

# BIOCHEMISTRY (BA)

Department Website (<http://as.nyu.edu/chemistry/>)

NYSED: 78102 HEGIS: 0414.00 CIP: 26.0202

## Program Description

The Department of Chemistry has a long tradition in the College of Arts and Science, dating back well before the founding of the American Chemical Society at New York University in 1876. Professor John W. Draper, the first president of the society and chair of the department, was a remarkable polymath: chemist, physician, philosopher, historian, and pioneering photographer.

The department has undertaken a major development plan, strengthening its faculty, instructional laboratories, course offerings, and research facilities in the areas of physical, biophysical, bioorganic, and biomedical chemistry, as well as in chemical biology, nanoscience, and materials sciences. Qualified undergraduates are strongly encouraged to participate in research as early as their sophomore year of study. The department houses state-of-the-art laboratory facilities for its undergraduate chemistry courses.

Majoring in chemistry at NYU provides strong preparation for graduate study in chemistry and biochemistry; professional education in medicine, dentistry, or patent law; and careers in industrial or pharmaceutical chemistry and biotechnology.

## Departmental Objectives

Chemistry is an incredibly broad field. It is known as the central natural science because it intersects with physics, biology, engineering, materials science, and environmental science. The atomic and molecular structure and properties of matter are fundamental to the investigation of the physical world and to the understanding of living systems. Our chemistry program has an interdisciplinary approach that creates context for studying real-world problems and their solutions.

The department offers majors in chemistry, biochemistry, and global public health/science with a concentration in chemistry. Students have the opportunity to earn either a B.A. or B.S. in the chemistry major. A selection of elective advanced courses, undergraduate and graduate, can be combined (in consultation with the director of undergraduate studies) to provide a broad, varied program of study in chemistry or an undergraduate specialization in organic, biochemical, physical, or theoretical chemistry. The opportunity to participate in scientific research as an undergraduate is one of the most exciting features of a chemistry major. Research allows you to work alongside graduate students, postdoctoral fellows and faculty to develop new ideas to solve real-world problems and make new discoveries. Many of our students produce results that lead to publications and research is also a great preparation for graduate school and a wide range of chemistry careers.

The programs of study in chemistry and biochemistry prepare students for graduate study leading to careers in research, development, and teaching and/or for further study in areas such as medicine, dentistry, basic medical sciences, and allied health fields (including forensic science). In addition, the chemistry and biochemistry majors both prepare students for alternative careers, especially when paired with a minor in economics, data science, or business studies: for example, patent law, technology investment, or management in the chemical industry.

## Research Opportunities

The department endeavors to make research opportunities available during the summer and the academic year to well-qualified students at all levels. We encourage interested students to begin research as early as freshman or sophomore year. Students are encouraged to apply for the FAST and DURF grants awarded by the College. To participate in research in the department, students must meet any prerequisites and register for the research courses Advanced Independent Study and Research (CHEM-UA 997, 998) or, if eligible, Senior Honors in Chemistry (CHEM-UA 995, 996). In either case, permission of the director of undergraduate studies is required before registering for these courses.

## General Information

*For Majors in Chemistry and Biochemistry*

Students considering a major in chemistry or biochemistry are strongly urged to seek course advisement from the undergraduate academic team as early in their academic careers as possible. Chemistry is a sequential subject with courses building on earlier courses. Delay in taking certain key prerequisite courses can make it impossible to complete a major in four years without summer attendance.

Students must earn a grade of C or better in all courses required for the chemistry or biochemistry major, even if they are in other departments (such as mathematics or physics). Students who do not have an average of 2.0 or better in courses required by the department by the time they have completed 64 credits in all courses will be asked to change their major.

The Department of Chemistry strictly enforces all prerequisites and de-enrolls students from courses for which they do not meet the prerequisites. Prerequisite courses must be completed with a grade of C (not C minus) or better.

