

Required Courses		
Name	Number	Points
General Chemistry, with laboratory	CHE BC2001x	5
Two semesters of Calculus ¹	MATH V1101x-V1102y	6
Introductory Physics, with laboratory ²	PHYS BC2001x-BC2002y	9
Introductory Biology ³	BIO BC1500x-BC1502y [formerly BC2002x-BC2001y]	6
Introductory Biology Lab ⁴	BIO BC1501x <i>or</i> BC1503y [formerly BC2003x <i>or</i> BC2004y]	2
Organic Chemistry I, with laboratory	CHE BC3230y and BC3328y	6
Organic Chemistry II	CHE BC3231x	3.5
Modern Techniques of Organic Chemistry Lab ⁵	CHE BC3333x	3
Quantitative and Instrumental Techniques Lab ⁵	CHE BC3338y	3
Introduction to Thermodynamics and Kinetics	CHE BC3252y	3.5
Structure, Bonding, and Spectroscopy	CHE BC3253x	3.5
Biological Chemistry	CHE BC3282y	3.5
Molecular and Mendelian Genetics ⁶	BIO BC2100 [BC3200y]	3
<i>Laboratory: Either Biochemistry Techniques Lab or Biochemistry Techniques Laboratory and Laboratory in Molecular Biology</i>	CHE BC3355x <i>or</i> CHE BC3357x <i>and</i> BIO BC3303y	5 or 3 plus 3
<i>Elective course: One course in Biology or Chemistry chosen from the list on the next page</i>		3 or more
<i>Senior requirement: Senior Honors Thesis</i>	CHE BC3901x-BC3902y	8
<i>or Guided Research at Barnard [or Columbia]</i>	CHE BC3599x <i>or</i> y	4
<i>(for two or four points, by arrangement)</i>	CHE BC3597x <i>or</i> y	2
<i>or Guided Research elsewhere (with approval)</i>	CHE BC3598x <i>or</i> y	4
<i>or Senior Colloquium at Barnard (spring)</i>	CHE BC3590y	2
<i>or Senior Colloquium at Columbia (fall)</i>	CHE C3920x	2

Notes on the mathematics, physics, and biology requirements for the biochemistry 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 (9 points) is strongly recommended. Any strongly *calculus-based* Columbia sequence, with two semesters of laboratory work, is acceptable; C1201-02 and C1301-02 are not ok.
(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.
- Students with weak high school biology, or none at all, might take BIO BC1001x (4.5 points) as an introduction to biology before starting the Biology 1500-level sequence required for the biochemistry major. Consult the Biology Department on which course is best for you to start.
- Cell and Molecular Intro Lab, BIO BC1503y [BC2004y], is preferred, but either laboratory course is suitable. If you have little or no background in biology, consider taking both courses.
- A biochemistry major may of course choose to complete CHE BC3335x (5 points) rather than only CHE BC3333x (3 points), and / or to complete CHE BC3340y (5 points) rather than only CHE BC3338y (3 points), if she wishes to obtain more extensive laboratory training in organic laboratory techniques and in analytical chemistry, especially if she is interested in graduate study or professional work in chemistry, biochemistry, or molecular biology.

6. The Barnard biology department no longer offer a separate Molecular Biology lecture course. BC2100x and y (*Molecular and Mendelian Genetics*), covers much of the same material. Columbia alternatives are C3512y (*Molecular Biology*) or C3032x (*Genetics*). (If you already completed BC3302y, *Molecular Biology*, that is also fine.)

With her adviser's permission, a student may satisfy any of the major requirements using Columbia chemistry and biology courses equivalent to those listed above. However CHE BC3333x, CHE BC3338y, the three-semester Physical Chemistry sequence, and CHE BC3355x do not have close equivalents at Columbia. Furthermore, so that our department can maintain its close personal relationship with its biochemistry majors, at least eight of the minimum twelve required chemistry courses must be taken at Barnard. This requirement is adjusted as needed for transfers.

List of Possible Elective Courses for the Biochemistry Major

Number	Name	Points
BIO BC2278x [3278]	Evolution	3
BIO BC3303y	Laboratory in Molecular Biology	3
BIO BC3305y	Project Laboratory in Molecular Biology	5
BIO BC3310x	Cell Biology	3
BIO BC3320x	Microbiology	3
BIO BC3340y	Plant Physiology	3
BIO BC3342y	Plant Development	3
BIO BC3360y	Animal Physiology	3
BIO BC3362x	Molecular and Cellular Neuroscience	3
BIO W3034x	Biotechnology	3
BIO W3073y	Immunology	3
CHE BC3254y	Methods and Applications in Physical Chemistry	3.5
CHE BC3271x	Inorganic Chemistry	3.5
CHE BC3280y	Advanced Organic Chemistry	3.5
CHE BC3598x or y	Individual Research Problems (external)	4
CHE BC3599x or y	Individual Research Problems (at Barnard)	4
CHE C3098x or y	Individual Research Problems (at Columbia)	4 to 6
BIO BC3591x or y	Guided Laboratory Research (at Barnard) plus seminar	3 or 4 +1
BIOC G4170	Biophysical Chemistry	4.5
BIO-CHE W4510	Molecular Systems Biology	4

New courses are offered and old ones deleted with some frequency, so this list must be updated regularly. Some courses above may not be offered, and suitable new courses may have been introduced. Consult with your adviser *before* taking any course to satisfy the elective requirement if it is not on this list. Be sure that you have the necessary prerequisites for any course.

