Field of Chemistry
Chemistry probes the fundamental concepts of nature and works to solve society's problems. Sometimes, in unexpected ways, these endeavors come together—a fundamental research study occasionally leads to a useful product and the applied project can unearth a previously unknown phenomenon. Chemistry is obviously intrinsically important, but it also has significant impacts on other disciplines. For instance, if we are to understand the complexities of biology, it is essential to understand why sugar molecules, proteins, or DNA molecules behave as they do. Chemists are interested in the structure of molecules, the properties of materials, and reactions that convert one material into another. As an example, they want to understand why some polymers are elastic, and they want to develop new polymers based upon this knowledge. Chemists provide perhaps the most important resource for solving energy and environmental problems.

Department of Chemistry University of Minnesota
Because of the for people to solve problems using chemistry, there is a strong and continuing demand for trained chemists. Many graduates are employed in research and development laboratories, but there are also job opportunities in government, teaching, health, and business. The chemistry program at the University of Minnesota is nationally recognized. Students receive broad training in the major subfields of chemistry and learn to apply modern techniques with a thorough understanding. Students receive the full benefits of modern research facilities and access to sophisticated instruments needed for chemical research. The department offers many research opportunities for undergraduate students.

The Department of Chemistry offers a Bachelor of Arts degree through the College of Liberal Arts (CLA) and a Bachelor of Science in Chemistry degree through the College of Science and Engineering (CSE). The requirements for these degrees are similar. The total credit requirement is the same for both degrees. The curriculum offers flexibility for students to design and prepare for career paths of their choice. By selecting appropriate electives it is possible for a student to construct a program with emphasis in special interest areas such as bioscience, chemical physics, education, environmental chemistry, and materials chemistry. A chemistry degree may be combined with a degree in chemical engineering. This double major program is easy to plan and is excellent preparation for a career in the chemical industry or for graduate study in chemistry or chemical engineering. Students planning to teach chemistry and physics in secondary schools can obtain a bachelor's degree in chemistry and apply to the College of Education's post baccalaureate licensure program in Science Education. A chemistry minor is also available.

Program Facilities And Resources
• The Department of Chemistry is housed in two adjacent buildings, Smith Hall and Koltzoff Hall on the University Northrop Mall.
• The Science and Technology Library, housed in Walter Library, immediately to the north of Smith Hall and connected by an underground corridor, subscribes to all the major journals of interest to chemists and has an unusually extensive book collection.
• There are 43 active faculty members with a full-time staff of 35 employees.
• There are approximately 225 undergraduate chemistry majors in the College of Science and Engineering and 100 in the College of Liberal Arts.
• There are approximately 250 graduate students.
• Housed in the department are a microcomputer lab, nuclear magnetic resonance and mass spectrometry Labs, computer and electronic services, glass technology services, and a fully equipped research stockroom.

High School Preparatory Courses
Students planning to major in chemistry should have taken the following courses in high school

<table>
<thead>
<tr>
<th>Course</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>4 years</td>
</tr>
<tr>
<td>Mathematics</td>
<td>4 years</td>
</tr>
<tr>
<td></td>
<td>(beginning &amp; intermediate algebra, trigonometry, &amp; geometry)</td>
</tr>
<tr>
<td>Chemistry</td>
<td>1 year</td>
</tr>
<tr>
<td>Physics</td>
<td>1 year</td>
</tr>
<tr>
<td>Biological Science</td>
<td>1 year</td>
</tr>
<tr>
<td>Language</td>
<td>2 years of a single second language</td>
</tr>
<tr>
<td>Social Studies</td>
<td>2 years including U.S. history</td>
</tr>
</tbody>
</table>

Prerequisites
Because completion of the general chemistry sequence is prerequisite for advanced coursework in the major, students planning to major in chemistry are advised to complete Chem 1061/5 and 1062/6 (Chemical Principles I and II and labs) during their freshman year. Also note that math and physics are required for upper division chemistry courses and should be completed during the second year.

Transfer students must have transfer courses evaluated by a faculty adviser in 135 Smith Hall to determine point of entry into the major program, and should consult the University of Minnesota-Twin Cities Campus Bulletin for a description of general graduation requirements.

American Chemical Society Committee on Professional Training Guidelines for Certification

Scope of the Chemistry Program
An active, modern program of chemical education at the undergraduate level must do more than simply train professional chemists. Chemistry, the central science, is an important component of many disciplines and should be made accessible to all students seeking a liberal education. The Chemistry Department should contribute actively to the raising of the level of scientific literacy of all students. The nature of any particular undergraduate program is governed by the overall educational objectives and resources of the institution. The entire program should effectively serve all students within the institution by recognizing their different needs, interests, and career goals.

Curriculum Requirements
The principal purpose of the American Chemical Society's program of approval of undergraduate curricula is to help departments provide chemistry majors with a sound education in the fundamental areas of modern chemistry. The Committee on Professional Training believes that it can help departments best by setting general curricular goals rather than by specifying exact curricular structure, realizing that a department's curriculum should build on the strengths of the institution and its faculty. Programs as different in character as those with a major emphasis on fundamental principles and those that are strongly based on industrial applications have produced students who have gone on to have distinguished careers in chemistry. The
Committee encourages departments to explore the many ways by which a curriculum can meet the guidelines that are described below.

**Core Curriculum Requirements**

Programs of study in chemistry curricula for majors and non-majors can be organized in many ways to reflect the institution's mission, the available facilities, and the interests and capabilities of the students and faculty. Regardless of what organization is adopted, that part of the program specified as the core curriculum must be taken by all certifiable graduates and must include a minimum of 28 semester credit-hours of basic instruction with comparable emphasis on:

- inorganic chemistry
- chemical analysis and instrumental methods of analysis
- organic and bioorganic chemistry
- calculus-based physical chemistry

And at least 3 semester credit hours of biochemistry must be taken.

The 28 semester credit hours of study shall include the equivalent of 7 semester credit hours (300-350 contact hours) of laboratory instruction distributed, not necessarily in equal proportions, among:

- synthesis and characterization of inorganic and organic compounds
- chemical and instrumental methods of analysis
- experimental physical chemistry

**Advanced Course Requirements**

The minimum requirements for the degree option in chemistry are at least 6 semester credit hours of advanced courses that include sufficient laboratory work to bring the total laboratory hours to 500. The courses may include or even consist entirely of research that culminates in a comprehensive written report.

**ACS Certification of Degree Program**

Potential employers might ask you whether your degree program in chemistry was certified by the American Chemical Society. The CSE degree program (minimum of 40 credits of chemistry) meets the ACS certification requirements credit-wise; but, depending upon which laboratory courses are taken, it may not meet the distribution requirements for laboratory instruction. The CLA degree program (minimum of 35 credits of chemistry) does not meet the ACS certification requirements but could easily be made to do so by the proper choice of advanced technical electives. Please consult an undergraduate studies adviser for further information.

**General procedures to advising in chemistry**

**Planning the Major**

In planning a chemistry major, students should see an undergraduate adviser in 135 Smith Hall as soon as they begin considering majoring in chemistry. Students develop their program in consultation with a faculty adviser. All majors must keep a one-year plan of study for every term they are a major on file in 135 Smith Hall.

**Adviser and Appointments**

The Chemistry Advising Office (135 Smith Hall) is open from 9 a.m. to 4 p.m. five days a week. Stephanie Stathopoulos, assistant to the Director of Undergraduate Studies, is the first contact for most undergraduate advising questions. The faculty input to the advising is handled by a small group of faculty (four plus the
Director of Undergraduate Studies) who rotate the advising duties. Each adviser is available a different day of the week. An adviser schedules a block of time during which the advising duties have first priority. This means that advising appointments can be scheduled without consulting the faculty member, with the assurance that the appointment will be honored. As a rule, the appointments are held in 135 Smith Hall and not in the faculty member's office. Given this arrangement, a student can always talk to someone in the advising office immediately and can usually see a faculty adviser in a day or less. Students are not assigned to specific advisers and are encouraged to see different advisers, not only for the convenience of scheduling appointments, but to receive different points of view.

