UCLA Department of Chemistry and Biochemistry

Undergraduate Handbook 2007-2008
# CHEMISTRY AND BIOCHEMISTRY HANDBOOK

## 2007 - 2008

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</tbody>
</table>
I. INTRODUCTION

Chemistry is concerned with the composition, structure, and properties of substances. It analyzes the transformations of these substances into others by reactions, and studies the kinds of energy changes that accompany these reactions. The UCLA Chemistry and Biochemistry Department is organized into four interrelated and overlapping sub-disciplines, including the chemistry of inorganic substances (inorganic chemistry), the chemistry of carbon-containing compounds (organic chemistry), the chemistry of living systems (biochemistry), and the physical behavior of substances in relation to their structures and chemical properties (physical chemistry).

As part of the Division of Physical Sciences in the College of Letters and Science, the Chemistry and Biochemistry Department has approximately 1,100 undergraduate majors, 335 graduate students (including about 130 teaching assistants per quarter) and a faculty and teaching staff of approximately 80. Due to our large size, our faculty and teaching staff represent nearly all aspects of chemistry.

Chemistry and biochemistry are complex subjects that require a strong background in math, physics, and biology. As chemistry or biochemistry majors, students will be required to take a series of rigorous preparation courses to aid them in their understanding of the various chemical fields. The organization of the curriculum allows students to begin taking chemistry courses, along with other preparation courses, immediately during the first quarters of their freshman year. Since many upper division courses have preparation courses as prerequisites, students should begin their background preparation early. In fact, the department recommends that students take at least one chemistry course each quarter. Additionally, the department recommends that students utilize their GE requirements to take courses in writing. The mastery of English is extremely important, and well-developed verbal and writing skills are essential for success in any technical career. Upon completion of the major, students will be equipped to pursue a variety of career options based on the student's exposure to a wide assortment of fields of study during their undergraduate career.

There are many people on campus that can assist students in finding courses, planning for the future, and finding other resources on campus. Students should look at the “Academic Resources” section of this handbook to make sure they are going to the appropriate people for help. This handbook should serve as a great resource for any questions students may have about the department or the major. For further questions, students can contact the Chemistry and Biochemistry Undergraduate Office at (310) 825-1859 or by e-mail at ugrad@chem.ucla.edu.
II. MAJOR REQUIREMENTS

MAJORS
The UCLA Chemistry and Biochemistry Department offers FOUR undergraduate majors, TWO concentrations, and ONE specialization*. The following pages will give specific information about each of these majors and their requirements.

1. Chemistry Major
   - Optional Physical Chemistry Concentration
2. Biochemistry Major
3. Chemistry-Materials Science Major
   - Optional Chemistry-Materials Science Organic Concentration
4. General Chemistry Major

*The Computing Specialization can be added to any of the four majors above.

MINORS
The Department does NOT offer a minor in either Chemistry or Biochemistry. Please see the General Catalog online for the most up-to-date list of minors offered at UCLA. www.registrar.ucla.edu/catalog/majors-2.htm.

DECLARING/CHANGING YOUR MAJOR
To declare one of the majors in the Chemistry and Biochemistry Department, a student must visit the Undergraduate Office in 4009 Young Hall and fill out a change of major petition. The counselors will then evaluate the petition by checking to see if the student has at least a 2.0 GPA, that he/she has no outstanding D's or F's in any courses for the major, that he/she has no holds on their record, and that he/she can complete the major within the unit maximum (216 + AP units). If there are any problems with the processing of the change of major, the department will contact the student with further instructions. If the petition is approved, the student will receive a copy of the approved petition and their updated Degree Progress Report in the mail. The update will be made on URSA and MyUCLA as soon as the petition is approved.

DOUBLE MAJOR
Students in good academic standing may be permitted to have a double major consisting of departmental majors from two departments. If students are trying to double major between schools (Arts and Architecture, Engineering, etc.), they should visit both schools to determine if rules are different. Students can apply for a double major after they have:

1. Completed all major prerequisites for both majors, and
2. Completed two upper division courses in each major.

Students cannot double major in two majors from the same department. Students should consult with undergraduate counselors from both departments about the requirements for each major. They should also visit their College Counseling Unit (Letters and Science, Honors, or AAP) to pick up the Double Major Guidelines which contain instructions regarding how to file double major paperwork. Students must meet the requirements that each department stipulates in addition to the requirements of the College. If adding the double major will cause the student to exceed their unit maximum, the student must petition for an extension of their unit maximum with their college counseling unit. The double major cannot be approved unless the unit maximum petition is approved.
THE UCLA CHEMISTRY MAJOR 2007 - 2008

The Department of Chemistry and Biochemistry offers four undergraduate majors, two concentrations, and one specialization: the CHEMISTRY major (described here), the PHYSICAL CHEMISTRY concentration, the BIOCHEMISTRY major, the GENERAL CHEMISTRY major (for students who want to acquire a good chemical background in preparation for careers outside chemistry), the CHEMISTRY-MATERIALS SCIENCE major, the CHEMISTRY-MATERIALS SCIENCE ORGANIC concentration, and the COMPUTING SPECIALIZATION. For more details about these majors, consult your faculty advisor or the Undergraduate Office in 4009 Young Hall.

The major is designed primarily for students who are interested in attending graduate school in Chemistry or related areas. It also satisfies some of the requirements of pre-medical and pre-professional schools. Refer to the UCLA General Catalog for course descriptions.

<table>
<thead>
<tr>
<th>Preparation for the Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Chemistry:</td>
</tr>
<tr>
<td>Chem 20A(H), 20B(H), 20L, 30AL</td>
</tr>
<tr>
<td>Organic Chemistry:</td>
</tr>
<tr>
<td>Chem 30A(H), 30B, 30BL, 30C, 30CL</td>
</tr>
<tr>
<td>Math:</td>
</tr>
<tr>
<td>31A, 31B, 32A, 32B, 33B</td>
</tr>
<tr>
<td>Physics:</td>
</tr>
<tr>
<td>1A(H), 1B(H), 1C(H), 4BL</td>
</tr>
</tbody>
</table>

Note: (H) indicates that an HONORS section is available

<table>
<thead>
<tr>
<th>Upper Division Major Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
</tr>
<tr>
<td>Chem 110A, 113A, 110B or C113B, 114(H), 136 or 144, 171, C172</td>
</tr>
<tr>
<td>Biochemistry</td>
</tr>
<tr>
<td>Chem 153A(H), 153L</td>
</tr>
<tr>
<td>Two Chemistry Electives (8 units)</td>
</tr>
<tr>
<td>One upper division or graduate-level courses offered in the Dept. of Chemistry &amp; Biochemistry (at least 4 Units)</td>
</tr>
<tr>
<td>One laboratory from Chemistry 136, 144, 154, 174, 184, C185</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Important Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>You may not take or repeat a chemistry or biochemistry course for credit if it is a prerequisite for a more advanced course for which you already have credit.</td>
</tr>
<tr>
<td>Seminars, individual study courses, and research courses (e.g. 196, 199) may not be used to satisfy the requirements for the Chemistry major.</td>
</tr>
<tr>
<td>You must maintain at least a 2.0 GPA in all upper division coursework taken to fulfill the major requirements.</td>
</tr>
<tr>
<td>All prep for major and major courses must be taken for a letter grade.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Class Scheduling - Tips &amp; Suggestions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SCHEDULE:</strong> The following schedule for the first six quarters is strongly recommended for students planning to major in Chemistry:</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSES</th>
<th>QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Chemistry:</td>
<td>20A</td>
</tr>
<tr>
<td></td>
<td>and 20L</td>
</tr>
<tr>
<td>Mathematics:</td>
<td>31A</td>
</tr>
<tr>
<td>Physics:</td>
<td>1A</td>
</tr>
</tbody>
</table>
**UPPER DIVISION COURSES:** The program of upper division courses for the Chemistry major should be planned with care. Particular attention should be paid to prerequisites for advanced courses and the quarter(s) in which courses are offered. Please use this prerequisite list as a guide to plan your courses. Consult with an Undergraduate Advisor for assistance.

<table>
<thead>
<tr>
<th>COURSE</th>
<th>PREREQUISITE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required:</strong></td>
<td></td>
</tr>
<tr>
<td>110A</td>
<td>Chem 20B; Math 32A or 3C; Physics 1A(H), 1B(H), 1C(H)<em>, or Physics 6A(H), 6B(H), 6C(H)</em></td>
</tr>
<tr>
<td>110B</td>
<td>Chem 110A, 113A; Math 32B</td>
</tr>
<tr>
<td>113A</td>
<td>Chem 20B; Math 32A, 32B 33B; Physics 6A, 6B, 6C or 1A, 1B, 1C</td>
</tr>
<tr>
<td>C113B</td>
<td>Chem 113A</td>
</tr>
<tr>
<td>114(H)</td>
<td>Chem 30AL, 110A, 113A and EITHER 110B* or C113B*</td>
</tr>
<tr>
<td>136</td>
<td>Chem 30C and 30CL</td>
</tr>
<tr>
<td>144</td>
<td>Chem 30C and 30CL</td>
</tr>
<tr>
<td>153A(H)</td>
<td>Chem 30B (Life Science 2 &amp; 3 recommended)</td>
</tr>
<tr>
<td>153L</td>
<td>Chem 30B and 30BL, and 153A(H)*</td>
</tr>
<tr>
<td>171</td>
<td>Chem 30B</td>
</tr>
<tr>
<td>C172</td>
<td>Chem 171</td>
</tr>
<tr>
<td><strong>Possible Electives:</strong></td>
<td></td>
</tr>
<tr>
<td>103</td>
<td>Chem 30B, 30BL, 110A, 153A(H) and 153L</td>
</tr>
<tr>
<td>C115A</td>
<td>Chem 113A; Math 32B, 33A (see catalog for recommended courses)</td>
</tr>
<tr>
<td>C115B</td>
<td>Chem C115A</td>
</tr>
<tr>
<td>C123A</td>
<td>Chem 110B or 156, (113A recommended)</td>
</tr>
<tr>
<td>C123B</td>
<td>Chem C123A</td>
</tr>
<tr>
<td>125</td>
<td>Chem 110A, 110B, 113A + knowledge of Fortran IV or PL/1</td>
</tr>
<tr>
<td>C126A</td>
<td>Chem 110A, Math 33B</td>
</tr>
<tr>
<td>C140</td>
<td>Chem 30C, 110A</td>
</tr>
<tr>
<td>C143A</td>
<td>Chem 30C and 30CL*, 110B, 113A</td>
</tr>
<tr>
<td>C143B</td>
<td>Chem C143A</td>
</tr>
<tr>
<td>C145</td>
<td>Chem 30C, 113A</td>
</tr>
<tr>
<td>153B</td>
<td>Chem 153A, Life Sci 2, 3</td>
</tr>
<tr>
<td>153C</td>
<td>Chem 153A</td>
</tr>
<tr>
<td>154</td>
<td>Chem 153A, 153B, 153L, (156 recommended)</td>
</tr>
<tr>
<td>156</td>
<td>Chem 110A, 153A</td>
</tr>
<tr>
<td>C160A</td>
<td>Statistics recommended</td>
</tr>
<tr>
<td>C160B</td>
<td>Chem C160A</td>
</tr>
<tr>
<td>C161A</td>
<td>Chem 153C</td>
</tr>
<tr>
<td>C174</td>
<td>Chem C172, 30CL</td>
</tr>
<tr>
<td>C175</td>
<td>Chem 110AB, 113A, C172</td>
</tr>
<tr>
<td>C176</td>
<td>Chem 113A, C172</td>
</tr>
<tr>
<td>C179</td>
<td>Chem 153A, 171</td>
</tr>
<tr>
<td>C180</td>
<td>Chem C172</td>
</tr>
<tr>
<td>C181</td>
<td>Chem 30B, 110A</td>
</tr>
<tr>
<td>184</td>
<td>Chem 30CL, 110A</td>
</tr>
<tr>
<td>C185</td>
<td>Chem 30AL, 110A, 113A, 171</td>
</tr>
</tbody>
</table>

* indicates may be taken concurrently with the course

**COLLEGE REQUIREMENTS FOR THE B.S. DEGREE:** Requirements for the B.S. degree established by the College of Letters and Science are listed in the UCLA General Catalog. A total of at least 180 quarter units are required for the degree. **60 of these 180 units must be upper division (course numbers 100-199).**
THE UCLA PHYSICAL CHEMISTRY CONCENTRATION 2007-2008

The Department of Chemistry and Biochemistry offers four undergraduate majors, two concentrations, and one specialization: the CHEMISTRY major, the PHYSICAL CHEMISTRY concentration (described here), the BIOCHEMISTRY major, the GENERAL CHEMISTRY major, the CHEMISTRY-MATERIALS SCIENCE major, the CHEMISTRY-MATERIALS SCIENCE ORGANIC concentration, and the COMPUTING SPECIALIZATION. For more details about these majors, consult your faculty advisor or the Undergraduate Office in Young Hall 4009.

THE PHYSICAL CHEMISTRY CONCENTRATION: This concentration is designed primarily for Chemistry majors who are interested in attending graduate school in Physical Chemistry/Physics or related areas. It may also satisfy some of the needs of pre-medical and other pre-professional schools. Refer to the UCLA General Catalog for course descriptions.

### Preparation for the Major

| General Chemistry: | Chem 20A(H), 20B(H), 20L, 30AL |
| Organic Chemistry: | Chem 30A(H), 30B, 30BL |
| Math:              | 31A, 31B, 32A, 32B, 33A, 33B |
| Physics:           | 1A(H), 1B(H), 1C(H), 4BL |
| Note: (H) indicates that an HONORS section is available |

### Concentration Course Requirements

<table>
<thead>
<tr>
<th>Chemistry</th>
<th>Chem 110A, 110B, 113A, C113B, 114(H), 153A(H), 171, C172</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Laboratory Elective (4 units)</td>
<td>One additional approved upper division physics, chemistry, or electrical engineering laboratory course from Chemistry M120, 184, C185; Physics 117, 180B, 180C; Electrical Engineering 122L, 172L, 173DL</td>
</tr>
<tr>
<td>Three Lecture Electives (12 units)</td>
<td>Three approved elective lectures chosen from upper division or graduate courses in physics, mathematics, electrical engineering, physical chemistry, physical inorganic chemistry, biophysical chemistry, or physical organic chemistry (see approved elective list below)</td>
</tr>
</tbody>
</table>

### Approved Lecture Electives (pick 3)

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Engineering:</td>
<td>Electrical Engineering 100, 101, 102, 121B, 136, 172, 173</td>
</tr>
</tbody>
</table>

### Important Notes

- You may not take or repeat a chemistry or biochemistry course for credit if it is a prerequisite for a more advanced course for which you already have credit.
- Seminars, individual study courses, and research courses (e.g. 196, 199) **may not be used** to satisfy the requirements for the physical chemistry major.
- You must maintain at least a 2.0 GPA in all upper division coursework taken to fulfill the major requirements.
- All prep for major and major courses must be taken for a letter grade.
- **By their junior year, students are strongly encouraged to join a research group within the physical chemistry division to obtain research experience.**
THE UCLA BIOCHEMISTRY MAJOR 2007 - 2008

The Department of Chemistry and Biochemistry offers four undergraduate majors, two concentrations, and one specialization: the CHEMISTRY major, the PHYSICAL CHEMISTRY concentration, the BIOCHEMISTRY major (described here), the GENERAL CHEMISTRY major (for students who want to acquire a good chemical background in preparation for careers outside chemistry), the CHEMISTRY-MATERIALS SCIENCE major, CHEMISTRY-MATERIALS SCIENCE ORGANIC concentration, and the COMPUTING SPECIALIZATION. For more details about these majors, consult your faculty advisor or the Undergraduate Office in Young Hall 4009.

This major is appropriate for students who are interested in attending graduate school in Biochemistry or related areas. It also satisfies many of the requirements of pre-medical and other pre-professional schools. Refer to the UCLA General Catalog for course descriptions.

Preparation for the Major

| General Chemistry: | Chem 20A(H), 20B(H), 20L, 30AL |
| Organic Chemistry: | Chem 30A(H), 30B, 30BL, 30C, 30CL |
| Math: | 31A, 31B, 32A (33B recommended) |
| Physics: | 6A(H), 6B(H), 6C(H) OR 1A(H), 1B(H), 1C(H), 4BL |
| Life Science: | Lifesci 2, Lifesci 3, Lifesci 4 |
| Note: (H) indicates that an HONORS section is available |

Upper Division Major Requirements

| Chemistry | Chem 110A, 171 |
| Biochemistry | Chem 153A(H), 153B(H), 153C(H), 153L, 154, 156 |
| One Chemistry or Biochemistry Elective | One upper division or graduate-level course offered in the Dept. of Chemistry & Biochemistry (4 Units) |
| Four Electives | Four upper division or graduate level courses selected from the approved list.* (16 Units) |
| *Microbiology 101 & 101L are highly recommended to fulfill two of the elective requirements. |

Important Notes

- You may not take or repeat a chemistry or biochemistry course for credit if it is a prerequisite for a more advanced course for which you already have credit.
- Seminars, individual study courses, and research courses (e.g. 196, 199) may not be used to satisfy the requirements for the biochemistry major.
- You must maintain at least a 2.0 GPA in all upper division coursework taken to fulfill the major requirements.
- All prep for major and major courses must be taken for a letter grade.

Class Scheduling - Tips & Suggestions

The following schedule for the first six quarters is recommended for students planning to major in Biochemistry. A normal course load is 16 units per quarter; students should also integrate their lower division general education requirements.

