CHEMISTRY MAJOR

MAJOR DESCRIPTION

Chemistry is the science of molecules. Scientific, medical, and technological phenomena ultimately are understood in terms of molecular structure and interactions. Understanding chemistry is essential to effective work in all sciences, and some knowledge of chemistry is useful in such fields as law, government, business, and art. Many aspects of our high-technology society can be understood better from the viewpoint of chemistry.

The following are typical important chemical problems: the structure of DNA, the molecular details of the resistance of bacteria to penicillin, the chemistry of biofuel production, the synthesis of new molecules that might be expected to have medical applications, the consequences of putting electrons and photons into molecules, the details of what happens as two molecules collide, the fundamental basis of the energies of molecules, and the synthesis of nanomaterials. These are all areas of research by Wesleyan faculty and their undergraduate and graduate coworkers.

ADMISSION TO THE MAJOR

Students who anticipate the possibility of majoring in chemistry should, if possible, take CHEM143/CHEM144 as first-year students. The program for majors is described in detail below. Students who have scores of 4 or 5 in the chemistry Advanced Placement examination or 5, 6, or 7 on IB courses in chemistry should consult with the department chair about the possibility of advanced placement in organic chemistry (or, in exceptional circumstances, in physical chemistry). A student whose interest in biochemistry arises from a desire to understand biological systems at the molecular level may choose to study biochemistry as a chemistry major. (See biological chemistry track below.)

To declare the Chemistry major students must have earned a grade of C or better in all 100- and 200-level Chemistry courses completed at the time of declaration.

MAJOR REQUIREMENTS

To major in chemistry, a student should complete a year of General Chemistry (CHEM141/CHEM142 or, preferably, CHEM143/CHEM144, and the associated lab CHEM152), unless the student has been given Advanced Placement credit. In addition, a year of organic chemistry (CHEM251/CHEM252), the concurrent laboratories (CHEM257/CHEM258), and a year of physical chemistry (CHEM337/CHEM338) are required. One year of advanced laboratory is required (CHEM375/CHEM376). Chemistry majors are also required to register for and attend two semesters of CHEM521/CHEM522. The major is completed by electing a total of at least three credits from 300-level courses (other than CHEM337/CHEM338). All courses other than seminars that are required for the chemistry major must be taken under a letter-grading mode (A–F). One of the three 300-level electives may be replaced by two semesters of research (CHEM409/CHEM410 or CHEM423/CHEM424). Seminars or journal clubs cannot be counted as electives. All chemistry majors are strongly encouraged to do research with a faculty member, both during the academic year and over at least one summer. Financial support for summer research is generally available.

Students must either (i) complete calculus courses through MATH122, (ii) receive an Advanced Placement score of a 4 or 5 on the BC calculus exam, or (iii) place into a course beyond MATH122 on the Math Placement Exam. Students must take one year of physics (PHYS111/112 or PHYS113/116) or receive an Advanced Placement score of a 4 or 5 on AP physics exam. Students who do not study inorganic chemistry in CHEM144, either through exemption or because they have satisfied the general chemistry requirement with CHEM141/CHEM142, must select CHEM361 as one of their 300-level electives.

Before or during the second semester of the sophomore year, a student interested in majoring in chemistry should consult with the chair of the Chemistry Department or the departmental advisors for specific areas of chemistry (analytical, biochemistry, inorganic, organic, and physical) concerning a suitable program of study. If the student does opt for the chemistry major, these people may also assist in the choice of a major advisor for the student. Students who intend to be multiple majors are strongly advised to consult with their chemistry advisors at the beginning of their junior year to plan their chemistry program.

A chemistry major planning graduate work in chemistry usually takes at least one additional 300-level chemistry course (excluding CHEM337/CHEM338) and two semesters of undergraduate research, CHEM409/CHEM410 or CHEM423/CHEM424. When feasible, an intensive continuation of research during at least one summer is encouraged. The preparation of a senior thesis based on this research (CHEM409/CHEM410 or CHEM423/CHEM424) provides extremely valuable experience and is strongly recommended.