**Differences Between CLA & CSE Chemistry Degrees**

1. **Degrees:**
   - CLA - Bachelor of Arts
   - CSE - Bachelor of Science in Chemistry
2. CSE program requires more technical courses.
3. CLA requires two years of a second language

**What's the difference between a degree in Chemistry and Chemical Engineering?**

Degrees in chemistry or chemical engineering (ChEn) are both excellent preparation for graduate study and a career in research. The ChEn degree is more specialized and includes more concentrated study in the discipline while a degree in chemistry, as with the other sciences, is more general and offers the student more opportunity to take courses in other areas. The ChEn degree is excellent preparation for immediate employment in industry, whereas a chemistry degree is designed as preparation for advanced or graduate study in chemistry or related fields such as medicine, biochemistry, chemical engineering, education, law or business. In general, a bachelor’s degree in engineering is more applied while a science degree is more fundamental and assumes continued, more specialized study in the science. If you like chemistry and can't decide between chemistry and chemical engineering, think about being a double major. The job you would do in industry will vary with each company. Generally, a chemical engineer with a bachelor’s degree will work in problem solving such as changing the method of manufacturing of a product. Chemical engineers rarely, if ever, work at the molecular level; most of their work is in process scale up. A chemist with a bachelor’s degree will typically do laboratory, bench chemistry, or research under the supervision of a chemist with a doctorate.

**How do you get started?**

Chemistry majors, whether in CSE or CLA, should be aware that the advising office is open to them and are urged to see an adviser as early as possible. Once a student is a major, he or she is required to come in once a year to fill out a one-year plan in consultation with an adviser. Students are required to have their registration approved before fall term registration, complying with their one-year plan; if there is a serious deviation, they will be asked to discuss it with an adviser. Further, students are invited to discuss problems or questions with an adviser whenever the need.

**Chemistry Curriculum**

**General Requirements for All Majors**

- All required courses for the major including composition must be taken on A-F grading.
- All required courses must be completed with at least a "C-" grade.
- Transfer students must complete at least 10 credits of upper level chemistry courses here, including one laboratory course.
- Completion of a minimum of 120 credits is required for a B.S. in Chemistry degree (CSE) or for a B.A. degree (CLA).
• Any substitutions to the required courses must be formally approved by the Director of Undergraduate Studies
• All lower division students need to apply to the major.

Major Requirements
35-40 credits in Chemistry
- two courses in general chemistry (1061/5-1062/6)
- two lectures and one lab course in organic chemistry (2301, 2302 or 2304, 2311)
- one lecture and a lab course in analytical chemistry (2101, 2111)
- two lectures in physical chemistry (4501, 4502)
- one lecture in inorganic chemistry (4701)
Advanced chemistry lectures (CSE 3 cr., CLA 0 cr.)
  Selected from any non-required upper level course in chemistry.
Advanced chemistry labs (CSE 3 courses, CLA 2 courses)
  Selected from Chem 4311 (Advanced Organic Laboratory), Chem 4111 (Intermediate Analytical Chemistry Laboratory), Chem 4511 (Advanced Physical Laboratory), Chem 4711 (Advanced Inorganic Laboratory), Chem 4223 (Polymer Laboratory), Chem 4423 (Foundations of Chemical Biology Lab). Directed Studies Research (Chem 4094, CLA can also use 2094) can be used in place of one Adv. Chem. Lab. CSE students can use selected 3XXX level or higher labs in science or engineering departments in place of one adv lab.

12 credits in Math
  1271 Calculus I
  1272 Calculus II
  2263 Multivariable Calculus

8 credits in Physics
  1301-1302, Introductory Physics and Laboratories (calculus level.)

3-4 credits Advanced Math or Physics Elective
  CSE students only. Selected from Math 2243 (Linear Algebra and Differential Equations) or Phys 2303 (Introductory Physics III) or 2503 (Modern Physics Principles) or Stat 3021 (Introduction to Probability and Statistics.)

3-6 credits Advanced Technical Electives
  (CSE 6 cr., CLA 3 cr.); Selected from upper-level courses of 3 credits or more in Chemistry, Biology, Biochemistry, Genetics & Cell Biology, Chemical Engineering, Materials Science, Math, Physics, Public Health, Geology, Computer Science, and Statistics.

Composition and Writing
  Freshman Writing (4 cr.)
  4 Writing Intensive Requirements

Foreign language The CLA program requires 2 years of a single language.

Recommended Curriculum
CSE Chemistry Semester Program Requirements

Freshman Year
Fall Semester (16 cr)
Chem 1061/5   Chemical Principles I (4 cr)
Math 1271     Calculus I (4 cr)
Phys 1301     Physics I (4 cr)
Freshman Writing (4 cr)

Spring Semester (16 cr)
Chem 1062/5   Chemical Principles II (4 cr)
Math 1272     Calculus II (4 cr)
Phys 1302     Physics II (4 cr)
Biol 1009     General Biology (4 cr)

Sophomore Year
### Fall Semester (15 cr)
- Chem 2301  Organic Chemistry I (3 cr)
- Chem 2101  Analytical Chemistry (3 cr)
- Chem 2111  Analytical Chemistry Lab (2 cr)
- Math 2263  Multivariable Calculus (4 cr)
- Elective (3 cr)

### Spring Semester (16 cr)
- Chem 2302  Organic Chemistry II (3 cr)
- Chem 2311  Organic Chemistry Lab (4 cr)
- Math 2243 or Phys 2303 or 2503 or Stat 3021 Elective (3-4 cr)
- Electives (5 cr)

### Junior Year

#### Fall Semester (14 cr)
- Chem 4502  Physical Chemistry II (3 cr)
- Advanced Lab Elective (2-4 cr)
- Electives (6 cr)

#### Spring Semester (15 cr)
- Chem 4501  Physical Chemistry I (3 cr)
- Advanced Technical Elective (3 cr)
- Electives (9 cr)

### Senior Year

#### Fall Semester (14cr)
- Chem 4701  Inorganic Chemistry Lect (3 cr)
- Advanced Lab Elective (2-4 cr)
- Electives (6 cr)

#### Spring Semester (15 cr)
- Chem 4501  Physical Chemistry I (3 cr)
- Advanced Technical Elective (3 cr)
- Electives (9 cr)

### CLA Chemistry Semester Program

#### Freshman Year

#### Fall Semester (16 cr)
- Chem 1061/5  Chemical Principles I (4 cr)
- Math 1271  Calculus I (4 cr)
- Phys 1201  Physics I (4 cr)
- Freshman Writing (4 cr)

#### Spring Semester (16 cr)
- Chem 1062/6  Chemical Principles II (4 cr)
- Math 1272  Calculus II (4 cr)
- Phys 1202  Physics II (4 cr)
- Biol 1009  General Biology (4 cr)

#### Sophomore Year

#### Fall Semester (15 cr)
- Chem 2301  Organic Chemistry I (3 cr)
- Chem 2101  Analytical Chemistry (3 cr)
- Chem 2111  Analytical Chemistry Lab (2 cr)
- Math 2263  Multivariable Calculus (4 cr)
- Elective (3 cr)

#### Spring Semester (15 cr)
- Chem 2302  Organic Chemistry II (3 cr)
- Chem 2311  Organic Chemistry Lab (4 cr)
- Electives (8 cr)

#### Junior Year

#### Fall Semester (14 cr)
- Chem 4502  Physical Chemistry II (3 cr)
- Advanced Lab Elective (2-4 cr)
- Electives (9 cr)

#### Spring Semester (15 cr)
- Chem 4501  Physical Chemistry I (3 cr)
- Advanced Technical Elective (3 cr)
- Electives (9 cr)

#### Senior Year

#### Fall Semester (14cr)
- Chem 4701  Inorganic Chemistry Lect (3 cr)
- Advanced Lab Elective (2-4 cr)
- Electives (9 cr)

#### Spring Semester (14 cr)
- Electives (15 cr)

* Advanced Chem Lab Electives: CSE Select 3 courses from the following; CLA select 2 course from the following:
  - Chem 4094 Directed Research (any time); prereq any 3xxx or 5xxx Chem course
  - Chem 4111 Intermediate Analytical Chemistry Lab (spring semester, 2 cr.); prereq Chem 4101
  - Chem 4223 Polymer Laboratory (spring semester, 2 cr.); prereq 4221
  - Chem 4311 Advanced Organic Chemistry Lab (fall and spring semester, 4 cr.); prereq Chem 2311
  - Chem 4423 Foundations of Chemical Biology Lab (spring semester, 2 cr.); prereq Chem 2311
  - Chem 4511 Advanced Physical Chemistry Lab (fall semester, 3 cr.); prereq Chem 4501, 4502
  - Chem 4711 Advanced Inorganic Chemistry Lab (spring semester, 3 cr.); prereq Chem 4701

### Directed Studies (Chem 2094 or 4094)
Directed Studies is an excellent way to experience modern chemistry research first-hand. Chem 4094 can substitute for one of the required advanced chemistry labs or for an advanced technical elective but not both. To register for Chem 4094, you must be in upper division or have taken (or be taking) a 3xxx-level chemistry course. To receive credit for 4094, you must submit a comprehensive written report on your research project to your adviser. Laboratory research taken under Chem 2094 does not require a written report and can be taken at any time. You can do research with a member from another department provided the project has enough of a chemistry component and is approved by the DUGS. Prerequisites vary with each professor but some are willing to take on students as early as their freshman year. CLA students wishing to do a library research project to satisfy their Directed Studies requirement should register for 2 cr. of 2094; in this case a written report will also be required.

