

## Chemistry

Department office: 359 Ingersoll Hall Extension  
Phone: 718.951.5458

### Full-time Faculty

Professors: Ciszowska, Davenport, Greer, Levine, Magliozzo, Sanchez-Delgado

Associate Professors: Contel, Dowd, Gibney, Jarzecki, Kobrak

Assistant Professors: Brenner, Juszczak, Murelli

Lecturer: Horowitz

Chemistry considers the nature of matter, its transformation, and its interaction with energy. The discipline provides the foundation for modern biology and is a cornerstone to such emerging fields as materials science and nanotechnology. The Brooklyn College Department of Chemistry offers a bachelor of science degree and a bachelor of arts degree in chemistry as well as a bachelor of arts degree in adolescence education for chemistry teachers. The department also offers a minor in chemistry and a minor in biochemistry. Its faculty members maintain active research programs and mentor promising students who express interest.

The bachelor of science degree is a rigorous program designed to prepare students to work as professional chemists, either upon graduation or after graduate school, and is recommended for those interested in pursuing scientific research. The bachelor of arts degree is less rigorous, and is recommended for students interested in the medical professions. The more flexible course schedule allows for the additional course work and extracurricular activity necessary for admission to professional schools. The B.A. degree is also suited to students who are seeking careers related to chemistry, but who do not wish to pursue advanced study. The requirements for the major for individuals who want to teach high school chemistry are equivalent to those of the B.A. degree, with supplementary courses in education. The minor in biochemistry provides strong preparation for students who wish to specialize in biochemistry at the master's or doctoral degree level. Internship opportunities in local commercial concerns are available, and interested students should contact the departmental counselor as should those students seeking honors.

A chemistry degree from Brooklyn College prepares students to be in the forefront of scientific and medical research in industry, government, and academia. Our graduates find employment as chemists in many different roles across an enormous range of fields, from government laboratories testing food, air, and water quality to commercial environments. A bachelor's degree in science is a prerequisite for a career in patent law, and can facilitate careers in such other areas as environmental law or in managerial positions, particularly in fields that rely on science and technology. The department maintains an office library of materials on careers in chemistry. Our students go on to graduate and professional programs nationwide. Students who wish to pursue graduate studies may apply to the master's and doctoral degree programs offered by or in conjunction with this department.

---

### Core curriculum

---

The Department of Chemistry participates in the college's core curriculum through Core Curriculum 1322.

---

### Courses for reentering students

---

A student who completed courses in chemistry at Brooklyn College that are no longer offered and who wants to take additional courses in chemistry must consult a department counselor to determine which courses in the present numbering system are equivalent to those for which credit has already been given. Without clearance, credit may be denied.

---

### Choosing a first course in chemistry

---

Chemistry 1100 and 1050 are intended for students planning a career in any of the following: the physical, chemical, or biological sciences; engineering; geology; medicine; dentistry; pharmacy; or physical therapy. Students who have taken one year of high school chemistry and who have taken or are enrolled in Mathematics 1011 (or 1026) or its equivalent should take Chemistry 1100. Students who are not prepared for Chemistry 1100 but who have completed intermediate high school algebra or its equivalent should take Chemistry 1050.

Chemistry 1040 is intended for students who plan a career in such health-related fields as occupational therapy, nursing, or nutrition. Students in health and nutrition sciences should consult with their department counselor before choosing a chemistry course.

---

### American Chemical Society Certification

---

The American Chemical Society recommends a program of study for students planning a career in chemistry. Chemistry majors who complete the curriculum described for the B.S degree in chemistry and who have taken selected courses, including instrumental analysis (Chemistry 3420),

inorganic chemistry (Chemistry 4760), and biochemistry (Chemistry 4570 or 4571) may receive American Chemical Society accreditation. Certified graduates are eligible to become members of the society; other chemistry graduates may become associate members of the society and members after three years of professional experience in chemistry. Interested students should consult the department counselor.

---

**B.A. degree program in chemistry**  
**HEGIS code 1905; SED program code 02082**

---

Department requirements (49-53 1/2 credits)

Chemistry 1100 or both Chemistry 1050 and 2050.

All of the following: Chemistry 2100, 3410 or 3415W, 3510 or both 3511 and 3512, 3520 or both 3521 and 3522, 4600 or 4610.

