates/chemistry/)

Biochemistry Major Requirements

(70 credits)

Code	Title	Credits
Required Courses:		
Biology		
BIO 115 & 115L	Principles of Biology I and Principles of Biology I Lab	4
BIO 116 & 116L	Principles of Biology II and Principles of Biology II Lab	4
BIO 260 & 260L	Principles of Biology: Evolution, Diversity, and Biology of Cells and Principle of Biology: Cells Lab	4
BIO 265	Genetics	4
Chemistry		
CHE 120 & CHE 121	Principles of Chemistry and Principles of Chemistry Lab	4
CHE 122 & CHE 123	Intro to Chemical Systems and Quantitative Methods Lab	4
CHE 211 & 211L	Organic Chemistry I and Organic Chemistry I Lab	4
CHE 214 & 214L	Organic Chemistry II and Organic Chemistry II Lab	4
CHE 250 & 250L	Quantitative Analysis and Statistics Methods and Quantitative Analysis and Statistical Methods Lab	4
CHE 305	Physical Chemistry I	3
BCH 325	Biochemistry	3
BCH 326	Biochem and Enzymology I Lab	1
BCH 4XX - Advanced 400-level Biochemistry Elective		3
BCH 430	Advanced Lab Techniques in Biochemistry.	1
BCH 490	Independent Study: Research and Creative Expression	3
Mathematics		**8**
MTH 210	Calculus I	
MTH 211	Calculus II	
Physics		**8**
PHY 200 & 200L	General Physics I and General Physics I Lab	
PHY 201 & 201L	General Physics II and General Physics II Lab	

Upper Level Electives	**4**
Students must take 4 more credits of upper level courses. These are courses at 300 level or above in BCH, CHE, BNS, or BIO (excluding extra credits in Independent Research and Study). At least one of the four credits must be connected to a laboratory course.	
Total Credits	**70**

Students wishing an ACS-certified degree in Biochemistry will need to take at least one additional course and four additional lab credits in chemistry or biochemistry. The additional requirements should be discussed with their academic advisor and/or the Department Chair.

Academic Plan of Study

The following educational plan is provided as a sample only. Rider students who do not declare a major during their freshman year; who are in a Continuing Education Program; who change their major; or who transfer to Rider may follow a different plan to ensure a timely graduation. Each student, with guidance from their academic advisor, will develop a personalized educational plan.

Course	Title	Credits
Year 1		
Fall Semester		
CHE 120	Principles of Chemistry	3
CHE 121	Principles of Chemistry Lab	1
MTH 210	Calculus I [1]	4
CMP 120	Seminar in Writing and Rhetoric	3
BIO 115	Principles of Biology I	4
BIO 115L	Principles of Biology I Lab	0
	Semester Credit Hours	**15**
Spring Semester		
CHE 122	Intro to Chemical Systems	3
CHE 123	Quantitative Methods Lab	1
MTH 211	Calculus II	4
CMP 125	Seminar in Writing and Research	3
BIO 116	Principles of Biology II	4
BIO 116L	Principles of Biology II Lab	0
	Semester Credit Hours	**15**
Year 2		
Fall Semester		
CHE 211	Organic Chemistry I	4
CHE 211L	Organic Chemistry I Lab	0
BIO 260	Principles of Biology: Evolution, Diversity, and Biology of Cells	4
BIO 260L	Principle of Biology: Cells Lab	0
HIS 150	Pre-Modern World: Evolution to Revolution	3
Social Perspectives		3
	Semester Credit Hours	**14**
Spring Semester		
CHE 214	Organic Chemistry II	4
CHE 214L	Organic Chemistry II Lab	0
BIO 265	Genetics	4
BIO 265L	Genetics Lab	0
HIS 151 or HIS 152 or HIS 153	World in the Modern Era: Exploration to Globalization or Contemporary World: Historical Perspectives or Cold War: A Global History	3
Social Perspectives		3
Philosophical Perspectives		3
	Semester Credit Hours	**17**
Year 3		
Fall Semester		
BCH 325	Biochemistry	3
BCH 326	Biochem and Enzymology I Lab	1
PHY 200	General Physics I	4
PHY 200L	General Physics I Lab	0
CHE 250	Quantitative Analysis and Statistics Methods	4
CHE 250L	Quantitative Analysis and Statistical Methods Lab	0
Foreign Language [1]		3
	Semester Credit Hours	**15**
Spring Semester		
BCH 400	Advanced Biochemistry.	3
BCH 430	Advanced Lab Techniques in Biochemistry.	1
PHY 201	General Physics II	4
PHY 201L	General Physics II Lab	0
Aesthetic Perspectives: Literature		3
Foreign Language		3
Elective Course [2]		3
	Semester Credit Hours	**17**
Year 4		
Fall Semester		
CHE 305	Physical Chemistry I	3
BCH 490	Independent Study: Research and Creative Expression	3
Advanced Biochemistry Elective Course		3-4
Aesthetic Perspectives: Fine Arts		3
Elective Course [2]		3
	Semester Credit Hours	**15-16**
Spring Semester		
Advanced Biochemistry Elective Course		3-4
BCH 490	Independent Study: Research and Creative Expression (Optional but suggested.)	1-4
Three Elective Courses [2]		9
	Semester Credit Hours	**13-17**
	Total Credit Hours for Graduation	**121-126**

