

# DEPARTMENT OF CHEMISTRY

## Bachelor of Science

### Andrew Torelli, *Associate Professor and Chairperson*

The chemistry curriculum, approved by the American Chemical Society, provides an exceptionally strong foundation for further training at the graduate level. The department is nationally noted for its research program, and students are regularly involved in research publications. Approximately 80 percent of chemistry majors continue in postgraduate education to pursue a Ph.D. or M.D. immediately after graduation. Chemistry majors are well-prepared for a wide range of career opportunities, including medicine, dentistry, veterinary medicine, pharmacology, environmental science, toxicology, food science, forensic science, secondary school teaching, and engineering.

## Chemical Engineering and Material Science

Students with an interest in chemical engineering can prepare for a career in this field by obtaining a bachelor of science degree at Ithaca College and then enrolling in a master of engineering program in chemical engineering from an engineering school. Students can concentrate their degree in an area of material science such as polymers, solar cells, batteries, superconductors, and semiconductors. The department offers several advanced electives covering recent trends in these areas, and several faculty have active research programs in these areas. The department curriculum is also designed to provide outstanding classroom and laboratory experience as preparation for a career in the chemical industry directly after graduation.

## Requirements for Honors in Chemistry

Eligible students may apply to earn Honors in chemistry during their senior year. The process and criteria by which students may earn departmental honors to be awarded at graduation are fully described in the departmental policy on honors in chemistry, available from the chair of the department and online on the department website.

## Majors & Minors

- Chemistry Major – B.S. (<https://catalog.ithaca.edu/undergrad/schools/school-humanities-sciences/department-chemistry/chemistry-major-bs/>)
- Chemistry Minor (<https://catalog.ithaca.edu/undergrad/schools/school-humanities-sciences/department-chemistry/chemistry-minor/>)

### CHEM 10100 Chemistry and Your Body (LA)

A course designed for students who have chosen to major in areas other than science. An introduction to the basic ideas of chemistry, the nature and structure of chemical compounds, and the meaning of chemical symbols. An application of these ideas and understandings to the chemistry of the body, with specific discussion of food, drugs, cosmetics, and other health-related topics. Three hours of lecture and/or discussion per week. Not open to students who have taken CHEM 12100 or CHEM 12300. (S,Y)

Attributes: 2A, NS, SC, TMBS, TWOS  
3 Credits

### CHEM 10200 Contemporary Chemical Issues (LA)

A description and discussion of new compounds and materials made by the chemical industry during the past 100 years that have properties superior to those of naturally occurring products. Many of these advances have significantly improved modern living; however, byproducts of some of these advances have also decreased the overall quality of life. After an introduction to the language and symbols of chemistry, topics related to contemporary problems and examples follow some compounds from research curiosities to industrial products. Three hours of lecture and/or discussion per week. Not open to students who have taken CHEM 12100 or CHEM 12300. (IRR)

Attributes: 2A, NS  
3 Credits

### CHEM 10500 Energy and the Environment (LA)

Description and discussion of types and sources of natural resources with a special emphasis placed on energy resources. Background is presented in terms of simple chemical principles understandable to students with majors other than the sciences. Topics of societal concern include air pollution, acid rain, global warming, ozone depletion, and upcoming energy shortages. Viable solutions to these problems are discussed. Primarily for students majoring in areas other than science or physical therapy. Three hours of class meeting per week, including discussion, lecture, and quizzes. Not open to students who have taken CHEM 12100 or CHEM 12300. (F,Y)

Attributes: ABSS, SC, TQSF  
3 Credits

### CHEM 10600 Preparation for Principles of Chemistry (LA)

Reviews fundamental mathematical skills and provides strategies for general chemistry problem solving, supporting students to develop scientific and proportional reasoning skills, as well as critical thinking and analytic problem-solving skills within a chemistry context in order to prepare them for success in CHEM 12100 Principles of Chemistry. Emphasis is placed on student participation and the application of chemistry concepts to solving real-world problems. Three hours of lecture/discussion per week. Prerequisites: Math placement in group 3 or higher, math placement assessment score or 46 or greater, or C- or better in MATH 10000. (F,Y)

