CHEMISTRY

Chemistry Program Requirements and Opportunities

The Chemistry major is offered with several different options:

- American Chemical Society (ACS) Certified A.B., recommended for graduate school
- Chemistry major, A.B. Only
- Chemistry minor
- Chemistry major with concentration in biochemistry
- Chemistry major with concentration in geochemistry

For all degree options, merit level work is expected in every chemistry, math, biology, geology, and physics course.

FAQ About The Chemistry Major (https://www.brynmawr.edu/inside/academic-information/departments-programs/chemistry/frequently-asked-questions-about-chemistry-major/)

ACS Certified A.B. Major Requirements

A student may qualify for a major in chemistry by completing a total of 15 units in chemistry with the distribution:

Code	Title	Units
CHEM B103	General Chemistry I	1
CHEM B104	General Chemistry II	1
CHEM B211 & CHEM B216	Organic Chemistry I and Organic Chemistry Laboratory I	1.5
CHEM B212 & CHEM B217	Organic Chemistry II: and Organic Chemistry Laboratory II	1.5
CHEM B221	Physical Chemistry I	1
CHEM B222	Physical Chemistry II	1
CHEM B231	Inorganic Chemistry	1
CHEM B242	Biological Chemistry	1
CHEM B251	Research Methodology I	1
CHEM B252	Research Methodology II	1
CHEM B398	Senior Seminar	1
CHEM B399	Senior Seminar	1
Select two other CHEM 3xx courses		2
Total Units		**15**

Other required courses: MATH B201 Multivariable Calculus is a prerequisite for CHEM B221 Physical Chemistry I & CHEM B222 Physical Chemistry II.

Students majoring in Chemistry fulfill the disciplinary writing requirement by satisfactorily completing CHEM B251 Research Methodology I and CHEM B252 Research Methodology II, which are writing attentive courses.

Major, A.B. only

A non-ACS certified major requires all of the above coursework except CHEM B398 Senior Seminar, CHEM B399 Senior Seminar.

Academic Opportunities

A.B./M.A. Program

The combined A.B./M.A. program lets the well-prepared undergraduate student work toward a master's degree while still completing the bachelor's degree. To earn an M.A. degree in Chemistry in the College's A.B./M.A. program, a student must complete the requirements for the A.B. in Chemistry concurrently with those of the M.A. in Chemistry, six units in Chemistry. Up to two units may counted towards both degrees.

- Chemistry major A.B. requirements
- Four units of 500-level courses, two units may be at the 300-level
- Two units of 700-level
- M.A. thesis
- Written final exam

3-2 Program in Engineering and Applied Science

The 3-2 Program in Engineering and Applied Science is offered in cooperation with the California Institute of Technology and awards both an A.B. at Bryn Mawr and a B.S. at Cal Tech. Chemistry students considering this program should contact Chemistry Senior Lecturer Lisa Watkins.

4+1 Program in Engineering at UPenn

The University of Pennsylvania 4+1 engineering program allows students to earn an A.B. at Bryn Mawr and an M.S. in Engineering (M.S.E) at UPenn. Students apply between the beginning of the sophomore year and end of the junior year. Chemistry students considering this program should contact Chemistry Senior Lecturer Lisa Watkins. See also the description of the 4+1 Program in Engineering at UPenn.

Timetables for Meeting Major Requirements

Students may follow various schedules to meet their major requirements. However, a fairly typical one is:

Course	Title	Units
Freshman		
CHEM B103	General Chemistry I	1
CHEM B104	General Chemistry II	1
MATH B101	Calculus I	1
MATH B102	Calculus II	1
	Units	**4**
Sophomore		
CHEM B211 & CHEM B216	Organic Chemistry I and Organic Chemistry Laboratory I	1.5
CHEM B212 & CHEM B217	Organic Chemistry II: and Organic Chemistry Laboratory II	1.5
MATH B201	Multivariable Calculus	1
	Units	**4**
Junior		
CHEM B221	Physical Chemistry I	1
CHEM B222	Physical Chemistry II	1
CHEM B231	Inorganic Chemistry	1
CHEM B242	Biological Chemistry	1
CHEM B251	Research Methodology I	1
CHEM B252	Research Methodology II	1
	Units	**6**