<table>
<thead>
<tr>
<th>QUARTER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>COURSES</td>
<td>Chemistry</td>
<td>20A</td>
<td>20B &amp; 20L</td>
<td>30A &amp; 30AL</td>
<td>30B &amp; 30BL</td>
<td>30C &amp; 30CL</td>
</tr>
<tr>
<td>Mathematics</td>
<td>31A</td>
<td>31B</td>
<td>32A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physics</td>
<td>6A</td>
<td>6B</td>
<td>6C</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>English 3</td>
<td>Life Sci. 2</td>
<td>Life Sci. 3</td>
<td>Life Sci. 4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
UPPER DIVISION COURSES: The program of upper division courses for the Biochemistry major should be planned with care. Particular attention should be paid to prerequisites for advanced courses and to the quarter(s) in which courses are offered.

<table>
<thead>
<tr>
<th>COURSE</th>
<th>PREREQUISITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>110A</td>
<td>Chem 20B; Math 32A or 3C; Physics 1A(H), 1B(H), 1C(H)<em>, or Physics 6A(H), 6B(H), 6C(H)</em></td>
</tr>
<tr>
<td>153A(H)</td>
<td>Chem 30B (Life Science 2 &amp; 3 recommended)</td>
</tr>
<tr>
<td>153B(H)</td>
<td>Chem 153A(H), Life Science 2 &amp; 3</td>
</tr>
<tr>
<td>153C(H)</td>
<td>Chem 153A(H)</td>
</tr>
<tr>
<td>153L</td>
<td>Chem 30B and 30BL, and 153A(H)*</td>
</tr>
<tr>
<td>154</td>
<td>Chem 153A(H), 153B(H) and 153L (Chem 156 recommended)</td>
</tr>
<tr>
<td>156</td>
<td>Chem 110A and 153A(H)</td>
</tr>
<tr>
<td>171</td>
<td>Chem 30B</td>
</tr>
</tbody>
</table>

* indicates *may be taken concurrently* with the course

RECOMMENDED TIMING OF ADVANCED CHEMISTRY COURSES:

<table>
<thead>
<tr>
<th>COURSES</th>
<th>QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>153L, 153B(H) or 153C(H)</td>
<td>7, 8</td>
</tr>
<tr>
<td>110A, 153B(H) or 153C(H)</td>
<td>9</td>
</tr>
<tr>
<td>154</td>
<td>11</td>
</tr>
<tr>
<td>156</td>
<td>12</td>
</tr>
</tbody>
</table>

COLLEGE REQUIREMENTS FOR THE B.S. DEGREE: Requirements for the B.S. degree established by the College of Letters and Science are listed in the UCLA General Catalog. A total of 180 quarter units are required for the degree; 60 of these 180 units must be upper division (course numbers 100-199).

APPROVED LIST OF COURSES TO SATISFY UPPER DIVISION ELECTIVES

All upper division chemistry & biochemistry courses are eligible with the exception of seminars, individual study courses, and research courses (e.g. 190, 199). Although only one of your electives **MUST** be a chemistry & biochemistry course, you may choose to take all of your electives within our department.

**Other Departments:**
You may use all upper division courses in the following departments with the exception of seminars, individual study courses, field courses, research courses (e.g. 190, 199), and any listed exceptions.

| Biostatistics | Molecular & Medical Pharmacology |
| Biomathematics | Neuroscience |
| MCD Biology *with the exception* of 104, 144 | EEB *with the exception* of 121, 123, 125, 126, M127, CM189AB |
| Mathematics *with the exception* of 106 | Physics |
| Microbiology & Molecular Genetics | Physiological Science *with the exception* of 102, 103, M168 |

**Departments with a limited selection of electives:** For the departments listed below, you may use only the courses listed.

| Anthropology 153 | Human Genetics C144, CM156, CM169, CM178 |
| Atmospheric Sciences 104, M105, M140, C145, C165 | Material Science & Engineering CM180 |
| Biol Chem M140, CM159A, CM169, M178 | Medical History M169 |
| Biomedical Engineering CM180, C185 | Molecular Toxicology M110A |
| Chemical Engineering 100, 101A, 109, 110, CM145 | Neurobiology M169 |
| Civil and Environmental Engineering 108 | Philosophy M134 |
| Earth & Space Science C107, C109, M118 | Programming in Computing 197 |
| Electrical Engineering M185 | Psychiatry M191 |
| Environmental Health 100 | Psychology 115, 116, M117ABCJL, M119LNX, 119R |
| Epidemiology 100 | Public Health 150 |
| Gerontology M119X | Statistics 100A, 100B, 100C, 110A, 110B |
Biochemistry Upper Division Electives

This list is subject to change. At least 16 units of electives must be completed.

<table>
<thead>
<tr>
<th>Course</th>
<th>Course</th>
<th>Course</th>
<th>Course</th>
<th>Course</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmos Sci 104</td>
<td>Chem C175</td>
<td>Hum Gen C144</td>
<td>MCDB CM156</td>
<td>Phys Sci C133</td>
<td>Psych 116</td>
</tr>
<tr>
<td>Atmos Sci M105</td>
<td>Chem C176</td>
<td>Hum Gen CM156</td>
<td>MCDB CM160</td>
<td>Phys Sci C135</td>
<td>Psych M117A</td>
</tr>
<tr>
<td>Biomath 106</td>
<td>ChemEng 100</td>
<td>Math 110B(H)</td>
<td>MCDB C174A</td>
<td>Phys Sci 147</td>
<td>Psych 119R</td>
</tr>
<tr>
<td>Biomath 110</td>
<td>ChemEng CM145</td>
<td>Math 114A</td>
<td>MCDB M175A</td>
<td>Phys Sci C152</td>
<td>Pub Hlth 150</td>
</tr>
<tr>
<td>Biomath 160</td>
<td>Civ &amp; Env Eng 108</td>
<td>Math 114B</td>
<td>MCDB M175B</td>
<td>Phys Sci 153</td>
<td>Stats 100A</td>
</tr>
<tr>
<td>BioMed Eng CM180</td>
<td>EE Bio 100</td>
<td>Math 115A</td>
<td>MCDB CM176</td>
<td>Phys Sci 155</td>
<td>Stats 100B</td>
</tr>
<tr>
<td>BioMed Eng C185</td>
<td>EE Bio 101</td>
<td>Math 115B</td>
<td>MCDB CM178</td>
<td>Phys Sci 165</td>
<td>Stats 110A</td>
</tr>
<tr>
<td>Biostats 100A</td>
<td>EE Bio 105</td>
<td>Med Hist M169</td>
<td>MIMG 101</td>
<td>Phys Sci 166</td>
<td>Stats 110B</td>
</tr>
<tr>
<td>Biostats 100B</td>
<td>EE Bio 109</td>
<td>M IMG 101L</td>
<td>M IMG 101L</td>
<td>Phys Sci 167</td>
<td></td>
</tr>
<tr>
<td>Biostats 110A</td>
<td>EE Bio 110</td>
<td>M IMG 102</td>
<td>M IMG 102</td>
<td>Phys Sci 173</td>
<td></td>
</tr>
<tr>
<td>Biostats 110B</td>
<td>EE Bio 111</td>
<td>M IMG 102L</td>
<td>M IMG 102L</td>
<td>Phys Sci M180A</td>
<td></td>
</tr>
<tr>
<td>Biostats 115</td>
<td>EE Bio 112</td>
<td>M IMG 106</td>
<td>M IMG 106</td>
<td>Phys Sci M180B</td>
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<tr>
<td>Chem 103</td>
<td>EE Bio 113A</td>
<td>M IMG 120</td>
<td>M IMG 120</td>
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<td>Chem C108</td>
<td>EE Bio 115</td>
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<td>Physics 105A</td>
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<tr>
<td>Chem 110B</td>
<td>EE Bio 116</td>
<td>M IMG CM156</td>
<td>M IMG CM156</td>
<td>Physics 105B</td>
<td></td>
</tr>
<tr>
<td>Chem 113A</td>
<td>EE Bio 117</td>
<td>M IMG C159</td>
<td>M IMG C159</td>
<td>Physics 108</td>
<td></td>
</tr>
<tr>
<td>Chem C113B</td>
<td>EE Bio C119</td>
<td>M IMG C168</td>
<td>M IMG C168</td>
<td>Physics 110A</td>
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<tr>
<td>Chem 114</td>
<td>EE Bio 120</td>
<td>M IMG C174</td>
<td>M IMG C174</td>
<td>Physics 110B</td>
<td></td>
</tr>
<tr>
<td>Chem C115A</td>
<td>EE Bio 122</td>
<td>M IMG M176</td>
<td>M IMG M176</td>
<td>Physics 112</td>
<td></td>
</tr>
<tr>
<td>Chem C115B</td>
<td>EE Bio 128</td>
<td>M IMG 185A</td>
<td>M IMG 185A</td>
<td>Physics 114</td>
<td></td>
</tr>
<tr>
<td>Chem M120</td>
<td>EE Bio 129</td>
<td>Mol Tox M110A</td>
<td>Mol Tox M110A</td>
<td>Physics 115A</td>
<td></td>
</tr>
<tr>
<td>Chem 121</td>
<td>EE Bio 130</td>
<td>MS&amp;Eng CM180</td>
<td>MS&amp;Eng CM180</td>
<td>Physics 115B</td>
<td></td>
</tr>
<tr>
<td>Chem C123A</td>
<td>EE Bio 134A</td>
<td>Neurobio M169</td>
<td>Neurobio M169</td>
<td>Physics 116</td>
<td></td>
</tr>
<tr>
<td>Chem C126A</td>
<td>EE Bio 137</td>
<td>Neurosci M101C</td>
<td>Neurosci M101C</td>
<td>Physics 123</td>
<td></td>
</tr>
<tr>
<td>Chem C140</td>
<td>EE Bio M145</td>
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<td>Physics 126</td>
<td></td>
</tr>
<tr>
<td>Chem C143A</td>
<td>EE Bio 146</td>
<td>Neurosci M119L</td>
<td>Neurosci M119L</td>
<td>Physics 131</td>
<td></td>
</tr>
<tr>
<td>Chem C143B</td>
<td>EE Bio 151A</td>
<td>Neurosci M119N</td>
<td>Neurosci M119N</td>
<td>Physics 132</td>
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</tr>
<tr>
<td>Chem 144</td>
<td>EE Bio 154</td>
<td>Neurosci M130</td>
<td>Neurosci M130</td>
<td>Physics 140A</td>
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<tr>
<td>Chem CM155</td>
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<td>Neurosci 151</td>
<td>Neurosci 151</td>
<td>Physics 160</td>
<td></td>
</tr>
<tr>
<td>Chem C159A</td>
<td>EE Bio 170</td>
<td>Neurosci C172</td>
<td>Neurosci C172</td>
<td>Physics 180A</td>
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</tr>
<tr>
<td>Chem C159B</td>
<td>EE Bio 181</td>
<td>MCDB 100</td>
<td>MCDB 100</td>
<td>Physics 180B</td>
<td></td>
</tr>
<tr>
<td>Chem C160A</td>
<td>Elec Eng M185</td>
<td>MCDB 138</td>
<td>Phys Sci 100</td>
<td>Physics 180C</td>
<td></td>
</tr>
<tr>
<td>Chem C160B</td>
<td>Env Hlth 100</td>
<td>MCDB C139</td>
<td>Phys Sci 107</td>
<td>Physics 180D</td>
<td></td>
</tr>
<tr>
<td>Chem C161A</td>
<td>Epid 100</td>
<td>MCDB M140</td>
<td>Phys Sci 111A</td>
<td>Physics 180E</td>
<td></td>
</tr>
<tr>
<td>Chem C165</td>
<td>ESS C107</td>
<td>MCDB C141</td>
<td>Phys Sci 111B</td>
<td>Physics 180F</td>
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</tr>
<tr>
<td>Chem CM170</td>
<td>ESS C109</td>
<td>MCDB 143</td>
<td>Phys Sci 111C</td>
<td>Physics C185</td>
<td></td>
</tr>
<tr>
<td>Chem C172</td>
<td>ESS M118</td>
<td>MCDB C150</td>
<td>Phys Sci 111L</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Some electives may not show up automatically on the DPR. Call 310-825-1859 to correct this.
THE UCLA GENERAL CHEMISTRY MAJOR 2007-2008

Advisor: Dr. Steve Hardinger, 3007C Young Hall, harding@chem.ucla.edu

THE GENERAL CHEMISTRY MAJOR: The General Chemistry major is intended for students who wish to acquire considerable background in chemistry in preparation for careers outside chemistry. It may be appropriate for students who plan careers in environmental science, patent law, public health, or teaching with an emphasis on science.

Please note the following:
- This major cannot be used as part of a double major.
- Students MUST declare the General Chemistry major before reaching senior status (135 units, not including AP credit).

<table>
<thead>
<tr>
<th>Preparation for the Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Chemistry:</td>
</tr>
<tr>
<td>Chem 20A(H), 20B(H), 20L, 30AL</td>
</tr>
<tr>
<td>Organic Chemistry:</td>
</tr>
<tr>
<td>Chem 30A(H), 30B, 30BL, 30C, 30CL</td>
</tr>
<tr>
<td>Math:</td>
</tr>
<tr>
<td>31A, 31B, 32A, 33B</td>
</tr>
<tr>
<td>Physics:</td>
</tr>
<tr>
<td>1A(H), 1B(H), 1C(H), 4BL</td>
</tr>
</tbody>
</table>

Note: (H) indicates that an HONORS section is available

<table>
<thead>
<tr>
<th>Upper Division Major Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry &amp; Biochemistry</td>
</tr>
<tr>
<td>Chem 110A, 153A(H), 153L, 171</td>
</tr>
<tr>
<td>3 Chemistry Dept. Electives</td>
</tr>
<tr>
<td>Three (3) additional upper division electives in the departments. At least one must be a laboratory course (Courses must total 12 or more units)</td>
</tr>
<tr>
<td>6 Additional Electives</td>
</tr>
<tr>
<td>Six (6) additional upper division courses in any department (Courses must total 24 or more units).</td>
</tr>
</tbody>
</table>

WRITTEN PROPOSAL GUIDELINES: Any student who is considering the General Chemistry major should prepare a written proposal for submission. It should be written in essay format and should include items 1-3 below.

1. Your specific career interests.
2. A detailed statement of your rationale for choosing each of the nine elective courses and how each of them contribute to a coherent major, relative to your overall career goals.
3. A proposed schedule of the courses you still need to take (including the nine proposed electives) showing when you will complete all of your requirements. You will need to contact the departments outside the Chemistry & Biochemistry Department to determine:
   a. the quarters in which the courses are offered
   b. availability - i.e. if the courses are limited to majors; if they fill up quickly.
4. Fill out a change of major petition in the Undergraduate Chemistry & Biochemistry Office, 4009 Young Hall.
5. Email your proposal to harding@chem.ucla.edu and cfire@chem.ucla.edu.
6. Please allow one week for your proposal to be evaluated.

*To view a sample proposal, visit the General Chemistry advisor’s website at: http://web.chem.ucla.edu/~harding/

Important Notes

- You may not take or repeat a chemistry or biochemistry course for credit if it is a prerequisite for a more advanced course for which you already have credit.
- Seminars, individual study courses, and research courses (e.g. 196, 199) may not be used to satisfy the requirements for the general chemistry major.
- You must maintain at least a 2.0 GPA in all upper division coursework taken to fulfill the major requirements. Letter grades are required for all major classes.
- Until the proposal has been approved, there is NO guarantee that the proposed courses can be used for the major, even if they have already been taken.
THE UCLA CHEMISTRY-MATERIALS SCIENCE MAJOR 2007 - 2008

The Department of Chemistry and Biochemistry offers four undergraduate majors, two concentrations, and one specialization: the CHEMISTRY major, the PHYSICAL CHEMISTRY concentration, the BIOCHEMISTRY major, the GENERAL CHEMISTRY major (for students who want to acquire a good chemical background in preparation for careers outside chemistry), the CHEMISTRY-MATERIALS SCIENCE major (listed here), the CHEMISTRY-MATERIALS SCIENCE ORGANIC concentration, and the COMPUTING SPECIALIZATION. For more details about these majors, consult your faculty advisor or the Undergraduate Office in 4009 Young Hall.

THE CHEMISTRY-MATERIALS SCIENCE MAJOR: The major is designed primarily for students who are interested in chemistry with an emphasis on material properties. The major provides appropriate preparation for graduate studies in fields emphasizing interdisciplinary research involving chemistry, engineering, and applied science. Refer to the UCLA General Catalog for course descriptions.

### Preparation for the Major

| General Chemistry: | Chem 20A(H), 20B(H), 20L, 30AL |
| Organic Chemistry: | Chem 30A(H) |
| Math: | 31A, 31B, 32A, 32B, 33B |
| Physics: | 1A(H), 1B(H), 1C(H), 4BL |
| Note: (H) indicates that an HONORS section is available |

### Upper Division Major Requirements

| Chemistry | Chem 110A, 113A, 171, C185, [C172 or C180 or C181] |
| Math: | 104, 110, 110L, 120, 131, [121 or 150 or 160] |
| Mathematics: | 111, 121*, 122, 132, 150*, 160*, 162, CM180 |
| Materials Science & Engineering: | Chem 114, 184, Materials Science & Engineering 121L, 131L, 161L |

*course may only be applied once to the major [ ] pick one course enclosed in brackets

### Important Notes

- You may not take or repeat a chemistry or biochemistry course for credit if it is a prerequisite for a more advanced course for which you already have credit.
- Seminars, individual study courses, and research courses (e.g. 196, 199) may not be used to satisfy the requirements for the Chemistry Materials Science major.
- You must maintain at least a 2.0 GPA in all upper division coursework taken to fulfill the major requirements.
- All prep for major and major courses must be taken for a letter grade.