Attributes: NS  
2 Credits

### CHEM 10800 Introduction to Technology (LA)

A course for non-science students, with an emphasis on the applications rather than the theories of science. This course examines those technologies, primarily nuclear technology (civilian and military) and biotechnology, that will significantly affect our lives in the years to come. Three hours of lecture and/or discussion per week. (IRR)

Attributes: 2A, NS  
3 Credits

### CHEM 11000 General Chemistry (LA)

General chemistry for occupational therapy majors. Topics from inorganic, organic, and biological chemistry, including the electronic structure of atoms, stoichiometry, equilibria, acids and bases, thermodynamics, kinetics, nomenclature, structure, and reactions of organic compounds and biochemicals. Required for occupational therapy majors. Prerequisites: High school chemistry. (S,Y)

Attributes: 2A, NS  
3 Credits

**CHEM 11200 Organic Chemistry and Biochemistry (LA)**

Introduction to general theories and principles of organic chemistry and biochemistry. The naming and structure of organic compounds, reactivities of the various functional groups in both aliphatic and aromatic compounds, and an introduction to the organic chemistry of biologically important systems. Three hours of lecture per week, with a fourth hour scheduled for review session and exams. Prerequisites: CHEM 12100 and CHEM 12200. (S,Y)

Attributes: 2A, NS

3 Credits

**CHEM 11400 Chemistry Laboratory (LA)**

Designed to complement the CHEM 12100-11200 sequence. Deals with organic reactions. One laboratory per week. Prerequisites: CHEM 12100 and CHEM 12200 or CHEM 12300; CHEM 11200 prior or concurrent. (S, Y)

Attributes: 2A, NS

1 Credit

**CHEM 11700 Environmental Chemistry (LA)**

General principles of chemistry needed for the study of environmental science. Topics include mathematical methods, electronic structure of atoms, stoichiometry, equilibria, acids and bases, thermodynamics, kinetics, and nuclear chemistry. Not open to students who have taken CHEM 12100 or CHEM 12300. (F,Y)

Attributes: 2A, NS

3 Credits

**CHEM 11900 Environmental Chemistry Laboratory (LA)**

Hands-on experience with modern analytical instruments that are frequently encountered in environmental assessments. The course prepares students to be technologically knowledgeable and authoritative in their future careers. Prerequisite: CHEM 11700 (may be taken concurrently) Laboratory: Four hours. (F,Y)

Attributes: NS

1 Credit

**CHEM 12000 Topics in Chemistry and Biochemistry (LA)**

Introduction to research projects and selected topics in chemistry and biochemistry. Natural science faculty in Biology, Chemistry, and Physics will present topics of interest on a rotating basis. Primarily intended for biochemistry and chemistry majors. One meeting per week. Pass/Fail only. (F,Y)

Attributes: NS

1 Credit

**CHEM 12100 Principles of Chemistry (LA)**

Introduction to general theories and principles of chemistry stressing underlying correlations. Systematic study of the periodic table, with an emphasis on bonding and the quantitative relationships among the elements. Three hours of lecture per week. Intended for students who have completed high school chemistry with minimum grade of C. Students cannot receive credit for both CHEM 12100 and CHEM 12300. Co-requisite: CHEM 12200. Prerequisites: Math placement in group 3 or higher, math placement assessment score of 46 or higher. (F,S,Y)

Attributes: 2A, NS

3 Credits

**CHEM 12200 Principles of Chemistry Laboratory (LA)**

Introduction to basic chemistry laboratory practice and techniques. The experiments reinforce the concepts covered in CHEM 12100. Prerequisites: Math placement in Group 3 or higher, math placement assessment score of 46 or higher. Co-requisite: CHEM 12100. (F,S,Y)

1 Credit

**CHEM 12300 Principles of Chemistry - Enriched Section (LA)**

Introduction to general theories and principles of chemistry, stressing underlying correlations. Systematic study of the periodic table with an emphasis on bonding and the quantitative relationships among the elements. The course covers additional topics and examples of scientific interest not included in CHEM 12100. Three hours of lecture per week and one laboratory per week. Intended for students with a strong background in chemistry with a score of 4 or 5 on AP Chemistry, or minimum score of 50 on General Chemistry CLEP, or 4-7 on IB Chemistry. Students cannot receive credit for both CHEM 12100 and CHEM 12300. Prerequisites: Math placement in group 1, math placement assessment score of 76-87 and permission of instructor. (F,Y)

Attributes: 2A, NS

4 Credits

**CHEM 12400 Experimental Chemistry I (LA)**

Emphasis is placed on quantitative analysis, organic synthesis, and modern instrumental techniques, such as ultraviolet, visible, and infrared spectrophotometry. One lecture and one laboratory per week.