**Classic Track**
The Classic Track is designed for students planning to apply to graduate school in chemistry, or to work as a chemist in industry at the bachelor’s level. Students planning to enter graduate school are strongly advised to take additional chemistry lecture and lab courses beyond the minimum required for their degree. Advanced lecture courses in mechanisms, polymers, synthesis and bioorganic will provide additional preparation for the Chemistry GRE and for graduate school proficiency examinations. Student should take at least one synthetic (4311 or 4711) and at least one instrumental (4111 or 4511) advanced lab. Students planning to enter industry are advised to take 4311 and 4111, since many jobs involve analytical or synthetic chemistry. Whether headed for graduate school or for industry, students are advised to take at least one additional chemistry lab, and also to obtain significant research experience through Directed Studies (2094 or 4094). Careful selection of Advanced Technical Electives can also help focus on a specific area of interest.

**Education Track**
The College of Education offers a 12-month post baccalaureate program that leads to licensure to teach chemistry in middle and high school, and (with 9 additional credits) a master of education (M.Ed.) degree in teaching. Chemistry majors wishing to enter this program after receiving the bachelor's degree will need 35 credits in Chemistry and additional education pre-requisites as listed below. Further information concerning this program is available in the College of Education. The DirectTrack To Teaching program is designed to identify and advise those who know early on they want to go in to teaching. Apply by February 1 in your first or second year to be considered for admission. http://www.cehd.umn.edu/direct/default.html

### Freshman Year

**Fall Semester (16 cr)**
- Chem 1061/5 Chemical Principles I (4 cr)
- Math 1271 Calculus I (4 cr)
- Phys 1301 Physics I (4 cr)
- Freshman Writing (4 cr)

**Spring Semester (16 cr)**
- Chem 1062/6 Chemical Principles II (4 cr)
- Math 1272 Calculus II (4 cr)
- Phys 1302 Physics II (4 cr)
- Biol 1009 General Biology (4 cr)

### Sophomore Year

**Fall Semester (15 cr)**
- Chem 2301 Organic Chemistry I (3 cr)
- Chem 2101 Analytical Chemistry (3 cr)
- Chem 2111 Analytical Chemistry Lab (2 cr)
- Math 2263 Multivariable Calculus (4 cr)

**Spring Semester (16 cr)**
- Chem 2302 Organic Chemistry II (3 cr)
- Chem 2311 Organic Chemistry Lab (4 cr)
- Math 2243 or Phys 2303 or 2503 or Stat 3021 Elective (3-4 cr) [Required of CSE only]
- Biol at the 2, 3 or 4xxx with a lab, not counted as another prereq (4 cr)

### Junior Year

**Fall Semester (14 cr)**
- Chem 4502 Physical Chemistry II (3 cr)

**Spring Semester (15 cr)**
- Chem 4501 Physical Chemistry I (3 cr)
Advanced Lab Elective (2-4 cr) *  
Psy 1001 or PSTL 1281 Gen Psychology (4 cr)  
Ast 1001 Exploring the Universe (4 cr)

Senior Year

Fall Semester (14cr)  
Chem 4701 Inorganic Chemistry Lect (3 cr)  
Advanced Chemistry Lect Elective (3 cr)  
Advanced Lab Elective (2-4 cr) *

Spring Semester (14 cr)

Chem 4701 Inorganic Chemistry Lect (3 cr)  
Advanced Lab Elective (2-4 cr) *

* One Adv Chem Lab needs to be Directed Research Chem 4094

Bioscience Track

This curriculum is recommended for premedical chemistry majors. It incorporates all of the chemistry courses, which are acceptable for a chemistry degree as well as the recommended premedical biology courses. The recommended course sequence is designed to prepare a student for the MCAT, which is generally taken during the spring term of the third year. A chemistry degree via this curriculum is the same degree, which is awarded after completion of the normal chemistry requirements and it will serve as adequate preparation for any chemistry career including graduate school. It is important to seek frequent advising from a chemistry adviser. All required courses, including composition, must be taken A-F. Some courses are offered during additional terms to those shown below; consult a chemistry adviser for major sequence changes.

Freshman Year

Fall Semester (16 cr)
Chem 1061/5 Chemical Principles I (4 cr)  
Math 1271 Calculus I (4 cr)  
Phys 1301 Physics I (4 cr)  
Freshman Writing (4 cr)

Spring Semester (16 cr)
Chem 1062/6 Chemical Principles II (4 cr)  
Math 1272 Calculus II (4 cr)  
Phys 1302 Physics II (4 cr)  
Biol 1009 General Biology (4 cr)

Sophomore Year

Fall Semester (15 cr)
Chem 2301 Organic Chemistry I (3 cr)  
Chem 2101 Analytical Chemistry (3 cr)  
Chem 2111 Analytical Chemistry Lab (2 cr)  
Math 2263 Multivariable Calculus (4 cr)

Spring Semester (16 cr)
Chem 2302 or 2304 Organic Chemistry II (3 cr)  
Chem 2311 Organic Chemistry Lab (4 cr)  
Math 2243 or Phys 2303 or 2503 or Stat 3021 Elective (3-4 cr)  
Biol at the 2, 3 or 4xxx not counted as another prereq (4 cr.)

Junior Year

Fall Semester (14 cr)
Chem 4502 Physical Chemistry II (3 cr)  
Advanced Lab Elective (2-4 cr)  
BioC 3021 Biochemistry (3 cr)  
BioC 4025 Lab in Biochemistry (2 cr)

Spring Semester (15 cr) MCAT
Chem 4501 Physical Chemistry I (3 cr)  
Biol 4003 Genetics (3 cr)

Senior Year

Fall Semester (15cr)
Chem 4701 Inorganic Chemistry Lect (3 cr)  
Advanced Chemistry Lect Elective (3 cr)  
Advanced Lab Elective (2-4 cr)

Spring Semester (14 cr)

Chemistry/Chemical Engineering, dual major

This program is designed for CSE students who wish to obtain a double major in Chemistry and Chemical Engineering. Highlighted courses below are the additional Chemistry courses needed beyond the Chemical Engineering required courses (note: Chem 2121 replaces Chem 2101/2111.) Talk to an adviser in Chemistry
about the options for Advanced Chem Lecture (1 needed) and Chem Lab Electives (2 needed). Be sure to check with advisers in ChEn for appropriate program.

**Freshman Year**

**Fall Semester**
- Chem 1061/5 Gen Principles of Chem I with Lab (4 cr)
- Math 1271/1371 Calculus I (4 cr)
- Phys 1301 Introductory Physics I (4 cr)
- Freshman Writing (4 cr)

**Spring Semester**
- Chem 1062/6 Gen Principles of Chem II with Lab (4 cr)
- Math 1272/1372 Calculus II (4 cr)
- Phys 1302 Introductory Physics II (4 cr)
- Biol with lab (4 cr)

**Sophomore Year**

**Fall Semester**
- Chem 2301 Organic Chemistry I (3 cr)
- ChEn 2001 Materials and Energy Balance (4 cr)
- Math 2263/2374 Multivariable Calculus (4 cr)
- MatS 3011 Intro to the Science of Materials (3 cr)

**Spring Semester**
- Chem 2302 Organic Chemistry II (3 cr)
- Chem 4501 Physical Chemistry I (3 cr)
- Chem 2121 Process Analytical Chem Lab (3 cr)
- Math 2243/2373 Linear Alg & Differential Equations (4 cr)

**Junior Year**

**Fall Semester**
- Chem 2311 Organic Chemistry Lab I (4 cr)
- **Chem 4701 Inorganic Chem Lect (3 cr) (also offered Spring)**
- ChEn 3101 Chem Eng Thermodynamics (4 cr)
- ChEn 3005 Fluid & Heat Transport (4 cr)

**Spring Semester**
- Chem 3401 Jr ChEn Lab (2 cr)
- ChEn 3006 Mass Transfer and Separations (4 cr)
- ChEn 3102 Reaction Kin&Reactor Eng (4 cr)
- ChEn 3201 Computational Methods in ChEn (3 cr)
- **Advanced Chemistry Lect or Lab Elective (2-4 cr)**

**Senior Year**

**Fall Semester**
- ChEn 3701 Into to Biomolecular Eng (3 cr) #
- ChEn 4401 Sr Chemical Engineering Lab (3 cr)
- ChEn 4501 Chem Eng Process Design I (3 cr)
- ChEn 4601 Process Control (3 cr)
- **Advanced Chemistry Lect or Lab Elective (2-4 cr)**

# ChEn 3701 gets moved to the senior year to accommodate Chem 4701.

**Chemistry and Food Science**

Food Science applies scientific principles to the manufacture, distribution, marketing, and consumer aspects of food. Food scientists apply the basic principles and techniques of many disciplines including chemistry, physics, economics, microbiology, nutrition, management, and marketing to food processing and preservation, new product development, and food marketing. The dual degree in chemistry will provide a broader foundation in fundamental science upon which you can develop a proficiency or area of specialization. Listed below are the science courses in the Food Science major and the core chemistry requirements. Students seeking this dual track should contact the appropriate college and departmental offices for further requirements.

