CHEMISTRY B.S. / CHEMISTRY B.A.

Program Overview

Students in the chemistry 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 (http://www.rider.edu/academics/colleges-schools/college-liberal-arts-education-sciences/science-programs/chemistry-biochemistry-physics/chemistry-biochemistry-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.

The major has been approved by the American Chemical Society (ACS), which means that the program is nationally recognized as providing adequate experimental skills, oral and written communication skills, and knowledge that prepare students to be future professionals in the chemical sciences. Chemistry students at Rider University have challenging and engaging experiences in the five areas of chemistry: analytical, inorganic, organic, physical chemistry, and biochemistry.

Curriculum Overview

Core chemistry classes include one year of general chemistry, one year of organic chemistry, quantitative analysis, biochemistry, physical chemistry and inorganic chemistry. Students must also take calculus and general physics I and II. Advanced chemistry courses include biochemistry II, medicinal chemistry, physical organic chemistry, chemical bonding, and others. Students must also earn four lab credits from the following courses: biochemistry I lab, biochemistry II lab, advanced organic synthesis and spectroscopy, computational chemistry lab, and physical organic chemistry.

Degrees Offered:

- B.S. in Chemistry
- B.A. in Chemistry
- Minor in Chemistry

Contact

Alexander Grushow, Ph.D.
Professor and Chairperson
Science Hall 336D
609-896-5095
grushow@rider.edu

Program Website: Chemistry (http://www.rider.edu/academics/colleges-schools/college-liberal-arts-education-sciences/science-programs/chemistry-biochemistry-physics)
Associated Department: Department of Chemistry, Biochemistry & Physics (http://www.rider.edu/academics/colleges-schools/college-liberal-arts-education-sciences/science-programs/chemistry-biochemistry-physics)

Related programs:

- Biochemistry (http://catalog.rider.edu/undergraduate/colleges-schools/liberal-arts-sciences/majors-minors-certificates/biochemistry)
- Physics (http://catalog.rider.edu/undergraduate/colleges-schools/liberal-arts-sciences/majors-minors-certificates/physics)

Requirements for the Chemistry B.S. Major (p. 1)

Requirements for the Chemistry B.A. Major (p.)

Requirements for the Major (B.S.)

(66 credits)

Code	Title	Credits
General Education Curriculum		
See CLAS General Education Curriculum Page (http://catalog.rider.edu/undergraduate/colleges-schools/liberal-arts-sciences/general_education_requirements)		
Core Chemistry		
CHE 120	Principles of Chemistry	3
CHE 121	Principles of Chemistry Lab	1
CHE 122	Intro to Chemical Systems	3
CHE 123	Quantitative Methods Lab	1
CHE 211	Organic Chemistry I	4
CHE 214	Organic Chemistry II	4
CHE 250	Quantitative Analysis and Statistics Methods	4
CHE 305	Physical Chemistry I	3
CHE 315	Inorganic Chemistry	3
CHE 316	Inorganic Chemistry Laboratory	1
CHE 325	Physical Chemistry Laboratory	1
CHE 330	Instrumental Analysis Laboratory	2
BCH 325	Biochemistry I	3
Mathematics		12
MTH 210	Calculus I	
MTH 211	Calculus II	
MTH 212	Calculus III	
Physics		8
PHY 200	General Physics I	
PHY 201	General Physics II	
Advanced Chemistry Courses		9
Select three of the following:		
BCH 330	Biochemistry II	
BCH 425	Medicinal Chemistry	
CHE 306	Physical Chemistry II	
CHE 320	Polymer Chemistry	
CHE 400	Chemical Bonding	
CHE 415	Special Topics in Chemistry	

CHE 420	Physical Organic Chemistry [1]	
Advanced Laboratory Courses		4
Select four lab credits from the following: [2]		
BCH 326	Biochem and Enzymology I Lab	
BCH 331	Biochemistry II Lab	
CHE 350	Advanced Organic Synthesis	
CHE 375	Computational Chemistry Lab	
CHE 420L	Physical Organic Chemistry Lab [1]	
Total Credits		66

Notes:

1. CHE 420 counts as a three credit course and one lab credit only.
2. Lab courses count for one or two credits (see course descriptions).

Bachelor of Arts Option

The curriculum described above is for a Bachelor of Science program that is approved by the American Chemical Society (ACS) and carries with it a certification that graduates with the B.S. degree are recognized by the ACS. All students admitted to the School of Liberal Arts and Sciences seeking a chemistry degree will be enrolled in the B.S. program. However, there is the option to be enrolled in a Bachelor of Arts program in chemistry. This program consists of 52 credits in the major and is designed for students who may desire a chemistry degree, but do not have a full eight semesters to commit to the program. Such students may be those enrolled in the School of Education, transfer students or students choosing a second major.