### SCHEDULE:

The following schedule for the first six quarters is strongly recommended for students planning to major in Chemistry-Materials Science:

<table>
<thead>
<tr>
<th>COURSES</th>
<th>QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry</td>
<td>1</td>
</tr>
<tr>
<td>20A</td>
<td>20B &amp; 20L</td>
</tr>
<tr>
<td>Mat. Science</td>
<td>104</td>
</tr>
<tr>
<td>Mathematics</td>
<td>31A</td>
</tr>
<tr>
<td>Physics</td>
<td>1A</td>
</tr>
</tbody>
</table>
COLLEGE REQUIREMENTS FOR THE B.S. DEGREE: Requirements for the B.S. degree established by the College of Letters and Science are listed in the UCLA General Catalog. A total of 180 quarter units are required for the degree, **60 of these 180 units must be upper division (course numbers 100-199)**.

UPPER DIVISION COURSES: The program of upper division courses for the Chemistry-Materials Science major should be planned with care. Particular attention should be paid to prerequisites for advanced courses. Please consult with the Undergraduate Office in 4009 Young Hall if you have questions about course planning.

<table>
<thead>
<tr>
<th>COURSE</th>
<th>PREREQUISITE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Required:</strong></td>
<td></td>
</tr>
<tr>
<td>Chemistry</td>
<td></td>
</tr>
<tr>
<td>110A</td>
<td>Chem 20B; Math 32A or 3C; Physics 1A(H), 1B(H), 1C(H)<em>, or Physics 6A(H), 6B(H), 6C(H)</em></td>
</tr>
<tr>
<td>110B</td>
<td>Chem 110A, 113A; Math 32B</td>
</tr>
<tr>
<td>113A</td>
<td>Chem 20B; Math 32A, 32B 33B; Physics 6A, 6B, 6C or 1A, 1B, 1C</td>
</tr>
<tr>
<td>113B</td>
<td>Chem 113A</td>
</tr>
<tr>
<td>114</td>
<td>Chem 30AL, 110A, 113A and EITHER 110B* or C113B*</td>
</tr>
<tr>
<td>171</td>
<td>Chem 30B</td>
</tr>
<tr>
<td>C172</td>
<td>Chem 171</td>
</tr>
<tr>
<td>C174</td>
<td>Chem 30CL, C172</td>
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<tr>
<td>C175</td>
<td>Chem 110AB, 113A, C172</td>
</tr>
<tr>
<td>C176</td>
<td>Chem 113A, C172</td>
</tr>
<tr>
<td>C180</td>
<td>Chem C172</td>
</tr>
<tr>
<td>C181</td>
<td>Chem 30B, 110A</td>
</tr>
<tr>
<td>184</td>
<td>Chem 30CL, 110A</td>
</tr>
<tr>
<td>C185</td>
<td>Chem 30AL, 110A, 113A, 171</td>
</tr>
<tr>
<td><strong>Material Science &amp; Engineering</strong></td>
<td></td>
</tr>
<tr>
<td>104</td>
<td>Chem 20A, 20B, 20L, Physics 1A, 1B</td>
</tr>
<tr>
<td>110</td>
<td>Mat-Sci and Eng 104</td>
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<tr>
<td>110L</td>
<td>Mat-Sci and Eng 104</td>
</tr>
<tr>
<td>111</td>
<td>Mat-Sci and Eng 104, 110</td>
</tr>
<tr>
<td>120</td>
<td>Mat-Sci and Eng 104, 110 (or Chem 113A)</td>
</tr>
<tr>
<td>121</td>
<td>Mat-Sci and Eng 120</td>
</tr>
<tr>
<td>121L</td>
<td>Mat Sci 121 (co-requisite)</td>
</tr>
<tr>
<td>122</td>
<td>Mat-Sci and Eng 104</td>
</tr>
<tr>
<td>131</td>
<td>Mat-Sci and Eng 130</td>
</tr>
<tr>
<td>131L</td>
<td>Mat-Sci and Eng 131</td>
</tr>
<tr>
<td>132</td>
<td>Mat-Sci and Eng 131</td>
</tr>
<tr>
<td>150</td>
<td>No prerequisites required</td>
</tr>
<tr>
<td>160</td>
<td>Mat-Sci and Eng 104, 130</td>
</tr>
<tr>
<td>161L</td>
<td>Mat-Sci and Eng 160 (161 is a recommended co-requisite)</td>
</tr>
<tr>
<td>162</td>
<td>Mat-Sci and Eng 104 Electrical Eng 100</td>
</tr>
<tr>
<td>CM180</td>
<td>Mat-Sci and Eng 104 or Chem 20A, 20B, 20L</td>
</tr>
</tbody>
</table>

* indicates may be taken concurrently with the course
THE UCLA CHEMISTRY-MATERIALS SCIENCE ORGANIC CONCENTRATION 2007 - 2008

The Department of Chemistry and Biochemistry offers four undergraduate majors, two concentrations, and one specialization: the CHEMISTRY major, the PHYSICAL CHEMISTRY concentration, the BIOCHEMISTRY major, the GENERAL CHEMISTRY major (for students who want to acquire a good chemical background in preparation for careers outside chemistry), the CHEMISTRY-MATERIALS SCIENCE major, the CHEMISTRY-MATERIALS SCIENCE ORGANIC concentration (listed here) and the COMPUTING SPECIALIZATION. For more details about these majors, consult your faculty advisor or the Undergraduate Office in 4009 Young Hall.

THE CHEMISTRY-MATERIALS SCIENCE MAJOR: The major is designed primarily for students who are interested in chemistry with an emphasis on the material properties of organic matter. The major provides appropriate preparation for graduate studies in fields emphasizing interdisciplinary research involving chemistry, engineering, and applied science. Refer to the UCLA General Catalog for course descriptions.

<table>
<thead>
<tr>
<th>Preparation for the Major</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Chemistry: Chem 20A(H), 20B(H), 20L, 30AL</td>
</tr>
<tr>
<td>Organic Chemistry: Chem 30A(H), 30B, 30BL, 30C, 30CL</td>
</tr>
<tr>
<td>Math: 31A, 31B, 32A, 32B, 33B</td>
</tr>
<tr>
<td>Physics: 1A(H), 1B(H), 1C(H), 4BL</td>
</tr>
</tbody>
</table>

Note: (H) indicates that an HONORS section is available

<table>
<thead>
<tr>
<th>Upper Division Major Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemistry: Chem 110A, 113A, 136, 171, C185</td>
</tr>
<tr>
<td>4 Units from Chemistry: 110B, C113B, C143A, C143B, 144, C172, C174, C175, C176, C180, C181</td>
</tr>
<tr>
<td>Materials Science &amp; Engineering: 104, 110, 110L, 120, 150</td>
</tr>
<tr>
<td>4 Units from Materials Science &amp; Engineering: 111, 121, 122, 131, 132, 160, 162, CM180</td>
</tr>
<tr>
<td>7 Laboratory Units from: Chem 114, 184, Materials Science &amp; Engineering 121L, 131L, 161L</td>
</tr>
</tbody>
</table>

*course may only be applied once to the major [ ] pick one course enclosed in brackets

<table>
<thead>
<tr>
<th>Important Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ You may not take or repeat a chemistry or biochemistry course for credit if it is a prerequisite for a more advanced course for which you already have credit.</td>
</tr>
<tr>
<td>➢ Seminars, individual study courses, and research courses (e.g. 196, 199) may not be used to satisfy the requirements for the Chemistry Materials Science Organic Concentration major.</td>
</tr>
<tr>
<td>➢ You must maintain at least a 2.0 GPA in all upper division coursework taken to fulfill the major requirements.</td>
</tr>
<tr>
<td>➢ All prep for major and major courses must be taken for a letter grade.</td>
</tr>
</tbody>
</table>

SCHEDULE: The following schedule for the first six quarters is strongly recommended for students planning to major in Chemistry-Materials Science with the Organic Concentration:

<table>
<thead>
<tr>
<th>COURSES</th>
<th>QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Chemistry</td>
<td>20A</td>
</tr>
<tr>
<td>Mat. Science</td>
<td>104</td>
</tr>
<tr>
<td>Mathematics</td>
<td>31A</td>
</tr>
<tr>
<td>Physics</td>
<td>1A</td>
</tr>
</tbody>
</table>
COLLEGE REQUIREMENTS FOR THE B.S. DEGREE: Requirements for the B.S. degree established by the College of Letters and Science are listed in the UCLA General Catalog. A total of 180 quarter units are required for the degree, 60 of these 180 units must be upper division (course numbers 100-199).

UPPER DIVISION COURSES: The program of upper division courses for the Chemistry-Materials Science Organic Concentration should be planned with care. Particular attention should be paid to prerequisites for advanced courses. If you have questions about planning your schedule, please feel free to visit an undergraduate advisor in 4009 Young Hall.

<table>
<thead>
<tr>
<th>COURSE</th>
<th>PREREQUISITE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required:</td>
<td></td>
</tr>
<tr>
<td>Chemistry</td>
<td></td>
</tr>
<tr>
<td>110A</td>
<td>Chem 20B; Math 32A or 3C; Physics 1A(H), 1B(H), 1C(H)<em>, or Physics 6A(H), 6B(H), 6C(H)</em></td>
</tr>
<tr>
<td>110B</td>
<td>Chem 110A, 113A; Math 32B</td>
</tr>
<tr>
<td>113A</td>
<td>Chem 20B; Math 32A, 32B 33B; Physics 6A, 6B, 6C or 1A, 1B, 1C</td>
</tr>
<tr>
<td>C113B</td>
<td>Chem 113A</td>
</tr>
<tr>
<td>114</td>
<td>Chem 30AL, 110A, 113A and EITHER 110B* or C113B*</td>
</tr>
<tr>
<td>136</td>
<td>Chem 30C, 30CL</td>
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<tr>
<td>C143A</td>
<td>Chem 30C, 30CL*</td>
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<td>Chem 110A, 113A</td>
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<td>Chem 30C, 30CL</td>
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<td>171</td>
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<tr>
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<td>Chem 171</td>
</tr>
<tr>
<td>C174</td>
<td>Chem 30CL, C172</td>
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<tr>
<td>C175</td>
<td>Chem 110AB, 113A, C172</td>
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<td>C176</td>
<td>Chem 113A, C172</td>
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<td>C180</td>
<td>Chem C172</td>
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<tr>
<td>C181</td>
<td>Chem 30B, 110A</td>
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<td>C185</td>
<td>Chem 30AL, 110A, 113A, 171</td>
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<td>104</td>
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<td>Mat-Sci and Eng 104</td>
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<td>110L</td>
<td>Mat-Sci and Eng 104</td>
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<td>111</td>
<td>Mat-Sci and Eng 104, 110</td>
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<td>120</td>
<td>Mat-Sci and Eng 104, 110 (or Chem 113A)</td>
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<tr>
<td>121</td>
<td>Mat-Sci and Eng 120</td>
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<tr>
<td>121L</td>
<td>Mat Sci 121 (co-requisite)</td>
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<tr>
<td>122</td>
<td>Mat-Sci and Eng 104</td>
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<tr>
<td>131</td>
<td>Mat-Sci and Eng 130</td>
</tr>
<tr>
<td>131L</td>
<td>Mat-Sci and Eng 131</td>
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<td>132</td>
<td>Mat-Sci and Eng 131</td>
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<tr>
<td>150</td>
<td>No prerequisites required</td>
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<tr>
<td>160</td>
<td>Mat-Sci and Eng 104, 130</td>
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<tr>
<td>161L</td>
<td>Mat-Sci and Eng 160 (161 is a recommended co-requisite)</td>
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<tr>
<td>162</td>
<td>Mat-Sci and Eng 104, Electrical Eng 100</td>
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<tr>
<td>CM180</td>
<td>Mat-Sci and Eng 104 or Chem 20A, 20B, 20L</td>
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</tbody>
</table>

* indicates may be taken concurrently with the course
THE UCLA COMPUTING SPECIALIZATION 2007-2008

The Department of Chemistry and Biochemistry offers four undergraduate majors, two concentrations, and one specialization: the CHEMISTRY major, the PHYSICAL CHEMISTRY concentration, the BIOCHEMISTRY major, the GENERAL CHEMISTRY major (for students who want to acquire a good chemical background in preparation for careers outside chemistry), the CHEMISTRY-MATERIALS SCIENCE major, the CHEMISTRY-MATERIALS SCIENCE ORGANIC concentration, and the COMPUTING SPECIALIZATION (described here). For more details about these majors, consult your faculty advisor or the Undergraduate Office in 4009 Young Hall.

THE COMPUTING SPECIALIZATION: The specialization is designed for students who are interested in adding computer programming and computational chemistry to their Chemistry, Biochemistry, General Chemistry, or Chemistry-Materials Science degree. Refer to the UCLA General Catalog for course descriptions.

<table>
<thead>
<tr>
<th>The Specialization Requirements</th>
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<tr>
<td>Major Requirements</td>
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<tr>
<td>Program in Computing Courses:</td>
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<tr>
<td>Program in Computing Elective:</td>
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<tr>
<td>Two Computation Chemistry Courses:</td>
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</tbody>
</table>

Important Notes

- Courses must be completed with a combined GPA of at least 2.0.
- Students must petition for admission to this program AFTER they complete Programming in Computing 10A and 10B.
- Petitions should be filed in the Undergraduate Office in 4009 Young Hall.
- Students graduate with a bachelor's degree in their major and a specialization in computing.
### III. COURSE OFFERINGS FOR 2007 – 2008

#### Tentative Course Offerings by Quarter 2007-2008

<table>
<thead>
<tr>
<th>Course</th>
<th>Fall</th>
<th>Winter</th>
<th>Spring</th>
<th>Course</th>
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<tr>
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<td>17</td>
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<td>153A</td>
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<td>156</td>
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<td>171</td>
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</tbody>
</table>

All Information is Subject to Change
IV. ACADEMIC RESOURCES

UCLA GENERAL CATALOG
The General Catalog contains policies and procedures for the College of Letters and Science as well as for each academic department. Course descriptions, prerequisites, and unit credit are also listed in the catalog. Students are held responsible for the information contained in the Catalog for the academic year in which they were admitted to UCLA. It is published every year, and is updated online with the most current information. The General Catalog, with updates, is accessible on the web at http://www.registrar.ucla.edu/catalog.

UCLA SCHEDULE OF CLASSES
This quarterly publication lists all courses offered along with discussion and laboratory sections, final exam dates and times, class sizes and locations. The Schedule also includes information on important deadline dates for the current academic year, registration policies, billing and fees information, financial support, academic counseling, URSA, enrollment, official notices, libraries, emergency instructions, student services, and listings of seminars and special programs for undergraduates. The Schedule is available on the web at http://www.registrar.ucla.edu/schedule.

CHEMISTRY & BIOCHEMISTRY UNDERGRADUATE OFFICE
The Undergraduate Office staff offers counseling to Chemistry, Biochemistry, General Chemistry, and Chemistry-Materials Science majors and prospective majors. If students need assistance in planning their schedule or have questions regarding petitions, they should stop by 4009 Young Hall. The Undergraduate Office staff also answers questions regarding Departmental and/or University regulations, career planning and problems of academic status. All students are seen on a walk-in basis. Additional resources provided by this office include information about research projects (Chemistry/Biochemistry 196, 199), faculty room and phone numbers, summer internships, tutoring, scholarships, fellowships and job openings. The Scheduling and Enrollment Coordinator will provide answers to questions concerning enrollment for all chemistry courses and schedule changes. Other departmental information and updates are available online at www.chem.ucla.edu/dept/Ugrad.

Undergraduate Counselor: Connie Firestone
undergrad@chem.ucla.edu
4009 Young Hall
M-F 8:30AM – 5PM
310-825-1859

Scheduling and Enrollment Coordinator: Denise Mantonya
denise@chem.ucla.edu
4009 Young Hall
310-825-4660

LISTSERV
Sign up for this service to receive e-mails from the undergraduate office with the most current announcements on jobs, internships, scholarships, awards, and changes in the department. Send an e-mail to majordomo@chem.ucla.edu with the message “subscribe ugradlist youremail@ucla.edu” to sign up for these e-mail announcements.
FACULTY ADVISORS
Faculty Advisors provide assistance with academic course planning. They meet with students who want to know more details about the content of their chemistry courses. These professors can also provide important information about different careers in chemistry.

Biochemistry Faculty Advisor
Rob Clubb
rclubb@mbi.ucla.edu
656 Boyer Hall
310-206-2334

Chemistry Faculty Advisor
Craig Merlic
merlic@chem.ucla.edu
3505B Mol Sci
310-825-5466

Physical Chemistry Advisor
Tom Mason
mason@chem.ucla.edu
3040 Young Hall
310-206-0828

Chemistry-Materials Science Advisor
Sarah Tolbert
tolbert@chem.ucla.edu
3045A Young Hall
310-206-4767

General Chemistry Faculty Advisor
Steve Hardinger
harding@chem.ucla.edu
3077C Young Hall
310-825-4009

COLLEGE COUNSELORS
Questions regarding University or College of Letters & Science requirements (e.g. General Education, Foreign Language, Writing I/II, etc.) are handled by College Counseling Services. They also provide assistance with petitions. If you are an Honors student, you should visit the Honors Counseling Office in A-311 Murphy Hall. Academic Advancement Program (AAP) students receive counseling in 1209 Campbell Hall. Athletes should seek help from their counselors in the Morgan Center. All other students can receive academic counseling from the College counselors in A-316 Murphy Hall. For additional information on the College, counseling services, and other academic programs, please visit www.college.ucla.edu/up.

ACADEMIC OFFICE ASSISTANTS
Academic assistants prepare class materials and organize divisional seminars.