At least five credits chosen from the following: Chemistry 2700, 3420, 4530, 4550, 4570, 4571, 4580, 4581, 4620, 4640, 4720, 4760, 4761, either 4780 or 4790; Biology 2073 and 2074 (or Biology 17 and 17.1).

One of the following physics sequences a) or b) or c):

a) Physics 1100 (or Physics 1111 and 1112) and 2100.

b) Physics 1150 and 2150.

c) Physics 1150 and 2100.

The following mathematics sequence:

Mathematics 1201 and 1206.

A minimum of 15 credits in advanced courses in chemistry must be completed at Brooklyn College with a grade of C- or higher in each course.

---

**B.A. degree program in adolescence education: chemistry teacher**  
**HEGIS code 1905.01; SED program code 26813**

---

The Department of Secondary Education and the Department of Chemistry jointly offer a program for students who plan to teach chemistry in grades 7 through 12. Additional information may be obtained from the Department of Secondary Education or the Department of Chemistry. Adolescence education (grades 7-12) and special subject programs are writing intensive. Students should consult a counselor as early as possible to plan their program.

Program requirements (71 - 84 1/2 credits):

Chemistry 1100 or both Chemistry 1050 and 2050.

All of the following: Chemistry 2100, 2700, 3410 or 3415W, 3450, 2500 or 3510 and 3520 or 3511 and 3512 and 3521 and 3522, 4600 or 4610.

One of the following physics sequences, a), or b), or c):

a) Physics 1100 (or Physics 1111 and 1112) and 2100.

b) Physics 1150 and 2150.

c) Physics 1150 and 2100.

One of the following biology sequences, a), or b):

Biology 1001 or 1080 and Biology 1002 or 1081

Biology 2073 and 2074.

The following mathematics sequence: Mathematics 1201 and 1206.

The following pedagogical courses in the Department of Secondary Education: SEED 2001, 2002, 3401, 3402, 4404, 4410, 3456 (total of 24 credits):

This four-term sequence may be started in the lower-sophomore term, or upper-sophomore term: SEED 2001, 2002, 3401, 3402 (12 credits).

The appropriate 5-credit course in student teaching: SEED 4404 Seminar on Methods of Teaching Science, Student Teaching I

The appropriate 4-credit course in student teaching: SEED 4410 Advanced Seminar on Methods of Teaching Science, Student Teaching II

This program reflects changes in teacher certification requirements recently implemented by the New York State Education Department.

Degree programs in adolescence education and in special subjects include a major in an appropriate department of the college and in the case of social studies may also include an approved selection of interdepartmental courses.

Completion of an adolescence education program as part of a major in English, one of the appropriate social sciences, mathematics, one of the sciences, or a language other than English qualifies students for New York State initial certification in adolescence education for grades 7 through 12.

Students qualifying for the initial certification in adolescence education may obtain an extension to teach English, social studies, mathematics, or one of the sciences in grades 5 and 6 by taking SEED 4410.

Students must complete 24 credits in the Department of Secondary Education as specified above.

---

#### Admission requirements and academic standing

---

Students must have a GPA of 2.50 or higher based on a minimum of 30 credits in liberal arts and sciences to take SEED 2001, 2002, 3401 or 3402; an average of 2.75 in SEED 2001 and 2002 is required to continue to SEED 3401 and/or 3402; to take SEED 4413 or 4401-4406, students must have an overall GPA of 2.75 or higher and permission of the head of adolescence education and special subjects; to take SEED 4407-4412, students must earn a B- or higher in SEED 4401-4406, a GPA of 2.75 or higher in their major, and the permission of the head of adolescence education and special subjects. A student who takes SEED 4407-4412 prior to SEED 4401-4406 must earn a B- or better grade in SEED 4407-4412 to take SEED 4401-4406.

---

### **B.S. degree program in chemistry** **HEGIS code 1905; SED program code 02084**

---



---

#### Department requirements (67-70 1/2 credits)

---

Chemistry 1100 or both Chemistry 1050 and 2050.

All of the following: Chemistry 2100, 3410 or 3415W, 3510 or both 3511 and 3512, 3520 or both 3521 and 3522, 4610, 4620.

At least nine credits chosen from the following: Chemistry 2700, 3420, 4530, 4550, 4570, 4571, 4580, 4581, 4640, 4720, 4760, 4761, either 4780 or 4790; Biology 2073 and 2074 (or Biology 17 and 17.1).