Senior	
Two or more CHEM 3xx	
Units	**0**
Total Units	**14**

In particular note that:

- MATH B201 Multivariable Calculus must be completed before taking CHEM B221 Physical Chemistry I or CHEM B222 Physical Chemistry II.
- CHEM B221 Physical Chemistry I/CHEM B222 Physical Chemistry II can be taken concurrently with CHEM B211 Organic Chemistry I/CHEM B212 Organic Chemistry II:.

Students who wish to deviate from the usual schedule (including those who want to complete the major in 3 years) should consult with the major adviser as early as possible to devise an alternative plan.

Honors

The requirements for departmental honors are:

- Complete one of the major plans
- Maintain a chemistry GPA of 3.7 or better. A maximum of 2 credits of 403 will be factored into the chemistry GPA
- Complete CHEM B398 Senior Seminar and CHEM B399 Senior Seminar with a grade of 3.3 or better each semester.
- Participate in research oral/poster presentations.
- Write an acceptable thesis, and meet all department deadlines for submission of the thesis.
- Complete an additional unit of CHEM 3xx (for a total of three 300-level chemistry units). With department approval, one unit of 300-level work in certain fields may be substituted.

Chemistry Major Concentrations

Concentration in Biochemistry

Code	Title	Units
CHEM B103	General Chemistry I	1
CHEM B104	General Chemistry II	1
CHEM B211 & CHEM B216	Organic Chemistry I and Organic Chemistry Laboratory I	1.5
CHEM B212 & CHEM B217	Organic Chemistry II: and Organic Chemistry Laboratory II	1.5
CHEM B242	Biological Chemistry [1]	1
Select two of the following:		2
CHEM B221	Physical Chemistry I [2]	
CHEM B222	Physical Chemistry II [2]	
CHEM B231	Inorganic Chemistry	
CHEM B251	Research Methodology I	1
CHEM B252	Research Methodology II	1
CHEM B345	Advanced Biological Chemistry	1
CHEM B377	Biochemistry II: Biochemical Pathways and Metabolism	1
CHEM 3xx		
BIOL B201	Genetics	1
BIOL B376	Molecular Biology [3]	1
Total Units		**14**

1. BIOL B375 Biochemistry may be substituted for CHEM B242 Biological Chemistry
2. Pre-requisite: MATH B201 Multivariable Calculus
3. CHEM B242 Biological Chemistry satisfies the pre-requisite for this course.

Concentration in Geochemistry

Code	Title	Units
CHEM B103	General Chemistry I	1
CHEM B104	General Chemistry II	1
CHEM B211 & CHEM B216	Organic Chemistry I and Organic Chemistry Laboratory I	1.5
CHEM B212 & CHEM B217	Organic Chemistry II: and Organic Chemistry Laboratory II	1.5
Select three of the following:		3
CHEM B221	Physical Chemistry I [1]	
CHEM B222	Physical Chemistry II [1]	
CHEM B231	Inorganic Chemistry	
CHEM B242	Biological Chemistry [2]	
CHEM B251	Research Methodology I	1
CHEM B252	Research Methodology II	1
CHEM B332	Advanced Inorganic Chemistry	1
CHEM 3xx		1
GEOL B101	How the Earth Works	1
GEOL B202	Mineralogy and Crystal Chemistry	1
Select two of the following:		2
GEOL B302	Low-Temperature Geochemistry	
GEOL B305	Igneous and Metamorphic Petrology	
GEOL B350	Advanced Topics in Geology (requires Geology major adviser approval)	
Total Units		**16**

1. Pre-requisite: MATH B201 Multivariable Calculus
2. BIOL B375 Biochemistry may be substituted for CHEM B242 Biological Chemistry

The Chemistry major can also be combined with any of the minors offered in the College. In particular, the minors in Environmental Studies, Education and Computational Science offer attractive combinations with a Chemistry major for future career paths that require competency in those allied fields. Detailed information about these minors can be found in the appropriate section of the catalog. Students may double major in Chemistry and Biology, but are not permitted to double major in Biology and BCMB (Biochemistry & Molecular Biology) or Chemistry and BCMB.