Organic Chemistry:
3505 Mol Sci
310-206-1036

Physical Chemistry:
Judith Sweeney
3064 Young Hall
310-206-4956

Inorganic Chemistry:
1521 Mol Sci
310-825-4208

Biochemistry:
Penny Jennings
5034 Young Hall
310-825-7071
**TUTORING**
Free tutoring is available through the Academic Advancement Program (AAP) 310-825-1481, [www.college.ucla.edu/up/aap/tutoring/index.html](http://www.college.ucla.edu/up/aap/tutoring/index.html) and College Tutorials in Covel Commons 310-825-9315, [www.college.ucla.edu/up/aitc/](http://www.college.ucla.edu/up/aitc/). Students need to contact each of the services at the beginning of the quarter for information about signing up. Space may be limited, so contact them as soon as possible. Alpha Chi Sigma, the Chemistry fraternity, also offers tutoring in Chemistry courses. They can be contacted at Young 1275 or by calling 310-825-9720 for more information. The Undergraduate Office also generates a tutoring list by the second week of each quarter of graduate students who offer one-on-one tutoring on a fee-for-service basis. The list is available at 4009 Young Hall. It is also posted on the web from our Undergraduate page [http://www.chem.ucla.edu/dept/Ugrad/Counseling/tutor_list.htm](http://www.chem.ucla.edu/dept/Ugrad/Counseling/tutor_list.htm).

**VIRTUAL OFFICE HOURS**
The Chemistry Virtual Office Hours webpage is available for students to access their class homepages, contact their professors, view TA/professor office hours and course announcements, and obtain course materials for Chemistry courses. Visit this site online at [http://voh.chem.ucla.edu](http://voh.chem.ucla.edu).

**CHEMISTRY AND BIOCHEMISTRY DEPARTMENT WEBPAGE**
This page has links to faculty web pages, course homepages, research project updates, chemistry news, seminar schedules, and undergraduate/graduate information. [www.chem.ucla.edu](http://www.chem.ucla.edu)

**CHEMISTRY LIBRARY/COMPUTER LABS**
The Chemistry Library is available for students to check out books, study and use the photocopiers. The Instructional Computing Lab is open to all students in the Chemistry & Biochemistry Department. The Science Learning Center computer labs are open for any undergraduate enrolled in Physical or Life Science courses. Microsoft Word, Microsoft Excel and ChemDraw are available for student use. For times and locations, visit [http://www.chem.ucla.edu/student/chemlab.html](http://www.chem.ucla.edu/student/chemlab.html). For additional computer lab locations, refer to [http://www.computerlabs.ucla.edu/](http://www.computerlabs.ucla.edu/)

Chemistry Library
4238 Young Hall
(310) 825-3342

<table>
<thead>
<tr>
<th>Regular Session Hours:</th>
<th>Summer Session Hours:</th>
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<tr>
<td>M-Th 8AM-10PM</td>
<td>M-F 9AM-5PM</td>
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<td>Fri 8AM-5PM</td>
<td>Sat 1PM-5PM</td>
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<tr>
<td>Sat 1PM-5PM</td>
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</tr>
<tr>
<td>Sun 1PM-10PM</td>
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</tbody>
</table>
V. FREQUENTLY ASKED QUESTIONS

CHEMISTRY CLASSES

1. Can I pass out of 20A with my AP credit?
   If a student receives a 4 or a 5 on their AP Chemistry test, they can choose to pass out of Chemistry 20A and go directly to Chemistry 20B. If a student wants to do this, the student can contact the Undergraduate Office (4009 Young) and fill out an enrollment sheet that will override the prerequisite restriction. Even with a high score, the computer will not automatically give the exemption. Students are offered the option, but not required to pass out of this class, because medical schools do not recognize AP credit as part of their requirements; therefore, pre-med students should take Chemistry 20A(H) at UCLA.

2. Can I take a graduate-level course?
   Undergraduates can enroll in most graduate-level classes with permission from the instructor. If URSA allows the student to enroll, there is no restriction, but the student should contact the instructor to let them know an undergraduate has enrolled in their course. If a student cannot enroll through URSA, he/she should contact the instructor and, if permission is given, students should bring proof (written note or printed e-mail) to 4009 Young Hall to Denise Mantonya, who will enroll the student in the class as long as space is available.

3. I think I may have taken a course at another school that I didn't get credit for here. What should I do so I don't have to take it again?
   If a student transfers coursework to UCLA that is not given equivalent credit to a UCLA course, the student will need to petition to get credit for the course. For GE coursework and college requirements, students can petition at their college counseling unit (AAP, Honors, Athletics, or Letters and Science College Academic Counseling).

   For Chemistry classes, students should bring a syllabus of the course to the Undergraduate Office (4009 Young) and the counselors will have the course content evaluated for credit by our faculty advisors. For credit in subjects other than Chemistry, i.e. math, physics, or life science, students must petition with the appropriate department. Whatever credit the advisors determine will be reported to the student in writing. For Chemistry and Biochemistry majors, all necessary changes to the DPR will be made by the Chemistry and Biochemistry Undergraduate Counselor. Students from other majors must have changes to their DPR made by their department counselors.

4. Can I take classes at another college to complete UCLA requirements?
   Students can take classes at other institutions but they must verify with the department that the courses will be equivalent to the course they need at UCLA. Additionally, students must follow all other UCLA rules concerning this matter:

   Concurrent Enrollment
   Students will not receive credit for coursework completed at another institution while simultaneously enrolled at UCLA as a regular session student (excludes summer school). This policy includes Extension classes.

   Summer School
   Students may receive course credit for courses taken at other UC campuses, other four-year institutions and community colleges provided that the courses are deemed equivalent.
Unit Limits
Students who have completed 105 units or more will not receive unit credit for classes taken at a community college, but the classes will still satisfy specific requirements if the courses have been deemed equivalent.

Grade Point Averages
Only UC courses or UCLA Extension classes marked XLC will apply to a student's UCLA grade point average.

Residency Requirement
Thirty-five out of the last forty-five units toward a student's degree must be completed at UCLA.

5. Do I have to take a Chemistry placement test?
The department is not requiring students to take the Chemistry Diagnostic Exam for the 2007-2008 academic year, so students may enroll in Chemistry 20A or 14A at their discretion. Students can feel free to speak to the profs or to the Chemistry Undergraduate Counselors if they are not sure which course is appropriate.

6. What is an impacted class?
Many Chemistry and Biochemistry courses are designated as impacted. Impacted courses may NOT be dropped after the second week of class. If there are extraordinary circumstances (i.e. hospitalization) that cause the student to consider dropping an impacted course, they can petition for a late drop of an impacted course through their college counseling unit. Approval is not guaranteed. The following courses in the department ARE impacted: Chemistry 14BL, 14CL, 20L, 30A, 30AL, 30B, 30BL, 30C, 30CL, 110A, 114(H), 144, 153A, 153B(H), 153C, 153L, 154, C174, 184.

7. Who do I talk to if I need to figure out what classes I should take next quarter?
If students would like academic advice regarding major classes, they can see the departmental counselors in 4009 Young Hall. The counselors are free to see students on a drop-in basis, weekdays from 8:30am-5pm. For College and University requirements, including GE's, students should visit their college counseling unit (AAP, Honors, Athletics, or the College). To find information on specific courses or course content, students may also look up information in the online publications of the General Catalog or Schedule of Classes. These publications can be found online at www.registrar.ucla.edu/catalog and www.registrar.ucla.edu/schedule.

ENROLLMENT / DROPS

8. The computer is not letting me enroll in a class that I've met the prerequisites for. What do I do?
If a student has taken the prerequisites for a UCLA chemistry class at a different school, URSA will restrict enrollment because it does not recognize courses that were not taken at UCLA, even if the courses are equivalent and the student has been given credit for them. If this happens, or the student cannot enroll for another reason, students can either come into the Undergraduate Office (4009 Young) and fill out an enrollment form or e-mail our enrollment coordinator at denise@chem.ucla.edu with their name, student ID number, the course, and the 9-digit course ID number. The student will be enrolled within 24 hours (on business days) of submitting an enrollment request if there are no other restrictions and space is available.

9. Can I enroll in a class that I have not met the prerequisites for?
URSA will not allow students to enroll in chemistry classes unless they have already met the prerequisites. This rule is only waived for students who bring written permission from the instructor stating that he/she knows the prerequisites have not been completed and is still allowing the student admission into the class. These permission notes should be brought to Denise Mantonya in 4009 Young Hall. We do not recommend this, as it is difficult to do well in courses where one is not fully
prepared. Additionally, professors will not waive prerequisites simply because a student needs the class to graduate.

Students must be careful about taking courses without having completed the prerequisites because chemistry courses are sequential and once a more advanced course in the sequence is completed, the student cannot take an earlier course in the sequence for unit or grade credit. A credit restriction will be applied, which means that no unit credit will be granted for the course and the grade will not be calculated into the GPA.

10. **What is my chance of getting into a Chemistry class if I am waitlisted? What if I can't even get on the waiting list?**

Our waitlists are fairly realistic. Many people who are waitlisted have a good chance of getting into the class, but there is no guarantee. If someone drops the course, a spot will open up. Other than that, no enrollment decisions will be made until at least the first day of the class. Students should be sure to attend class on the first day, even if they are not on the waiting list. The professor will communicate the most updated enrollment information on the first day of class.

11. **Why are there some Chemistry classes where you can only enroll on the waitlist?**

These classes are upper division lab classes (114, 136, 144, 154, C174, 184, C185) where enrollment priority is given to graduating seniors. Students should sign up on the waiting list and then show up to class on the first day. The professor will give enrollment spots to graduating seniors first. Even if a student's name is on the waitlist, however, he/she must show up on the first day of classes or his/her spot will be given to someone else.

12. **How can I drop a class?**

   **Non-impacted Courses**

   Students can drop a non-impacted class anytime up until Friday of the fourth week of the quarter through URSA online. Students have until Friday of the second week to drop the course with no restrictions, notations, or fees. From the end of second week to the end of fourth week, students can drop non-impacted courses through URSA, but a fee is charged.

   During the fifth, sixth, and seventh week, students need to get a Late Drop Petition from their college counseling unit to drop a non-impacted course. From week eight through ten, students need to get a Restricted Late Drop petition (maximum of three allowed during a students career) from their counseling unit. Both petitions require the instructor's signature. If approved by the College, students will pay a fee and a notation will appear on the transcript indicating the week that the course was dropped. UCLA places this notation instead of a "W," which is the notation that many other colleges use to indicate a dropped course. UCLA does not use the "W" notation. All fees are charged to students' BAR accounts. Students cannot drop a course once the final has been taken.

   **Impacted Courses**

   After the first two weeks of the quarter, students must petition with their college counseling unit (College of Letters and Science, AAP, Honors, Athletics) to drop an impacted class. These petitions are rarely approved except when students are facing extraordinary circumstances and have physical documentation. If approved, students are charged a fee and a notation is added to their transcript. See page 21 for a list of impacted courses in the Chemistry and Biochemistry Department.

13. **What do I do if I have an emergency and need to drop all of my classes for the quarter?**

   This is called a "withdrawal". If a student has an emergency situation (hospitalization, death in family, etc.) where he/she knows they will not be able to finish their classes or will not be able to catch up in their coursework, the student has the option of petitioning to drop all of their classes for the quarter if they are in good academic standing. A student may withdraw at any time during the quarter PRIOR TO TAKING THE FINAL EXAMS. Withdrawals require all the students' professors to sign a petition, which
then must be approved by the College of Letters and Science. The withdrawal is noted on the student's transcript, although there is no indication of the courses in which he/she was enrolled. Withdrawing from a quarter can affect financial aid, international student status, athletics, and on-campus housing status, so students should check with these departments before withdrawing.

**GRADUATE/PROFESSIONAL SCHOOLS & CAREER INFORMATION**

14. **I want to go to professional health school (medical, dental, pharmacy, optometry, etc). Where should I go to receive counseling about what courses I need to take?**
   For pre-health counseling, students should start out by taking a workshop at the Career Center or through Academics in the Commons. From there, if students have basic questions they can speak to Pre-Medical Peer Counselors, who are available Monday-Friday on the second floor of Covel Commons, to get them started in the right direction. For more information on MCAT tests, information specific to medical schools, professional school workshops and a library of books and catalogs about professional schools, students should visit the Career Center in the Strathmore Building or check out their website at: www.career.ucla.edu/GraduateSchool&PreProfessionalServices.
   For academic advice on what classes will work for medical school, students should visit their departmental counselors and check with individual health schools about their admission requirements.

15. **I want to go to a professional health school (medical, dental, pharmacy, optometry, etc). Will a Chemistry/Biochemistry major meet the pre-health requirements?**
   All professional schools are different, so students should check the requirements for each school individually to make sure they are taking the correct classes to qualify for admission. However, there are some standard science requirements that students usually need that the Chemistry/Biochemistry majors will cover (1 year of general chem., 1 year of organic chem., 1 year of physics, 1 year of math, 1 course in biochemistry, 1 year of biology--required by the Biochemistry major only). However, additional coursework will be necessary and students should check with the professional school's admissions office to find additional requirements.

16. **I'm planning on going to graduate school in Chemistry/Biochemistry/Materials Science. Who should I speak to?**
   General information about graduate study in chemistry, biochemistry and related fields is available in the Undergraduate Office. Furthermore, for quick access to hundreds of graduate programs in the life and physical science fields, students can access the Graduate School Web Finder from the Undergraduate website. Search by school or by field of study: http://www.chem.ucla.edu/dept/Ugrad, then click the link to Graduate School and then the link to Graduate School Web Finder. The Career Center also has a huge library of books about graduate schools and specific programs. For specific questions about graduate studies at UCLA, students can speak to a counselor in the Chemistry and Biochemistry Graduate Office (4006 Young). They can also download applications at www.chem.ucla.edu/grad/admin.html.

**MISCELLANEOUS**

17. **How can I find out about applying for awards and scholarships?**
   When our office is notified about scholarships and awards, we will post notices on the bulletin board outside our office and on our website. www.chem.ucla.edu/dept/Ugrad. We also send out notices on the Undergraduate Listserv, so students should make sure they are signed up for it (see "Academic Resources" section) to get the most current announcements from the department. In addition to the scholarship information available in the Undergraduate Office, the Scholarship Resource Center distributes materials on scholarships and other forms of merit-based and need-based financial aid. The
18. **Who do I see about possible room and/or time changes?**
For information about possible room or time changes for Chemistry courses, check with Denise Mantonya in the Undergraduate Office (4009 Young) or the Mail and Information Center (Young 3034). Most updates are also current on the Schedule of Classes and URSA online.

19. **How do I get/remove an 'Incomplete Grade'?**
An Incomplete (I) grade is given to a student who is doing satisfactory work in the course, and due to unforeseen circumstances (e.g. accident, illness, etc.), is unable to complete the course. A grade of “I” may only be issued if a student has a passing grade of “C” or better at the time the incomplete is granted. Only the instructor of the course can grant approval for an "I" and determine the terms for completion. The decision to grant an "I" is entirely at the discretion of the instructor, regardless of the circumstances. Students are not required to petition with the College for an Incomplete. Additionally, the remaining coursework must be completed prior to the end of the next academic quarter in which the student is registered, or the incomplete grade will lapse into an F or NP. The student **does not** enroll in the course again. Students should inform instructors if they will be sitting in on a class to remove their previous Incomplete. The professor will submit a grade change form to remove the Incomplete when the coursework is completed.

20. **Can I reschedule a final exam if I have a conflict?**
According to policy, students are responsible for being aware of the final exam schedule when they register for classes. Final exam schedules and codes can be found at [www.registrar.ucla.edu/schedule](http://www.registrar.ucla.edu/schedule). It is only a rumor that if you have two or three final exams on the same day, you may have them changed. Should the situation arise that a final exam conflicts with a student's religious observances, the student should contact the instructor within the first two weeks of the quarter, or as soon as possible after the exam date is announced, to set up an alternate exam schedule. This is in compliance with Section 92640(a) of the California Education Code.

21. **What is the policy on Academic Dishonesty at UCLA?**
Cheating will result in disciplinary action taken against you by the Dean of Students Office. Cheating includes, but is not limited to: copying (or permitting copying) from notes or from another student's exam; plagiarizing on laboratory reports or from scientific papers; altering an exam or lab report before resubmitting for a grade. Presenting false medical excuses for missing exams is also grounds for disciplinary action. The consequences of cheating include dismissal from the University. For more information, visit [www.deanofstudents.ucla.edu](http://www.deanofstudents.ucla.edu).

22. **Who should I speak to if I have compliments or complaints about an instructor?**
At the end of each course, students will be given the opportunity to evaluate professors and teaching assistants. Those being evaluated take the comments seriously, so please provide honest evaluations that will help enhance their teaching and the course. If a student needs to make an immediate complaint and has already spoken with the instructor personally, he/she should speak to the Department Chair in 3010 Young Hall.
VI. RESEARCH OPPORTUNITIES

STUDENT RESEARCH: WHERE TO START

Undergraduate research is an amazing opportunity for students to receive hands-on training directly from faculty, post-doctorates, and graduate students. Not only does research give students an opportunity to learn more about their areas of interest, it also assists them in being more competitive applicants to graduate and professional schools. At UCLA, students have the opportunity to volunteer as a researcher in labs all over campus. They are not restricted to their major department. Students can also receive academic credit for their research. You are encouraged to seek out the experience of working in a lab whether you can receive credit for it or not. Frequently, a student who first volunteers in a laboratory can pursue his/her interest with a full-fledged research project. Undergraduate research may improve the caliber of your letters of recommendation and provide chances for exploring various areas of chemistry and biochemistry.