One of the following physics sequences a) or b) or c):

a) Physics 1100 (or Physics 1111 and 1112) and 2100.

b) Physics 1150 and 2150.

c) Physics 1150 and 2100.

Computer and Information Science 1110.

One of the following mathematics sequences a) or b):

a) Mathematics 1201 and 1206 and 2201.

b) Mathematics 3.20 and 4.20 or 1211 and 2201.

A college-wide minimum of 24 credits in advanced courses in chemistry must be completed at Brooklyn College with a grade of C- or higher in each course.

---

#### Additional requirements for a B.S. degree

---

Candidates for a B.S. degree with a major in chemistry must complete at least 60 credits in science and mathematics; 24 of these 60 credits must be completed in advanced courses in the Chemistry Department. These 24 credits must be completed at Brooklyn College with a grade of C- or higher in each course. Specific course requirements for a B.S. degree are described above.

The following courses may be applied toward the 60 credits in science and mathematics:

A) All courses in the departments of biology, chemistry, computer and information science, earth and environmental sciences, mathematics, physics and psychology.

B) Courses marked with a number sign (#) in the Department of Health and Nutrition Sciences.

C) ---Anthropology and Archaeology 2200, 3199, 3230, 3240, 3250, 3260, 3265, 3266, 3425, 3440, 3470, 4665.

---Core Studies 5, 5.1, 5.2, 7.1, 7.2, 8.1, 8.2.

---Core Curriculum 1300 through 1399

---Core Curriculum 3301 through 3399

---Economics 3400, 4410, 3410, 4422.

---Philosophy 3203, 3204, 3231, 3232, 3422, 3423, 3601, 3605, 3610.

---Physical Education 3023, 3271, 3275, 3281, 3285, 4229, 4251.

---Sociology 2701.

## **Departmental Minor(s)**

---

### **Minor in Biochemistry**

---



---

#### Department Requirements

---

Biology 2073;

Chemistry 1100 or both 1050 and 2050;  
 Chemistry 2100;  
 Chemistry 3410 or 3415W or Biology 2074 or Biology 1002;  
 Chemistry 3510 or both 3511 and 3512, 3520 or both 3521 and 3522, 4570;  
 Chemistry 4580 or 4581.

---

## Minor in Chemistry

---

-----  
 Department Requirements  
 -----

A program of 12 credits of advanced electives in chemistry, each completed with a grade of C- or higher.  
 Each course must be completed at Brooklyn College and must have 3 or more credits.

---

## Division of Graduate Studies

---

The Chemistry Department offers master of arts degree programs in chemistry and chemistry teacher (grades 7 through 12). Some courses may be creditable toward the CUNY doctoral degree. For information, students should consult the department's deputy chairperson for graduate studies. A Graduate Bulletin may be obtained online.

## Courses

\*Courses marked with an asterisk (\*) are not counted toward the requirement of no fewer than 15 credits in advanced courses for majors in this department for the B.A. degree or 24 credits for the B.S. degree.

§Independent work means not less than three additional hours each week per credit of conference, research, independent reading, and writing as assigned by the instructor. The student's grade is determined in part by the successful completion of this independent work.

Students with superior records and the recommendation of a department faculty member may apply to the chairperson for permission to register for honors courses (Chemistry 5110 through 5320). Students may not register for more than six credits in honors courses in the department in one term.

### CHEM \*1000 Chemistry and Society

3 hours lecture; 3 credits

Role of chemistry in contemporary life. Topics may include consumer products, foods, drugs, energy sources, and environmental problems. Recommended for nonscience majors.

Prerequisite: Core Curriculum 1321 [3.21] or 1322 [3.22].

### CHEM \*1040 General Chemistry for Health-related Professions

1 hour recitation, 3 hours lecture, 3 hours laboratory; 5 credits  
 Principles of chemistry with applications to biological systems and processes. Intended for students in nursing or other health-related fields. (Not open to students who have completed Chemistry \*1100 [1] or 2050 [1.2] or the equivalent.)

Prerequisite: one year of high school algebra.

### CHEM \*1050 General Chemistry IA

3 hours lecture; 3 credits

Introduction to the principles of chemistry with more introductory material than is covered in Chemistry \*1100 [1]. Chemistry \*1050 [1.1] and \*2050 [1.2] constitute a two-term sequence intended for students who are not prepared for Chemistry \*1100 [1]. (Not open to students who are enrolled in or who have completed Chemistry \*1100 [1].)