Minor

A student may qualify for a minor in chemistry by completing a total of 8 units in chemistry with the distribution:

Code	Title	Units
CHEM B103	General Chemistry I	1
CHEM B104	General Chemistry II	1
CHEM B211 & CHEM B216	Organic Chemistry I and Organic Chemistry Laboratory I	1.5

CHEM B212 & CHEM B217	Organic Chemistry II: and Organic Chemistry Laboratory II	1.5
CHEM B221	Physical Chemistry I [1]	1
or CHEM B222	Physical Chemistry II	
CHEM B231	Inorganic Chemistry [2]	1
or CHEM B242	Biological Chemistry	
CHEM B251	Research Methodology I	1
or CHEM B252	Research Methodology II	
Total Units		**8**

1 Pre-requisite: MATH B201 Multivariable Calculus

2 BIOL B375 Biochemistry may be substituted for CHEM B242 Biological Chemistry

CHEM B101 An Introduction to Problem Solving in Chemistry (1 Unit)
This course prepares students who have successfully completed QSEM for the introductory chemistry sequence. It offers students an environment in which to further develop the quantitative approaches and skills necessary for success in the chemistry classroom and laboratory. This course is not open to students who have completed General Chem I (CHEM B103 or H111). Prerequisite: QSEM or permission of instructor.

CHEM B103 General Chemistry I (1 Unit)
This is an introductory course in chemistry, open to students with no previous chemistry experience. Topics include aqueous solutions and solubility; the electronic structure of atoms and molecules; chemical reactions and energy; intermolecular forces. Examples discussed in lecture and laboratory include applications of the material to environmental sciences, material science and biological chemistry. Lecture three hours, recitation one hour and laboratory three hours a week. Prerequisite: Quantitative Readiness Required.

CHEM B104 General Chemistry II (1 Unit)
For students who have completed General Chemistry I or have some previous work in chemistry. Topics include chemical kinetics; aqueous solutions and solubility; chemical equilibrium; electrochemistry; thermochemistry. Examples discussed in lecture and laboratory workshop include nuclear chemistry, geochemistry, environmental sciences, material sciences and biological chemistry. One section of the course is designed for students considering a major in the sciences and takes an interdisciplinary approach to the course topics. Lecture three hours, recitation one hour and laboratory three hours a week. Prerequisite: CHEM B103 with a grade of at least 2.0 or permission of the instructor.

CHEM B208 Topics in Art Analysis (1 Unit)
This is a topics course and topics will vary. All courses will cover a variety of methods of analysis of works of art centered around a specific theme. Using both completed case studies and their own analysis of objects in the Bryn Mawr College collection, students will investigate a number of instrumental methods of obtaining both quantitative and qualitative information about the manufacture, use and history of the objects. This course counts towards the major in History of Art.

CHEM B211 Organic Chemistry I (1 Unit)
An introduction to the basic concepts of organic chemistry, including acid-base principles; functional groups; alkane and cycloalkane structures; alkene reactions; alkynes; dienes and aromatic structures; substitution and elimination reactions; alcohol reactivity; and radical reactions. Lecture three hours, recitation one hour a week. There is no longer a laboratory portion of CHEM B211. Instead, students can enroll in CHEM B216 which is a half-credit laboratory course that introduces basic operations in the organic chemistry lab, spectroscopy, and reactions discussed CHEM B211. Students should consult with their deans/advisors about whether to enroll in CHEM B216. Students planning to major in STEM disciplines or intending to fulfill pre-health requirements will need to take CHEM B216 in addition to CHEM B211. Prerequisite: CHEM 104 with a grade of at least 2.0.