1 For course placement information see https://www.rider.edu/student-life/first-year-experience/orientation/placement-testing (https://www.rider.edu/student-life/first-year-experience/orientation/placement-testing/)

2 Please note that elective credits may be used to complete requirements in a second major or a minor.

Courses and Descriptions

BCH 325 Biochemistry 3 Credits
Outlines the chemistry and biological function of carbohydrates, proteins, lipids, nucleic acids, vitamins, and enzymes, and introduces enzyme kinetics and biological energetics. Degradative metabolic pathways of carbohydrates and lipids, and their controlled interrelationships are discussed in detail.
Prerequisite(s): CHE 122, CHE 214 with a minimum grade of D.

BCH 326 Biochem and Enzymology I Lab 1 Credits
The laboratory work illustrates techniques and methods essential to the biochemist. Methods for quantification of proteins, purification of enzymes and determination of their kinetic parameters, polarimetry, and structure proof of carbohydrates. The lab must be taken concurrently with BCH 325 by biochemistry and biology majors, but is optional for others.
Prerequisite(s): CHE 123, CHE 214.

BCH 400 Advanced Biochemistry. 3 Credits
Continuation of Biochemistry I. Includes molecular analysis of biological membrane structure and function and a molecular level analysis of information flow from DNA through RNA to proteins. Other topics include mechanisms of hormone action and an expansion on metabolic concepts.
Prerequisite(s): BCH 325.

BCH 410 Metabolism and Bioenergetics 3 Credits
An examination of principles of energetics and chemical transformations as they pertain to metabolism. Students will explore general issues of bioenergetics and will delve into biochemical pathways of catabolism and anabolism of biological molecules, including key nutrients, and xenobiotic compounds, including drugs and toxins. Attention will be placed on the enzymes and cofactors that mediate critical metabolic transformations, and students will use the scientific literature to investigate mechanisms of regulation and integration of metabolic pathways as well as consequences of aberrant enzyme function to human disease.
Prerequisite(s): BCH 325.

BCH 415 Signal Transduction 3 Credits
Cells in multicellular organisms are in constant communication with each other. One way that cells communicate is through the sharing of chemical signals through a process called “signal transduction.” In this course, we will study the basic biochemical principles of signal transduction to better understand life on a molecular level. Topics to be covered include a broad overview of signal transduction mechanisms, including basic receptor theory and the use of second messengers; investigations into specific signaling strategies, including signaling via receptor ion channels, G protein-coupled receptors, and nuclear hormone receptors; and examinations of cellular mechanisms used to coordinate signaling spatially and temporally. Special focus will be placed on roles of signal transduction pathways in health and disease.
Prerequisite(s): BCH 325.

BCH 425 Medicinal Chemistry 3 Credits
A comprehensive description of the important principles of medicinal chemistry including principles of rational drug design with synthetic strategies, mechanisms of drug actions, structure-activity relationships, the absorption, distribution, metabolism and elimination of drugs. Specific classes of drugs to be discussed include: anticancer agents, analgesics, anti-inflammatory drugs, steroids, drugs acting on the nervous system and antibiotics.
Prerequisite(s): BCH 325 or permission of instructor.