Prerequisite: a passing grade in intermediate high school algebra or equivalent.

### CHEM \*1100 General Chemistry I

1 hour recitation, 3 hours lecture, 3 hours laboratory; 5 credits  
 Principles of chemistry. Emphasis on the facts, theories, and laboratory techniques needed for further courses in the sciences. Intended for

students planning a career in any of the following: the physical, chemical, or biological sciences; engineering; geology; medicine; dentistry; pharmacy; physical therapy. (Not open to students who are enrolled in or have completed Chemistry \*1050 [1.1])

Prerequisite: a passing grade in high school chemistry.  
 Prerequisite or corequisite: Mathematics \*1011 [2.9] or 1026 [2.92]; or assignment by the Department of Mathematics to Mathematics \*1201 [3.3].

### CHEM \*2050 General Chemistry IB

3 hours lecture, 3 hours laboratory; 4 ½ credits  
 Continuation of Chemistry \*1050 [1.1]. (Not open to students who are enrolled in or who have completed Chemistry \*1100 [1].)

Prerequisite: Chemistry \*1050 [1.1]

### CHEM \*2100 General Chemistry II

1 hour recitation, 3 hours lecture, 3 hours laboratory; 5 credits  
 Continuation of Chemistry \*1100 [1].

Prerequisite: Chemistry \*1100 [1] or 2050 [1.2].

### CHEM \*2500 Organic Chemistry for Health-related Professions

1 hour recitation, 3 hours lecture, 3 hours laboratory; 5 credits  
 Survey of fundamental classes of organic compounds, and principles of organic chemistry as applied to aliphatic, aromatic, and biologically important compounds. Emphasis on structure, properties, and preparative methods. Intended for students in nursing or other health-related fields. Not intended for chemistry majors. (Not open to students who are enrolled in or have completed Chemistry 3510 [51] or both 3511 and 3512.)

Prerequisite: Chemistry \*1100 [1] or 2050 [1.2] or 1040 [5].

### **CHEM 2700 Introduction to Inorganic Chemistry**

3 hours; 3 credits

Introduction to the principles of modern inorganic chemistry. Integration of the properties and reactions of representative compounds with illustrations of the importance of inorganic chemistry in the chemical industry, in fuel and advanced materials technology, in biology/medicine, and in environmental issues.

Prerequisite: Chemistry \*2100 [2].

### **CHEM 3410 Analytical Chemistry**

3 hours lecture, 4 hours laboratory; 5 credits

Theory and practice of classical and modern analytical chemistry. Laboratory emphasizes quantitative methods. (Not open to students who are enrolled in or have completed Chemistry 3415W [41W].)

Prerequisite: Chemistry \*2100 [2].

### **CHEM 3415W Analytical Chemistry**

3 hours lecture, 4 hours laboratory, 1 hour writing workshop; 5 credits

Theory and practice of classical and modern analytical chemistry. Laboratory emphasizes quantitative methods. Writing-intensive section. (Not open to students who are enrolled in or have completed Chemistry 3410 [41].)

Prerequisite: Chemistry \*2100 [2] and English \*1012 [2].

### **CHEM 3420 Instrumental Analysis**

2 hours lecture, 6 hours laboratory; 5 credits

Principles and applications of modern instrumentation in analytical chemistry including basic electronics, electroanalytical methods, chromatography, and spectroscopic methods.

Prerequisite: Chemistry 3410 [41] or 3415 [41W]; and Physics \*2100 [2] or 2150 [2.5].

### **CHEM 3450 Chemistry Teaching Laboratory Management**

Hours: 2 lecture, 4 laboratory; 4 credits

Course Description: Basics of creating a chemistry laboratory curriculum, including laboratory safety, the procurement, storage, dispensing and disposal of chemicals, and budgeting experiments. Introduction to modern laboratory pedagogies. Role of chemistry in modern society, with examples of industrial chemistry and information on careers in the field.