Prerequisites: CHEM 12100 and CHEM 12200, or CHEM 12300; and CHEM 22100 (may be taken concurrently). (S,Y)

Attributes: 2A, NS

2 Credits

**CHEM 16000 Natural World by the Numbers (LA)**

Practical application of precollege level mathematics to natural phenomena. Practice evaluating the interpretation and presentation of data. Cross-listed with BIOL 16000. Prerequisites: Passing score on math competency exam. (IRR)

Attributes: NS

3 Credits

**CHEM 17100-17200 Undergraduate Instruction in Chemistry (NLA)**

Qualified undergraduates are given opportunities to participate in the department's instructional program, serving as laboratory assistants and/or tutors. Prerequisites: Permission of department. Pass/fail only.

1 Credit

**CHEM 18100-18200 Selected Topics: Chemistry (LA)**

Course content depends on interests of the registrants and may include informed discussions, outside reading, and either library or laboratory projects. This course may be repeated for credit for selected topics on different subjects. Prerequisites: Permission of instructor. (IRR)

Attributes: NS

1-3 Credits

**CHEM 19100-19200 Research in Chemistry (LA)**

After consultation with the faculty of the Department of Chemistry, the student undertakes a research problem under the guidance of one or more faculty members. Prerequisites: Permission of department.

Attributes: NS

1-3 Credits

**CHEM 20500 Chemistry and Art (LA)**

Investigates, through lecture and laboratory activities, the scientific basis of such topics as paints and pigments, metalworking and sculpture, dyes and fabrics, polymeric materials, and chemical hazards in art. Introduces students to basic chemical concepts and laboratory techniques, as well as modern analytical instruments. Lectures on the material history of art establish the context for the study of these chemical and analytical concepts. Students may enroll for ARTH 20500 or CHEM 20500, but not both. Prerequisites: Sophomore standing; permission of instructor. (S,O)

Attributes: 2A, 3B, CA, FA, HU, NS, SC, TIII

4 Credits

**CHEM 22100 Organic Chemistry I (LA)**

Introduction to the structure and reactivity of carbon compounds. Topics include bonding, isomerism, stereochemistry and the reactions of alkenes, alkynes, and alkyl halides with emphasis on reaction mechanisms. Analytical methods to study organic molecules; particularly infrared spectroscopy and nuclear magnetic resonance spectroscopy are also covered. The use of scientific and logical thought patterns is stressed in problem solving. Three hours of lecture per week. Co-requisite: CHEM 22300. Prerequisites: CHEM 12100 and CHEM 12200. (F,S,Y)

Attributes: NS  
3 Credits

**CHEM 22200 Organic Chemistry II (LA)**

Continuation of CHEM 22100. Course covers the chemistry and reactivity of carbonyl functional groups, including aldehydes, ketones, esters, and amides. Aromaticity and select topics in biological chemistry are also covered. The use of scientific and logical thought patterns is stressed in problem solving. Three hours of lecture per week. Co-Requisite: CHEM 22400. Prerequisites: CHEM 22100 and CHEM 22300 (with a grade of C- or better). (F,S,Y)

Attributes: NS  
3 Credits

**CHEM 22300 Organic Chemistry I Laboratory (LA)**

Emphasizes basic techniques of experimental organic chemistry, including reactions, purification of mixtures, and determination of structure. Experiments reinforce concepts covered in CHEM 22100. Co-requisite: CHEM 22100. Prerequisites: CHEM 12100 and CHEM 12200. (F,S)