**Freshman Year**

**Fall Semester**
- Chem 1061/5 Chemical Principles I (4 cr)
- Math 1271 Calculus I (4 cr)
- Freshman Writing (4 cr)
- FScN 1102 Food: Safety, Risk & Technology (3 cr)

**Spring Semester**
- Chem 1062/6 Chemical Principles II (4 cr)
- Math 1272 Calculus II (4 cr)
- Phys 1301 Physics I (4 cr)
- Biol 1009 General Biology (4 cr)

**Sophomore Year**

**Fall Semester**
- Chem 2301 Organic Chemistry I (3 cr)
- Phys 1302 Physics II (4 cr)

**Spring Semester**
- Chem 2302 Organic Chemistry II (3 cr)
- Chem 2311 Organic Chemistry Lab I (4 cr)
Chemistry & Biochemistry Dual Major

Biochemists study molecules found in living organisms, particularly proteins, nucleic acids, lipids, and carbohydrates. The biochemistry major differs from the chemistry major in that biochemistry emphasizes the integration of chemical principles into biological processes from molecular genetics to enzymology. Both majors prepare students to pursue graduate study in biochemistry/chemistry or a related biological science, attend medical or veterinary school, or seek entry-level biochemical/chemical positions in industry. Both programs are experimental sciences, and majors, especially those who plan to pursue graduate studies in the field, should become acquainted with laboratory research approaches beyond those introduced in the formal lab courses. Research options are available through Chem 2094 or 4094 and BioC 4994 and the Honors Program. Students should start planning the research component of their major program as early as possible.

**Freshman Year**

**Fall Semester**
- Chem 1061/5 Chemical Principles I (4 cr)
- Math 1271 Calculus I (4 cr)
- Phys 1301 Physics I (4 cr)
- Freshman Writing (4 cr)

**Spring Semester**
- Chem 1062/6 Chemical Principles II (4 cr)
- Math 1272 Calculus II (4 cr)
- Phys 1302 Physics II (4 cr)
- Biol 2002 Foundational Biology I (5 cr)

**Sophomore Year**

**Fall Semester**
- Chem 2301 Organic Chemistry I (3 cr)
- Chem 2101 Analytical Chemistry (3 cr)
- Chem 2111 Analytical Chemistry Lab (2 cr)
- Biol 2003/2004 Foundational Biology II (6 cr)

**Spring Semester**
- Chem 2304 Organic Chemistry II (3 cr)
- Chem 2311 Organic Chemistry Lab I (4 cr)
- Biol 3007 Plant Biology (4 cr)
- Math 2263 Multivariable Calculus (4 cr)
- Biol 3211 Animal Physiology (3 cr) or Biol 3301
- Biol 2005 Animal Diversity Lab (1 cr) or Biol 3301

**Junior Year**

**Fall Semester**
- Chem 4502 Physical Chemistry II (3 cr)
- Chem 4701 Inorganic Chemistry Lect (3 cr)
- BioC 4331 Biochemistry I (4 cr)
- Stat 3021 Intro. to Probability and Statistics (3 cr)

**Spring Semester**
- Chem 4501 Physical Chemistry I (3 cr)
- Chem 4332 Biochemistry II (4 cr)
- BioC 4025 Biochemistry Lab (2 cr)
- Biol 3301 Biol of Microorganisms (5 cr) or Biol 3211/2005

**Senior Year**

**Fall Semester**
- Chem 4502 Physical Chemistry II (3 cr)
- Chem 4701 Inorganic Chemistry Lect (3 cr)
- FScN 4312 Food Quality (3 cr)
- FScN 4311 Chemical Reactions in Food Systems (2 cr)
- FScN 4096 Professional Experience: Internship (3 cr)

**Spring Semester**
- Chem 4511 Physical Chemistry I (3 cr)
- Advanced Chemistry Lab Elective (2-4 cr)
- FScN 4349 Food Science Capstone (1-2 cr)
- FScN 4-5xxx Food Science elective (3-4 cr)
- Stat 3021 Intro to Probability and Statistics (3 cr)
enables a student to gain a better understanding of and appreciation for sustainable use of the renewable bioresources including forestry, agriculture and other biomass. A minor in bio-based products engineering enables a student to gain a better understanding of and appreciation for sustainable use of the renewable bio-based products engineering.

Chemistry & Biology Dual Major
Biologists are concerned with the fundamental properties of living things, from the interactions of molecules unique to life through the maintenance and integration of organisms and the interactions of populations in space and time. Both majors prepare students to pursue graduate study in biology/chemistry or a related biological science, attend medical or veterinary school, or seek entry-level biological/chemical positions in industry. Both programs are experimental sciences, and majors, especially those who plan to pursue graduate studies in the field, should become acquainted with laboratory research approaches beyond those introduced in the formal lab courses. Research options are available through Chem 2094 or 4094. Students should start planning the research component of their major program as early as possible.

Chemistry & Bioproducts Engineering Major
This program is designed for the student who wishes to get a minor in Bio-based Products Engineering along with a Chemistry degree. Bio-based products are materials, chemicals, and energy derived from renewable, bio-resources including forestry, agriculture and other biomass. A minor in bio-based products engineering enables a student to gain a better understanding of and appreciation for sustainable use of the renewable bio-based products engineering.

<table>
<thead>
<tr>
<th>Senior Year</th>
<th>Spring Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Semester</td>
<td></td>
</tr>
<tr>
<td>Advanced Chemistry Lecture Elective (3 cr) <strong>Chem 4411 rec.</strong></td>
<td>Advanced Chemistry Lab Elective (2-4 cr)</td>
</tr>
<tr>
<td>Advanced Chemistry Lab Elective (2-4 cr)</td>
<td>Biol 3960 Research Topics in Biochemistry (1 cr)</td>
</tr>
<tr>
<td>Biol 3407 Ecology or 3409 Evolution (3 cr)</td>
<td>Biol 4004 Cell Biology (3 cr)</td>
</tr>
<tr>
<td>Biol 4003 Genetics (3 cr)</td>
<td>BioC 4125 Lab in Molecular Biology &amp; Biotechnology (3 cr)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Junior Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Semester</td>
<td></td>
</tr>
<tr>
<td>Chem 2301 Organic Chemistry I (3 cr)</td>
<td>Chem 2302 Physical Chemistry I (3 cr)</td>
</tr>
<tr>
<td>Chem 2101 Analytical Chemistry (3 cr)</td>
<td>Chem 4502 Physical Chemistry II (3 cr)</td>
</tr>
<tr>
<td>Chem 2111 Analytical Chemistry Lab (2 cr)</td>
<td>Biol 3407/3409/3411 – Choose from ecology, evolution, or animal behavior (3 cr)</td>
</tr>
<tr>
<td>Biol 2003 Foundations of Biology II Lecture (3 cr)</td>
<td>Stat 3021 Intro. to Probability and Statistics (3 cr)</td>
</tr>
<tr>
<td>Biol 2004 Foundations of Biology II Lab (3 cr)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Senior Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Semester</td>
<td></td>
</tr>
<tr>
<td>Advanced Chemistry Lecture Elective (3 cr)</td>
<td>Advanced Chemistry Lab Elective (2-4 cr)</td>
</tr>
<tr>
<td>Advanced Chemistry Lab Elective (2-4 cr)</td>
<td>Biol 4004 Cell Biology (3 cr)</td>
</tr>
<tr>
<td>Biol 4003 Genetics (3 cr)</td>
<td>Directed Research (1-6 cr) +</td>
</tr>
<tr>
<td>Directed Research – Writing Intensive (1-6 cr) +</td>
<td>Program layout does not contain all college or liberal education requirements.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Freshman Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Semester</td>
<td></td>
</tr>
<tr>
<td>Chem 1061/5 Chemical Principles I (4 cr)</td>
<td>Chem 1062/6 Chemical Principles II (4 cr)</td>
</tr>
<tr>
<td>Math 1271 Calculus I (4 cr)</td>
<td>Math 1272 Calculus II (4 cr)</td>
</tr>
<tr>
<td>Phys 1301 Physics I (4 cr) or Phys 1201</td>
<td>Phys 1302 Physics II (4 cr) or Phys 1202</td>
</tr>
<tr>
<td>Biol 1805 The Nature of Life (2 cr)</td>
<td>Biol 2002 Foundations of Biology I (5 cr)</td>
</tr>
<tr>
<td>Freshman Writing (4 cr)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sophomore Year</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall Semester</td>
<td></td>
</tr>
<tr>
<td>Chem 2301 Organic Chemistry I (3 cr)</td>
<td>Chem 2304 Organic Chemistry II (3 cr)</td>
</tr>
<tr>
<td>Chem 2101 Analytical Chemistry (3 cr)</td>
<td>Chem 2311 Organic Chemistry Lab I (4 cr)</td>
</tr>
<tr>
<td>Chem 2111 Analytical Chemistry Lab (2 cr)</td>
<td>Math 2263 Multivariable Calculus (4 cr)</td>
</tr>
<tr>
<td>Biol 2003 Foundations of Biology II Lecture (3 cr)</td>
<td>Organismal Biology – Choose from animal, plant, or microbiology (4-5 cr)</td>
</tr>
<tr>
<td>Biol 2004 Foundations of Biology II Lab (3 cr)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring Semester</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Winter Semester</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring Semester</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Stat 3021 Intro. to Probability and Statistics (3 cr) |                                                                                                                                             |