Prerequisite: one semester of organic chemistry (Chemistry \*2500 [50] or 3510 [51] or both 3511 and 3512) and one semester of analytical chemistry (Chemistry 3410 [41] or 3415W [41W])

### **CHEM 3510 Organic Chemistry I**

1 hour recitation, 3 hours lecture, 4 hours laboratory; 5 credits

Structure and properties of fundamental classes of organic compounds. Emphasis on reactivity, reaction mechanisms, synthesis, stereochemistry, and applications to allied fields. Chemistry 3510 [51] (or both Chemistry 3511 and 3512) and 3520 [52] (or both 3521 and 3522) are required for admission to medical and dental schools. (Students who have taken Chemistry \*2500 [50] will lose credit for Chemistry \*2500 [50] upon successful completion of this course.)

Prerequisite: Chemistry \*2100 [2].

### **CHEM 3511 Organic Chemistry I Lecture**

3 hours lecture, 1 recitation; 3 credits

Structure and properties of fundamental classes of organic compounds. Emphasis on reactivity, reaction mechanisms, synthesis, stereochemistry, and applications to allied fields. First semester of a two-semester sequence intended for students interested in science and in health professional programs including medical, dental and pharmacy school. (Students who have taken Chemistry 2500 or 3510 will lose credit for Chemistry 2500 and 3510 upon successful completion of this course.)

Prerequisite: Chemistry 2100

Prerequisite or co-requisite: Chemistry 3512

### **CHEM 3512 Organic Chemistry I Laboratory**

4 hours laboratory; 2 credits

An introduction to basic laboratory skills of organic chemistry including distillation, synthesis, and purification techniques such as column chromatography. (Students who have taken Chemistry 2500 or 3510 will lose credit for Chemistry 2500 and 3510 upon successful completion of this course.)

Prerequisite: Chemistry 2100

Prerequisite or co-requisite: Chemistry 3511

### **CHEM 3520 Organic Chemistry II**

1 hour recitation, 2 hours lecture, 4 hours laboratory; 5 credits

Continuation of Chemistry 3510 [51] or both 3511 and 3512.

Prerequisite: Chemistry 3510 [51] or both 3511 and 3512.

### **CHEM 3521 Organic Chemistry II Lecture**

3 lecture, 1 recitation; 3 credits

Continuation of Chemistry 3511. Different classes of compounds, including biomolecules and polymers, with a greater emphasis on reaction mechanisms and synthesis. A second semester of a two-semester sequence intended for students interested in science and in health professional programs including medical, dental, and pharmacy school. (Students who have taken Chemistry 2500 or Chemistry 3520 will lose credit for Chemistry 2500 and 3520 upon successful completion of this course.)

Prerequisite: Chemistry 3511 and Chemistry 3512; or Chemistry 3510

Prerequisite or co-requisite: Chemistry 3522

### **CHEM 3522 Organic Chemistry II Laboratory**

4 laboratory; 2 credits

An introduction to basic laboratory skills of organic chemistry. Emphasis is placed on qualitative analysis and spectroscopic identification of compounds. (Students who have taken Chemistry 2500 or Chemistry 3520 will lose credit for Chemistry 2500 or 3520 upon successful completion of this course.)

Prerequisite or Corequisite: Chemistry 3521.

### **CHEM 4530 Advanced Organic Laboratory Techniques**

2 hours lecture, 6 hours laboratory; 5 credits

Elucidation of the structures of organic compounds by spectrometric methods. Separation, purification, and identification of the components of mixtures. Synthesis of compounds utilizing modern methods.

Prerequisite: Chemistry 3410 [41] or 3415W [41W]; and 3520 [52] or both 3521 and 3522.

### **CHEM 4550 Advanced Organic Chemistry**

3 hours lecture; 3 credits

Intensive study of organic reaction mechanisms including topics of current interest.

Prerequisite: Chemistry 3520 [52] or both 3521 and 3522.

### **CHEM 4570 Biochemistry I**

3 hours lecture, 4 hours laboratory; 5 credits

Properties and reactions of compounds of biological importance. Oxygen-transport proteins. Enzyme kinetics and mechanisms. Basic immunology. Biological membranes. DNA replication, mutation, and repair. Transcription and the Genetic Code. Protein biosynthesis. Laboratory work emphasizes basic biochemical skills. (Not open to students who are enrolled in or have completed Chemistry 4571 [57.1].)

Prerequisite: Chemistry 3410 [41] or 3415W [41W], or Biology 2074 [17.1] or 1002.

Prerequisite or corequisite: Chemistry 3520 [52] or both 3521 and 3522.