Here are some tips for some good ways to get started in finding a research position! For further assistance, please feel free to visit the Chemistry and Biochemistry Undergraduate Office (4009 Young) or the Undergraduate Research Center (2121 LS).

• Think about what professors and/or subjects you have taken and enjoyed. Consider doing research in those areas first.
• Visit the Undergraduate Research Center in 2121 Life Sciences. They have a computer database of professors doing research on campus and their research topics. Find a few professors who are working on interesting projects and record their contact information. Counselors at the Undergraduate Research Center can also provide help in finding professors with available research positions.
• Contact the professors individually and provide them with information about yourself (experience, academic level, interests, goals, etc.). Request a meeting in person to learn more about their research.
• During the meeting, ask the professor questions about his/her projects and if they have positions available in their labs for undergraduates. If they do not, thank them for their time and ask them to keep you in mind for the future.
• Persistence is KEY! Even if you do not immediately get a response from a professor, keep sending e-mails and trying to make contact. It may be a busy time of year or professors may prefer calls to e-mails. Professors do not always advertise their openings, so it is up to the student to keep making contact.
• When you find a professor who has space in their lab, ask about expected time commitment, possible wages or course credit, duties, etc. and decide if you think the lab is right for you.
• Ask your professor about opportunities for receiving academic credit for your research.

WHAT CHEMISTRY AND BIOCHEMISTRY STUDENTS HAVE TO SAY ABOUT UNDERGRADUATE RESEARCH...

“Sampling research topics in various fields—including biochemistry, photoorganic chemistry, and biomaterials—has allowed me to refine my interests in science at large. My experiences have prepared me for those which await me at the graduate level, such as group and individual work, presentation, and the ever-delightful late night in lab!”

-Carrie Brubaker, Biochemistry major,
Researcher for 4 years.
“Performing undergraduate research was one of my most memorable experiences because it allowed me to apply many of the concepts that I learned in my science classes to the actual experiments I was performing. My research also helped me to understand the concepts from class much more thoroughly because I had the opportunity to use techniques and machines that other students were only reading about. Laboratory research also helped me to make my final decision about my major because I realized how applicable biochemical concepts are from medicine to law.”

-Robert Scholz, General Chemistry major, researching with Dr. Carla Koehler for over one year.

“As a biochemistry undergraduate, the work done in most classes is not representative of the work done as a professional in the field. Being a part of a research project has elements of excitement and intrigue that laboratory classes lack. If you love science, but are bored by monotonous lectures and busy work, then a lab internship might just be the thing to remind you why you chose this major.”

-Gabriella Boulting, Biochemistry researcher for Dr. Jim Bowie for over three years.

UNDERGRADUATE RESEARCH FOR ACADEMIC CREDIT

Student Research Program (SRP)
The Student Research Program (SRP) is an option recommended for first and second year students who wish to be involved in research. Students will receive from 1-4 units of credit for SRP (based on how much time you can volunteer each week) and a notation on their transcript that specifies the research area. There is no required minimum GPA; many professors only require that you be enthusiastic and responsible. For more information about participation requirements, contact the Undergraduate Research Center for the area in which you would like to do research:

URC Humanities and Social Sciences
1201A Campbell Hall
Phone: (310) 825-2935
E-Mail: urhass@college.ucla.edu

URC Life and Physical Sciences
2121 Life Sciences
Phone: (310) 794-4227
E-Mail: urlaps@college.ucla.edu

Departmental Independent Research (Chemistry/Biochemistry 196/199)
The Chemistry and Biochemistry 196/199 independent research courses offer students an opportunity to receive upper division elective units for their research. This credit cannot be used toward the major. Students interested in enrolling must be supervised by a faculty member in the department. Descriptions of faculty research interests are located at the end of this handbook to assist students in finding and contacting a mentor. Students working with professors in other departments must sign up for the undergraduate research course through that department.

Prerequisites for participation in Chemistry/Biochemistry 196/199’s include 1) junior standing with a 3.0 GPA in the major, or senior standing, or consent of the instructor, 2) a written proposal of the research to be conducted that is approved by a Chemistry or Biochemistry faculty advisor and the department chair (visit the Undergraduate Office for Proposal Guidelines) and 3) a research contract which can be downloaded from the “Contracts” link on the student’s MyUCLA page. Prospective 196/199 students must submit all paperwork/contracts to the Undergraduate Office by Monday of the second week of the quarter. For specific deadline dates please check with the Undergraduate Office. Students are required to enroll in Chemistry 196A for their first 8 units of research. This course is taken Pass/No Pass. After completing 8 units of 196A research, students have the option of enrolling in Chemistry 196B for a maximum of 4 units, or Chemistry 199 for a maximum of 12 units, and earn a letter grade for their research. Please consult the Undergraduate Office for further information.
VII. ACADEMIC PROGRAMS FOR UNDERGRADUATES IN SCIENCE

DEPARTMENTAL SCHOLAR PROGRAM

Exceptionally promising undergraduate students with junior or senior standing may petition to pursue their bachelor’s and master’s degrees simultaneously. Qualifications include the completion of 24 courses (96 quarter units) at UCLA or the equivalent at a similar institution, the completion of the major preparation, and a UC cumulative GPA and major GPA of 3.5 or better. You must also have at least one term of coursework remaining at UCLA. Students should be doing research with a faculty member in the department as well.

To obtain both the Bachelor’s and Master’s degrees, you must be provisionally admitted to the Graduate Division, fulfill requirements for each program and maintain a minimum B average. No course may be used to fulfill requirements for both degrees. If you are interested in becoming a Departmental Scholar, consult Tony Leadholm in the Graduate Office (4006 Young, 825-3150) in advance of application dates for graduate admission.

ALPHA CHI SIGMA

Alpha Chi Sigma is a student fraternity for men and women who have taken at least one chemistry course at UCLA. The members of this group participate in social events together, but also support each other academically by striving for the advancement of chemistry, both as a science and as a profession. These students work in the Alpha Chi Sigma office (1275 Young Hall) to offer free tutoring services and sell lab equipment for current UCLA students. For more information about becoming a part of AXE, call (310)825-9720 or log on to the AXE home page at www.chem.ucla.edu/~AXE/.

THE ACS STUDENT AFFILIATES PROGRAM (SAACS)

Any student working towards an undergraduate degree in the chemical sciences may become a Student Affiliate of the American Chemical Society (ACS). Affiliation with ACS helps you network with future colleagues and established professionals. Some benefits include discounts on ACS publications, career information and access to the ACS Office of Employment Services. Student Affiliates also have access to national, regional and local meetings of ACS as well as opportunities to present their research through the annual ACS Undergraduate Research Poster Session. Students should check out www.chemistry.org for more information.

PROGRAM FOR EXCELLENCE IN EDUCATION AND RESEARCH IN THE SCIENCES (PEERS)

The Program for Excellence in Education and Research in the Sciences starts students out on the right foot, offering first-year students an opportunity to create a network of assistance during their academic career at UCLA. PEERS students receive personal academic advising, tutoring, and assistance with research opportunities. They also attend collaborative learning workshops in math and science courses, career planning workshops, and seminars with UCLA faculty experts. PEERS targets students who have overcome significant hurdles prior to being accepted at UCLA. Interested students should e-mail peers@lifesci.ucla.edu.
THE CENTER FOR ACADEMIC AND RESEARCH EXCELLENCE (CARE)

CARE facilitates student placement in paid laboratory research positions with UCLA faculty members in the College of Letters & Science and three of the professional schools (Engineering, Medicine, and Public Health). CARE also offers research opportunities at other UC campuses, California research universities, and national laboratories. Research stipends, funded by federal and private agencies, are available during the summer and academic year on a competitive basis. CARE emphasizes the need to increase the number of historically underrepresented individuals who will attain bachelor's and graduate science degrees as well as promotes a more ethnically diverse science community. Students from educationally or socio-economically disadvantaged backgrounds are encouraged to apply. www.care.ucla.edu

For further information, contact:  

Laina Long  
Assistant Director  
2121 Life Sciences  
(310) 206-4600

SCIENCE TEACHER EDUCATION PROGRAM (STEP)

The College of Letters and Science and the Graduate School of Education and Informational Studies offers a joint B.S./M.Ed./credential program for students planning science teaching careers. Students can begin preparing for a career in science teaching as early as their sophomore year. The Junior and Senior programs are highly structured, and include the completion of major classes for the B.S., graduate-level courses for the M.Ed., and part-time student teaching. Students earn increasing levels of financial support for their teaching.

For further information, visit the website (http://www.nslc.ucla.edu/STEP), or contact:

Dr. Arlene Russell, Director  
russell@chem.ucla.edu  
(310) 825-7570

Dr. Fred Freking, Advisor  
ffreking@ucla.edu  
(310) 794-2191
VIII. CAREERS IN CHEMISTRY

• What can I do with my Chemistry/Biochemistry Degree?

Individuals who graduate with a degree in chemistry or biochemistry are employed in a wide variety of occupations. A career choice should be based on a thorough exploration of various alternatives so that your interests, abilities and values are related as closely as possible to your work. A career choice involves a substantial amount of self-understanding, trial and error and time. When considering a career, take your own unique qualifications and interests into consideration.

Graduates with a Bachelor’s degree in chemistry or biochemistry will find a broad range of career options available. Industry is the largest employer of chemists (about 60%). These chemists are most often involved in either research and development (R&D) or production. Private and non-profit institutions, such as agricultural service firms, biotechnical firms, food products companies, and insurance companies hire many chemists and biochemists to do research and analysis of their data. Other chemists may work in marketing, sales, computer programming or in non-traditional fields such as patent law, science journalism, consulting, personnel recruitment and art conservation. The second largest employers of chemists are academic institutions (about 24%). High school chemistry teachers usually have Bachelors or Master’s degrees. The doctorate is required by colleges and universities and is preferred by most two-year colleges; professors function as both instructors and researchers. The government employs chemists (about 9%) for a variety of jobs in federal, state and local government agencies, especially in the administration or monitoring of activities with a scientific component. For example, the Food and Drug Administration employs medicinal, analytical and biochemical chemists; the Environmental Protection Agency employs physical, environmental, inorganic, biochemical and organic chemists; and the National Science Foundation hires administrators, writers and editors.

• Where can I go to find out what jobs are available now?

The following websites will lead you to Science specific career search links or information.

<table>
<thead>
<tr>
<th>UCLA Career Center</th>
<th><a href="http://www.career.ucla.edu">www.career.ucla.edu</a></th>
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<tr>
<td>Aerotek</td>
<td><a href="http://www.aerotek.com">www.aerotek.com</a></td>
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<tr>
<td>American Chemical Society’s Chem Jobs</td>
<td><a href="http://www.acs.org/careers">www.acs.org/careers</a></td>
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<tr>
<td>American Institute of Chemical Engineers</td>
<td><a href="http://www.aiche.org/careers">www.aiche.org/careers</a></td>
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<tr>
<td>Chemical Online Digital Marketplace</td>
<td><a href="http://www.chemicalonline.com">www.chemicalonline.com</a></td>
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<td>Chemistry Jobs</td>
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<td>Jobs for Scientists</td>
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<td>Kelly Scientific</td>
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<td>Kforce Scientific</td>
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<tr>
<td>Lab Support</td>
<td><a href="http://www.onassignment.com">www.onassignment.com</a></td>
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<tr>
<td>Occupational Outlook for Chemists and Material Scientists</td>
<td><a href="http://stats.bls.gov/oco/ocos049.htm">http://stats.bls.gov/oco/ocos049.htm</a></td>
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<tr>
<td>Science a Go-Go</td>
<td><a href="http://www.scienceagogo.com">www.scienceagogo.com</a></td>
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<tr>
<td>Science Careers</td>
<td><a href="http://recruit.sciencemag.org">http://recruit.sciencemag.org</a></td>
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<td>Science's Next Wave</td>
<td><a href="http://nextwave.sciencemag.org">http://nextwave.sciencemag.org</a></td>
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• **What kind of job can I get with a Chemistry/Biochemistry degree?**

Students have a wide variety of options when deciding on a career with a Chemistry/Biochemistry degree. Whether you’re thinking of continuing your education at professional/graduate school or just starting your career right away, there are jobs out there for you. These are just a few of the options available to graduates in Chemistry and Biochemistry. Feel free to look up more information about these career opportunities to see what the job would entail and what additional education you may need. Additionally, the faculty advisors in the department will also be able to give you advice about what field would be appropriate for you based on your interests.

<table>
<thead>
<tr>
<th>AGRICULTURAL SCIENTIST</th>
<th>MOLECULAR BIOCHEMIST</th>
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<tbody>
<tr>
<td>ANESTHESIOLOGIST</td>
<td>OCCUPATIONAL SAFETY SPECIALIST</td>
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<td>APPLICATION CHEMIST</td>
<td>OPTOMETRIST</td>
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<td>ASSAYER</td>
<td>PATENT AGENT</td>
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<td>BEVERAGE TECHNOLOGIST</td>
<td>PHARMACEUTICAL SALES REP</td>
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<td>BIOCHEMIST</td>
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<td>BIOTECHNICIAN</td>
<td>PHYSICIAN</td>
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<td>BREWER LAB ASSISTANT</td>
<td>PLASTICS ENGINEER</td>
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<td>CHEMICAL ENGINEER</td>
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<td>CHEMICAL OCEANOGRAPHER</td>
<td>QUALITY CONTROL MANAGER</td>
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<td>CHEMIST</td>
<td>RADIATION HEALTH SPECIALIST</td>
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<td>COOPERATIVE EXTENSION AGENT</td>
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<td>CRIME LAB ANALYST</td>
<td>SAFETY INSPECTOR</td>
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<td>DENTIST</td>
<td>SALES REPRESENTATIVE</td>
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<td>ENVIRONMENTAL HEALTH SPECIALIST</td>
<td>SCIENTIFIC EDITOR</td>
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<tr>
<td>FOOD SCIENTIST/TECHNOLOGIST</td>
<td>SPECIFICATION WRITER</td>
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<tr>
<td>FORENSIC CHEMIST</td>
<td>SPECTROSCOPIST</td>
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<td>GENETIC COUNSELOR</td>
<td>SOIL SCIENTIST</td>
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<td>HAZARDOUS MATERIALS MANAGER</td>
<td>SYSTEMS ANALYST</td>
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<td>HEALTH INSPECTOR</td>
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<td>LAB TECHNICIAN</td>
<td>VETERINARIAN</td>
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<td>MANAGEMENT CONSULTING</td>
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<td>MEDICAL EXAMINER</td>
<td>WATER SCIENTIST</td>
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<tr>
<td>MEDICAL TECHNOLOGIST</td>
<td>WATER/WASTE PLANT MANAGER</td>
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<tr>
<td>OCEANOGRAHER</td>
<td>YIELD ENGINEER</td>
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</table>
IX. GRADUATE OR PROFESSIONAL SCHOOL

GRADUATE OR PROFESSIONAL SCHOOL?

A Bachelor’s degree in chemistry or biochemistry provides a foundation for further study in many other fields. Some choose graduate study in chemistry and biochemistry, but many students also apply for schools that are professional or applied in nature, such as Medicine, Dentistry, Pharmacy or Public Health. Making this decision can often be a tough one, so students should consult with their professors and counselors about this decision. The important thing is that you leave yourself open to new ideas and experiences. The best opportunity could be something a student never even considered. Students intending to pursue advanced study in an area other than chemistry or biochemistry should check with admissions officers or counselors in those areas to see what additional coursework might be necessary.

The Chemistry and Biochemistry Undergraduate Office has several books that can assist students in finding career options and necessary graduate/professional school requirements. They also offer one-on-one counseling. Students should also speak with their professors and faculty advisors about career choices. They know a great deal about what professions dealing with chemistry are on the rise and can provide career advice based on your specific interests in chemistry.

The UCLA Career Center has an even more extensive library that students can reference at any time. In addition to this service, the Career Center also has counselors who can offer the following services:

- Program planning for pre-health students.
- Assistance with the application process to professional schools: advice regarding the timing of your application and school selection; help on filling out applications; reading personal statements; help on getting prepared for professional school interviews.
- Letters of recommendation services (see page 33) for all pre-professional and pre-graduate students.
- Collection of professional school handouts, directories, catalogs, MCAT prep books, phone numbers for prep classes and books on careers in health-related fields.
- Various test applications (MCAT, GRE, etc.).
- Additional services can be found online at www.career.ucla.edu. Students should start visiting the career center early in their college career to start searching for the path that is right for them.

CAMPUS RESOURCES

- **Academics in the Commons Workshops** – The Academics in the Commons program provides several workshops every quarter on Preparing for Medical School, Graduate School, Applications, GRE/MCATs, Internships, Interview and Personal Statement Prep, and Alternatives to Medical School. Students can find out the days/times of these workshops at www.college.ucla.edu/up/aitc and sign up for them on their My.UCLA page.

- **UCLA Career Center** – As mentioned above, this center has career counselors that provide information and assistance in preparing for one’s career. They also offer numerous workshops outlining graduate/professional school preparation. Check out all of the additional benefits of the Career Center at www.career.ucla.edu and/or drop in to their office in the Strathmore Building to set up an appointment for counseling.

- **College Counselors** – The UCLA College Counselors help students plan academic schedules at UCLA, including pre-health requirements. They can also answer questions regarding other UCLA requirements. Students who are in Honors (A-311 Murphy), AAP (1209 Campbell), and Athletics (Morgan Center) should
go to their respective counseling unit for help. All other students should visit a counselor at UCLA College Counseling in A-316 Murphy.

- **Pre-Health Peer Advisors** – Peer advisors are available for drop-in counseling to assist students with basic program planning, timelines for applications and entrance exam preparation, finding updated information about application/acceptance statistics, career trends, and opportunities for undergraduates. They also provide application advice about entrance exams, letters of recommendation, interviews, and personal statements. They are all current UCLA students who have completed the application process themselves. Peer Advisors can be found on the second floor of Covel Commons Monday-Thursday 1-9pm and Friday 1-5pm.