<table>
<thead>
<tr>
<th>Summer Semester</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Program layout does not contain all college or liberal education requirements.
resources. Since the minor consists of 14 credits of specific BP courses students interested in the minor should contact the Department of Bio-based Products in the College of Natural Resources. Scholarships are available to qualified chemistry majors taking selected BP courses. See either department for further information.

Complete a minimum of 14 credits from the following:
- BBE 4001—Chemistry of Biomass and Biomass Conversion to Fuels and Products (4 cr)
- BBE 4301—Applied Surface and Colloid Science (3 cr)
- BBE 4302—Biodegradation and Bioproducts (3 cr)
- BBE 4303—Intro. to Bio-based Materials Science (3 cr)
- BBE 4305—Pulp and Paper Technology (3 cr)
- BBE 4401—Bioproducts Engineering (4 cr)
- BBE 4404—Biopolymers and Biocomposites Engineering (3 cr)
- BBE 4502W—BBE Capstone Design (3 cr)

It is important to plan ahead since some courses are only offered once a year.

University Honors Program
- Students admitted to Honors will fulfill UHP Honors Requirements. To get the most up to date information on honors visit their website.
  - Honors Experience Requirements: [http://www.honors.umn.edu/experiences/requirements/](http://www.honors.umn.edu/experiences/requirements/)
  - Graduation with Latin Honors: [http://www.honors.umn.edu/latin-honors/graduation/](http://www.honors.umn.edu/latin-honors/graduation/)

Graduating with Distinction and High Distinction
It is possible for students to graduate with distinction, high distinction, or with a Latin honors degree. To graduate with distinction you must have a cumulative GPA of at least 3.75. To graduate with high distinction your GPA must be at least 3.9. There are no other requirements for graduating with distinction or high distinction other than these grade point averages.

Study Abroad in Chemistry
More than 300 programs are available to University of Minnesota students. The Department has worked closely with the Learning Abroad Center to select some programs that fit particularly well for Chemistry students. Consider your academic interests, your geographic interests, and your academic goals. Visit the Learning Abroad Center webpage ([http://www.umabroad.umn.edu/](http://www.umabroad.umn.edu/)) and talk with your academic adviser to set up a program that fits your goals. Experiences like this will change your life and career options in many ways. And, in today’s increasingly interdependent world, significant cross-cultural experience is exactly what employers and graduate schools are looking for.

Minors, Electives & Lib Ed Requirements
The courses listed below are possible electives and are not necessarily recommended courses. You may wish to choose an area of study in which you wish to concentrate your elective courses. Below are some possible options. It is recommended that you consult an as to selection of possible courses. If you are unsure of the content of a course, you should go to the department offering the course to obtain a course syllabus.

Teaching Chemistry
Students who wish to teach chemistry at the junior and senior high school levels should consult with the Education Student Affairs Office in the College of Education 612-625-6501 and review the Education Bulletin for requirements. The College of Education's post-baccalaureate programs are for individuals with bachelor's
degrees who want to become licensed K-12 teachers. Postbaccalaureate students are admitted to the science education program on the basis of:

- Work or volunteer experience with students that demonstrates commitment to teaching.
- A fully developed knowledge base in the life, earth, or physical sciences, including research
- Bachelor's degree with a 2.5 GPA overall and in major course work,
- A writing sample addressing philosophy of science education and professional goals,
- Two letters of recommendation, and
- Work or volunteer experience with students that demonstrates commitment to teaching.

Chemistry and Business

The Carlson School's Management Minor provides an excellent opportunity for students to gain a broad exposure to the basic elements of business and management. Adding a Management Minor to your current major enhances your preparation for professional school (e.g. Law, MBA) or for entering a career upon graduation. The Management Minor is available to students in all majors. Applications for admission to the Management Minor are accepted in the fall or spring semester. Deadlines are April 1 for fall semester and November 1 for spring semester.

General eligibility requirements include:

- Completion of the following courses:
  - Econ 1101, Microeconomics (4cr)
  - Math 1031, College Algebra (4 cr) *(An advanced math course will also meet the requirement)*
  - OMS 2550, Business Statistics (4cr) *(or Stat 3011, 3021, or 3022, Psych 4801, or Soc 3811)*
  - *(Macroeconomics is also recommended but not required)*
- A 3.0 GPA or higher (in some cases, students with a GPA lower than 3.0 may be considered).
- Applicants are asked to submit a paragraph with their application explaining their interest in the minor and how it fits into their educational and career goals.

Minor requirements include:

- Acct 2050, Introduction to Financial Accounting (4cr)
- 12 credits chosen from the list below:
  - Acct 3001, Introduction to Managerial Accounting (3cr)
  - Fina 3001, Finance Fundamentals (3cr)
  - HRIR 3021, Human Resource Management and Industrial Relations (3cr)
  - IDSc 3001, Information Systems for Business Processes and Management (3cr)
  - Mgmt 3010, Into. To Entrepreneurship (3cr)
  - Mktg 3010, Marketing Research (3cr)
  - OMS 3001, Operations Management (3cr)

All coursework must be completed with a C- or better. No more than one course may be transferred from outside the University of Minnesota to fulfill minor requirements. Transfer courses may be accepted for prerequisite courses upon review and are not included in two-course limit. The College of Science and Engineering recommends its students take Mgmt 3001, Mktg 3001, Fina 3001, and Acct 3001.

Chemistry and the Environment

The Environment and Natural Resources (ENR) minor provides students in programs such as biology, education, journalism, political science, and others with the basic understanding to recognize, evaluate and develop solutions to a range of environmental problems. Students are encouraged to focus their coursework
on either (1) Environmental Management and Policy or (2) Environmental Science. Students interested in the minor should visit their website. https://www.espm.umn.edu

**Chemistry and the Food Industry**
For an undergraduate minor in food science you will need to take a minimum of 20 credits from the list of courses below. Many of the listed courses have prerequisites that do not count towards the 20 credits.
FScN 1102 Food: Safety Risks and Technology (3cr)
FScN 3102 Introduction to Food Science (3cr)
FScN 4111 Food Chemistry (3cr)
FScN 4121 Food Microbiology and Fermentations (3cr)
FScN 4122 Lab in Microbiology and Fermentations (2cr)
FScN 4131 Food Quality (3cr)
FScN 4312W Food Analysis (4cr)
FScN 4332 Food Processing Operations (3cr)
FScN 4349 Food Science Capstone (1-2cr)
BBE 4744 Engineering Principles for Biological Scientists (4cr)
To declare a minor in Food Science go to their website and complete the Food Science Minor Form and submit it to Undergraduate Student Services in 225 FSCN.

**CBS Minors**
To declare a minor in Biochemistry, Biology, Microbiology, or Plant Biology, complete the online form at http://www.cbs.umn.edu/students/cbs-minors.

**Math Minor**
Beyond the required Math needed in the CSE program: 1271, 1272, 2243, 2263
You will need to take Math 2283 and two 4xxx or 5xxx level courses.