BCH 430 Advanced Lab Techniques in Biochemistry. 1 Credits
Methods of protein analysis, building on techniques and principles learned in BCH 326. Students will use bioinformatics and molecular biological techniques, including PCR, to harness and change protein sequence. They will implement modern protein purification techniques, develop enzyme essays, and perform equilibrium binding assays to investigate the relationships among protein sequence, structure, and function.
Prerequisite(s): BCH 326.

BCH 490 Independent Study: Research and Creative Expression 1-4 Credits
Immerses the student in laboratory research. The student learns to organize material, use the literature, make precise measurement, and obtain reproducible data. If possible, the student will publish the results or present them at a scientific meeting.

BIO 115 Principles of Biology I 4 Credits
An introductory biology course focusing on major themes of biology: what is life?; Cells as fundamental structure and functional unit of life; information transmission, storage and retrieval; Diversity and unity of life explained by evolution. Three hours of lecture and one three- hour lab per week.
Corequisite(s): BIO 115L.

BIO 115L Principles of Biology I Lab 0 Credits
This lab is a co-requisite and must be taken with the corresponding course.
Corequisite(s): BIO 115.

BIO 116 Principles of Biology II 4 Credits
An introductory biology course focusing on major themes of biology: Energy and matter to carry out life's essential functions; Interdependent relationships characterize biological systems (homeostasis, growth & development); Behavior of living things; Ecology and the environment. Three hours of lecture and one three-hour lab per week.
Corequisite(s): BIO 116L.

BIO 116L Principles of Biology II Lab 0 Credits
This lab is a co-requisite and must be taken with the corresponding course.
Corequisite(s): BIO 116.

BIO 260 Principles of Biology: Evolution, Diversity, and Biology of Cells 4 Credits
Lectures and labs focus on basic cell biology. Cell diversity and function, genetics and biotechnology are emphasized. Three hours of lecture and one three-hour lab per week. Prerequisite(s): BIO 115/115L and BIO 116/116L or BIO 115, BIO 117, (BNS 118 or BNS 275).
Corequisite(s): BIO 260L.

BIO 260L Principle of Biology: Cells Lab 0 Credits
This lab is a co-requisite and must be taken with the corresponding course.
Corequisite(s): BIO 260.

BIO 265 Genetics 4 Credits
A comprehensive course focusing on molecular, Mendelian, and population genetics. Topics covered will include molecular advances in the study of genetics, including genomics and bioinformatics; evolution and the effects of genetic mutations; the application of population genetics to forensic science; genetic problem solving, including genetic crosses and statistical analysis; and regulation of gene expression. The laboratory for this course will introduce students to commonly used genetic model organisms and basic molecular biology techniques. Three hours of lecture and one three-hour lab per week. Prerequisite(s): BIO 115 with a minimum grade of C and BIO 116 with a minimum grade of C and (BIO 117 with a minimum grade of C or BIO 260 with a minimum grade of C)
Corequisite(s): BIO 265L.

BIO 265L Genetics Lab 0 Credits
This lab is a co-requisite and must be taken with the corresponding course. Prerequisite(s): BIO 115 with a minimum grade of C and BIO 116 with a minimum grade of C and (BIO 117 with a minimum grade of C or BIO 260 with a minimum grade of C)
Corequisite(s): BIO 265.

CHE 120 Principles of Chemistry 3 Credits
For students who have successfully completed one year of high school chemistry. This systematic study of the fundamental principles and concepts of chemistry covers atomic structure, bonding, stoichiometric relationships, including solution and oxidation-reduction reactions, and molecular structure. Three hours of lecture per week. Prerequisite(s): High school chemistry or CHE 100 is recommended before taking this course.
Corequisite(s): CHE 121.

CHE 121 Principles of Chemistry Lab 1 Credits
For students concurrently taking CHE 120. Experiments involve gravimetric, volumetric, and spectrophotometric quantitative analysis. One three-hour lab per week. Fall.

CHE 122 Intro to Chemical Systems 3 Credits
A continuation of CHE 120. For students majoring in the sciences but may be taken by others. Chemical systems in which the study of kinetics, thermodynamics, equilibrium, and radiochemistry are emphasized. Three hours of lecture per week. Prerequisite(s): CHE 120, MTH 105 or higher.
Corequisite(s): CHE 123.