CHEM B212 Organic Chemistry II: (1 Unit)
The second semester of organic chemistry includes discussion of the reactivity of carbonyl carbons such as ketones, aldehydes, carboxylic acids and derivatives, saccharides and enolate chemistry. This course also emphasizes biologically relevant topics. There is no longer a laboratory portion of CHEM B212. Instead, students can enroll in CHEM B217 which is a half-credit laboratory course that covers reactions discussed in CHEM B212, more advanced NMR spectroscopy and an extended total-synthesis project. Students should consult with their deans/advisors about whether to enroll in CHEM B217. Students planning to major in STEM disciplines or intending to fulfill pre-health requirements will need to take CHEM B217 in addition to CHEM B212. Lecture three hours, recitation one hour a week. Prerequisite: CHEM 211 with a grade of at least 2.0.

CHEM B213 Organic Chemistry I (1 Unit)
An introduction to the basic concepts of organic chemistry, including acid-base principles; functional groups; alkane and cycloalkane structures; alkene reactions; alkynes; dienes and aromatic structures; substitution and elimination reactions; alcohol reactivity; and radical reactions. The laboratory course introduces basic operations in the organic chemistry lab, spectroscopy, and reactions discussed in lecture. Lecture three hours, recitation one hour and laboratory five hours a week. Prerequisite: CHEM 104 with a grade of at least 2.0. For students enrolled in the postbaccalaureate premedical program only

CHEM B214 Organic Chemistry II: Biochemistry (1 Unit)
The second semester (biological organic chemistry) is broken into two modules. In the first module, the reactivity of carbonyl carbon is discussed, including ketones, aldehydes, carboxylic acids and derivatives, saccharides and enolate chemistry. Traditional biochemistry coverage begins with the second module. Amino acids (pI, electrophoresis, side chain pKa), protein structure (1°, 2°, 3°, 4°), and enzymatic catalysis, kinetics and inhibition are introduced. The reactivity of the co-enzymes (vitamins) is also covered as individual case studies in bio-organic reactivity. Lecture three hours, recitation one hour and laboratory five hours a week. Prerequisite: CHEM 213 with a grade of at least 2.0. For students enrolled in the postbaccalaureate premedical program only.

CHEM B216 Organic Chemistry Laboratory I (0.5 Unit)
This is a half-credit laboratory course that introduces basic operations in the organic chemistry lab, spectroscopy, and reactions discussed CHEM B211. 1 hour of lecture and 4 hours of laboratory per week. Prerequisite: Either concurrent enrollment in CHEM B211 or prior completion of CHEM B211 with a grade of at least 2.0.

CHEM B217 Organic Chemistry Laboratory II (0.5 Unit)
This is a half-credit laboratory course that covers reactions discussed in CHEM B212, more advanced NMR spectroscopy and an extended total-synthesis project.. 1 hour of lecture and 4 hours of laboratory per week. Prerequisite: CHEM B216 with a grade of at least 2.0 and either concurrent enrollment in CHEM B212 or prior completion of CHEM B212 with a grade of at least 2.0.

CHEM B221 Physical Chemistry I (1 Unit)
Introduction to quantum theory and spectroscopy. Atomic and molecular structure; molecular modeling; rotational, vibrational, electronic and magnetic resonance spectroscopy. Lecture three hours. Prerequisites: CHEM B104 and MATH B201.

CHEM B222 Physical Chemistry II (1 Unit)
Modern thermodynamics, with application to phase equilibria, interfacial phenomena and chemical equilibria; statistical mechanics; chemical dynamics. Kinetic theory of gases; chemical kinetics. Lecture three hours. Prerequisite: CHEM B104 and MATH 201. May be taken concurrently with CHEM B212, with permission of instructor.