**Liberal Education**

**Core**
One course of at least three credits in each of the following:
- Arts/Humanities ________  
- Historical Perspectives ______
- Mathematical Thinking ______
- Social Science ______

One course of at least four credits, with a laboratory or field experience, in each of the following:
- Physical Science ________
- Biological Science ______

**Themes**
A minimum of one course of at least three credits in each of the following thematic areas:
- Civic Life and Ethics ______
- Diversity & Social Justice in the US ______
- The Environment ________
- Global Perspectives ________
- Technology & Society ______

*Courses may be certified for both a Core and a Theme if the theme is fully infused into the Core course.*

**General Advising Information & Common Questions**

**Residency Requirements**
CSE - A student earning a bachelor's degree must complete 30 credits after admission to CSE, of which at least 20 credits must be completed in the Sr. year.
CLA - 20 of the last 30 credits must be completed in CLA at the University of Minnesota-Twin Cities campus.

Chemistry - At least 10 credits of advanced chemistry courses of which at least one lab course must be taken at the University of Minnesota.

What is the difference between Lower & Upper Division?
In CLA, you are considered to be in Upper Division after you have declared your major. In CSE, you are considered to be in Upper Division when you have more than 60 credits.

When should you declare your major?
Students are eligible to apply for Chemistry major status once they have met the following minimum requirements: Completion of the following courses by the application deadline(s) (December 30 and May 25) with a minimum (unbracketed) technical GPA of 2.0. For Chem 1062 and 2301, minimum grades of C are required. For the other courses listed, minimum grades of C- are required. Note: "Unbracketed" means that all attempts at a course (which resulted in a letter grade of A - F) are factored into the GPA. Courses taken at other institutions may fulfill degree requirements; however, they will not be included in the technical GPA calculation.

- Chem 1061 (lecture) and 1065 (lab)
- Chem 1062 (lecture), and 1066 (lab)
- Chem 2301 (organic chemistry lecture)
- Math 1271 or 1371 (Calculus I)
- Math 1272 or 1372 (Calculus II)
- Math 2263 or 2374 (Multivariable Calculus)
- Physics 1201W or 1301W
- Physics 1202W or 1302W

How do you apply to Upper Division?
CLA – Meet with an adviser in the Chemistry Department (135 Smith Hall) and submit the two page major application by the deadline(s) (December 30 and May 25).

CSE - Students should apply in the College Office 105 Lind Hall during the fourth semester or upon completion of a minimum of 47 credits of coursework. The application will permit you to list your first, second and third choices for a major. Students who do not meet upper division admission requirements may not be permitted to continue in CSE upon completion of lower division coursework.

Double Major In CSE
Students interested in having two majors (in CSE) may submit a petition to 105 Lind Hall requesting the addition of the second major. (Be sure to attach a transcript.) Only one major will appear on your grade slip, registration notices, etc. Your computer record will carry both major codes, which you may need to enter controlled courses. The transcript will also show both majors. You may receive both degrees at the same time or one before the other.

Second Major in another College
Degrees from other colleges can be obtained in one of two ways: Complete the degree in one college before transferring to the other college for that degree. Keep in mind that most colleges have residency requirements, i.e. minimum number of credits taken in that college. If the other college (or CSE) is willing to waive the residency requirement you may pursue and receive both bachelor's degrees at the same time. If you stay in CSE, you will need to provide transcripts to the other department and college with which you are working. Be sure to apply for both degrees. Some colleges have special requirements for their degrees (such as a foreign language) that you may not wish to complete. Nevertheless recognition may be earned for completion of requirements for a "major" in a particular subject of a college. The procedure for formal recognition of that work in CLA is as follows:

1. Pick up the major program from the appropriate department. Keep the form.
2. After applying for your CSE degree, bring the form and a transcript to the appropriate CLA Upper Division Office.
3. Bring your final grades to the upper division office. The following statement will then be posted to your record after the CSE degree:
   a. "Also fulfills the course requirements of a (major)__________ in (subject)____ as of (date)_______________. Fulfillment of these requirements does not imply fulfillment of the graduation requirements of the College of Liberal Arts."

Chemistry Minor Requirements

- The minor shall consist of 2xxx level or higher Chem courses to total 15 semester credits.
- No credits from seminar or special topics courses may be applied toward the minor.
- No more than 2 credits of Directed Study may apply although more may be taken as an addition.
- All courses in the minor program must be taken for a grade.
- Grades of C- or better are required in the minor program courses.
- At least 5 credits (two courses) must be completed at the University of Minnesota

Required Courses: Chem 2301/2301/2311 Organic Chemistry
5 Credits

Chemistry Elective Lecture/Lab
5 Credits

Totaling 15 Credits

Receiving a minor in a different college

A number of departments offer minors and it may be worth your time to check with the department you are interested in. Take a copy of your transcript to the proposed minor department to receive a minor program form. This form should list the courses that fulfill the requirements for the minor. After you complete all the course work for your minor, and have paid your graduation fee in your college, bring a current transcript and your minor program form to the appropriate college office. You may also need to complete an "Application for Minor in a Second College" form. It is also possible to receive a Management Minor through the Carlson School of Management. For more information see the Office of the Center for the Development of Technological Leadership in 107 Lind Hall.

Exemption For Industrial Work

It is possible to receive exemption for industrial work for specific courses but not directed research. Formal permission must be received from the Director of Undergraduate Studies and the Coordinator of the specialty area whose course is to be exempted and a total of up to 5 credits will be the maximum awarded for outside work. A letter from the job supervisor must accompany the request.

Testing Out of a Course
Students may apply to take Special Examinations for any University course in which they feel adequately prepared. Students need to apply in their college office. The cost is $30 per examination.

Getting on the Dean's List?
In CLA there are two Dean's Lists. The first is the All A's List. Students must earn 12 credits of A and all other credits with A or S grades. The second is the 2/3rds A List. Students must complete 12 or more credits (at least 8 on A-F grading) with A grades in 2/3 of their A-F credits and all other credits with B or S grades.

In CSE, students whose academic performance each term places them in the top 10% of their respective class qualify for the Dean's List. Students must complete 12 credits or more to be eligible. The credits may be completed in day school or extension. Only A-F grading, of the minimum 12 credits, is used in considering who is on the Dean's List.

First Day of Class
All students must attend the first class meeting of every course in which they are registered. Those students who fail to attend the first meeting of either the lecture or lab will forfeit their place. If it is not possible to be there on the first day, notify the instructor and/or appropriate departmental office prior to the first day. Due to the high demand for chemistry courses it is important for the Chemistry Department to strictly enforce the regulation requiring attendance on the first day of class.

Use of Petitions
CLA - Request for amendment of major program forms are used when a CLA student needs to make changes to the required chemistry curriculum. These forms need the department approval. Students wishing to make amendments should see a chemistry Adviser.

CSE - Petition forms are available in 105 Lind Hall and are used to seek approval for that which falls outside of regular policy matters. Petitions may be used to, change a major, add a major, to repeat a course in which you have received a grade of C or higher, to substitute a course to fulfill a requirement, to change the grading system for a course after the first two weeks of the term due to unusual circumstances. You must attach a transcript if the petition deals with: a.) Liberal Education requirements, b.) Change of Major, c.) Adding a Major, d.) Transfer of credits to CSE. Petitions should be dropped off at 105 Lind Hall. Results will be processed within 1-2 weeks and mailed to students. In general it is good advice to file a petition for any requirement change, substitution, or exemption to your degree program.

Credit Load
Registration for more than 19 credits per term requires college approval.

Departmental policy on Incomplete Grade
An incomplete grade or I may only be assigned when a prior arrangement has been made between instructor and student. It will only be considered if most of the work in the course has been completed satisfactorily. All I grades must be accompanied by a written agreement which clearly spells out the details of the arrangement to make up the I. The agreement must be signed by the instructor and the student and by any third party involved in making up the I. In the case that a third party is required but cannot be immediately identified, the Director of Undergraduate Studies must sign the form. An I grade submitted without the signed agreement will be recorded as an F.
It is clear from University policy (CLA and CSE policy statements included below) that students should not be permitted to repeat an entire course without registering.

I grades should only be given when a small amount of work which can easily be made up has been missed.

**CSE POLICY**
Assigning by an instructor to indicate Incomplete, in accordance with provisions announced in class at the beginning of the term, when in the instructor's opinion there is a reasonable expectation that the student can complete successfully the work of the course. An I that is not made up by the end of the next term of residence becomes an F if the course was taken under the A-F grading system or an N if the course was taken under the S-N grading system. Instructors may set dates within the term for make-up examinations.