The B.A. in Chemistry does explore the five subdisciplines of chemistry and does have a laboratory component. However, the depth of student exploration in the chemical sciences is not sufficient enough to attain certification by the ACS.

Students in the School of Education will automatically be enrolled in the B.A. program. Other students seeking to enroll in the Bachelor of Arts program in Chemistry must consult with the Chair of the Department of Chemistry, Biochemistry & Physics before being considered for this program.

Requirements for the Major (B.A.)

(52 credits)

Code	Title	Credits
CLAS General Education Curriculum		
See CLAS General Education Curriculum Page (http://catalog.rider.edu/undergraduate/colleges-schools/liberal-arts-sciences/general_education_requirements)		
Core Chemistry		
CHE 120	Principles of Chemistry	3
CHE 121	Principles of Chemistry Lab	1
CHE 122	Intro to Chemical Systems	3
CHE 123	Quantitative Methods Lab	1
CHE 211	Organic Chemistry I	4
CHE 214	Organic Chemistry II	4
CHE 250	Quantitative Analysis and Statistics Methods	4
CHE 315	Inorganic Chemistry	3
CHE 305	Physical Chemistry I	3
BCH 325	Biochemistry I	3
Mathematics		8
MTH 210	Calculus I	
MTH 211	Calculus II	
Physics		8
PHY 200	General Physics I	
PHY 201	General Physics II	
Or		
PHY 100	Principles of Physics I	
PHY 100L	Principles of Physics I Lab	
PHY 101	Principles of Physics II	
PHY 101L	Principles of Physics II Lab	
Advanced Chemistry Course		3
Select one course from CHE or BCH at 300 or above		
Advanced Laboratory Courses		4
Laboratory courses from CHE or BCH at 300 or above. Some lab courses are 1-credit and some are 2-credit. See course descriptions for details.		
Total Credits		52

Chemistry Minor Requirements

(24 credits)

Code	Title	Credits
CHE 120	Principles of Chemistry	3
CHE 121	Principles of Chemistry Lab	1
CHE 122	Intro to Chemical Systems	3
CHE 123	Quantitative Methods Lab	1
CHE 211	Organic Chemistry I	4
Select twelve elective credits (including two labs) from the following:		
Chemistry or biochemistry courses at the 200 level or above, six credits of which must be at the 300 level or above. At least one course must be taken in three of the five disciplines: organic chemistry, inorganic chemistry, biochemistry, physical chemistry and analytical chemistry		12
Total Credits		24

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 change their major; or those who transfer to Rider may follow a different plan to ensure a timely graduation. Each student, with guidance from his or her 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	Expository Writing [1]	3
HIS 150	World History to 1500	3
NCT 010	Freshman Seminar	0
	Semester Credit Hours	14

Spring Semester		
CHE 122	Intro to Chemical Systems	3
CHE 123	Quantitative Methods Lab	1
MTH 211	Calculus II	4
CMP 125	Research Writing	3
HIS 151	World History Since 1500	3
	Semester Credit Hours	14
Year 2		
Fall Semester		
CHE 211	Organic Chemistry I	4
CHE 211L	Organic Chemistry I Lab	0
PHY 200	General Physics I	4
PHY 200L	General Physics I Lab	0
MTH 212	Calculus III	4
Social Perspectives		3
	Semester Credit Hours	15
Spring Semester		
CHE 214	Organic Chemistry II	4
CHE 214L	Organic Chemistry II Lab	0
PHY 201	General Physics II	4
PHY 201L	General Physics II Lab	0
Social Perspectives		3
Aesthetic Perspectives: Literature		3
Elective Course [2]		3
	Semester Credit Hours	17
Year 3		
Fall Semester		
CHE 250	Quantitative Analysis and Statistics Methods	4
CHE 250L	Quantitative Analysis and Statistical Methods Lab	0
CHE 305	Physical Chemistry I	3
Lab Elective Course		1-2
Foreign Language		3
Philosophical Perspectives		3
	Semester Credit Hours	14-15
Spring Semester		
CHE 330	Instrumental Analysis Laboratory	2
CHE 325	Physical Chemistry Laboratory	1
Advanced Elective Course		3
Foreign Language		3
Aesthetic Perspectives: Fine Arts		3
Elective Course [2]		3
	Semester Credit Hours	15
Year 4		
Fall Semester		
BCH 325	Biochemistry I	3
CHE 315	Inorganic Chemistry	3
CHE 316	Inorganic Chemistry Laboratory	1
Advanced Lab Course		1-2
Two Elective Courses [2]		6
	Semester Credit Hours	14-15
Spring Semester		
Two Advanced Biochemistry or Chemistry Elective Courses		6
Advanced Lab Course		1-2
Three Elective Courses [2]		9
	Semester Credit Hours	16-17
	Total Credit Hours for Graduation	119-122