CHEM B231 Inorganic Chemistry (1 Unit)
Bonding theory; structures and properties of ionic solids; symmetry; crystal field theory; structures, spectroscopy, stereochemistry, reactions and reaction mechanisms of coordination compounds; acid-base concepts; descriptive chemistry of main group elements. Lecture three hours a week. Prerequisite: CHEM 212.

CHEM B242 Biological Chemistry (1 Unit)
The structure, chemistry and function of amino acids, proteins, lipids, polysaccharides and nucleic acids; enzyme kinetics; metabolic relationships of carbohydrates, lipids and amino acids, and the control of various pathways. Lecture three hours a week. Prerequisite: CHEM B212 or CHEM H222.

CHEM B251 Research Methodology I (1 Unit)
This is a laboratory topics course integrating advanced concepts in chemistry from biological, inorganic, organic and physical chemistry. Students gain experience in the use of departmental research instruments and in scientific literature searches, quantitative data analysis, record keeping and writing. Prerequisite CHEM B212. Co-requisite: CHEM B221 or B231 or B242. Attendance at departmental colloquia is expected of all students.

CHEM B252 Research Methodology II (1 Unit)
This laboratory course integrates advanced concepts in chemistry from biological, inorganic, organic and physical chemistry. Students will gain experience in the use of departmental research instruments and in scientific literature searches, quantitative data analysis, record-keeping, and writing. Attendance at departmental colloquia is expected of all students. Course Prerequisites: CHEM B212. Course Co-requisites: CHEM B222 or CHEM B231 or CHEM B242.

CHEM B311 Advanced Organic Chemistry (1 Unit)
A survey of the methods and concepts used in the synthesis of complex organic molecules. Lecture three hours a week. Prerequisites: CHEM 212 and 222.

CHEM B332 Advanced Inorganic Chemistry (1 Unit)
This is a topics course covering topics in advanced inorganic chemistry. Prerequisites: CHEM 231 and 242 or permission of the instructor.

CHEM B334 Organometallic Chemistry (1 Unit)
Fundamental concepts in organometallic chemistry, including structure and bonding, reaction types, and catalysis, and applications to current problems in organic synthesis. Lecture three hours a week. Prerequisite: CHEM 212 and 231 or permission of instructor.

CHEM B345 Advanced Biological Chemistry (1 Unit)
This is a topics course. Topics vary. Prerequisite: CHEM B242 or BIOL B375.

CHEM B377 Biochemistry II: Biochemical Pathways and Metabolism (1 Unit)
This course is a continuation of CHEM B242 or BIOL B375. Biochemical pathways involved in cellular metabolism will be explored in molecular detail. Energy producing, degradation, and biosynthetic pathways involving sugars, fats, amino acids, and nucleotides will be discussed with an emphasis on structures and mechanisms, experimental methods, regulation, and integration. Additional topics, drawn from the primary research literature, may be covered. Readings will be drawn from textbooks and from the primary literature and assessments may include oral presentations, problem sets, written examinations, and writing assignments. This is a second course in Biochemistry and assumes a strong foundation in the fundamentals of Biochemistry. Prerequisite: BIO 375 or CHEM 242, or permission of instructor.

CHEM B398 Senior Seminar (1 Unit)

CHEM B399 Senior Seminar (1 Unit)

CHEM B403 Supervised Research (0.5-1 Unit)
Many individual research projects are available, each under the supervision of a member of the faculty. Laboratory at least 10 hours a week. Oral or written presentations are required at the end of each semester. Suggested Preparation: student must seek permission of faculty supervisor.

CHEM B511 Advanced Organic Chemistry I (1 Unit)
A survey of the methods and concepts used in the synthesis of complex organic molecules. Lecture three hours a week.

CHEM B512 Advanced Organic Chemistry (1 Unit)
Principles of physical organic chemistry with emphasis on reaction mechanisms, reactive intermediates, stereochemistry, and qualitative molecular orbital theory reasoning. Prerequisites: a standard two-semester course in organic chemistry (such as BMC Chemistry 211/212), and some coursework in physical chemistry.