- **Departmental Counselors** – Feel free to visit the Chemistry and Biochemistry counselors to get information about general graduate and professional school requirements and how to incorporate them into your academic program. Visit them in 4009 Young Hall or call 310-825-1859.

**ONLINE RESOURCES FOR STUDENTS CONSIDERING GRADUATE OR PROFESSIONAL SCHOOL**

- **College Net**
  [www.collegenet.com](http://www.collegenet.com)
  Admissions and standardized test information. Links to law, medical, and MBA programs, plus Catholic colleges, Ivy League schools, and programs for women and minorities.

- **Graduate & Professional School Guides**
  [www.jobweb.org](http://www.jobweb.org)
  The applications, financial aid, and the transition between college and graduate school.

- **Graduate School Guide**
  [www.graduateguide.com](http://www.graduateguide.com)
  Comprehensive guide to doctoral, masters, and medical schools.

- **Graduate & Professional Schools**
  [www.petersons.com/graduate/](http://www.petersons.com/graduate/)
  Keyword search of 3,000 in-depth program descriptors, or search by academic areas, professional degrees. Provided by Peterson’s.

- **America’s Best Graduate Schools Guide**
  [www.usnews.com](http://www.usnews.com)
  Current rankings of graduate schools, divided up into various departments, made by U.S. News & World Report.

- **American Association of Medical Colleges**
  [www.aamc.org/students](http://www.aamc.org/students)
  Information about opportunities in medicine, applying to medical school, and resources that you may need to get started (including how to finance your medical education).
LETTERS OF RECOMMENDATION

Professional and graduate schools usually seek a combination of all of the following: good to excellent grades; high test scores (GRE, MCAT, etc.); strong letters of recommendation; and a well-written Statement of Purpose. Excellent letters may sometimes compensate for deficiencies in other areas.

It is essential to provide plenty of time for the letters to be written. The best way to get stronger letters of recommendation is to become acquainted with professors through office hours, enrolling in small classes or performing independent research in a laboratory so that the professor can get to know you better.

If you happen to be in a large class and have very little interaction with the professor, a letter of recommendation is likely to be perfunctory and may not help your application. However, a professor may be willing to write a letter of recommendation based on a written evaluation from the T.A. (who should know you better). In this instance, you benefit by receiving a more personalized letter of recommendation under a professor’s name. Letters of recommendation can be held by the Career Center until you are ready to apply to graduate/professional schools.

TIMELINES FOR APPLYING TO GRADUATE/PROFESSIONAL SCHOOL

Here is a basic timeline of preparation for students who are planning on staying at UCLA for four years and then going to graduate or professional school immediately following graduation. For students whose plan will vary from this, meet with a counselor to plan your schedule accordingly.

FIRST YEAR
- Attend workshops in Covel Commons and at the UCLA Career Center. Check your MyUCLA page and www.career.ucla.edu for details.
- Meet with a career counselor to explore all options. Make an appointment at www.career.ucla.edu.
- Meet with your College counselor or counseling assistant for program planning and course selection.
- Begin extracurricular activities and participate in pre-professional student organizations.
- Develop a pre-professional course of study based on that field’s admissions requirements.
- Consider summer internship, work, or volunteer experience.
- Request letters of recommendation and open a Letter of Recommendation file in the Career Center.

SECOND YEAR
- Continue with extracurricular activities, including leadership.
- Fine-tune your college schedule.
- Maintain a strong GPA.
- Attend pre-health preparation workshops from Academics in the Commons and the Career Center.
- Start researching the appropriate entrance exam (dates offered, costs, average scores, etc.).
- Visit the EXPO Center office in the Career Center for information on pre-professional internships and jobs or visit the UCLA Medical Center for volunteer/job opportunities.
- Apply for special summer pre-professional or research programs.
- Complete a practice application from a school you are interested in.
- Request letters of recommendation.
THIRD YEAR

• Study for your entrance exam. You should take your entrance exams by April of the year before graduation to have the opportunity to retake it (if necessary) and have your application in early.
• Meet with career counselor to review timeline to apply.
• Meet with major advisor and college counselors to fine tune the academic plan.
• Research your schools and programs of choice, taking special care to find professors and special opportunities for students in your area.
• Request letters of recommendation.
• Develop your personal statement.
• Obtain transcripts and review them to take care of any pending changes or notations.
• Start applications this summer. Most of them should be sent before the September of senior year.
• Sign up for a mock interview at the UCLA Career Center.
• Start researching and applying for scholarships and grants, if necessary.

FOURTH YEAR

• Maintain your GPA and schedule your fall and winter courses to work with the interview process.
• Visit college campuses.
• Meet with college and major advisors to review graduation requirements.
• Send in acceptance offers or keep track of waiting list results. All decisions should be sent by March or April unless you have been notified otherwise.
• Complete appropriate secondary/supplemental applications, like housing and financial aid.

THE MOST IMPORTANT THING!

Getting into medical school is difficult and takes a great deal of hard work, but make sure that you are not letting the stress consume your college career. Have fun, make friends, and try to become a well-rounded person. You should work hard to achieve your goals, but as long as you are doing everything you can, the decision is out of your hands. Many qualified applicants apply every year to schools and, inevitably, some are rejected. If you do not get into the school you wanted or do not get in at all, you always have the option to wait a year and work to build up your resume, gain more experience, retake the entrance exam, or anything else you might want to do to make you a stronger applicant before you reapply. This process is just a piece of the huge puzzle that makes up your career. If you are having trouble dealing with the process or the results, please make sure you talk to someone who can help.
X. FACULTY AND FIELDS OF INVESTIGATION

This is a list of our faculty members, not including lecturers or visiting professors. To get a list of all professors in the department, their contact information, and their websites, please go to www.chem.ucla.edu/faculty.

**DELROY A. BAUGH**, Associate Professor. Dynamics of photochemical and atomic-radical/surface reactions. The UCLA hexapole and polarization analysis of product quantum states are used to measure the transition matrix (magnitude/phase) for photochemical reactions. Hyperthermal H-atom beams are used to study etching reactions & do vibrational spectroscopy of adsorbates on Si and diamond surfaces.

E-mail: baugh@chem.ucla.edu   Office: Young 2048   Phone: 310-206-1485

**JAMES BOWIE**, Professor. Protein structure and folding, particularly membrane proteins; structure and function of signal transduction proteins.

E-mail: bowie@mbi.ucla.edu   Office: Boyer 655   Phone: 310-206-4747

**GUILAUME F. CHANFREAU**, Assistant Professor. RNA processing in the control of gene expression in eukaryotes; RNA-Protein interactions; mRNA splicing and RNA endonucleases.

E-mail: guillom@chem.ucla.edu   Office: Young 4054A   Phone: 310-825-4399

**CATHERINE CLARKE**, Professor. Biosynthesis, regulation and function of ubiquinone (coenzyme Q); characterization of genes in the ubiquinone biosynthetic pathway; interspecific complementation of yeast ubiquinone mutants; anti-oxidant defense mechanisms

E-mail: cathy@mbi.ucla.edu   Office: Young 5072B   Phone: 310-825-0771

**STEVEN G. CLARKE**, Professor. Protein methylation reactions in eukaryotic cells; non-enzymatic degradation reactions of proteins; biochemistry of aging, signal transduction.

E-mail: clarke@mbi.ucla.edu   Office: Boyer 640   Phone: 310-825-8754

**ROBERT T. CLUBB**, Associate Professor. Structural studies of proteins and protein complexes using heteronuclear multidimensional NMR spectroscopy; Biochemical characterization of proteins involved in DNA recombination and repair.

E-mail: rclubb@mbi.ucla.edu   Office: Boyer 656   Phone: 310-206-2334

**ALBERT J. COUREY**, Professor. Transcriptional regulation; biochemical and molecular genetic analysis of pattern formation during fruit fly embryogenesis.

E-mail: courey@chem.ucla.edu   Office: Young 5040B   Phone: 310-825-2530

**PAULA L. DIACONESCU**, Assistant Professor. Applications of lanthanide and actinide organometallic chemistry to organic synthesis and biological mimics.

E-mail: pld@chem.ucla.edu   Office: Mol Sci 1515   Phone: 310-794-4809

**DAVID S. EISENBERG**, Professor. Study of proteins by X-ray diffraction and computational methods; structure and action of enzymes and of membrane-related proteins; protein folding and the atomic basis of biological recognition: Bioinformatics.

E-mail: david@mbi.ucla.edu   Office: Boyer 201A   Phone: 310-825-3754

**JULI F. FEIGON**, Professor. Conformational studies of nucleic acids using multidimensional NMR techniques: DNA triplexes and quadruplexes; drug-DNA complexes, DNA and RNA aptamers; DNA and RNA-protein complexes.

E-mail: feigon@mbi.ucla.edu   Office: Boyer 241A   Phone: 310-206-6922
**PETER M. FELKER**, Professor. High resolution nonlinear laser spectroscopy of species in molecular beams; picosecond time-resolved studies of photochemical and photophysical dynamics of molecules.

E-mail: felker@chem.ucla.edu  
Office: Young 4077A  
Phone: 310-206-6924

**MIGUEL GARCIA-GARIBAY**, Professor. Solid state organic chemistry. Control of reactive intermediates in organic crystals; environmentally benign solvent-free organic synthesis; structure-reactivity correlations; supramolecular organic photochemistry, X-ray diffraction and solid state NMR; crystal engineering and material science.

E-mail: mgg@chem.ucla.edu  
Office: Mol Sci 4505C  
Phone: 310-825-3159

**NEIL GARG**, Professor. Synthetic strategies and methods, while pursuing the total synthesis of bioactive molecules. Areas of interest include asymmetric catalysis, organometallic transformations, heterocycle synthesis, umpolung reactions, and cascade processes.

E-mail: neilgarg@chem.ucla.edu  
Office: Mol Sci 5505C  
Phone: 310-825-1536

**ROBIN L. GARRELL**, Professor. Laser spectroscopy of surfaces, interfaces, and thin films; experimental and theoretical studies of molecule-metal interactions; development of new techniques for probing adlayer microstructure and its effects on macroscopic optical and mechanical properties such as viscosity and adhesion; design of novel biomolecular and polymeric thin films.

E-mail: garrell@chem.ucla.edu  
Office: Young 4077B  
Phone: 310-825-2496

**WILLIAM M. GELBART**, Professor. Physical aspects of viral life cycles: doing theory and experiment on representative viruses from the bacterial, plant, and animal kingdoms, focusing on the generic properties of their structures and replication; both in vitro and in vivo.

E-mail: gelbart@chem.ucla.edu  
Office: Young 3047  
Phone: 310-825-2005

**JAMES K. GIMZEWSKI**, Professor. Nanotechnology and nanobiotechnology research: cell sonics; nanomechanics of cells and bacteria; design, fabrication and measurements of molecular systems that exhibit functionality at the level of single molecules and in the field of nanofabrication; atom and molecule manipulation with scanning tunneling microscopy; compact nuclear fusion devices; and carbon nanotubes.

E-mail: gim@chem.ucla.edu  
Office: Young 3042A  
Phone: 310-794-7514

**JAMES W. GOBER**, Professor. Transcriptional regulation during cell differentiation in *Caulobacter*; genetics and biochemistry of cell cycle and polar gene expression; DNA higher-order structure and transcriptional activation; chromosome structure.

E-mail: gober@chem.ucla.edu  
Office: Young 5072C  
Phone: 310-206-9449

**JAY D. GRALLA**, Professor. The role of nucleic acid-protein complexes in cellular controls; repression and activation of transcription; mechanism of action of anti-cancer drugs that attack DNA; chemical probes of DNA structure.

E-mail: gralla@mbi.ucla.edu  
Office: Boyer 440  
Phone: 310-825-1620

**KENDALL N. HOUK**, Professor. Theoretical and experimental organic chemistry; transition structures of organic and biological reactions; theoretical studies of catalytic antibodies and transition state binding; theory of reactive intermediates and fast reactions; structures, dynamics, and reactions of host-guest complexes and molecular recognition; gating in hemi-carceplexes and proteins; quantitative models of asymmetric organic reactions and catalyst design; mechanisms and synthetic applications of pericyclic reactions.

E-mail: houk@chem.ucla.edu  
Office: Mol Sci 5505B  
Phone: 310-206-0515

**WAYNE L. HUBBELL**, Professor. Molecular mechanisms of membrane transduction and switching processes, primarily visual transduction and voltage dependent membrane gating systems. Development of spectroscopic approaches for the study of membrane structure, dynamics and electrostatic phenomena.

E-mail: hubbellw@jsei.ucla.edu  
Office: JSEI 3-219  
Phone: 310-206-8830
MICHAEL E. JUNG, Professor. Organic synthesis, particularly of biologically active natural products; development of new synthetic methods; bioorganic chemistry; study of electrocyclic reactions and their use in organic synthesis; gem-disubstituent effect and polar solvent effects in synthesis; design, synthesis and testing of inhibitors of enzymatic reactions.

E-mail: jung@chem.ucla.edu  Office: Mol Sci 3505A  Phone: 310-825-7954

RICHARD B. KANER, Professor. Inorganic chemistry; solid state synthesis and characterization; rapid precursor routes to refractory materials; conducting polymers as separation membranes; fullerenes-doping, superconductivity and physical properties.

E-mail: kaner@chem.ucla.edu  Office: Mol Sci 2515  Phone: 310-825-5346

CARLA M. KOEHLER, Associate Professor. Genetic and biochemical studies of protein import into mitochondria, role of mitochondrial biogenesis in cellular functions and disease.

E-mail: koehlerc@chem.ucla.edu  Office: Young 4041A  Phone: 310-794-4834

OHYUN KWON, Assistant Professor. Research in our group consists of 4 major areas. One is development of new methodologies for organic transformations. Asymmetric organocatalysis as well as conventional transition metal-catalyzed asymmetric reactions will be developed. Two is the target orientated synthesis of natural products. Potentials of the reactions developed in the aforementioned area can be manifested in this process. The utility of the new reactions and that of the entire total synthesis scheme will be further explored in the third area. Combinatorial synthesis of natural product-like molecules is our third area of interest. Forward and reverse chemical genetics will be practiced as we make progresses in other areas, also.

E-mail: ohyun@chem.ucla.edu  Office: Young 3505C  Phone: 310-267-4954

CHRISTOPHER LEE, Associate Professor. Bioinformatics and genomics: genome sequence analysis; computational methods for identification of single nucleotide polymorphisms; genomics databases; prediction of protein structure and function.

E-mail: leec@chem.ucla.edu  Office: Boyer 601A  Phone: 310-825-7374

ALEXANDER LEVINE, Assistant Professor. Working at the interface of the theory of soft condensed matter and biology, studying a wide range of systems including the properties of biopolymers and their aggregates, particle and polymer dynamics in membranes and at interfaces as well as the theory of microrheology.

E-mail: alevine@chem.ucla.edu  Office: Young 3044A  Phone: 310-794-4436

RAFAEL LEVINE, Professor. Interested in Chemistry under extreme conditions; Chemistry on multi electronic states; Ab initio reaction dynamics; dynamics of high Rydberg states; dynamics and spectroscopy in congested level systems; reaction dynamics and mechanism in large systems including clusters and in solution; algebraic techniques for structure and dynamics in anharmonic systems; and dynamics in phase space, including the application of information theory.

E-mail: rafi@chem.ucla.edu  Office: Geology 3608A  Phone: 310-206-0476

YUNG-YA LIN, Assistant Professor. Research in theory and experiment in magnetic resonance spectroscopy, microscopy, and imaging; quantum chaos, spin turbulence, ultra-high-gain avalanching amplification, imaging contrast enhancement, molecular imaging, tumor detection.

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E-mail: jloo@chem.ucla.edu  Office: Boyer 402  Phone: 310-794-7023
HAROLD G. MARTINSON, Professor and Chairman. Transcription Termination and RNA Processing in Eukaryotes: All eukaryotic mRNAs are processed by cleavage at their 3' ends, and most are then polyadenylated. These processing events all take place, together with splicing and other activities, within a large multifunctional transcription-processing factory, for which RNA polymerase II serves as the foundation. Termination of the transcription by this factory depends on the same signal in the RNA that directs cleavage and polyadenylation. We are studying both the mechanism of the 3'-end processing directed by this signal, and the mechanism of signal transduction by which this signal directs the polymerase to terminate.

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Phone: 310-825-3767

TOM MASON, Assistant Professor. Experimental physical chemistry; design and fabrication of novel colloidal architectures in solution through directed assembly; dynamic light scattering, rheology, and optical microscopy of the structure, phase behavior, and dynamics of concentrated dispersions of solid particles and liquid emulsion droplets; small angle neutron and light scattering measurements of structures in nanoscale and microscale soft materials; shear-induced structural transitions in multiphase materials.

E-mail: mason@chem.ucla.edu
Office: Young 3040
Phone: 310-206-0828

HEATHER D. MAYNARD, Assistant Professor. Our research program takes advantage of the recent flood of information on the underlying mechanisms of human diseases to prepare new materials with tailored biological properties. We address clinical problems and explore biological interactions at the nanoscale by constructing new materials using organic and polymer chemistry. The research is multidisciplinary in nature, employing chemical synthesis as well as materials and biological characterization to reach our goals. Projects include developing new strategies for the synthesis of multivalent ligands, manipulating polymer functionality and architecture to achieve specific biological properties, preparing polymer surfaces with nanosized features to probe cellular events and for applications in nanotechnology, and synthesizing materials for natural macromolecule delivery.