Graduate courses may be elected with permission. A chemistry major planning to attend medical school, teach in a secondary school, or do graduate work in such fields as biochemistry, geochemistry, environmental science, or chemical physics may request permission from the departmental curriculum committee to replace one of the elective credits in the concentration program with an appropriate course offered by another science or mathematics department. A similar substitution may be requested when appropriate as part of an interdepartmental major. Independent research is encouraged. A solid mathematical background is important to those students who plan to do graduate work in chemistry. Such students should also try to take PHYS113 and PHYS116 prior to their junior year. MATH221 and MATH222 are recommended to those whose interests lie in physical chemistry.

BIOLOGICAL CHEMISTRY TRACK

The Chemistry Department recognizes that a number of students each year are interested in a major program containing both a strong biology or biochemistry component and somewhat less emphasis on chemistry than the standard chemistry major. In response to this interest, the Chemistry Department now offers a biological chemistry track. This track would, for example, be an excellent preparation for medical school or graduate school in biochemistry. (Students interested in chemistry as a profession are advised to take the standard chemistry major track, which provides a better preparation for graduate school in chemistry.)

To begin a major in the biological chemistry track, a student should complete a year of General Chemistry (CHEM141/CHEM142 or, preferably, CHEM143/CHEM144, and the associated laboratory, CHEM152), unless the student has been given Advanced Placement credit. In addition, one year of organic chemistry (CHEM251/CHEM252), the concurrent laboratories (CHEM257/CHEM258), and a year of physical chemistry (CHEM337/CHEM338) are required. One year of advanced laboratory is required (CHEM375/CHEM376). Chemistry majors are also required to register for and attend two semesters of CHEM521/CHEM522. The major is completed by electing a total of at least three credits from 300-level courses (other than CHEM337/CHEM338). All courses other than seminars that are required for the chemistry major must be taken under a letter-grading mode (A–F). One of the three 300-level electives may be replaced by two semesters of research (CHEM409/CHEM410 or CHEM423/CHEM424). Seminars or journal clubs cannot be counted as electives. All chemistry majors are strongly encouraged to do research with a faculty member, both during the academic year and over at least one summer. Financial support for summer research is generally available.

Students must either (i) complete calculus courses through MATH122, (ii) receive an Advanced Placement score of a 4 or 5 on the BC calculus exam, or (iii) place into a course beyond MATH122 on the Math Placement Exam. Students must take one year of physics (PHYS111/112 or PHYS113/116) or receive an Advanced Placement score of a 4 or 5 on AP physics exam. Students who do not study inorganic chemistry in CHEM144, either through exemption or because they have satisfied the general chemistry requirement with CHEM141/CHEM142, must select CHEM361 as one of their 300-level electives.

Before or during the second semester of the sophomore year, a student interested in majoring in chemistry should consult with the chair of the Chemistry Department or the departmental advisors for specific areas of chemistry (analytical, biochemistry, inorganic, organic, and physical) concerning a suitable program of study. If the student does opt for the chemistry major, these people may also assist in the choice of a major advisor for the student. Students who intend to be multiple majors are strongly advised to consult with their chemistry advisors at the beginning of their junior year to plan their chemistry program.

A chemistry major planning graduate work in chemistry usually takes at least one additional 300-level chemistry course (excluding CHEM337/CHEM338) and two semesters of undergraduate research, CHEM409/CHEM410 or CHEM423/CHEM424. When feasible, an intensive continuation of research during at least one summer is encouraged. The preparation of a senior thesis based on this research (CHEM409/CHEM410 or CHEM423/CHEM424) provides extremely valuable experience and is strongly recommended.