1 Credit

**CHEM 22400 Organic Chemistry II Laboratory (LA)**

Emphasizes more advanced techniques of experimental organic chemistry, including reactions, purification of mixtures, and determination of structure. Experiments reinforce concepts covered in CHEM 22200. Co-Requisite: CHEM 22200. Prerequisites: CHEM 22100 and CHEM 22300. (F,S)

1 Credit

**CHEM 22500 Experimental Chemistry II (LA)**

Emphasis is placed on synthesis and qualitative analysis, using infrared and nuclear magnetic resonance spectroscopy and various chromatographic techniques. One lecture and one laboratory per week. Prerequisites: CHEM 12400 (with a grade of C- or better); CHEM 22200 (may be taken concurrently). (F,Y)

Attributes: ENRE, NS  
2 Credits

**CHEM 23200 Quantitative Chemistry (LA)**

Foundations for advanced work in chemistry, biochemistry, biology, and related subjects. Quantitative approach to chemical equilibrium, chemical kinetics, chemical thermodynamics, and electrochemistry. Prerequisites: CHEM 12100 and CHEM 12200; Math Placement in Group 2 or higher, math placement assessment score of 54 or greater. Co-requisite: CHEM 23300. (S,Y)

Attributes: ENRE, NS  
3 Credits

**CHEM 23300 Quantitative Chemistry Laboratory (LA)**

Continued study of general and inorganic chemistry laboratory practices and techniques. The experiments reinforce the concepts covered in CHEM 23200. Co-requisite: CHEM 23200. Prerequisites: CHEM 12100 and CHEM 12200; Math placement in Group 2 or higher, math placement assessment score of 54 or greater. (S,Y)

Attributes: ENRE  
1 Credit

**CHEM 27100-27200 Undergraduate Instruction in Chemistry (NLA)**

Qualified undergraduates are given opportunities to participate in the department's instructional program, serving as laboratory assistants and/or tutors. Prerequisites: Permission of department. Pass/fail only. 1 Credit

**CHEM 28100-28200 Selected Topics: Chemistry (LA)**

Course content depends on interests of the registrants and may include informed discussions, outside reading, and either library or laboratory projects. This course may be repeated for credit for selected topics on different subjects. Prerequisites: Permission of instructor. (IRF)

Attributes: NS  
1-3 Credits

**CHEM 29100-29200 Research in Chemistry (LA)**

After consultation with the faculty of the Department of Chemistry, the student undertakes a research problem under the guidance of one or more faculty members. Prerequisites: Permission of department.

Attributes: NS  
1-3 Credits

**CHEM 32400 Experimental Chemistry III (LA)**

Part three of the unified sequence. Project-oriented experiments to deal with concepts normally found in instrumental analysis laboratory courses. Emphasis is placed on using synthetic techniques, modern analysis by instrumentation, and studies of the physical properties of chemical systems. Two lectures and one laboratory per week. Prerequisites: CHEM 22500 (with a grade of C- or better); CHEM 23200 prior or concurrent. (S,Y)

Attributes: ENRE, NS  
3 Credits

**CHEM 32500 Experimental Chemistry IV (LA)**

Part four of the unified sequence. Project-oriented experiments to deal with concepts normally found in instrumental analysis, physical, organic, and inorganic laboratory courses. Emphasis is placed on using synthetic techniques, modern analysis by instrumentation, and studies of the physical properties of chemical systems. One lecture and two laboratories per week. Prerequisites: CHEM 32400 (with a grade of C- or better); CHEM 34200 (may be taken concurrently). (S,Y)

Attributes: ENRE, NS, WI  
4 Credits

**CHEM 33100 Physical Chemistry: Thermodynamics and Kinetics (LA)**

A theoretical interpretation of nature from the macroscopic viewpoint. Includes an introduction to thermodynamics, electrochemistry, and chemical kinetics. Prerequisites: CHEM 23200; MATH 10800 or MATH 11200; PHYS 10200 or PHYS 11800. (F,Y)