AP, IB, and A Level credit by examination in chemistry is not accepted toward any departmental majors or minors.

## Honors Program

While the Department of Chemistry has several accelerated courses—for example, CHEM-UA 129 Accelerated General Chemistry and CHEM-UA 227 Majors Organic Chemistry I & Laboratory and CHEM-UA 228 Majors Organic Chemistry II & Laboratory—these offerings need not be taken to earn a chemistry or biochemistry degree with departmental honors. The main requirement for earning an honors degree is the completion of an honors thesis based upon independent experimental or theoretical research. Students interested in research and an honors degree must enroll in CHEM-UA 995 Senior Honors in Chem and CHEM-UA 996 Senior Honors Chemistry. Students must first become involved in research, CHEM-UA 997 Adv Independent Study & Research or CHEM-UA 998 Adv Independent Study & Research for at least one semester or one summer prior to the senior year, as two semesters of research are generally not enough time to execute a successful project. Students seeking entry into the honors program must obtain the approval of the director of undergraduate studies prior to the end of their junior year. Candidates for a degree with honors in chemistry must have an overall GPA of 3.65 and a GPA of 3.65 in all required courses for the chemistry or biochemistry major. A senior thesis based on this work must be prepared, approved by the adviser, and presented in a seminar format during the spring term of the senior year. Please contact Carol

Hollingsworth, academic program administrator, or Professor Walters, director of undergraduate studies, for more detailed information.

## Admissions

New York University's Office of Undergraduate Admissions supports the application process for all undergraduate programs at NYU. For additional information about undergraduate admissions, including application requirements, see How to Apply (<https://www.nyu.edu/admissions/undergraduate-admissions/how-to-apply.html>).

## Program Requirements

The major in biochemistry builds on a core of required courses in chemistry, physics, and mathematics.

**Note:** *Biology is not required for any major or minor offered by the Department of Chemistry, but only for the pre-health program.*

Course	Title	Credits
<b>General Education Requirements</b>		
First-Year Seminar		4
EXPOS-UA 1	Writing as Inquiry	4
Foreign Language <sup>1</sup>		16
Texts and Ideas		4
Cultures and Contexts		4
Societies and the Social Sciences		4
Expressive Culture		4
<b>Major Requirements</b>		
<i>General Chemistry Sequence</i> <sup>2</sup>		
CHEM-UA 125	General Chemistry I & Laboratory	5
CHEM-UA 126	General Chemistry II & Laboratory	5
<i>Organic Chemistry Sequence</i>		
CHEM-UA 225	Organic Chemistry I & Laboratory	5
or CHEM-UA 227	Majors Organic Chemistry I & Laboratory	
CHEM-UA 226	Organic Chemistry II & Laboratory	5
or CHEM-UA 228	Majors Organic Chemistry II & Laboratory	
<i>Physical Chemistry Courses</i>		
CHEM-UA 651	Quantum Mechanics & Spectroscopy	4
CHEM-UA 652	Thermodynamics & Kinetics	4
<i>Mathematics &amp; Physics Courses</i>		
MATH-UA 121	Calculus I <sup>3</sup>	4
MATH-UA 122	Calculus II <sup>4</sup>	4
PHYS-UA 11	General Physics I <sup>5</sup>	5
PHYS-UA 12	General Physics II <sup>6</sup>	5
<i>Additional Biochemistry Courses</i>		
CHEM-UA 881	Biochemistry I	4
CHEM-UA 882	Biochemistry II	4
CHEM-UA 885	Experimental Biochem & Laboratory	4
CHEM-UA 890	Advanced Biochemistry	4
<b>Electives</b>		
Advanced Chemistry Elective <sup>7</sup>		4
Other Elective Credits		22
<b>Total Credits</b>		<b>128</b>

1

The foreign language requirement is satisfied upon successful completion through the Intermediate level of a language. This may be accomplished in fewer than 16 credits, but those credits must then be completed as elective credit.