Graduate courses may be elected with permission. A chemistry major planning to attend medical school, teach in a secondary school, or do graduate work in such fields as biochemistry, geochemistry, environmental science, or chemical physics may request permission from the departmental curriculum committee to replace one of the elective credits in the concentration program with an appropriate course offered by another science or mathematics department. A similar substitution may be requested when appropriate as part of an interdepartmental major. Independent research is encouraged. A solid mathematical background is important to those students who plan to do graduate work in chemistry. Such students should also try to take PHYS113 and PHYS116 prior to their junior year. MATH221 and MATH222 are recommended to those whose interests lie in physical chemistry.
Students who have been exempted from CHEM144 must take CHEM361 to gain familiarity with inorganic chemistry.

The three electives normally required for chemistry majors should be taken from the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
</tr>
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<tbody>
<tr>
<td>CHEM309</td>
<td>Molecular and Cellular Biophysics</td>
<td>1</td>
</tr>
<tr>
<td>CHEM/M&amp;B321</td>
<td>Biomedical Chemistry</td>
<td>1</td>
</tr>
<tr>
<td>CHEM/M&amp;B325</td>
<td>Introduction to Biomolecular Structure</td>
<td>1</td>
</tr>
<tr>
<td>CHEM/M&amp;B386</td>
<td>Biological Thermodynamics</td>
<td>1</td>
</tr>
<tr>
<td>CHEM387</td>
<td>Enzyme Mechanisms</td>
<td>0.5</td>
</tr>
<tr>
<td>CHEM390/MB&amp;B340</td>
<td>Practical Methods in Biochemistry</td>
<td>1</td>
</tr>
<tr>
<td>MB&amp;B208</td>
<td>Molecular Biology (or any other chemistry courses, 300-level or higher)</td>
<td>1</td>
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One upper-level MB&B course can be used as an elective upon prior approval by the faculty advisor. (Note, however, that only one MB&B course, including MB&B208, not cross-listed with chemistry, may count as an elective toward the major.) Students must either (i) complete calculus courses through MATH122, (ii) receive an Advanced Placement score of a 4 or 5 on the BC calculus exam, or (iii) place into a course beyond MATH122 on the Math Placement Exam. Students are strongly encouraged to take one year of physics (PHYS111/PHYS112 or PHYS113/PHYS116) or receive an Advanced Placement score of a 4 or 5 on AP physics exam. One of the electives may be replaced by two semesters of research (CHEM409/Chemistry Major Research I or CHEM423/CHEM424). Other seminars or journal clubs cannot be counted as electives. Participation in the weekly biochemistry evening seminar (CHEM587/Chemistry Major Research II) and in research, both during the academic year and over at least one summer, are strongly recommended. Students who intend to be multiple majors are strongly advised to consult with their chemistry advisors at the beginning of their junior year to plan their chemistry program.

COURSES FOR NON-MAJORS

Nonscientists are encouraged to consider CHEM118, CHEM119, CHEM120, or CHEM141/CHEM142 as part of their program to meet NSM requirements. CHEM118 provides an interdisciplinary view of the DNA molecules and their impact on society at large. CHEM119 studies the basic chemistry of several diseases, including AIDS, cancer, bacterial infections, and the drugs used to treat them, as well as psycho-therapeutic drugs. CHEM120 covers basic chemical principles and then shows how these principles relate to important issues in the real world, such as global warming, alternative energy, genetic engineering, and the treatment of diseases. CHEM141/CHEM142 is an introduction to chemistry that includes quantitative material. CHEM141 can be taken as a single-semester course toward the NSM requirements and can be taken by students who have had no high school chemistry.

Scientists majoring in areas other than chemistry can prepare themselves better for work in their discipline by having a grounding in chemistry, which will enable them to understand molecular phenomena. The Chemistry Department offers two yearlong tracks of Introductory Chemistry (CHEM141/CHEM142 or CHEM143/CHEM144). The CHEM143/CHEM144 sequence, requiring some prior chemistry and calculus, provides a more sophisticated introduction and represents a better preparation for science majors. The CHEM141/CHEM142 sequence requires no previous exposure to chemistry or calculus and emphasizes environmental and biological applications. CHEM152 is taken concurrently with CHEM141 and CHEM143 in the fall semester or with CHEM142 or CHEM144 in the spring semester. CHEM251/CHEM252 normally follows General Chemistry.