1 For course placement information see http://www.rider.edu/offices-services/orientation/course-placement

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

Note:

1. Math and Science general education requirements are included in the major.

Courses and Descriptions

CHE 100 Intro to College Chemistry 3 Credits
Open to all students, but designed primarily for those who wish to major in a science which requires chemistry but whose chemistry background is not sufficient to allow entrance into Chemistry 120. It focuses on the nomenclature used in chemistry including the symbols used to designate the chemical elements, the construction of chemical formulas, and the writing and balancing of chemical equations. Other topics will include interpreting the Periodic Table, the valences of the elements, the mole concept, and simple stoichiometry. In addition, chemical calculations involving units, scientific notation, significant figures, and the algebraic manipulations of simple equations will be included. Three hours of lecture per week. This course does not satisfy the requirements for the biochemistry or chemistry degree, but does satisfy the core requirements for liberal arts, education and business majors.

CHE 114 Chemistry in the Kitchen 4 Credits
Chemistry permeates aspects of our daily lives in which we are often unaware. In this course, students will learn the core tenets of chemistry including atomic and molecular structure, bonding, intermolecular and macromolecular interactions, and chemical reactivity, and will personally investigate these properties in the context of cooking, baking, metabolism, and other kitchen-related activities. This 4-credit course will include a weekly 3-hour lab in which students will perform experiments that allow them to prepare dishes that illustrate key chemical concepts. As part of the course, students will collaborate with the Trenton Area Soup Kitchen to prepare and serve food to the community, as well as share their understanding about the chemical properties that are involved in the development of various dishes. This course counts towards the fulfillment of the Disciplinary Perspectives element of the CLAS general education curriculum.
Corequisite(s): CHE 114L.

CHE 114L Chemistry in the Kitchen Lab 0 Credits
This is the laboratory portion of CHE 114.
Corequisite(s): CHE 114.

CHE 115 Chem and Contemporary Society 3 Credits
Designed to give the nonscientist an appreciation of the role of chemistry in today's world. The approach is conceptual rather than mathematical. Topics include basic principles of chemical theory, energy sources, elementary organic chemistry, drugs, food additives, polymers, chemistry of living systems, inorganic solids in modern technology, and problems involving pollution of the environment. Three hours of lecture per week. This course satisfies the core requirements for liberal arts, education and business majors.

CHE 118 Exploration of Chemical Principles 4 Credits
A one-semester introduction to the principles of chemical sciences. Students will utilize inquiry-based learning methods to examine contextual problems as a means to explore introductory models and concepts of chemistry. Students will also gain an understanding of how scientific models are used to explain experimental observations. The laboratory component of this course is designed to provide students with an experimental context within which to develop some of the models described in the classroom. Three hours of lecture and one three-hour lab per week.

CHE 118L Exploration of Chemical Principles Lab 0 Credits
This lab is a co-requisite and must be taken with the corresponding course.
Corequisite(s): CHE 118.

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
TThe 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 122, CHE 123.
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.
Corequisite(s): CHE 214L.

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, MTH 210.
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 214, MTH 211, PHY 201.

CHE 306 Physical Chemistry II 3 Credits
Physical chemistry concepts are explored in more detail with emphasis on examination of systems that require multiple models in physical chemistry to explain. Topics will include, kinetic theory and transition state theory, statistical mechanics and its connections to thermodynamic functions, temperature dependence of spontaneity and equilibrium, the thermodynamics of condensed phases and multi-component equilibria, electrochemistry, multi-electron quantum mechanical systems, approximations in quantum mechanics, symmetry and advanced molecular spectroscopy.
Prerequisite(s): CHE 305, MTH 212.

CHE 315 Inorganic Chemistry 3 Credits
The periodic table as a tool for predicting the physical and chemical properties of chemical systems is developed and examined in conjunction with various theories of bonding, including valence bond, molecular orbital, valence shell electron repulsion, and ligand field theory. Emphasizes structure of crystalline solids, coordination compounds, reaction mechanisms, and structure-property relationships. Three hours of lecture per week.
Prerequisite(s): CHE 214.

