

## Required Courses

Course Name	Number	Points
General Chemistry, with laboratory	CHEM BC2001x	5
Two semesters of Calculus <sup>1</sup>	MATH V1101x-V1102y	6
Introductory Physics, with laboratory <sup>2</sup>	PHYS BC2001x-BC2002y	9
Organic Chemistry I, with laboratory	CHEM BC3230y and BC3328y	6
Organic Chemistry II	CHEM BC3231x	3.5
Modern Techniques of Organic Chemistry Lab	CHEM BC3335x	5
Quantitative and Instrumental Techniques Lab	CHEM BC3340y	5
Inorganic Chemistry	CHEM BC3271x	3.5
Thermodynamics and Kinetics	CHEM BC3252y	3.5
Quantum Chemistry	CHEM BC3253x	3.5
Integrated Chemistry Laboratory (two semesters)	CHEM BC3365x and BC3368y	6
<i>Elective course: One of the following:</i>		
Advanced Physical Chemistry	CHEM BC3254y	3.5 or
Advanced Organic Chemistry	CHEM BC3280y	3.5 or
Biological Chemistry	CHEM BC3282y	3.5 or
Advanced Inorganic Chemistry I	CHEM G4103	4.5
<i>Senior requirement: Senior Honors Thesis</i>	CHEM BC3901x-BC3902y	8 or
<i>or Guided Research at Barnard [or Columbia]</i>	CHEM BC3599x or y	4 or
(for two or four points, by arrangement)	CHEM BC3597x or y	2 or
<i>or Guided Research elsewhere (with approval)</i>	CHEM BC3598x or y	4 or
<i>or Senior Colloquium at Barnard (spring)</i>	CHEM BC3590y	2 or
<i>or Senior Colloquium at Columbia (fall)</i>	CHEM C3920x	2

**Notes** about the mathematics and physics requirements for the chemistry major:

- (a) Most majors take Calculus I and II (MATH V1101-V1102). The mathematics department now allows students to take I followed directly by III; that is also acceptable.
- (b) A third and fourth semester of calculus (MATH V1201-V1202) are strongly recommended.
- (a) The Barnard physics sequence, PHYS BC2001x-2002y (formerly PHYS BC1206x-BC1207y) (9 points) is strongly recommended. Any *calculus-based* Columbia sequence, with two semesters of laboratory work, is acceptable.
- (b) For greater coverage of basic physics, we recommend continued study with PHYS BC3001x.
- (c) Make every effort to begin the study of physics not later than your sophomore year.

With her adviser's permission, a student may satisfy any of the major requirements using Columbia chemistry courses equivalent to those above. Note, though, that CHEM BC3335x, CHEM BC3340y, and the three-semester Physical Chemistry sequence do not have any close equivalents at Columbia. Furthermore, so that our department can maintain its close personal relationship with its chemistry majors, at least eight of the minimum thirteen required chemistry courses must be taken at Barnard. This requirement may be adjusted as needed for transfer students.

Various advanced courses at Columbia University are open to students with the adviser's approval. Barnard chemistry majors with the appropriate prerequisites can elect first-year graduate courses in organic, inorganic, and quantum chemistry, either as options for the major or for additional training.

Pass/D/Fail grading is not permitted in any required course, except for External Research (BC3598).

C- is the lowest acceptable grade in all required chemistry, physics, and mathematics courses.

Students interested in majoring in chemistry should consult any member of the department as early as possible. Students who begin both chemistry and calculus in their first year can fulfill almost all the major requirements in three years, and devote their senior year to research and further courses. If you plan graduate or professional work in chemistry, we strongly advise some research experience, as well as additional course work in chemistry, biochemistry, physics, mathematics, or biology.

One possible program for a student who plans to do advanced work in chemistry:

Year	FALL	SPRING
1	CHEM BC2001x General Chemistry (includes laboratory work in a unified course) MATH V1101x Calculus I	CHEM BC3328y Organic Chem I Lectures CHEM BC3330y Organic Chem I Laboratory MATH V1102y Calculus II
2	CHEM BC3231x Organic Chem II Lectures CHEM BC3335x Organic Techniques Lab PHYS BC2001x Mechanics	CHEM BC3252y Thermodynamics/Kinetics CHEM BC3340y Quantitative/Instrument Lab PHYS BC2002y Electricity and Magnetism
3	CHEM BC3253x Quantum Chemistry CHEM BC3271x Inorganic Chemistry  CHEM BC3365x Integrated Chemistry Lab I	<i>Elective:</i> CHEM BC3254y Adv. Physical Chem <i>or</i> CHEM BC3280y Adv. Organic Chem <i>or</i> CHEM BC3282y Biological Chemistry CHEM BC3368y Integrated Chemistry Lab II
4	Senior Thesis CHEM BC3901x <i>or</i> Research [Optional additional or advanced course]	Senior Thesis CHEM BC3902y <i>or</i> Research [Optional additional or advanced course]

One possible program that spreads the required courses out more over four years:

Year	FALL	SPRING
1	CHEM BC2001x General Chemistry (includes laboratory work in a unified course) MATH V1101x Calculus I	CHEM BC3328y Organic Chem I Lectures CHEM BC3330y Organic Chem I Laboratory MATH V1102y Calculus II
2	CHEM BC3231x Organic Chem II Lectures PHYS BC2001x Mechanics	CHEM BC3340y Quantitative/Instrument Lab PHYS BC2002y Electricity and Magnetism
3	CHEM BC3335x Organic Techniques Lab CHEM BC3271x Inorganic Chemistry	CHEM BC3252y Thermodynamics/Kinetics [ <i>Elective:</i> CHEM BC3280y Adv. Org. Chem <i>or</i> CHEM BC3282y Biological Chemistry]
4	CHEM BC3253x Quantum Chemistry CHEM BC3365x Integrated Chemistry Lab I [ <i>Elective:</i> CHEM G4103 Adv. Inorganic I] Senior Thesis CHEM BC3901x <i>or</i> Research	CHEM BC3368y Integrated Chemistry Lab II [ <i>Elective:</i> CHEM BC3254y Phys. Chem III]  Senior Thesis CHEM BC3902y <i>or</i> Research