Attributes: NS  
3 Credits

**CHEM 33200 Physical Chemistry: Quantum Chemistry and Spectroscopy (LA)**

A theoretical interpretation of nature from the microscopic viewpoint. Includes an introduction to the kinetic molecular theory of gases, quantum chemistry, and spectroscopy. Prerequisites: CHEM 23200 (may be taken concurrently); MATH 10800 or MATH 11200; PHYS 10200 or PHYS 11800. (S,Y)

Attributes: NS  
3 Credits

**CHEM 34200 Inorganic Chemistry (LA)**

This course provides chemistry, biochemistry and other interested science majors with an understanding of the field of inorganic chemistry and as a foundation for advanced work in inorganic chemistry, materials science, biochemistry, and related subjects. The major topics are atomic structure, simple bonding theory, symmetry and group theory, acid-base chemistry, the crystalline solid state, coordination chemistry and organometallic chemistry. Three hours of lecture per week. Prerequisites: CHEM 23200 and CHEM 23300; Math placement in group 2 or higher, math placement assessment score of 54 or greater. (F,Y)

Attributes: NS  
3 Credits

**CHEM 34300 Inorganic Chemistry Laboratory (LA)**

Emphasizes basic techniques of experimental inorganic and organometallic chemistry, including synthetic methods, reaction progress monitoring and product characterization by spectroscopic methods. Experiments reinforce and expand concepts covered in CHEM 34200.

Prerequisites: CHEM 23200 and CHEM 23300; Math Placement Group of 2 or higher, math placement assessment score of 54 or greater. (F,Y)  
1 Credit

**CHEM 35300 Modern Instrumental Methods (LA)**

This course introduces modern analytical methods used in the fields of chemistry, biology, environmental science, geology, materials science, and physics. Explores an 'analytical toolbox' of instrumentation and techniques, including chromatography, spectroscopy, and mass spectrometry. Emphasis is placed both on fundamental principles (i.e. the workings and mechanics of each technique), which is critical for validating data and troubleshooting, and hands-on experience of each method. Prerequisites: CHEM 23200 and CHEM 23300. (S,Y)

3 Credits

**CHEM 35400 Polymer Chemistry (LA)**

Study of the synthesis, structure, and properties of polymers, with a special emphasis on practical applications in the chemical industry. Topics include sources of chemical raw materials, plastics, fibers, drugs, surface coatings, food chemicals, dyes, and pigments. Specific examples illustrate the scientific basis for the performance of familiar, everyday materials. Prerequisites: CHEM 22200. (IRR, B)

Attributes: NS  
1.5 Credits

**CHEM 35600 Nuclear Magnetic Resonance (LA)**

Study of nuclear magnetic resonance and its application in organic and inorganic chemistry. Topics include, instrumentation, chemical shift, spin-spin coupling, C-13 spectra, and modern pulse FT techniques. Emphasis on spectral interpretations and practical applications. Includes experiments using multi-pulse techniques. Prerequisites: CHEM 22200. (IRR, B)

Attributes: NS  
1.5 Credits

**CHEM 37100-37200 Undergraduate Instruction in Chemistry (NLA)**

Qualified undergraduates are given opportunities to participate in the department's instructional program, serving as laboratory assistants and/or tutors. Prerequisites: Permission of department. Pass/fail only.  
1 Credit

**CHEM 38100-38116 Selected Topics in Chemistry (LA)**

Course content depends on interests of the registrants and may include informed discussions, outside reading, and either library or laboratory projects. This course may be repeated for credit for selected topics on different subjects. Prerequisites: Permission of instructor. (IRR)

Attributes: ENRE, NS  
1-3 Credits

**CHEM 39100-39200 Research in Chemistry (LA)**

After consultation with the faculty of the Department of Chemistry, the student undertakes a research problem under the guidance of one or more faculty members. May be repeated up to a total of nine credits. Permission of department required. (F,S,Y)

Attributes: NS  
1-3 Credits

**CHEM 42100 Advanced Organic Chemistry (LA)**

Detailed discussion of reaction mechanisms, isotope effects, linear free energy relationships, bonding theories, and advanced synthetic methods. Prerequisites: CHEM 22200 and CHEM 33200. (IRR)