2

When offered, the one-semester CHEM-UA 129 Accelerated General Chemistry course may substitute for the CHEM-UA 125 General Chemistry I & Laboratory, and CHEM-UA 126 General Chemistry II & Laboratory sequence.

3

Or Advanced Placement (or equivalent international exam) credit.

4

Advanced Placement credit for MATH-UA 122 Calculus II (a score of 5 on BC Calculus) is not accepted for this major requirement. Students with this AP credit must either (1) take Calculus II at NYU and forfeit 4 of the 8 AP credits, or (2) register for one of the following: CHEM-UA 140 Mathematics of Chemistry, MATH-UA 123 Calculus III, or MATH-UA 140 Linear Algebra, using the BC credits as a prerequisite.

5

Credit for AP Physics C: Mechanics with a score of 4 or 5 is accepted, but only for students who are not prehealth. No other AP or equivalent international credit is accepted. *Because of medical, dental, etc. school admissions requirements, students on the prehealth track cannot use AP Physics C credit to place out of either or both semesters of General Physics.*

6

Credit for AP Physics C: Electricity and Magnetism with a score of 4 or 5 is accepted, but only for students who are not prehealth. No other AP or equivalent international credit is accepted. *Because of medical, dental, etc. school admissions requirements, students on the prehealth track cannot use AP Physics C credit to place out of either or both semesters of General Physics.*

7

CHEM-UA 997 Adv Independent Study & Research, CHEM-UA 998 Adv Independent Study & Research, CHEM-UA 995 Senior Honors in Chem, CHEM-UA 996 Senior Honors Chemistry, and CHEM-UA 140 Mathematics of Chemistry *do not count* as advanced electives for the major.

## Program Notes

CHEM-UA 140 Mathematics of Chemistry is strongly recommended as preparation for both Physical Chemistry: Quantum Mechanics and Spectroscopy (CHEM-UA 651) and Physical Chemistry: Thermodynamics and Kinetics (CHEM-UA 652), as well as for students interested in pursuing chemistry on the graduate level or who have an interest in theoretical chemistry or physical chemistry. Students may choose instead to take Calculus III (MATH-UA 123) and/or Linear Algebra (MATH-UA 140).

Freshmen who intend to pursue a major in biochemistry and are well prepared in mathematics and the physical sciences are strongly encouraged to take General Physics I and II as their second science sequence (concurrently with general chemistry) in the first year. This allows the physical chemistry courses to be taken as early as sophomore year if the mathematics prerequisites are completed. However, if students choose to take biology with chemistry in the freshman year they may wish to defer taking physics (e.g., for students who are undecided, are

considering a major in biology or neural science, and/or are on the pre-health track).

The core courses listed above provide a basic background in chemistry. Students are required to complete the courses in general chemistry, physics, and calculus prior to entry into CHEM-UA 651, 652 (the physical chemistry sequence), which is usually in the third year. It is strongly advised that advanced-level chemistry course enrollment begin no later than the fifth semester of study. This allows at least three more semesters to complete all major requirements.

Majors in Biochemistry are advised to take BIOL-UA 11 and BIOL-UA 12 as well as BIOL-UA 21 and BIOL-UA 22, especially if they are interested in graduate study. These courses do not count toward any major or minor in the Department of Chemistry.