**CLA POLICY**
Coursework incompletes will be assigned when the instructor has "reasonable expectation" that the student can successfully complete the unfinished work before the end of the next term. Conditions for an "I" should be announced in class at the beginning of the term. The student seeking an I and the instructor should understand clearly before term's end whether the student will receive an "I" and what conditions of making up the work will be. Students assigned "I's" have the right to complete the course during their next term of registration.

Students assigned "I's" are expected to make up the work on their own. They may not attend class sessions in a subsequent term without reregistering.

See the College Bulletins for further information.

**Organization of Department’s Undergraduate Teaching Function**
In case you experience problems in a course it is important to know the proper avenue to proceed with questions and complaints. If the problem is with a faculty member in a lecture or lab course you should first try to resolve it with the faculty member directly. If this is not appropriate or satisfactory proceed next to the Director of Undergraduate Studies (135 Smith Hall 624-8008). If the problem is still not resolved you should go to the Vice-Chair of the department (schedule appointments in the General Chemistry/Records Office, 115 Smith Hall 624-0026). The final authority at the department level is the department Chair (139 Smith Hall 624-6000). In the unlikely event that you wish to take the problem beyond the department you should contact the CSE Dean's Office (105 Walter Library 624-2006) or the Student Ombuds Service (SOS) (102 Johnston Hall 626-0891) or the Equal Opportunity & Affirmative Action Office (419 Morrill Hall 624-9547).

If the problem is with a teaching assistant you should first (if appropriate) try to solve it directly with the teaching assistant and next with the laboratory faculty instructor or appropriate Head TA. The General Chemistry Head TA may be contacted through the General Chemistry/Records Office or may be contacted at 624-3803. If the problem cannot be resolved at this level you should take it to the Vice-Chair of the department. If the problem still is not resolved you should follow the procedure described beyond the Vice-Chair in the previous section.

**Graduation and Beyond**

**How do you apply for Graduation?**
All students must submit an application for Graduation form (one for each degree) at OneStop. Be aware of the application deadlines, which are usually the beginning of the term you graduate.
The APAS form is used to clear you for graduation. Be sure to check this form well in advance of your graduation and clear all discrepancies prior to your final term.

**CLA Students Only** – your college office needs a final Degree Program Form filed with them to certify that you have completed all of the requirements.

### Commencement And Recognition Event
You must apply with your college office to take part in commencement. CSE commencement is only held in the spring but CLA has commencement fall and spring. The Department of Chemistry holds a recognition event for all graduating seniors and that year’s scholarship recipients prior to CSE commencement. All of that academic year graduates are invited and encouraged to bring their families to meet fellow students and faculty.

### How can I get job related experience while in school?
Chemistry majors can check the job posting board outside of 135 Smith Hall. This is updated as frequently as jobs, usually from the metro area, come in. You should also check the Career Services offices, http://www.career.umn.edu. If you are interested in research experience, Directed Studies is a good opportunity. Another option is to do research here or at another college in the United States usually during the summer of your junior year. This is an excellent opportunity and a good way to check out potential Graduate Schools. Postings for these positions can be found in 135 Smith Hall.

### What are employers looking for?
Companies are looking for students who have taken the appropriate classes with reasonably good grades, have relevant job experience, and demonstrate experience working with other people in such situations as extracurricular activities. A research experience in the department can be very valuable in landing you a job.

### What's available in the Career Services Offices?
Both Career Services Offices conduct workshops and have videotapes that give you tips on job hunting and resume writing, and their libraries contain information on a number of companies. Individual counseling is also available. These offices maintain lists of full-time, part-time, and summer jobs and can keep your resume on file for company representatives to review.

**CLA - Career & Community Learning Center**
411 STSS 612-624-7577 and 240 Appleby Hall 612-626-2044
email: clacareer@umn.edu website: http://www.cclc.umn.edu/

**CSE – 105 Lind Hall 612-624-4090**
email: ccse@umn.edu website: http://ccse.umn.edu/index.php

### How do you use the Career Services Offices?
It is important that you plan ahead. Do not wait until the year you are graduating. These offices provide numerous talks that will benefit you in life long career issues. Also they have many postings for part-time positions. When it comes time to get a full time job for after you graduate realize that most companies visit in the Fall so they can prepare their budgets for the coming year accordingly. Make sure you are registered with them at the latest the spring prior to your final year. The more students from Chemistry that register with the Career Services Offices the better the chances are that companies will find it worthwhile to visit the campus.
Where can I find career information?
In addition to the Career Services Offices you can stop by the Chemistry Advising Office (135 Smith Hall) to talk about careers, companies, and job-hunting skills. Chem 2910, 2920 Special Topics in Chemistry is a lunch hour seminar, which features speakers from the chemistry department and speakers from industry. This is a good way to find out the numerous opportunities available to you with a chemistry degree.

The American Chemical Society is another great resource. Start by looking over their College to Career website. www.acs.org/CollegeToCareer.

Career Options
After graduating some chemistry majors go on to graduate school to receive an advanced degree and others begin their careers by working in the laboratories of companies. These companies may be large or small and their products are not necessarily chemicals, but consumer goods such as food, drugs and clothing, or cosmetics. Other areas in which a chemist can work are with the environment, energy, medical and regulatory agencies. The chemist is often responsible for analyzing the materials used, designing new modifications and developing entirely new products. Bachelor degrees in chemistry can be used in a variety of ways.

An Advance Degree
With a chemistry degree you have a number of options for an advanced degree; medical, law, business, engineering or chemistry. However, in deciding between full-time graduate study immediately after obtaining the bachelors degree and full-time employment, you must consider a number of personal factors: abilities, career goals, financial resources, and motivation. Some important questions to consider when thinking about attending graduate school are:

• Why do I want to attend graduate school? What are my plans after graduate school?
• What are my goals, objectives, and expectations for graduate work?
• How will a graduate degree affect my future career plans and goals? Have I given enough thought to the type of degree I want to pursue—MS, MBA, PhD, JD, etc.?
• How will I survive financially while in graduate school?
• Do I enjoy rigorous academic work that requires total time and effort?
• Are my research skills such that I can define, implement, and carry out an original research project?
• Do I qualify for admission on the basis of my grade point average, test scores, and/or educational prerequisites?

When should you begin making plans for graduate school?
The sooner the better and definitely by spring of the junior year of undergraduate study. Far too many students wait until their senior year to decide to pursue graduate study following graduation. Waiting until the senior year can limit one’s opportunities and eliminate some choices of programs such as medicine, law, dentistry, and fellowships, which often require that some materials be filed during the junior year. During the early part of your junior year, gather information about the particular school or program of interest, take the appropriate admission test, and start a credential file. For those students who are already seniors or recent graduates, it’s never too late. Get started by making applications and following through on the application process.

How do you evaluate the institutions & academic programs?
There are many factors to consider when selecting the proper graduate school, such as whether your interest lies in chemistry, engineering, business, law, medicine, or another field. Where you do your graduate work can make a real difference in the value of your credentials upon receiving an advanced degree. So seek out those programs that have earned a reputation for excellence in your particular area of interest. Some questions to ask about the university or program you are considering:

- Does the faculty exhibit special strengths and research qualities through their graduate advisees, published works, and funded research?
- Are the libraries, laboratories, computers, and other research facilities adequate for you educational needs?
- Are the graduates of the school or program sought by recruiters?
- Does the department of interest offer sufficiently large and varied curriculum to allow you a broad offering of courses and options?
- How senior are the professors in your area, what are their interests, and what will their availability be?
- What are the degree requirements?
- Will I have to do a thesis/dissertation?
- Is financial support available?
- How long will it take for me to complete my program?
- How are the advisers assigned and selected? Will I have a choice in who my major adviser will be?
- Are study space or office carrels available for graduate students?

The national reputation of a school is determined by the quality of its faculty, library holdings, research facilities, and the success of its graduates.

**Considering Chemistry Graduate School?**

Did you know that you get paid to go to graduate school in chemistry? As a doctorate or master’s student, you receive a stipend of around $25,000 a year in most chemistry departments to be a teaching assistant (TA) or research assistant (RA) and tuition is generally waived. If you are interested in pursuing an advanced degree you can speak to an adviser and also attend talks on applying for graduate schools usually in the fall term. It is best to apply in December of your senior year; taking your GREs (Graduate Records Exam) in October of the senior year. To be considered for University fellowships, which would include additional stipends to top students, you should have your application completed as early as possible during your Senior year and it is very important to have taken the GRE exam. Most applications include the following:

- Complete transcripts from all schools
- Two or three letters of recommendation
- GREs (General & Subject) varies with each school
- Individual school's application
- Personal statement

There are several national fellowships for graduate study and these will go to the top students. Check with the chemistry advising office and the University Graduate Fellowship Office (313 Johnston Hall 625-7579) for information and application deadlines.