Attributes: NS  
3 Credits

**CHEM 42200 Advanced Inorganic Chemistry (LA)**

Chemistry of coordination compounds in light of modern theory. The electronic, magnetic, and spectral properties of transition metal complexes are considered, with the application of group theoretical techniques. Other topics include formation and stability of complex ions, mechanism of reactions of these ions, and complexes of transition metal ions of biological interest. Three hours of lecture per week. Prerequisites: CHEM 34200. (IRR)

Attributes: NS  
3 Credits

**CHEM 43200 Bio-Organic Chemistry (LA)**

Covers the modern interface of chemistry and biology, as well as an examination of current developments in biotechnology. Topics include combinatorial chemistry and modern synthetic methods, protein engineering, innovative approaches to drug design, enzyme mimics, and in vitro evolution of functional biopolymers. Prerequisites: CHEM 32400. (IRR)

Attributes: NS  
3 Credits

**CHEM 44000 Inquiry and the Nature of Science for the Science Teacher (LA)**

Considers issues pertaining to the nature and practice of science, especially as they relate to science education. Explores aspects that distinguish scientific inquiry from other forms of inquiry. Examines safety issues of teaching science in a classroom, and teaching science in the context of the community. Cross-listed with CHEM 44000 and PHYS 44000. Students can receive credit for only one of: BIOL 44000, PHYS 44000, CHEM 44000. Prerequisites: EDUC 34000 and junior standing. (IRR)

Attributes: NS  
3 Credits

**CHEM 44200 Computational Chemistry (LA)**

A solid understanding of the theoretical aspects of computational modeling and its utility and limitations in predicting electronic structures, molecular geometries, chemical dynamics, and chemical reactivity. In addition, the student will gain a hands-on, working knowledge of modern computational methods. Prerequisites: CHEM 32400; CHEM 33200. (IRR)

Attributes: NS

3 Credits

**CHEM 44400 Chemical Applications of Group Theory (LA)**

The chemical applications of symmetry and group theory, with a special emphasis placed on chemical bonding and spectroscopy. The necessary mathematical underpinnings for this course, including vectors, matrix algebra, and group theory, are presented largely in terms of symmetry operations and related properties of molecules. Prerequisites: CHEM 34200 and CHEM 33100. (IRR)

Attributes: NS

3 Credits

**CHEM 45200 Instrumental Analysis (LA)**

Familiarizes students with the principles and applications of modern analytical instrumentation for chemical analysis through hands-on experience with a wide variety of instrumental techniques. Prerequisites: CHEM 32400; PHYS 10200 or PHYS 11800. (IRR).

Attributes: NS

3 Credits

**CHEM 47100-47200 Undergraduate Instruction in Chemistry (NLA)**

Qualified undergraduates are given opportunities to participate in the department's instructional program, serving as laboratory assistants and/or tutors. Prerequisites: Permission of department. Pass/fail only.

1 Credit

**CHEM 48100-48110 Selected Topics in Chemistry (LA)**

Course content depends on interests of the registrants and may include informed discussions, outside reading, and either library or laboratory projects. Prerequisites: Permission of instructor. (IRR)

Attributes: ENRE, NS

1-3 Credits

**CHEM 48600 Chemistry Capstone: Senior Research Experience (LA)**

After consultation with the faculty of the Department of Chemistry, the student undertakes a research problem under the guidance of one or more faculty members. Permission of Instructor is required. (F,Y)

Attributes: NS

3 Credits

**CHEM 48700 Chemistry Seminar (LA)**

Series of lectures dealing with current research topics in chemistry and biochemistry presented by the faculty, visitors, and students. One meeting per week. Pass/Fail only. Permission of department required.

Attributes: NS

1 Credit

**CHEM 48800 Chemistry Capstone: Senior Thesis (LA)**

Students prepare a written thesis and an oral presentation describing their senior chemistry research experience (CHEM 48600) or literature search under the guidance of their research advisor. Ethics in science is addressed. Seminars will also be given by guest speakers. Explores the relationships between the various components of the integrative core curriculum (ICC), the chemistry major, other learning experiences at the College, and future goals. Reflection on the role of a liberal arts education. Prerequisites: Senior standing and major in Chemistry. (S,Y)

Attributes: CP, NS, WI

3 Credits