Other program variations are possible. If you do not take BC2001x until your second year, or if you postpone calculus or physics, a tighter schedule is needed, but you can still complete all the major requirements. One possible program:

Year	FALL	SPRING
2	CHEM BC2001x General Chemistry (includes laboratory work in a unified course) MATH V1101x Calculus I	CHEM BC3328y Organic Chem I Lectures CHEM BC3330y Organic Chem I Laboratory MATH V1102y Calculus II
3	CHEM BC3231x Organic Chem II Lectures CHEM BC3335x Organic Techniques Lab PHYS BC2001x Mechanics	CHEM BC3252y Thermodynamics/Kinetics CHEM BC3340y Quantitative/Instrument Lab PHYS BC2002y Electricity and Magnetism
4	CHEM BC3253x Quantum Chemistry CHEM BC3365x Integrated Chemistry Lab I CHEM BC3271x Inorganic Chemistry	<i>Elective:</i> Adv. Phys Chem <i>or</i> Biological Chem CHEM BC3368y Integrated Chemistry Lab II Research <i>or</i> Senior Colloquium CHEM 3590y

**Senior Requirement Options: (1) Honors Thesis, (2) Guided Research, (3) Senior Colloquium**

All qualified chemistry majors will be invited to participate in the senior honors thesis program. This consists of a year-long individual research project, under the direction of a member of the chemistry, biology, physics, or environmental science departments, culminating in a written thesis and a public presentation of the work. External thesis mentors are also acceptable, with permission. In addition to their research work, all chemistry and biochemistry students doing a senior thesis meet together with the faculty for a weekly seminar. Students doing senior thesis research work enroll in a year-long indivisible course, CHEM BC3901x–CHEM BC3902y, for 4 points credit each semester.

Students not doing a senior thesis are encouraged to undertake at least one semester of guided research work, either at Barnard (CHEM BC3599x or y, 4 points, or CHEM BC3597x or y, 2 points), or elsewhere, with prior approval of the adviser (CHEM BC3598x or y, 4 points, graded P/D/F only). As with the senior thesis, guided research may be under the direction of a member of the chemistry, biology, physics, or environmental science departments, with approval of the advisor, or undertaken externally, for example in a medical school department, with a Barnard faculty member as a liaison.

Those students not satisfying the senior requirement by doing research have the opportunity to take the Senior Colloquium, CHEM BC3590y or CHEM C3920x or y, 2 points, in their senior year. This option offers students with crowded schedules the most flexibility in satisfying the requirement.

**Summer Research Opportunities at Barnard and Elsewhere**

Both financial support and faculty sponsors are usually available for student research at Barnard during the summer. Summer research after the junior year, or even the sophomore year, in a laboratory at Barnard is strongly encouraged, as it gives students an opportunity to work full-time on their own particular projects, and often constitutes a significant part of honors thesis work.

There are many other good undergraduate summer research programs all over the country, offering reasonable stipends for what are usually 10 week programs of work. Sophomores who have taken the courses in modern organic laboratory techniques and in quantitative analysis and instrumental chemistry should be sufficiently well prepared to do some research, and all juniors should be very well qualified. All our students are strongly encouraged to apply to these programs and to take advantage of the many opportunities for paid summer research work.

**Computing**

Familiarity with computers is indispensable to every chemist. Learn as much as you can about word processing, including equation editing, using spreadsheets for doing calculations and making graphs, chemical structure drawing, molecular modeling, graphics, using chemical databases, on-line literature searching, presentation software, and using the internet to find and to provide information.

Computer use is increasingly incorporated into our courses, both in terms of our presentation and for doing your assignments and presentations. Combine self-study with material presented in courses to learn what you need. If time permits, you can gain broader experience with computers by taking a computer science programming course. COMS W1003 (C), COMS W1004 (Java), COMS W1005 (MATLAB), and COMS W1007 (Introduction) are most directly applicable to science problems.

### Language Study for Graduate Work

Though less common than in the past, chemistry graduate students may have to demonstrate a reading knowledge of one or two languages other than English. The most important ones for chemistry are German, Russian, French, and Japanese. If you plan graduate work, see if you can manage to take at least a year of one of these. Otherwise, you may be able to take a course in chemical German or Russian in graduate school, or even pick up a rudimentary reading knowledge on your own.

### The American Chemical Society (ACS) Requirements for Degree Certification

The ACS offers degree certification to all those students who complete a prescribed course of study. A certified degree carries a certain prestige, and the advantage of admission to full professional status (that is, full membership in the ACS) after a shorter period of post-graduate experience.

For ACS certification, students need two one-semester courses beyond the basic Barnard major lecture and laboratory requirements. One must be Biochemistry (BC3282y). The other may be a regular course or independent research, including senior thesis research. The Barnard Chemistry Department's lecture courses in Methods and Applications in Physical Chemistry (BC3254y), and Advanced Organic Chemistry (BC3280y) meet this requirement, as do any of the graduate courses in chemistry offered by the Columbia Chemistry Department. Advanced work in physics, molecular biology, or geochemistry may also be credited, with the approval of your major adviser.

If you feel that your chemistry program merits certification by the American Chemical Society, and you wish to have this officially recorded, please inform the chemistry department chair during your senior year.