CHEM B515 Modern Medicinal Chemistry (1 Unit)
A survey of topics related to drug discovery including lead discovery, target interactions, structural optimization, drug metabolism and drug synthesis. The course will engage in an advanced treatment of these topics with particular attention to an understanding of drug design and development on the molecular level. Case studies will be used to illustrate the application of these principles. Discussions may include OxyContin and related opiate analgesics; aspirin and related NSAIDs; penicillin and other antibacterial agents; Tamiflu and related anti-virals; Alzheimer's disease drugs; and anti-depressants. Prerequisites: CHEM 212 or by permission of the instructor

CHEM B521 Advanced Physical Chemistry (1 Unit)
Quantum mechanics and its application to problems in chemistry. Topics will include molecular orbital theory, density functional theory. Readings and problem sets will be supplemented with material from the current research literature. Students will gain experience with programming in Mathematica. Prerequisites: CHEM 221 and 222 or permission of the instructor. Lecture/seminar three hours per week.

CHEM B532 Advanced Inorganic Chemistry (1 Unit)
This is a topics course covering topics in advanced inorganic chemistry. Prerequisites: CHEM 231 and 242 or permission of the instructor.

CHEM B534 Organometallic Chemistry (1 Unit)
Fundamental concepts in organometallic chemistry, including structure and bonding, reaction types, and catalysis, and applications to current problems in organic synthesis. Lecture three hours a week. Course is open to graduate students and those undergraduates with CHEM 212 and CHEM B231 or permission from the instructor.

CHEM B535 Inorganic Seminar: Group Theory (1 Unit)
Fundamental concepts of mathematical groups, their derivation and their application to problems in bonding, spectroscopy and chemical reactivity.

CHEM B545 Advanced Biological Chemistry (1 Unit)
This is a topics course. Topics vary. Prerequisite: Any course in Biochemistry.

CHEM B550 Selected Topics in Current Chemical Research (1 Unit)
This is a topics course, course content varies. Lecture three hours a week. Prerequisites: CHEM 221-222 or permission of instructor.

CHEM B577 Biochemistry II: Biochemical Pathways and Metabolism (1 Unit)
This course is a continuation of CHEM B242 or BIOL B375. Biochemical pathways involved in cellular metabolism will be explored in molecular detail. Energy producing, degradation, and biosynthetic pathways involving sugars, fats, amino acids, and nucleotides will be discussed with an emphasis on structures and mechanisms, experimental methods, regulation, and integration. Additional topics, drawn from the primary research literature, may be covered. Readings will be drawn from textbooks and from the primary literature and assessments may include oral presentations, problem sets, written examinations, and writing assignments. This is a second course in Biochemistry and assumes a strong foundation in the fundamentals of Biochemistry. Prerequisite: BIO 375 or CHEM 375, or permission of instructor.

CHEM B800 Continuing Enrollment (0 Unit)

MATH B101 Calculus I (1 Unit)
This is the first in a sequence of two courses that covers single-variable calculus. Topics include functions, limits, continuity, derivatives, differentiation formulas, applications of derivatives, integrals, and the fundamental theorem of calculus. Prerequisite: proficiency in high-school mathematics (including algebra, geometry, and trigonometry).

MATH B102 Calculus II (1 Unit)
This is the second in a sequence of two courses that covers single-variable calculus. Topics include techniques of integration, applications of integration, infinite sequences and series, tests of convergence for series, and power series. Prerequisite: a merit grade in Math 101 (or an equivalent experience).

MATH B201 Multivariable Calculus (1 Unit)
This course extends calculus to functions of multiple variables. Topics include functions, limits, continuity, vectors, directional derivatives, optimization problems, multiple integrals, parametric curves, vector fields, line integrals, surface integrals, and the theorems of Gauss, Green and Stokes. Prerequisite: a merit grade in Math 102 (or an equivalent experience).