### **CHEM 4571 Biochemistry I Lectures**

3 hours ; 3 credits

This course is the same as Chemistry 4570 [57], but without laboratory work. (Not open to students who are enrolled in or have completed Chemistry 4570 [57].)

Prerequisite: Chemistry 3520 [52] or both 3521 and 3522.

### **CHEM 4581 Biochemistry II Lectures**

3 hours; 3 credits

This course presents common metabolic pathways and introduces reaction mechanisms and regulation of principal biochemical pathways. The course addresses the biochemistry of metabolic disorders with clinical implications. Special topics include photosynthesis, iron homeostasis, nitric oxide, and molecular biology. (Not open to students who are enrolled in or have completed Chemistry 4580 [58].)

Prerequisite: Chemistry 4570 [57] or 4571 [57.1].

### **CHEM 4600 Physical Chemistry for the Health Professions**

3 hours lecture; 3 credits

Physical chemistry with applications to biochemical processes. Topics include thermodynamics, chemical and physical equilibria, transport phenomena, kinetics, and quantum chemistry. Not recommended for students who intend to take graduate courses in chemistry or biochemistry. Students who complete Chemistry 4600 [60.1] may take Chemistry 4610 [61], but must forfeit three credits of Chemistry 4600 [60.1]. (Not open to students who are enrolled in or have completed Chemistry 4610 [61].)

Prerequisite: Chemistry \*2100 [2] and Mathematics \*1206 [4.3].

Prerequisite or corequisite: Physics \*2100 [2] or 2150 [2.5].

### **CHEM 4610 Physical Chemistry I**

3 hours lecture, 4 hours laboratory; 5 credits

Thermodynamics, including nonelectrolyte and electrolyte solutions, reaction equilibria, and phase equilibria. Laboratory emphasizes physicochemical measurements. Students who complete Chemistry 4600 [60.1] may take Chemistry 4610 [61], but must forfeit three credits earned for Chemistry 4600 [60.1].

Prerequisite: Chemistry 3410 [41] or 3415 [41W]; and Mathematics \*2201 [5.3]; and Physics \*2100 [2] or 2150 [2.5].

### **CHEM 4620 Physical Chemistry II**

3 hours lecture, 4 hours laboratory; 5 credits

Continuation of Chemistry 4610 [61]. Chemical kinetics; transport properties; quantum mechanics; atomic and molecular structure;

spectroscopy; statistical mechanics.

Prerequisite: Chemistry 4610 [61]

### **CHEM 4640 Quantum Chemistry**

3 hours lecture; 3 credits

Application of quantum mechanics to molecular electronic structure, including the Schrodinger equation, operators, angular momentum, variation and perturbation methods, electron spin, Pauli principle, many-electron atoms, application of molecular-orbital and valence-bond theories to diatomic and polyatomic molecules.

Prerequisite or corequisite: Chemistry 4620 [62].

### **CHEM 4760 Inorganic Chemistry**

3 hours lecture, 4 hours laboratory; 5 credits

Atomic structure. Symmetry and Group Theory. Molecular orbitals. Coordination chemistry. Organometallic chemistry. Elements of catalysis and bioinorganic chemistry. Solid-state materials. Laboratory emphasizes the synthesis, purification and characterization of coordination, organometallic, main group, solid state, and bioinorganic compounds. (Not open to students enrolled in or who have completed Chemistry 4761).

Prerequisite: Chemistry 4600 [60.1] or 4610 [61]; Chemistry 2700 [35] is strongly recommended.

### **CHEM 4761 Inorganic Chemistry**

3 hours lecture; 3 credits

Atomic structure. Symmetry and Group Theory. Molecular orbitals. Coordination chemistry. Organometallic chemistry. Elements of catalysis and bioinorganic chemistry. Solid state materials. (Not open to students enrolled in or who have completed Chemistry 4760).

Prerequisite: Chemistry 4600 [60.1] or 4610 [61]; Chemistry 2700 [35] is strongly recommended.

### **CHEM 4780 Environmental Chemistry**

3 hours lecture; 3 credits

Principles of chemistry applied to problems of the environment. Sources, reactions, effects of chemical species on the environment. General and specific problems of analysis, interpretation of results, and pollution control. Methods and impact of energy production.

Prerequisite: Chemistry 3410 [41] or 3415W [41W]; Chemistry 3520 [52] or both 3521 and 3522.