Advanced courses at Columbia are open to students with the adviser's approval. Barnard biochemistry majors with the appropriate prerequisites can elect first-year graduate courses in organic, and biophysical 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), for which the grading is mandatory P*/F.

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

Students interested in majoring in biochemistry should consult any member of the department as early as possible. The Biochemistry major has many required courses, many of which must be taken sequentially. Students who begin to study at least two of chemistry, biology, and calculus in their first year can fulfill almost all the major requirements in three years, and devote their senior year to research and to further courses. If you plan to do graduate work in biochemistry, we strongly advise research experience, as well as more course work in chemistry, biology, physics, or mathematics.

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

Year	FALL	SPRING
1	CHE BC2001x General Chemistry (includes laboratory work in a unified course) BIO BC1501x Introductory Biology I [Optional: BIO BC1501x Intro. Bio. Lab] MATH V1101x Calculus I	CHE BC3328y Organic Chem I Lectures CHE BC3330y Organic Chem I Lab BIO BC1502y Introductory Biology BIO BC1503y Intro. Bio. Lab MATH V1102y Calculus II
2	CHE BC3231x Organic Chem II Lectures CHE BC3333x Organic Techniques Lab PHYS BC2001x Mechanics	CHE BC3282y Biological Chemistry CHE BC3338y Quantitative/Instrument Lab PHYS BC2002y Electricity and Magnetism
3	CHE BC3355x Biochem Lab Techniques [Biology or Chemistry Elective]	CHE BC3252y Thermodynamics / Kinetics BIO BC2100y Genetics [Biology or Chemistry Elective]
4	CHE BC3253x Quantum Chemistry Senior Thesis CHE BC3901x or Research [Optional additional or advanced course]	[Biology or Chemistry Elective] Senior Thesis CHE BC3902y or Research [Optional additional or advanced course]

One possible variant of this program, that will spread the required courses out more over four years, is to take Calculus during the second year and Physics during the third year. If you want to take Biological Chemistry lectures immediately after Organic Chemistry, during your second year, you should take both semesters of Biology, with at least one semester of laboratory, in your first year.

Other program variations are possible. If you do not start chemistry until your second year, or if you postpone calculus or physics, a tight schedule is needed, but you can still complete the major requirements. One possible program for those who begin the major in the sophomore year:

Year	FALL	SPRING
2	CHE BC1601x General Chemistry (includes laboratory work in a unified course) BIO BC1500x Introductory Biology [Optional: BIO BC1501x Intro. Bio. Lab] MATH V1101x Calculus I	CHE BC3328y Organic Chem I Lectures CHE BC3330y Organic Chem I Laboratory BIO BC1502y Introductory Biology B BIO BC1503y Intro. Bio. Lab (Cell/Molecular) MATH V1102y Calculus II
3	CHE BC3231x Organic Chem II Lectures CHE BC3333x Organic Techniques Lab PHYS BC2001x Mechanics	CHE BC3282y Biological Chemistry CHE BC3338y Quantitative/Instrument Lab PHYS BC2002y Electricity and Magnetism
4	CHE BC3253x Quantum Chemistry CHE BC3355x Biochem Lab Techniques [Biology or Chemistry Elective]	CHE BC3252y Thermodynamics / Kinetics BIO BC2100y Genetics Research or Senior Colloquium CHE 3590y

If either Biology or Calculus is taken in the first year, then a less concentrated program is possible. If both Biology and Calculus are taken the first year, students are urged to take Physics the second year, so that they can take Thermodynamics and Kinetics (Physical Chemistry I, CHE BC3252y) first, as juniors, and then take Quantum Chemistry (Physical Chemistry II, CHE BC3253x).

Senior Requirement Options: Honors Thesis, Guided Research, Senior Colloquium

Qualified biochemistry 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 course, CHE BC3901x–CHE 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 (CHE BC3599x or y (4 points) or CHE BC3597x or y (2 points), or elsewhere, with prior approval of the adviser (CHE 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, CHE BC3590y or CHE 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. 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. Biology-Chemistry-Computer Science W4510 (*Molecular Systems Biology*) is an interesting new relevant course.

Language Study for Graduate Work

Though less common than in the past, some biochemistry graduate programs require that you demonstrate a reading knowledge of one or two languages other than English. Those most important for biochemistry 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 pick up a rudimentary reading knowledge on your own.