CHE 316 Inorganic Chemistry Laboratory 1 Credits
Students will explore a variety of synthetic methodologies for the growth of inorganic molecular systems, and solid-state materials. A transition metal or main group metal plays a central structural role in all systems that will be examined. Modern analytical methods will be applied to characterize synthesis products, such as FT-IR spectroscopy, polarimetry, NMR, and powder X-ray diffraction analysis.
Prerequisite(s): CHE 315 or as corequisite.

CHE 320 Polymer Chemistry 3 Credits
Designed to acquaint students with the structure and properties of polymers, the contrast between small molecules and polymers, methods of measuring molecular weight, the mechanism of polymerization, and the methods of fabricating polymers.
Prerequisite(s): CHE 214, CHE 305 or CHE 306.

CHE 325 Physical Chemistry Laboratory 1 Credits
Measurements are made of physical properties of molecules and chemical dynamical processes. These measurements will be used to develop models which explain the physical chemical nature of the systems under examination. Experiments will utilize various instrumental techniques such as infrared spectrometry, nuclear magnetic resonance, fluorescence and UV/Vis spectrometry. One three-hour lab per week.
Prerequisite(s): CHE 250, CHE 305.

CHE 330 Instrumental Analysis Laboratory 2 Credits
This course is designed to give students practical experience using modern analytical instrumentation and to provide students with the background theory and principles of operation. The instrumental methods introduced in this course include: ultraviolet and visible spectroscopy, atomic emission spectroscopy, gas chromatography (GC), high performance liquid chromatography (HPLC), X-ray powder diffraction analysis and electrochemical analysis. This experimental laboratory course meets two times per week with three hours for each session. One session will be focused on instrumentation background theory and discussion and the other session will be experimental practice.
Prerequisite(s): CHE 214, CHE 250, PHY 201.

CHE 350 Advanced Organic Synthesis 2 Credits
The first of four experimental chemistry labs designed for chemistry majors. It presents the use of modern techniques, and instrumentation in organic chemistry, including distillation, chromatography, infrared, ultraviolet, nuclear magnetic spectroscopy, and mass spectrometry. Two three-hour labs per week.
Prerequisite(s): CHE 214.

CHE 375 Computational Chemistry Lab 2 Credits
This course will provide students with a means to explore various methods in computational chemistry. Basic computational methods will be developed from first principles and these methods will then be tested using various modeling and computational software packages. Methods will include, but are not limited to, molecular mechanics, semi-empirical molecular orbital calculations, ab initio methods, and density functional calculations. Students will be exposed to various computational software packages and the strengths and limitations of each methodology will be explored. The course will meet in a computer laboratory for two for three-hour lab periods a week.
Prerequisite(s): CHE 305.

CHE 400 Chemical Bonding 3 Credits
The effects of the chemical bond on the structure and properties of molecules are investigated. Molecular orbital theories of bonding are introduced. Emphasis is placed on group theoretical methods utilizing molecular symmetry to simplify the description of the electronic structure of molecules and to predict their geometric structures and reactivity. Three hours of lecture per week.
Prerequisite(s): CHE 305, MTH 212.

CHE 415 Special Topics in Chemistry 3 Credits
An advanced level of one or more areas of modern chemistry. Emphasis on research and the literature of an area of current importance. Three hours of lecture per week.

CHE 420 Physical Organic Chemistry 4 Credits
In-depth studies of the methods for elucidating mechanisms of organic reactions for students who have completed one year of organic chemistry and physical chemistry. Topics include conformational analysis, linear free energy relationships, frontier molecular orbital theory, transition state theory, and chemical reaction kinetics. Isotopic scrambling, kinetic isotope effects, NMR and IR spectroscopy, polarimetry, and ultraviolet-visible spectrophotometry will be employed to investigate these concepts. Three hours of lecture and one three-hour lab per week.
Prerequisite(s): CHE 214, CHE 305.
Corequisite(s): CHE 214L.

CHE 420L Physical Organic Chemistry Lab 0 Credits
This lab is a co-requisite and must be taken with the corresponding course.
Corequisite(s): CHE 420.

CHE 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 measurements, and obtain reproducible data. If possible, the student will publish the results or present them at a scientific meeting.

CHE 491 Internship in Chemistry 1-4 Credits
A supervised research experience in an approved organization where qualified students gain real-world knowledge and utilize their academic training in a professional environment. Placement may be in a private, public, non-profit, or governmental organizations under the guidance of a mentor. The mentor and student will have regular consultation with the departmental internship coordinator to assess the student's progress. Normally, 50 hours of internship per credit is required. The grade for the course will be determined by the students' overall performance in their research work, a research paper documenting their work with their internship mentor and an oral or poster presentation at the end of the semester.
Prerequisite(s): 2.5 GPA and permission of the instructor.