The laboratory courses, CHEM257 and CHEM258, are usually taken concurrently with CHEM251/CHEM252, respectively. The two courses, General Chemistry and Organic Chemistry, plus the laboratory sequence, CHEM152, CHEM257, CHEM258, are required for admission to medical, dental, and veterinary schools.

STUDENT LEARNING GOALS

Students graduating with a BA degree in chemistry should be able to:

- **Apply the scientific method.** The student should understand how to develop and test scientific hypotheses.
- **Understand data.** The student should understand how chemical data is produced, interpreted, and applied.
- **Perform laboratory experiments.** The student should have the ability to carry out standard chemical experimental procedures safely and successfully.
- **Apply quantitative tools.** The student should be able to select and apply appropriate quantitative techniques (e.g., calculus, statistics, chemical group theory, or computational modeling) to chemical questions.
- **Use the primary literature.** The student should be able to search for and understand publications from the primary scientific literature.
- **Critically evaluate scientific claims.** The student should be able to critique claims and arguments made in the chemical literature.
- **Communicate.** The student should be able to present chemical data and their interpretation effectively in written, visual, and oral formats.
- **Practice science with integrity.** The student should adhere to established professional ethical standards in the generation, documentation, and presentation of chemical data.
- **Appreciate chemistry as an interdisciplinary science.** The student should understand how to apply chemical perspectives to topics from related fields.

STUDY ABROAD

A semester abroad is possible if adequately planned in advance. Students should discuss plans with their chemistry major advisors.

ADVANCED PLACEMENT

Placement in CHEM141 or CHEM143. Freshmen interested in environmental and/or biochemical material may take CHEM141. Those more interested in quantitative and inorganic materials should take CHEM143. Potential majors and other students will have a solid grounding in chemistry by taking either CHEM141, CHEM142 or CHEM143, CHEM144. CHEM152 is taken concurrently with CHEM141 or CHEM143 in the fall semester and CHEM142 or CHEM144 in the spring semester. Faculty will be available to discuss this at the Freshman Academic Forum. (http://www.wesleyan.edu/studentaffairs/)

Requirements for medical, dental, or veterinarian school are satisfied by either CHEM141, CHEM142 or CHEM143, CHEM144, plus CHEM152, followed by CHEM251, CHEM252 (Organic Chemistry) and the labs CHEM257, CHEM258.

Note: If CHEM144 was not taken (because of Advanced Placement credit or because sequence CHEM141/CHEM142 replaced CHEM143/CHEM144) then CHEM361 must be among the electives for the major.

For freshmen and new students to receive 2 credits:
Score of AP 5. Students can receive 2.00 credits by completing one full year of organic chemistry (CHEM251) with a minimum grade of B. No credit will be granted if a student completes any of the following courses: CHEM141, CHEM142, CHEM143, or CHEM144.

For freshmen and new students to receive 1 credit:

Score of AP 5. Students can receive 1.00 credit by completing CHEM144 with a minimum grade of B. No credit will be granted if a student takes either CHEM141, CHEM142, or CHEM143.

Score of AP 4. Students can receive 1.00 credit by either completing CHEM144 with a minimum grade of B or completing a full year of organic chemistry (CHEM251 & CHEM252) with a minimum grade of B. No credit will be granted if a student completes any of the following courses: CHEM141, CHEM142, or CHEM143.

Special note: AP students who intend to major in chemistry should consult with the department chair as soon as possible.

**ADVANCED PLACEMENT CREDIT FOR THE INTERNATIONAL BACCALAUREATE (IB) COURSES IN CHEMISTRY**

For freshmen and new students to receive 2 credits:

Score of IB 6 or 7. Students can receive 2.00 credits by completing one full year of organic chemistry (CHEM251 and CHEM252) with a minimum grade of B. No credit will be granted if a student completes any of the following courses: CHEM141, CHEM142, CHEM143, or CHEM144.

For freshmen and new students to receive 1 credit:

Score of IB 6 or 7. Students can receive 1.00 credit by completing CHEM144 with a minimum grade of B. No credit will be granted if a student takes either CHEM141, CHEM142, or CHEM143.