### **CHEM 5010 Research I**

Minimum of 6 hours conference and independent work§; 2 credits  
Planning and carrying out a research problem under supervision of a faculty member. Weekly conference. Written and oral reports. Students may not receive credit for more than three terms of undergraduate research.

Prerequisite: Chemistry 3410 or 3415W; Chemistry 3520 or both 3521 and 3522; and permission of the instructor and the chairperson.

### **CHEM 5020 Research II**

Minimum of 6 hours conference and independent work§; 2 credits  
Planning and carrying out a research problem under supervision of a faculty member. Weekly conference. Written and oral reports. Students may not receive credit for more than three terms of undergraduate research.

Prerequisite of 5020: Chemistry 5010 [73.1] and permission of the instructor and the chairperson.

**CHEM 5030 Research III**

Minimum of 6 hours conference and independent work§; 2 credits  
 Planning and carrying out a research problem under supervision of a faculty member. Weekly conference. Written and oral reports.  
 Students may not receive credit for more than three terms of undergraduate research.

Prerequisite of 5030: Chemistry 5020 [73.2] and permission of the instructor and the chairperson.

**CHEM 5400 Industrial Internship in Chemistry**

9 hours fieldwork; 2 credits  
 Off-campus internship in a commercial or government organization, supervised by a faculty member. Positions and assigned tasks will vary depending on the needs of the host institution, but will make extensive use of chemical knowledge and skills. A final report will be required.

Prerequisite or Corequisite: Chemistry 3510 or both 3511 and 3522, and either Chemistry 3520, or both 3521 and 3512, or Chemistry 3410, or Chemistry 3415W. A minimum GPA of 2.3 or better within Chemistry courses is also required.

---

**Honors courses**

---

**CHEM 5110 Independent Research I**

Minimum of 9 hours conference and independent work§; 3 credits  
 Independent research supervised by a faculty member. Weekly conference. Written and oral report. Students may not receive credit for more than three terms of undergraduate research.

Prerequisite: Chemistry 3410 or 3415W; 3520 or both 3521 and 3522; an index of 3.30 or higher in chemistry; and permission of the instructor and the chairperson.

**CHEM 5120 Independent Research II**

Minimum of 9 hours conference and independent work§; 3 credits  
 Independent research supervised by a faculty member. Weekly conference. Written and oral report. Students may not receive credit for more than three terms of undergraduate research.

Prerequisite of 5120 [83.2]: Chemistry 5110 [83.1], an index of 3.30 or higher in chemistry, and permission of the instructor and the chairperson.

**CHEM 5130 Independent Research III**

Minimum of 9 hours conference and independent work§; 3 credits  
 Independent research supervised by a faculty member. Weekly conference. Written and oral report. Students may not receive credit for more than three terms of undergraduate research.

Prerequisite of 5130 [83.3]: Chemistry 5120 [83.2], an index of 3.30 or higher in chemistry, and permission of the instructor and the chairperson.

**CHEM 5210 Seminar I**

Minimum of 3 hours conference and independent work§; 1 credit  
 Presentation and discussion of current topics.

Prerequisite: completion of an approved program of advanced courses and permission of the chairperson.

**CHEM 5220 Seminar II**

Minimum of 3 hours conference and independent work§; 1 credit  
 Presentation and discussion of current topics.

Prerequisite: completion of an approved program of advanced courses and permission of the chairperson.

**CHEM 5230 Seminar III**

Minimum of 3 hours conference and independent work§; 1 credit  
 Presentation and discussion of current topics.

Prerequisite: completion of an approved program of advanced courses and permission of the chairperson.

**CHEM 5310 Colloquium I**

Minimum of 9 hours recitation, conference, and independent work§; 3 credits  
 Intensive reading and group discussion of a special field. A term report or examination may be required. Students should consult the department bulletin board for current offerings. Colloquium topics may include: statistical mechanics, polymer chemistry, interfacial phenomena, neurochemistry, physical biochemistry, spectroscopy, separation methods, solid-state, modern electrochemical methods. Students and faculty may suggest colloquium topics to the chairperson.

Prerequisite: completion of an approved program of advanced courses and permission of the chairperson.