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Phone: 310-267-5162

SABEEHA MERCHANT, Professor. Copper, iron e oxygen-responsive gene expression with focus on the identification of sensors and their mechanism of action copper-responsive gene expression; protein assembly in eukaryotic cells with focus on compartmentalization and catalysis of cytochrome biosynthesis; tetrapyrrole biosynthesis; molecular biology of photosynthesis.

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Phone: 310-825-8300

CRAIG A. MERLIC, Associate Professor. Organic chemistry; applications of transition metal chemistry to organic synthesis; new synthetic methodology; natural products synthesis; organic and organometallic radical reactions; mechanistic and synthetic organometallic chemistry.

E-mail: merlic@chem.ucla.edu
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Phone: 310-825-5466

DANIEL NEUHAUSER, Professor. Theoretical Chemistry. Spintronics, molecular electronics, theory and simulation of nanosystems; interference based molecular devices. New approaches for very large scale simulations of nano- and mesoscopic quantum systems, both stationary and under strong fields.

E-mail: dxn@chem.ucla.edu
Office: Young 3049
Phone: 310-206-1274

EMIL REISLER, Professor. Structure and function of contractile proteins; protein-protein and protein-ligand interactions; mechanism of muscle contraction; mechanism of ATP hydrolysis; self assembly of myosin and actin.

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Phone: 310-206-2338
BENJAMIN SCHWARTZ, Professor. Experimental and Theoretical Physical Chemistry: femtosecond studies of solution phase photochemistry; solvation dynamics; classical, quantum and non-adiabatic molecular dynamics simulations; photophysics of conducting polymers, polymer interfaces and polymeric devices.
E-mail: schwartz@chem.ucla.edu Office: Young 2077A Phone: 310-206-4113

FRASER STODDART, Professor. Nanoscience as it relates to both supramolecular and macromolecular chemistry: Carbohydrate-containing dendrimers; catenanes, rotaxanes, and knots; concept transfer between the life sciences and materials science: interlocked and intertwined structures and superstructures; molecular machines; molecular shuttles, molecular switches; polycationic dendrimers; nature of the mechanical bond; nature of the noncovalent bond; self-assembly processes under both kinetic and thermodynamic control; synthetic cyclic oligosaccharides; template-directed synthesis.
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SARAH TOLBERT, Associate Professor. Solid state physical chemistry; self-organized nanoscale materials for optical, electronic, magnetic, and structural applications. Self-assembled inorganic/organic composites and colloidal materials designed to control optical and electronic properties. Biologically based materials. Kinetic control of nanoscale architectures; high pressure stability; understanding and correlating structural changes across length scales.
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JOAN S. VALENTINE, Professor. Bioinorganic chemistry study of the reactivity and other properties of transition metal complexes that are analogues of metalloenzyme active sites; study of structure-function relationships in the enzyme copper-zinc superoxide dismutase using site-directed mutagenesis; biochemistry of oxygen, superoxide, and peroxide.
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JOHN T. WASSON, Professor. Cosmochemistry; origin of the solar system; geochemistry; analytical chemistry; origin and composition of meteorites and tektites; noble metals in sediments; neutron activation; ion-microprobe analysis of oxygen isotopes.
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RICHARD L. WEISS, Professor. Compartmentation of enzymes and metabolites; molecular genetics, metabolic and genetic regulation in eukaryotic microorganisms.
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SHIMON WEISS, Professor. Application of single molecule spectroscopy to biology and nanotechnology; dynamic structural biology; conformational dynamics of molecular machines; protein folding; protein-DNA and protein-protein interactions; single molecule enzymology; ultrahigh resolution & ultrahigh sensitivity fluorescence microscopy and spectroscopy; physics and chemistry of mesoscopic (nano-scale) systems.
E-mail: sweiss@chem.ucla.edu Office: Young 2037A Phone: 310-794-0093

OMAR M. YAGHI, Professor. Inorganic, materials, solid-state, and nano chemistry. The design and construction of porous frameworks from the molecular building blocks of inorganic clusters, metal-organic complexes, organic macromolecules, peptides and proteins. Emphasis is placed on design of porous structures and control of their pore metrics and chemical functionality to produce materials with well-defined chemical structure and highly specific function. This approach has resulted in an extensive class of crystals named metal-organic frameworks (MOFs). So far, in my laboratory more than 500 MOFs have been prepared as bulk materials and studied for their gas storage/separation applications. We have collaborations with a large number of major chemical and auto companies to develop the applications of these materials in hydrogen storage and other gas storage and separations, liquid separations, polymerization catalysis, sensors and, more recently, drug transport.
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JEFFREY I. ZINK, Professor. Laser-assisted chemical vapor deposition and simultaneous characterization of photofragments; nano-materials and sol-gel optical materials; optical sensors; excited state processes in metal complexes including luminescence, photochemistry and photocatalysis; electronic and resonance Raman spectroscopic studies of excited state distortions.

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CHEMISTRY AND BIOCHEMISTRY

Lower Division Courses

2. Introductory Chemistry (4)
Lecture, two hours; discussion, two hours. Not open to students with credit for course 14A or 20A. Concept of submicroscopic world of chemistry, ranging from protons to proteins in subject matter. P/NP or letter grading.

14A. Atomic and Molecular Structure, Equilibria, Acids, and Bases (4)
Lecture, three hours; discussion, one hour. Preparation: high school chemistry or equivalent background and three and one-half years of high school mathematics. Not open to students with credit for course 20A. Introduction to physical and general chemistry principles; atomic structure based on quantum mechanics; atomic properties; trends in periodic table; chemical bonding (Lewis structures, VSEPR theory, hybridization, and molecular orbital theory); gaseous and aqueous equilibria; properties of inorganic and organic acids, bases, buffers; titrations. P/NP or letter grading.

14B. Thermodynamics, Electrochemistry, Kinetics, and Organic Chemistry (4)
Lecture, three hours; discussion, one hour. Enforced requisite: course 14A with grade of C- or better. Enforced corequisite: Mathematics 3A or 31A. Not open to students with credit for course 20A. Phase changes; thermochemistry; first, second, and third laws of thermodynamics; free energy changes; electrochemistry and its role as energy source; chemical kinetics, including catalysis, reaction mechanisms, and enzymes; coordination compounds; general classes and naming of organic molecules; structure, conformations, and relative energies of organic molecules; application of thermodynamics and kinetics to organic and biochemical reactions; use of molecular modeling software to illustrate molecular structures and their relative energies. P/NP or letter grading.

14BL. General and Organic Chemistry Laboratory I (3)
Lecture, one hour; laboratory, three hours. Enforced requisite: course 14A with a grade of C- or better. Enforced corequisite: course 14B. Not open to students with credit for course 20L. Preparation: high school chemistry or equivalent background and three and one-half years of high school mathematics. Honors course parallel to course 14B. Enforced corequisite: course 14BL, with grades of C- or better. Enforced corequisite: course 14C. Synthesis and analysis of compounds; purification by extraction, chromatography, recrystallization, and sublimation; characterization by mass spectroscopy, UV, NMR, and IR spectroscopy, optical activity, electrochemistry, pH titration. P/NP or letter grading.

14D. Organic Reactions and Pharmaceuticals (4)
Lecture, three hours; discussion, one hour. Enforced requisite: course 14C with a grade of C- or better. Organic reactions, nucleophilic and electrophilic substitutions and additions; electrophilic aromatic substitutions, carbonyl reactions, catalysis, molecular basis of drug action, and organic chemistry of pharmaceuticals. P/NP or letter grading.

17. Chemical Principles (0)
Lecture, four hours; laboratory, two hours. Chemistry 17 displaces 4 units on student's Study List but yields no credit toward a degree. Introduction to chemical principles: numbers, measurements, chemical calculations, gas laws, solutions, acids, bases, and salts, molecular structure, and nomenclature. Collaborative learning and problem solving; introduction to chemistry laboratory practice. P/NP grading.

19. Fiat Lux Freshman Seminars (1)
Seminar, one hour. Discussion of and critical thinking about topics of current intellectual importance, taught by faculty members in their areas of expertise and illuminating many paths of discovery at UCLA. P/NP grading.

20A. Chemical Structure (4)
Lecture, three hours; discussion, one hour. Preparation: high school chemistry or equivalent background and three and one-half years of high school mathematics. Recommended: high school physics. First term of general chemistry. Survey of chemical processes, quantum chemistry, atomic and molecular structure and bonding, molecular spectroscopy. P/NP or letter grading.

20AH. Chemical Structure (Honors) (4)
Lecture, three hours; discussion, one hour. Preparation: high school chemistry or equivalent background, high school physics, and three and one-half years of high school mathematics. Honors course parallel to course 20A. P/NP or letter grading.

20B. Chemical Energetics and Change (4)
Lecture, three hours; discussion, one hour. Enforced requisites: course 20A or 20AH, and Mathematics 31A, with grades of C- or better. Second term of general chemistry. Intermolecular forces and organization, phase behavior, chemical thermodynamics, solutions, equilibria, reaction rates and laws. P/NP or letter grading.

20BH. Chemical Energetics and Change (Honors) (4)
Lecture, three hours; discussion, one hour. Enforced requisite: course 20A with a grade of B+ or better or 20AH with a grade of B or better. Honors course parallel to course 20B. P/NP or letter grading.
experimental techniques in organic synthesis (distillation, requisites: courses 30A (or 30AH) and 30AL, with grades of C- or better. Lecture, one hour; laboratory, four hours. Enforced corequisite: course 20B. Use of the balance, volumetric techniques, volumetric and potentiometric analysis; Beer's law, applications for environmental analysis and materials science. P/NP or letter grading.

30A. Chemical Dynamics and Reactivity: Introduction to Organic Chemistry (4)
Lecture, three hours; discussion, one hour. Enforced requisite: course 20B with a grade of C- or better. First term of organic chemistry. Mechanisms of organic and inorganic reactions, including redox, elimination, addition, substitution, and radical processes. P/NP or letter grading.

30AH. Chemical Dynamics and Reactivity: Introduction to Organic Chemistry (Honors) (4)
Lecture, three hours; discussion, one hour. Enforced requisite: course 20B or 20BH, with a grade of B+ or better. Honors course parallel to course 30A. P/NP or letter grading.

30AL. General Chemistry Laboratory II (4)
Lecture, one hour; laboratory, six hours. Enforced requisites: courses 20B (or 20BH) and 20L, with grades of C- or better. Enforced corequisite: course 30A or 30AH. Qualitative and quantitative analysis of chemical reactions and compounds, kinetics, separations, and spectroscopy. P/NP or letter grading.

30B. Organic Chemistry: Reactivity and Synthesis, Part I (4)
Lecture, three hours; discussion, one hour. Enforced requisite: course 30A or 30AH, with a grade of C- or better. Second term of organic chemistry. Synthesis, properties, and reactions of organic functional groups, including alcohols, alkenes, alkynes, aromatic compounds, aldehydes, ketones, carboxyl derivatives, and amines. P/NP or letter grading.

30BL. Organic Chemistry Laboratory I (3)
Lecture, one hour; laboratory, four hours. Enforced requisites: courses 30A (or 30AH) and 30AL, with grades of C- or better. Enforced corequisite: course 30B. Basic experimental techniques in organic synthesis (distillation, extraction, crystallization, and performing reactions) and organic analytical chemistry (melting and boiling point, refractive index, chromatography, IR, NMR, GC). Single and multistep synthesis of known organic molecules on microscale level. P/NP or letter grading.

30C. Organic Chem: Reactivity and Synthesis, Part II (4)
Lecture, three hours; discussion, one hour. Enforced requisite: course 30B with a grade of C- or better. Third term of organic chemistry. Organic spectroscopy, including proton and carbon NMR, infrared mass and UV/Vis; pericyclic reactions and molecular orbital theory; dicarbonyl compounds; polyfunctional aromatic chemistry; heterocyclic compounds; and carbohydrates. P/NP or letter grading.

30CL. Organic Chemistry Laboratory II (4)
Lecture, two hours; laboratory, six hours. Enforced requisites: courses 30B and 30BL, with grades of C- or better. Enforced corequisite: course 30C. Modern techniques in synthetic organic and analytical organic chemistry. Semi-preparative scale, multistep synthesis of organic and organometallic molecules, including asymmetric catalysts. One- and two-dimensional multinuclear NMR techniques. Written reports and proposals. P/NP or letter grading.

88A. Lower Division Seminar: Serendipity in Science (2)
Limited to 20 freshmen. Inquiry into unexpected discoveries in science that have had significant impact on society and analysis of circumstances which brought these about, beginning with discovery of helium in the sun by Janssen in 1868 (using the newly developed field of spectroscopy). Discovery of X rays by Röntgen in 1895 and of radioactivity by Becquerel in 1896. Other topics include discoveries important to medicine, such as penicillin by Fleming in 1928 and cis-platin by Rosenberg in 1969.

89. Honors Seminars (1)
Seminar, three hours. Limited to 20 students. Designed as adjunct to lower division lecture course. Exploration of topics in greater depth through supplemental readings, papers, or other activities and led by lecture course instructor. May be applied toward honors credit for eligible students. Honors content noted on transcript. P/NP or letter grading.

89HC. Honors Contracts (1)
Tutorial, three hours. Limited to students in College Honors Program. Designed as adjunct to lower division lecture course. Individual study with lecture course instructor to explore topics in greater depth through supplemental readings, papers, or other activities. May be repeated for maximum of 4 units. Individual honors contract required. Honors content noted on transcript. Letter grading.

96. Special Courses in Chemistry (1 to 4)
Tutorial, to be arranged. May be repeated for maximum of 8 units. P/NP or letter grading.

M97X. PEERS Forum: Pathways in Science (1)
(Formerly numbered 97A.) (Same as Molecular, Cell, and Developmental Biology M97X.) Lecture, one hour. Limited to students in Program for Excellence in Education and Research in Sciences (PEERS). Series of lectures and workshops to acquaint students with practice of science, opportunities available to participate in research as undergraduate students, and careers available to graduates with science degrees. May be repeated twice, but only 1 unit may be applied toward graduation. P/NP grading.

98XA. PEERS Collaborative Learning Workshops for Life Sciences Majors (1)
(Formerly numbered 5.) Laboratory, three hours. Corequisite: associated undergraduate lecture course in chemistry and biochemistry for life sciences majors. Development of intuition and problem-solving skills in collaborative learning environment. May be repeated four times, but only 1 unit may be applied toward graduation. P/NP grading.
Upper Division Courses

103. Environmental Chemistry (4)
Lecture, four hours; discussion, one hour. Requisites: courses 30B, 30BL, 110A, 153A (or 153AH), 153L.
Chemical aspects of air and water pollution, solid waste disposal, energy resources, and pesticide effects.
Chemical reactions in the environment and effect of chemical processes on the environment. P/NP or letter grading.

M104. Environmental Chemistry Laboratory (4)
(Same as Atmospheric and Oceanic Sciences M140.) Lecture, two hours; laboratory, three hours. Requisite: course 20B. Laboratory experience for students who wish to pursue career in environmental science. Essential laboratory procedures to be performed in context of timely environmental issues involving smog formation, acid rain, and ozone depletion. Hands-on experience using scientific instruments and analytical techniques appropriate for environmental assessment. P/NP or letter grading.

C108. Mass Spectrometry for Chemists and Biochemists (2)
Lecture, one hour; laboratory, four hours. Requisite: course 153A. Introduction to principles and practice of organic and inorganic mass spectrometry. Topics include EI, Cl, ICPMS, GC/MS, LC/MS, ESI, MALDI, MS/MS protein identification, and proteomics. Concurrently scheduled with course C208. P/NP or letter grading.

110A. Physical Chemistry: Chemical Thermodynamics (4)
Lecture, three hours; discussion, one hour; tutorial, one hour. Requisites: course 20B, Mathematics 32A or 3C (for life sciences majors), Physics 1A, 1B, and 1C (may be taken concurrently), or 1AH, 1BH, and 1CH (may be taken concurrently), or 6A, 6B, and 6C (may be taken concurrently). Fundamentals of thermodynamics, chemical and phase equilibria, thermodynamics of solutions, electrochemistry. P/NP or letter grading.

110B. Physical Chemistry: Introduction to Statistical Mechanics and Kinetics (4)
Lecture, three hours; discussion, one hour; tutorial, one hour. Requisites: courses 110A, 113A, Mathematics 32B. Kinetic theory of gases, principles of statistical mechanics, statistical thermodynamics, equilibrium structure and free energy, relaxation and transport phenomena, macroscopic chemical kinetics, molecular-level reaction dynamics. P/NP or letter grading.

113A. Physical Chemistry: Introduction to Quantum Mechanics (4)
Lecture, three hours; discussion, one hour; tutorial, one hour. Requisites: course 20B, Mathematics 32A, 32B, 33B, Physics 1A, 1B, and 1C, or 1AH, 1BH, and 1CH, or 6A, 6B, and 6C, with grades of C or better. Departure from classical mechanics: Schrödinger vs. Newton equations; model systems: particle-in-a-box, harmonic oscillator, rigid rotor, and hydrogen atom; approximation methods: perturbation and variational methods; many-electron atoms, spin, and Pauli principle, chemical bonding. P/NP or letter grading.

C113B. Physical Chemistry: Introduction to Molecular Spectroscopy (4)
Lecture, three hours; discussion, one hour; tutorial, one hour. Requisite: course 113A. Interaction of radiation with matter, microwave spectroscopy, infrared and Raman spectroscopy, vibrations in polyatomic molecules, electronic spectroscopy, magnetic resonance spectroscopy. Concurrently scheduled with course C213B. P/NP or letter grading.