Score of IB 5. Students can receive 1.00 credit by either completing CHEM144 with a minimum grade of B, or completing a full year of organic chemistry (CHEM251 & CHEM252) with a minimum grade of B. No credit will be granted if a student completes any of the following courses: CHEM141, CHEM142, or CHEM143.

Score of IB 4. Students are not eligible to receive Wesleyan credit.

Note: A chemistry major is required to study inorganic chemistry. The requirement can be met by taking either CHEM144 or CHEM361 or both.

Special note: AP students who intend to major in chemistry should consult with the department chair as soon as possible.

**ENGLISH A-LEVELS**

For freshmen and new students:

Students with a grade of A on the Chemistry A-Levels can receive 1 credit by completing CHEM144 with a minimum grade of B or completing the yearlong organic chemistry (CHEM251 and CHEM252) with a grade of B or higher. No credit will be granted if the student has completed any of the following courses: CHEM141, CHEM142, or CHEM143.

Special note: Students with Chemistry AP, IB, or A-Levels scores who intend to major in chemistry should consult with the department chair as soon as possible.

**LANGUAGE REQUIREMENT**

There is no language requirement associated with this program.

**TRANSFER CREDIT**

Not all general chemistry or organic chemistry courses taken at other institutions will satisfy the criteria for transfer credit to Wesleyan. It is the students’ responsibility to find an acceptable course(s) and to have the course(s) preapproved by the Chemistry Department. Below are general guidelines for requests for transfer of credit for general and organic chemistry.

For Transfer of Credit:

- The instructor of the equivalent Wesleyan course (CHEM141 or CHEM142 for General Chemistry and CHEM251/CHEM252 for Organic Chemistry) for the current academic year must approve all transfer of credit requests. Such approvals are solely at his/her discretion.
- Permission should be requested before the course is taken. The student should submit:
  - the ‘Permission to Transfer Credit From Another College or University’ form available on the Dean’s Office website (http://www.wesleyan.edu/deans/forms/formspdf.html),
  - the title, author(s), and edition of the textbook used in the course,
  - the syllabus for the course, including which specific chapters of the textbook are actually covered in the course,
  - the length of the lectures,
  - the total number of actual class hours, excluding time taken for examinations, and
  - the name and contact information for the course instructor.

These materials must be compiled by the student and sent to the faculty member currently teaching the equivalent Wesleyan course; simply sending a copy of the syllabus or a link to a course website is not sufficient.

- The student must achieve at least a B- to get credit for the course.
- Courses taken elsewhere may not be counted toward a chemistry major at Wesleyan (except by special petition to the Curriculum Committee of the Chemistry Department).
- The Chemistry Department will not normally accept an online chemistry course for Wesleyan credit.

**ADDITIONAL INFORMATION**

Undergraduate research. Research is an important part of the program for most majors. Wesleyan’s small but excellent graduate program makes it possible for majors to work at the cutting edge of discovery in chemistry. Every tenured/tenure-track faculty member is involved in significant research. Undergraduates participating in the departmental research program normally attend a research seminar in their area, and most research groups have weekly meetings to discuss new results. Students involved in significant research have an opportunity to continue in the University’s BA/MA program.

Seminars. Seminars are a vital part of the intellectual life of the Chemistry Department. Weekly departmental seminars on Friday afternoons (CHEM521/CHEM522) are followed by refreshments and discussions in the chemistry lounge. Important scientists from other universities, research
laboratories, and industry are the speakers. In addition, chemistry students and faculty speak at weekly research seminars in chemical physics, organic/inorganic chemistry, and biochemistry. Programs for each semester are available on the chemistry website.

**HONORS**

Honors are awarded based on the evaluation of senior theses.

**CAPSTONE EXPERIENCE**

The recommended capstone experience is research followed by a senior thesis. Successful completion of the Integrated Lab sequence CHEM375/CHEM376 is considered a capstone for those students not doing research in chemistry.