Graduate degrees in chemistry enable students to specialize in a particular subfield such as organic, inorganic, physical, biological, or analytical. Both the Masters and Ph.D. provide training for research positions. Generally, the Ph.D. prepares students for higher-level research and administrative positions and is considered the usual requirement for teaching or research positions in colleges and universities.
Undergraduate Research

Directed Studies Chem 2094 and 4094
Opportunities exist for chemistry majors to do laboratory research for credit, helping faculty members with their research. Credit assignments vary; normally each credit earned requires 30 hours of academic work a term. There is no pay connected with this work, but it gives students excellent laboratory experience. In order to register for 4094 you must be upper division. A written report is required for a grade with all registrations for 4094. If you are taking 2094 and doing library research you also need to do a written report.

Undergraduate Research Opportunity Program (UROP) is a University program allowing students to work in conjunction with faculty on faculty research. Financial awards to undergraduates for research, scholarly, or creative projects include stipends (up to $1,500) and/or expense allowances (up to $300). For more information and application material http://ugresearch.umn.edu Particular attention should be paid to the deadlines for applications. Students have had a high probability for success in receiving UROP support.

Summer Fellows
The Department of Chemistry supports a number of junior chemistry majors during the summer to do research. Students who are interested in this opportunity should checkout the Summer Research website on the department website.

Enrichment Opportunities & Programs

ACS-Student Membership
The objectives of the student membership is to provide an opportunity for students of chemistry, chemical engineering, and related disciplines to become better acquainted, to secure the intellectual stimulation that arises from professional association, to learn about preparing and presenting technical material before a chemical audience, to instill a professional pride in the chemical disciplines, and to foster an awareness of the responsibilities and challenges of the modern chemist. As a member, you receive Chemical and Engineering News (C&E News, a weekly short magazine on current chemical issues), and other literature on books and publications. Members also receive a large discount on scientific journals. The ACS, with over 140,000 members, lists employment opportunities through a data bank in Washington and the National Employment Clearing House at all ACS National Meetings. For further information go to http://www.acs.org.

Student Groups https://cse.umn.edu/r/student-groups/

Iota Sigma Pi

Outreach Program
The Department of Chemistry is involved in community outreach and welcomes any student involvement. A group of undergraduate and graduate students along with faculty present chemistry demonstrations to primary and secondary students in their schools and at department-sponsored events such as National Chemistry Day to create an interest in the sciences. Volunteers go in groups of at least three (depending on the size of the audience). All materials are supplied and organized for a variety of demonstrations. There is at least one visit a week throughout the academic year. You may volunteer for as many as your schedule permits. If interested see the faculty adviser Ken Leopold.

Educational Facilities
Microcomputer Lab
101D Smith Hall
612-624-3372

The chemistry microcomputer lab is open to chemistry students and faculty who need to use a microcomputer. Many chemistry courses require students to run computer programs as part of their classwork and those programs are kept in the lab. Teaching assistants are on hand to distribute software and instruct students on how to use the programs.

Library Facilities
The Science and Technology Library, housed on the second floor of Walter Library (614-0224), immediately to the north of Smith Hall and connected by an underground corridor, subscribes to all the major journals of interest to chemists and has an unusually extensive book collection.

CSE Mentor Program
http://cse.umn.edu/admin/exrel/alumni/mentor/index.php This program matches current science and engineering students with professionals in technical fields. These volunteer mentors help students prepare for the transition from the academic environment to the professional world.

CLA Career & Community Learning Center
http://cla.umn.edu/student-services-advising/career-internship-services. This office provides a variety of services to help students learn effective job hunting skills, identify career goals and options, interviewing skills, special learning opportunities, independent studies, internships and field experience learning.

CSE Career Services Office
https://cse.umn.edu/r/career-center/ This office assists all levels of students with career choices and development needs. They also schedule on-campus interviews and maintain a library of information on prospective employers. Students wishing to use their services should register with them early to guarantee interview opportunities.

University Counseling Services
http://www.uccs.umn.edu Generally speaking, any concern that interferes with a student's effective functioning at the University is an appropriate topic for discussion with a professional counselor. (Reading and studying problems, test anxiety, general anxiety, choice of career and/or occupation, drug related problems, marital, relationship, and/or sexual concerns, problems with family relations, depression, decision-making concerns.)

Chemistry Tutors
124 Smith Hall
Tutorial service provided by Chemistry Teaching Assistants.

Private Tutors
A list of graduate students willing to provide private tutoring services at a fee ($15 - $20 per hour) is maintained in 115 Smith Hall.

Fellowships & Prizes for Undergraduate Chemistry Majors
There are several scholarships and prizes available to declared chemistry majors at the University of Minnesota-Twin Cities campus. To receive consideration for any departmental scholarship you need to apply and meet the following criteria. Applications can be found on the internet at [http://www.chem.umn.edu/undergraduate/Scholarships.html](http://www.chem.umn.edu/undergraduate/Scholarships.html). Awards are announced in the spring and awarded the following fall to your university account.

<table>
<thead>
<tr>
<th>Award</th>
<th>Eligibility</th>
<th>Application Material</th>
<th>Size of Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior Award</td>
<td>You have one year left in the Chemistry Program</td>
<td>One letter of recommendation must be from research adviser.</td>
<td>Up to 6 awards, $3,000 each</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brief description of undergraduate research.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Statement of career goals. *</td>
<td></td>
</tr>
<tr>
<td>Junior Award</td>
<td>Must have two years left in the program.</td>
<td>One letter of recommendation from chemistry faculty member.</td>
<td>Up to 5 awards, $2,000 each</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Statement of career goals. *</td>
<td></td>
</tr>
<tr>
<td>Sophomore Award</td>
<td>Must have three years left in the program and have done undergraduate research.</td>
<td>One letter of recommendation from chemistry faculty member.</td>
<td>Up to 2 awards, $1000 each</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Statement of career goals. *</td>
<td></td>
</tr>
</tbody>
</table>

* Be sure to state which award you are applying for. The following information should be included in your application; the number of publications, number of TA appointments, number of meeting presentations, any honors or awards previously received, and specific career plans (i.e., if you plan to go on to graduate school, where, what program). You can only apply for one award in a given year and you cannot receive the same award twice. All material must be received by March 15. Announcement of awards will take place in April and awards will be made to your student accounts the following academic year.
Smith Hall & Kolthoff Hall (Department of Chemistry)
Department offices are located on the main floor of Smith Hall. Smith Hall is located on the grassy mall of the East Bank of the Minneapolis Campus. There is no sign that says SMITH HALL, but on the top of the building it says School of Chemistry. Smith Hall is located next to Walter Library.
CHEMISTRY

_____ Chem 1061/5 (4) Chem Prin. I
_____ Chem 1062/6 (4) Chem Prin. II
_____ Chem 2301 (3) Organic Lect I
_____ Chem 2302 (3) Organic Lect II
_____ Chem 2311 (4) Organic Lab
_____ Chem 2101 (3) Intro Analytical Chem Lect
_____ Chem 2111 (2) Intro Analytical Chem Lab
_____ Chem 4501 (3) Physical Chem I
_____ Chem 4502 (3) Physical Chem II
_____ Chem 4701 (3) Intro. Inorganic Chem

Adv. Chem Lecture Elect. (CSE 3 cr., CLA 0 cr.)
Selected from any non-required upper level Chem course


MATH

_____ Math 1271 (4) Calculus I
_____ Math 1272 (4) Calculus II
_____ Math 2263 (4) Multivariable Calculus

_____ Math/Phys elective (4) CSE Only
(Math 2243 or Phys 2303 or 2503 or Stat 3021)

PHYSICS

_____ Phys 1301 (4) Intro Physics I
_____ Phys 1302 (4) Intro Physics II

WRITING PRACTICE

_____ Freshman Writing
_____ 4 Writing Intensive Requirements


ADVANCED TECHNICAL ELECTIVES

CSE 6 cr., CLA 3 cr. - upper level technical courses (> 3 cr)


CLA students can use 2094 or 4094 in place of one lab.


Liberal Education

Core

One course of at least three credits in each of the following:
• Arts/Humanities _________  • Historical Perspectives _________  • Literature _________
• Mathematical Thinking ________  • Social Science __________________________

One course of at least four credits, with a laboratory or field experience, in each of the following:
• Physical Science _____________  • Biological Science ________________

Themes

A minimum of one course of at least three credits in each of the following thematic areas:
• Civic Life and Ethics ____________  • Diversity & Social Justice in the US ____________
• The Environment ________________  • Global Perspectives ____________  • Technology & Society ______

Courses may be certified for both a Core and a Theme, if the theme is fully infused into the Core course.