**CHEM 5320 Colloquium II**

Minimum of 9 hours recitation, conference, and independent work§; 3 credits  
 Intensive reading and group discussion of a special field. A term report or examination may be required. Students should consult the department bulletin board for current offerings. Colloquium topics may include: statistical mechanics, polymer chemistry, interfacial phenomena, neurochemistry, physical biochemistry, spectroscopy, separation methods, solid-state, modern electrochemical methods. Students and faculty may suggest colloquium topics to the chairperson.

Prerequisite: completion of an approved program of advanced courses and permission of the chairperson.

**The following inactive course(s) will only be offered if there is sufficient demand:**

CHEM 5000 Introduction to Research



## Concentration(s) for majors in early childhood and childhood education teacher programs

---

### Children and Youth Studies

---

The requirements for early childhood education teacher (birth-grade 2) and childhood education teacher (grades 1-6) programs are described in the "Education" section of the Undergraduate Bulletin. Students who major in either of these programs and who elect a concentration in Children and Youth Studies must complete at least 30 credits in the Children and Youth Studies Program with a grade of C or higher in each course.

-----  
Concentration requirements (30 credits):  
-----

Children and Youth Studies 2100.

Two courses from the following:

Children and Youth Studies 3110; Children and Youth Studies 3120 or History 3320; Sociology 2400 or 2401.

Three courses from the following:

Children and Youth Studies 4200; Children and Youth Studies 3610; Children and Youth Studies 3620; Children and Youth Studies 3320; Psychology 2210 or 3220 or 3240; Speech 2231.

Three courses from the following:

Africana Studies 3335; Children and Youth Studies 2200; Children and Youth Studies 3310; Children and Youth Studies 3510; Children and Youth Studies 3630; Health and Nutrition Sciences 3170; Puerto Rican and Latino Studies 2005.

One course from the following:

Children and Youth Studies 3410; Children and Youth Studies 3430; Children and Youth Studies 3130; English 3189; Speech 1717.

All courses must be completed with a grade of C or higher.

A minimum of nine credits must be completed at Brooklyn College.

Students who are interested in the concentration in Children and Youth Studies should consult with the Children and Youth Studies program adviser to plan an appropriate sequence of courses and to declare their concentration.

### Courses

---

#### Introduction to children and youth studies

---

##### CHST 2100W Perspectives on Childhood

3 hours; 3 credits

Childhood viewed from the perspectives of health science, history, literature, psychology, sociology, and the arts. The history of childhood; autobiography as inquiry into the child's selfhood; the child's imagination; child development and health; adolescence as life-stage and perceptions of adolescence; the child in relation to the family, school, and community; children's experiences of personal, social, and political problems; social, economic, and educational policies affecting children; children's rights and international policy. May be team-taught. (Not open to students who have completed Children's Studies [1] or 2100.)

Prerequisite: English 1012 or permission of program director. This is a writing-intensive course.

##### CHST 2200 Special Topics: Issues in Children's Studies

3 hours; 3 credits

Emerging issues, policies, and research in rapidly developing areas relating to children and youth. Topics vary from term to term. (Not open to students who have completed Children's Studies [5].)

Prerequisite: English 1010 or permission of program director.

---

#### Children in history and society

---

##### CHST 3110 The Human Rights of Children: A Transnational Development

3 hours; 3 credits

Development of the human rights of children movement nationally and internationally. Central documents, data bases, national and international legislation in the area of children and youth rights, the U.N. Convention on the Rights of the Child of 1989, and its implementation, Children Ombudsmen in other countries, UNICEF activities, and more. Rights of children to full development, to education, health care, culture, and with such topics as street children, child abuse, child prostitution, discrimination on the basis of sex, race, and religion, child soldiers, and child labor.

Prerequisite: English 1010 [1]; or permission of program director.

##### CHST 3120 History of Children, Public Policy, and the Law in the United States

3 hours lecture; 3 credits

Political and legal history of children's issues in the United States, focused on the attitudes and actions of figures in power. Origins of public education and welfare; debate over child labor. Brown v. Board of Education, In re Gault, Tinker v. Des Moines. Abortion, busing, welfare reform, and children's rights in the legal and political arenas. (This course is the same as History 3457 [43.21].)

##### CHST 3130 Children of New York

3 hours; 3 credits

Examination of children's lives in New York and the institutions that affect them. Exploration of children's living conditions and lifestyles. Relevant demographic variables including: age, gender, ethnicity, race,