## Sample Plan of Study

Course	Title	Credits
<b>1st Semester/Term</b>		
CHEM-UA 125	General Chemistry I & Laboratory	5
MATH-UA 121	Calculus I	4
First-Year Seminar		4
Texts and Ideas		4
<b>Credits</b>		<b>17</b>
<b>2nd Semester/Term</b>		
CHEM-UA 126	General Chemistry II & Laboratory	5
MATH-UA 122	Calculus II	4
EXPOS-UA 1	Writing as Inquiry	4
Cultures and Contexts		4
<b>Credits</b>		<b>17</b>
<b>3rd Semester/Term</b>		
CHEM-UA 225 or CHEM-UA 227	Organic Chemistry I & Laboratory or Majors Organic Chemistry I & Laboratory	5
CHEM-UA 140	Mathematics of Chemistry <sup>1</sup>	4
BIOL-UA 11	Principles of Biology I <sup>2</sup>	4
Foreign Language		4
<b>Credits</b>		<b>17</b>
<b>4th Semester/Term</b>		
CHEM-UA 226 or CHEM-UA 228	Organic Chemistry II & Laboratory or Majors Organic Chemistry II & Laboratory	5
Elective		4
Elective		2
Foreign Language		4
<b>Credits</b>		<b>15</b>
<b>5th Semester/Term</b>		
CHEM-UA 881	Biochemistry I	4
PHYS-UA 11	General Physics I	5
Foreign Language		4
Expressive Culture		4
<b>Credits</b>		<b>17</b>
<b>6th Semester/Term</b>		
CHEM-UA 882	Biochemistry II	4
PHYS-UA 12	General Physics II	5
Foreign Language		4
Societies and the Social Sciences		4
<b>Credits</b>		<b>17</b>
<b>7th Semester/Term</b>		
CHEM-UA 651	Quantum Mechanics & Spectroscopy	4
CHEM-UA 885	Experimental Biochem & Laboratory	4
Advanced Chemistry Elective		4
Elective		4
<b>Credits</b>		<b>16</b>

### 8th Semester/Term

CHEM-UA 652	Thermodynamics & Kinetics	4
CHEM-UA 890	Advanced Biochemistry	4
Elective		4
<b>Credits</b>		<b>12</b>
<b>Total Credits</b>		<b>128</b>

1

CHEM-UA 140 Mathematics of Chemistry is recommended, but not required. Does **not** count toward any major requirements. May be substituted with an elective course.

2

Principles of Biology is recommended, but not required. Does **not** count toward any major requirements. Some biochemistry majors may need to choose to pursue additional coursework in biology.

## Learning Outcomes

Upon completion of program requirements, students are expected to have acquired:

1. A fundamental command of biochemistry, as well as of the subdisciplines of organic, inorganic, and physical chemistry.
2. Facility (via elective offerings) in analytical chemistry and/or mathematical and machine computational methods.
3. Mastery of laboratory skills in biochemistry and also in organic and physical chemistry.
4. Familiarity with contemporary problems in chemistry and the ability to articulate these problems and to propose well-considered solutions.

## Policies

### Program Policies

#### Grading and GPA Policy

The major in biochemistry requires six CHEM-UA core courses (28 credits), four mathematics and physics courses (18 credits), four biochemistry courses (16 credits), and one advanced chemistry elective (4 credits), all completed with a grade of C or better even if they are in other departments (such as mathematics or physics). Courses graded Pass/Fail do not count toward the major. Students who do not have an average of 2.0 (C) or better in courses required by the department by the time they have completed 64 credits in all courses will be asked to change their major.

#### Prerequisite Policy

The Department of Chemistry strictly enforces all prerequisites and de-enrolls students from courses for which they do not meet the prerequisites. Prerequisite courses must be completed with a grade of C (not C-) or better.

#### Laboratory Policy

Due to the potential hazard of any chemical experimentation, safety goggles, laboratory coats, and other protective gear must be worn at all times in the laboratories (but cannot be worn outside the laboratory). Laboratory equipment loaned to students must be replaced if damaged or broken. Students who do not return borrowed laboratory equipment at the end of a course are charged an additional fee, and their grade may be recorded as incomplete and not released until "checkout" is completed.

## **NYU Policies**

University-wide policies can be found on the New York University Policy pages (<https://bulletins.nyu.edu/nyu/policies/>).

## **College of Arts and Science Policies**

A full list of relevant academic policies can be found on the CAS Academic Policies page (<https://bulletins.nyu.edu/undergraduate/arts-science/academic-policies/>).