CHE 123 Quantitative Methods Lab 1 Credits
Usually taken concurrently with CHE 122. Primarily for students majoring in the sciences. A number of quantitative classical and instrumental methods of analysis are used to determine thermodynamic properties and reaction mechanisms. One three-hour lab per week. Prerequisite(s): CHE 121.
Corequisite(s): CHE 122.

CHE 211 Organic Chemistry I 4 Credits
The structure, chemical properties, and methods of preparation of the more important classes of carbon compounds are studied, with an emphasis on the relationship of structure, stereochemistry, and conformation to chemical reactivity. The preparation and reactivity of organic functional groups is introduced. The use of infrared and nuclear magnetic resonance spectroscopy, and mass spectrometry for elucidating structures of organic molecules is discussed. Three hours of lecture and one three-hour lab per week. Prerequisite(s): CHE 120, CHE 121.
Corequisite(s): CHE 211L.

CHE 211L Organic Chemistry I Lab 0 Credits
This lab is a co-requisite and must be taken with the corresponding course.
Corequisite(s): CHE 211.

CHE 214 Organic Chemistry II 4 Credits
A continuation of Chemistry 211, emphasizing the mechanism of organic reactions, structural interpretations of properties, preparations, reactivity and identification of organic compounds. Three hours of lecture and one three-hour lab per week.
Prerequisite(s): CHE 211 and CHE 211L.

CHE 214L Organic Chemistry II Lab 0 Credits
This lab is a co-requisite and must be taken with the corresponding course.
Corequisite(s): CHE 214.

CHE 250 Quantitative Analysis and Statistics Methods 4 Credits
This course will provide a deeper exploration of topics in chemistry that are steeped in numerical analysis. These topics include advanced analysis of equilibrium systems, acid-base systems and electrochemical systems. Additional detail will be given to methods of chemical measurement, statistical methods of data analysis and determination of data validity and reliability. Both lecture and laboratory will show an emphasis on using computer-based tools to analyze experimental data. Three hours of lecture and one three-hour lab per week. Prerequisite(s): CHE 122 & CHE 123
Corequisite(s): CHE 250L.

CHE 250L Quantitative Analysis and Statistical Methods Lab 0 Credits
This lab is a co-requisite and must be taken with the corresponding course.
Corequisite(s): CHE 250.

CHE 305 Physical Chemistry I 3 Credits
The mathematic and conceptual foundations of physical chemistry will be introduced with an over-arching theme of determination of energy allocation within atomic and molecular systems. Topics will include determination and measurement of energy states in atoms and molecules, simple quantum mechanical systems, distribution of energies and the connection to thermodynamic quantities, the three laws of thermodynamics, spontaneity, equilibrium and experimental kinetics.
Prerequisite(s): CHE 122, CHE 214, MTH 211, PHY 201.

MTH 210 Calculus I 4 Credits
Introduces analytic geometry, functions, limits, and derivatives; differentiation of algebraic and trigonometric functions, curve sketching, maxima and minima, and higher derivatives.
Prerequisite(s): Math SAT 650 or higher or Math ACT score of 28 or higher or MTH 105 or MTH 106 with a grade of C or higher.

MTH 211 Calculus II 4 Credits
The definite integral, differentiation of transcendental functions, methods of integration and approximate integration, determination of area, volume, and surface area.
Prerequisite(s): MTH 210 with a grade of C or higher.

PHY 200 General Physics I 4 Credits
Introductory classical physics; Newtonian mechanics, including the conservation laws, wave motion, gravity, thermodynamics. Three hours of lecture and one three-hour lab per week. Prerequisite(s): MTH 210 or concurrent enrollment
Corequisite(s): PHY 200L.

PHY 200L General Physics I Lab 0 Credits
This lab is a co-requisite and must be taken with the corresponding course.
Corequisite(s): PHY 200.

PHY 201 General Physics II 4 Credits
A continuation of the concepts developed in Physics 200. Electricity, electrical circuits, magnetism, Maxwell's equations. Light and optics, including lenses, interference, and diffraction. Three hours of lecture and one three-hour lab per week. Prerequisite(s): PHY 200, MTH 211 or concurrent enrollment.
Corequisite(s): PHY 201L.

PHY 201L General Physics II Lab 0 Credits
This lab is a co-requisite and must be taken with the corresponding course.
Corequisite(s): PHY 201.