114. Physical Chemistry Laboratory (5)
Lecture, two hours; laboratory, eight hours. Enforced requisites: courses 30AL, 110A, and 113A, with grades of C- or better. Enforced corequisite: course 110B or C113B. Lectures include techniques of physical measurement, error analysis and statistics, special topics. Laboratory includes spectroscopy, thermodynamic measurements, and chemical dynamics. P/NP or letter grading.

114H. Physical Chemistry Laboratory (Honors) (5)
Lecture, two hours; laboratory, eight hours. Enforced requisites: courses 30AL, 110A, and 113A, with grades of B or better. Enforced corequisite: course 110B or C113B. Lectures include techniques of physical measurement, error analysis and statistics, special topics. Laboratory includes topics in physical chemistry to be selected in consultation with instructor. P/NP or letter grading.

C115A. Quantum Chemistry (4)
Lecture, four hours; discussion, one hour. Requisites: course 113A, Mathematics 31A, 31B, 32A, 32B, 33A. Recommended: knowledge of differential equations equivalent to Mathematics 135A or Physics 131 and of analytic mechanisms equivalent to Physics 105A. Course C115A or Physics 115B is requisite to C115B. Students entering course C115A are normally expected to take course C115B the following term. Designed for chemistry students with serious interest in quantum chemistry. Postulates and systematic development of nonrelativistic quantum mechanics; expansion theorems; waves; oscillators; angular momentum; hydrogen atom; matrix techniques; approximation methods; time dependent problems; atoms; spectroscopy; magnetic resonance; chemical bonding. May be concurrently scheduled with course C215A.
C115B. Quantum Chemistry (4)
Lecture, four hours; discussion, one hour. Requisites: course 113A, C115A or Physics 115B, Mathematics 31A, 31B, 32A, 32B, 33A. Recommended: knowledge of differential equations equivalent to Mathematics 135A or Physics 131 and of analytic mechanics equivalent to Physics 105A. Students entering course C115A are normally expected to take course C115B the following term. Designed for chemistry students with serious interest in quantum chemistry. Postulates and systematic development of nonrelativistic quantum mechanics; expansion theorems; wells; oscillators; angular momentum; hydrogen atom; matrix techniques; approximation methods; time dependent problems; atoms; spectroscopy; magnetic resonance; chemical bonding. May be concurrently scheduled with course C215B.

C115C. Advanced Quantum Chemistry: Applications (4)
Lecture, three hours; discussion, one hour. Requisites: courses 113A, C115B. Topics in quantum chemistry selected from molecular structure, collision processes, theory of solids, symmetry and its applications, and theory of electromagnetic radiation. Concurrently scheduled with course C215C. P/NP or letter grading.

M120. Soft Matter Laboratory (4)
(Same as Physics M180G.) Laboratory, four hours. P/NP or letter grading.

121. Special Topics in Physical Chemistry (4)
Lecture, four hours. Requisite: course 110B. Recommended: course 113A. Topics of considerable research interest presented at level suitable for students who have completed junior-year courses in physical chemistry. P/NP or letter grading.

C123A. Classical and Statistical Thermodynamics (4)
Lecture, four hours; discussion, one hour. Requisite: course 110B or 116. Recommended: course 113A. Rigorous presentation of fundamentals of classical thermodynamics. Principles of statistical thermodynamics: probability, ensembles, partition functions, independent molecules, and the perfect gas. Applications of classical and statistical thermodynamics selected from diatomic and polyatomic gases, solid and fluid states, phase equilibria, electric and magnetic effects, ortho-para hydrogen, chemical equilibria, reaction rates, the imperfect gas, nonelectrolyte and electrolyte solutions, surface phenomena, high polymers, gravitation. May be concurrently scheduled with course C223A.

C123B. Classical and Statistical Thermodynamics (4)
Lecture, four hours; discussion, one hour. Requisite: course 110B or 116. Recommended: course 113A. Rigorous presentation of fundamentals of classical thermodynamics. Principles of statistical thermodynamics: probability, ensembles, partition functions, independent molecules, and the perfect gas. Applications of classical and statistical thermodynamics selected from diatomic and polyatomic gases, solid and fluid states, phase equilibria, electric and magnetic effects, ortho-para hydrogen, chemical equilibria, reaction rates, the imperfect gas, nonelectrolyte and electrolyte solutions, surface phenomena, high polymers, gravitation. May be concurrently scheduled with course C223B.

125. Computers in Chemistry (4)
Lecture, three hours. Preparation: working knowledge of Fortran IV or PL/1. Requisites: courses 110A, 110B, 113A. Discussion of computer techniques, including matrix manipulation, solution of differential equations, data acquisition, and instrumental control, and their applications to chemical problems in quantum mechanics, thermodynamics, and kinetics.

C126A. Computational Methods for Chemists (4)
Lecture, four hours; laboratory, four hours. Preparation: programming experience in either BASIC, Fortran, C, C++, Java, or Pascal. Requisites: course 110A, Mathematics 33B. Theoretical, numerical, and programming tools for constructing new chemical applications, including simple force fields and resulting statistical mechanics for simple molecules, simple ab-initio methods for organic molecules and nanotubes, and classical dynamics and spectroscopy. Concurrently scheduled with course C226A. P/NP or letter grading.

136. Organic Structural Methods (5)
Lecture, two hours; laboratory, eight hours. Requisites: courses 30C and 30CL, with grades of C- or better. Laboratory course in organic structure determination by chemical and spectroscopic methods; microtechniques. P/NP or letter grading.

C140. Bionanotechnology (4)
Lecture, three hours. Preparation: courses 30C, 110A. Basic physical, chemical, and biological principles in bionanotechnology; materials and strategies for top-down and bottom-up fabrication of ordered biologically derived molecules, characterization and detection techniques, and biomimetic materials and applications at nanoscale. Concurrently scheduled with course C240. P/NP or letter grading.

C143A. Structure and Mechanism in Organic Chemistry (4)
Lecture, three hours; discussion, one hour. Requisites: courses 30C and 30CL (may be taken concurrently), 110B, and 113A, with grades of C- or better. Mechanisms of organic reactions. Acidity and acid catalysis; linear free energy relationships; isotope effects. Molecular orbital theory; photochemistry; pericyclic reactions. May be concurrently scheduled with course C243A. P/NP or letter grading.

C143B. Mechanism and Structure in Organic Chemistry (4)
Lecture, three hours; discussion, one hour. Requisite: course C143A with a grade of C- or better. Mechanisms of organic reactions; structure and detection of reactive intermediates. May be concurrently scheduled with course C243B.

144. Practical and Theoretical Introductory Organic Synthesis (5)
Lecture, two hours; laboratory, eight hours. Enforced requisites: courses 30C and 30CL, with grades of C- or better. Lectures on modern synthetic reactions and processes, with emphasis on stereospecific methods for carbon-carbon bond formation. Laboratory methods of synthetic organic chemistry, including reaction techniques, synthesis of natural products, and molecules of theoretical interest. P/NP or letter grading.
153A. Biochemistry: Introduction to Structure, Enzymes, and Metabolism (4)
Lecture, four hours; discussion, one hour. Requisite: course 14D or 30B, with a grade of C- or better. Recommended: Life Sciences 2, 3. Honors course parallel to course 153A. P/NP or letter grading.

153AH. Biochemistry: Introduction to Structure, Enzymes, and Metabolism (Honors) (4)
Lecture, three hours; discussion, one hour; tutorial, one hour. Requisite: course 14D or 30B, with a grade of C- or better. Recommended: Life Sciences 2, 3. Honors course parallel to course 153A. P/NP or letter grading.

153B. Biochemistry: DNA, RNA, and Protein Synthesis (4)
Lecture, three hours; discussion, one hour; tutorial, one hour. Requisite: course 153A or 153AH, Life Sciences 2, 3. Nucleotide metabolism; DNA replication; DNA repair; transcription machinery; regulation of transcription; RNA structure and processing; protein synthesis and processing. P/NP or letter grading.

153BH. Biochemistry: DNA, RNA, and Protein Synthesis (Honors) (4)
Lecture, three hours; discussion, one hour; tutorial, one hour. Requisite: course 153A or 153AH, Life Sciences 2, 3. Honors course parallel to course 153B. P/NP or letter grading.

153C. Biochemistry: Biosynthetic and Energy Metabolism and Its Regulation (4)
Lecture, three hours; discussion, one hour; tutorial, one hour. Requisite: course 153A or 153AH. Metabolism of carbohydrates, fatty acids, amino acids, and lipids; photosynthetic metabolism and assimilation of inorganic nutrients; regulation of these processes. P/NP or letter grading.

153CH. Biochemistry: Biosynthetic and Energy Metabolism and Its Regulation (Honors) (4)
Lecture, three hours; discussion, two hours. Requisite: course 153A or 153AH. Honors course parallel to course 153C. P/NP or letter grading.

CM153G. Macromolecular Structure (4)
(Same as Biological Chemistry CM153G and Human Genetics CM153G.) Lecture, three hours; discussion, one hour. Requisites: courses 110A, 153A, 153B, 153C, 156. Chemical and physical properties of proteins and nucleic acids. Structure, cloning, and analysis of DNA; biosynthesis and processing of RNA; biosynthesis, purification, structure, and analysis of proteins; correlation of structure and biological properties. Concurrently scheduled with course CM253. Letter grading.

153L. Biochemical Methods I (4)
Lecture, two hours; laboratory, four hours. Enforced requisites: courses 14CL and 14D, or 30B and 30BL, and 153A or 153AH (may be taken concurrently), with grades of C- or better. Integrated term-long project involving characterization of an enzyme purified from meat obtained at local butcher. Techniques include ammonium sulfate fractionation, affinity chromatography, protein and enzyme assays, polyacrylamide gel electrophoresis, gel exclusion chromatography, and enzyme kinetic analysis. P/NP or letter grading.

154. Biochemical Methods II (5)
Lecture, two hours; laboratory, eight hours. Enforced requisites: courses 153A or 153AH, 153B or 153BH, and 153L, with grades of C- or better. Recommended: course 156. Two to three major laboratory projects using biochemical laboratory techniques to investigate contemporary problems in biochemistry. Topics include transcription activation, molecular basis of DNA-protein interactions, biochemical basis of platelet activation, and initiation of blood clotting cascade. Experiments entail characterizing function of proteins, nucleic acids, and lipids involved in these processes. P/NP or letter grading.

CM155. Biological Catalysis (4)
(Same as Molecular, Cell, and Developmental Biology CM160.) Requisites: courses 110A, 153A, 153B, Life Sciences 3, Molecular, Cell, and Developmental Biology 100 or C139 or M140. Reaction mechanisms in molecular biology; experimental approaches for study of enzymes, including kinetics, isotopic labeling, stereochemistry, chemical modification, and spectroscopy; design of pharmacologically active agents and artificial enzymes. Drug metabolism and interactions addressed on a mechanistic level. Concurrently scheduled with course CM255.

156. Physical Biochemistry (4)
Lecture, four hours; discussion, one hour. Requisites: courses 110A, 153A. Biochemical kinetics; solution thermodynamics of biochemical systems; multiple equilibria; hydrodynamics; energy levels, spectroscopy, and bonding; topics from structural, statistical, and electrochemical methods of biochemistry.

C159A. Mechanisms in Regulation of Transcription I (2)

C159B. Mechanisms in Regulation of Transcription II (2)
(Formerly numbered CM159B.) Second five weeks. Lecture, four hours. Requisite: course C159A. Eukaryotic general transcriptional apparatus; sequence-specific promoter recognition; mechanisms of transcriptional activation and repression, including role of chromatin structure; transcription factors as targets of signal transduction pathways; transcription factors in embryogenesis. Concurrently scheduled with course C259B. P/NP or letter grading.
C160A. Introduction to Bioinformatics and Genomics (4)
(Formerly numbered C160.) Lecture, three hours; discussion, one hour. Recommended requisite: Statistics 100A or 110A. Genomics and bioinformatics results and methodologies, with emphasis on concepts behind rapid development of these fields. Focus on how to think genomicsically via case studies showing how genomics questions map to computational problems and their solutions. Concurrently scheduled with course CM260A. P/NP or letter grading.

C160B. Algorithms in Bioinformatics and Systems Biology (4)
Lecture, four hours; laboratory, four hours. Enforced requisite: course C160A with a grade of C- or better. Recommended: Program in Computing 60, Statistics 100A, 110A. Development and application of computational approaches to biological questions. Understanding of mechanisms for determining statistical significance of computationally derived results. Development of foundation for innovative work in bioinformatics and systems biology. Concurrently scheduled with course C260B. P/NP or letter grading.

C161A. Plant Biochemistry (4)
Lecture, three hours; discussion, one hour. Requisite: course 153C. Introduction to distinctive features of plant biochemistry. Topics include photosynthesis, nitrogen metabolism, plant cell wall metabolism, and secondary metabolism in relation to stress. Concurrently scheduled with course C261A.

C165. Metabolic Control by Protein Modification (2)
First five weeks. Lecture, three hours; discussion, one hour. Requisites: courses 153A, 153B, 153C. Biochemical basis of controlling metabolic pathways by posttranslational modification of proteins, including phosphorylation and methylation reactions. Concurrently scheduled with course C265.

CM170. Biochemistry and Molecular Biology of Photosynthetic Apparatus (2 to 4)
(Same as Molecular, Cell, and Developmental Biology M170.) Lecture, two to three hours; discussion, zero to two hours. Requisites: courses 153A and 153B, or Life Sciences 3, and course 153L. Recommended: courses 153C, 154, Life Sciences 4. Light harvesting, photochemistry, electron transfer, carbon fixation, carbohydrate metabolism, pigment synthesis in chloroplasts and bacteria. Assembly of photosynthetic membranes and regulation of genes encoding those components. Emphasis on understanding of experimental approaches. Concurrently scheduled with course C270. P/NP or letter grading.

171. Intermediate Inorganic Chemistry (4)
Lecture, three hours; discussion, one hour. Requisite: course 30B with a grade of C- or better. Chemical bonding; structure and bonding in the solid state; main group, transition metal, lanthanide and actinide compounds and reactions; catalysis, spectroscopy, special topics. P/NP or letter grading.

C172. Advanced Inorganic Chemistry (4)
Lecture, three hours; discussion, one hour. Requisite: course 171 with a grade of C- or better. Systematic approach to modern inorganic chemistry, structure and bonding of inorganic molecules and solids, structure/reactivity relationships, vibrational spectra of complexes, electronic structure and ligand-field theory, mechanisms of inorganic reactions, bonding and spectroscopy of organometallic compounds, transition metals in catalysis and biology. Concurrently scheduled with course C273. P/NP or letter grading.

C174. Inorganic and Metalorganic Laboratory Methods (5)
Lecture, two hours; laboratory, eight hours. Enforced requisites: courses 30CL and C172, with grades of C- or better. Synthesis of inorganic compounds, including air-sensitive materials; Schlenck techniques; chromatographic and ion exchange methods; spectroscopic characterization and literature applications. Concurrently scheduled with course C274. P/NP or letter grading.

C175. Inorganic Reaction Mechanisms (4)
Lecture, three hours. Requisites: courses 110A, 110B, 113A, C172. Survey of inorganic reactions; mechanistic principles; electronic structure of metal ions; transition-metal coordination chemistry; inner- and outer-sphere and chelate complexes; substitution, isomerization, and racemization reactions; stereochemistry; oxidation/reduction, free/radical, polymerization, and photochemical reactions of inorganic species. May be concurrently scheduled with course C275. P/NP or letter grading.

C176. Group Theory and Applications to Inorganic Chemistry (4)
Lecture, three hours; discussion, one hour. Requisites: courses 113A, C172. Group theoretical methods; molecular orbital theory; ligand-field theory; electronic spectroscopy; vibrational spectroscopy. May be concurrently scheduled with course C276A. P/NP or letter grading.

C179. Biological Inorganic Chemistry (4)
Lecture, three hours. Requisites: courses 153A or 153AH, 171. Role of metal ions in biology. Topics include interactions of metal ions with proteins, nucleic acids, and other biological molecules; mechanisms of metal ion transport and storage; introduction to metalloenzyme; metalloproteins in electron transfer, respiration, and photosynthesis; metals in medicine. Concurrently scheduled with course C279. P/NP or letter grading.

C180. Solid-State Chemistry (4)
Lecture, three hours. Requisite: course C172. Survey of new materials and methods for their preparation and characterization, with emphasis on band theory and its relationship to chemical, optical, transport, and magnetic properties, leading to a deeper understanding of these materials. Concurrently scheduled with course C280. P/NP or letter grading.
181. Polymer Chemistry (4)
Lecture, three hours; discussion, one hour. Requisites: courses 30B, 110A. Synthesis of organic and inorganic macromolecules, thermodynamic and statistical mechanical descriptions of unique properties of polymers, polymer characterization methods, and special topics such as conductive and biomedical polymers and polymeric reagents in synthesis. Concurrently scheduled with course C281. P/NP or letter grading.

184. Chemical Instrumentation (5)
Lecture, two hours; laboratory, eight hours. Enforced requisites: courses 30CL and 110A, with grades of C- or better. Theory and practice of instrumental techniques of chemical and structural analysis, including atomic absorption spectroscopy, gas chromatography, mass spectrometry, nuclear magnetic resonance, polarography, X-ray fluorescence, and other modern methods. P/ NP or letter grading.

C185. Materials Chemistry Laboratory (5)

189. Advanced Honors Seminars (1)
Seminar, three hours. Limited to 20 students. Designed as adjunct to undergraduate lecture course. Exploration of topics in greater depth through supplemental readings, papers, or other activities and led by lecture course instructor. May be applied toward honors credit for eligible students. Honors content noted on transcript. P/NP or letter grading.

189HC. Honors Contracts (1)
Tutorial, three hours. Limited to students in College Honors Program. Designed as adjunct to upper division lecture course. