

Chemistry

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Chemistry is the science of the structure, properties, and reactions of matter. It is both a basic science, fundamental to an understanding of the world we live in, and a practical science with an enormous number and variety of important applications. Knowledge of chemistry is fundamental to an understanding of biology and biochemistry and of certain aspects of geology, astronomy, physics, and engineering.

The most important motivation for concentration in Chemistry is an intrinsic interest in the subject. Career opportunities in chemistry include the areas of basic research, applied research and development, biotechnology, chemical analysis, manufacturing, and marketing. In addition, a degree in chemistry can be an excellent background for careers in many related fields, including law, medicine, business, environmental science, and other areas of science. Because of the diversity of interests of prospective chemistry concentrators, the Department of Chemistry and Chemical Biology has designed a very flexible program of requirements which allows each student to select an area of emphasis. Courses in organic, physical, and inorganic chemistry and biochemistry are offered. A few of these courses include required laboratory work, and special laboratory courses are available to advanced students in each area. In addition, concentrators may elect to pursue an individual research project with one of the research groups of the department. Each research group consists of advanced undergraduates, graduate students, postdoctoral fellows, and a faculty member. In order to introduce students to chemical research and current topics of faculty interest, the department offers a non-credit sophomore tutorial in the spring term, a series of lectures by faculty members on their current research. This lecture series serves as the prerequisite for the junior tutorial, Chemistry 98r, in which the student joins a research group under the supervision of a faculty member. Often this work is continued throughout the senior year as Chemistry 99. Here the student becomes associated with current research in a particular area either by reading and studying recommended advanced material in that area or by undertaking an individual research project. Such projects often result in publications.

All of the courses in the department are open to properly prepared undergraduates and most upper-level courses do have some undergraduates. The courses emphasize fundamental laws and principles. The more advanced courses are designed to be related closely to active areas of research in chemistry. Current research activity is further stressed in the numerous seminars and colloquia in organic, physical, biophysical, and inorganic chemistry, some of which are held jointly with other departments at Harvard as well as at MIT. Most research groups have meetings and informal seminars at which topics of interest are discussed.

In addition to a balanced program of at least eight half-courses in chemistry, concentrators are encouraged to take courses in physics, biology, biochemistry, applied science, and mathematics as part of their concentration requirements. Because of the sequence of prerequisites for chemistry courses, the department strongly recommends some work in mathematics as well as chemistry in the first year. Freshmen contemplating this program are urged to consult the Co-Director of Undergraduate Studies of the Chemistry concentration in planning their work for the first year.

For information on the secondary field in Chemistry, please see page 319 of this *Handbook* or the secondary fields website (www.secondaryfields.fas.harvard.edu/Chem/program-desc-chem.htm).

REQUIREMENTS**Basic Requirements: 12-14 half-courses**

1. *Required courses:* Twelve to 14 half-courses required, including at least eight half-courses in chemistry (see item 5a):
 - a. *General chemistry (two half-courses):* Life Sciences 1a and Physical Sciences 1, or satisfactory placement out of the requirement.
 - b. *Inorganic chemistry (one half-course):* Chemistry 15, 40, or equivalent.
 - c. *Organic chemistry (two half-courses):* Chemistry 20 and 30, or Chemistry 17 and 27, or equivalent.
 - d. *Physical chemistry (two half-courses):* Chosen from Chemistry 160, or equivalent, and Chemistry 60, 161, 163, or equivalent.
 - e. *Advanced laboratory (one half-course):* Chemistry 135 or 165. Laboratory work performed in Chemistry 91r, 98r, or 99r may not be counted in fulfillment of the advanced laboratory requirement.
 - f. *Chemistry with a strong biological orientation (one half-course):* Life Sciences 1a, or Chemistry 27 or 170, or Molecular and Cellular Biology 52 or 54 (formerly Biological Sciences 52 or 54, or equivalent. (Life Sciences 1a may count for both this requirement and 1a above; Chemistry 27 may count for this requirement and 1c above.)
 - g. *Mathematics (at least one half-course):* Mathematics 21a or equivalent. Mathematics 21b is strongly recommended.
 - h. *Physics (at least two half-courses):* Physics 11a, 11b or the 15a (16), 15b, 15c sequence is strongly preferred to Physics 1a, 1b. (Physics 15a and 15b alone do not constitute a complete overview of general physics.) Physics 1a and 1b, and Physical Sciences 2 and 3, are not acceptable for honors candidates.
 - i. Additional half-courses as needed to meet the total of twelve in chemistry or in related fields (13 if the student places into Mathematics 1b; 14 if the student must take Mathematics 1a.)
2. *Tutorial:*
 - a. *Sophomore year:* Spring term. Optional, but highly recommended before enrolling in Chemistry 98r. Non-credit. A series of lectures by faculty members on their current research. A few very well prepared sophomores or first year students who are accepted for laboratory research work may register for Chemistry 91r, graded SAT/UNS only.
 - b. *Junior year:* Chemistry 98r, optional, for approved students only. Graded SAT/UNS only. Each term of Chemistry 98r involves individual reading and research projects under the direction of a member of the staff. Junior concentrators are advised to consult with their advisers and to inquire at the office of the Director of Undergraduate Studies concerning the tutorial program. Any student enrolling in Chemistry 98r must register the name of his or her research mentor at the office of the Director of Undergraduate Studies when study cards are submitted.
3. *General Examination:* None.
4. *Thesis:* Not required.
5. *Other information:*
 - a. Related fields, in the present context, include departmental courses in physics and mathematics, applied physics and applied mathematics, and upper-level departmental courses in biology, biochemistry, and earth and planetary sciences, that carry a chemistry prerequisite. Chemistry courses include many biochemistry courses.
 - b. *Prior work:* Students granted actual course credit by the College toward the AB degree for work done prior to admission will receive concentration credit on the same basis

as corresponding work done in residence. Other students substituting an advanced science course for a more elementary course may petition for a reduction in the total number of courses required for honors, but not below a minimum of 12 half-courses (excluding Mathematics 1a and 1b).

- c. *Pass/Fail*: Two half-courses counted for concentration credit may be taken Pass/Fail. This does not include SAT/UNS grades given in Chemistry 91r, 98r or 99r.

Requirements for Honors Eligibility: 14-16 half-courses

1. *Required courses*: 14 half-courses required, including at least eight half-courses in chemistry (see item 5a).
 - a-i. Same as **Basic Requirements**.
 - j. Two additional half-courses in chemistry or biochemistry, or at a suitable advanced level in a related field. Courses that meet this requirement include:
 - i. MCB 52, 54 (formerly Biological Sciences 52, 54).
 - ii. Life Sciences 1b.
 - iii. Mathematics 21b.
 - iv. Applied Mathematics 105a, 105b.
 - v. Physics 15c, 143a, 143b, 151, 153, 181.
 - vi. Other courses significantly related to chemistry may also be accepted on petition to the department.
 - k. Total program must include at least four half-courses in chemistry numbered higher than 100.
2. *Tutorials*:
 - a. *Sophomore year*: Same as **Basic Requirements**.
 - b. *Junior year*: Same as **Basic Requirements**.
 - c. *Senior year*: Chemistry 99r, optional, for honors candidates only. Graded SAT/UNS only. Chemistry 99r involves individual reading and research projects under the direction of a faculty member. Any student enrolling in Chemistry 99r must register the name of his or her research mentor at the office of the Director of Undergraduate Studies when study cards are submitted.
3. *General Examination*: None.
4. *Thesis*: Optional. Students enrolled in Chemistry 99r have the option of writing a thesis.
5. *Other information*: Same as **Basic Requirements**.

ADVISING

The Director of Undergraduate Studies initially serves as faculty adviser for new concentrators until they join research groups, usually through the Chemistry 98r tutorial, or otherwise establish a working relationship with another faculty member who agrees to serve as faculty adviser. Either the Director or Co-Director of Undergraduate Studies or another faculty adviser may sign study cards or advise on concentration matters. Students interested in concentrating in Chemistry should discuss their plans of study with the Co-Director of Undergraduate Studies.

For up-to-date information on advising in Chemistry, please see the Advising Programs Office website: www.fas.harvard.edu/~advising/concentrations/Chemistry.html.

HOW TO FIND OUT MORE

Further information is available at the Office of the Co-Director of Undergraduate Studies in Chemistry, Dr. Gregg Tucci, Science Center 114 (617-496-4668), tucci@fas.harvard.edu.

ENROLLMENT STATISTICS**Number of Concentrators as of November**

Concentrators	2002	2003	2004	2005	2006
Chemistry	73	89	91	86	82
Chemistry + another field	1	1	2	4	5
Another field + Chemistry	1	2	1	1	1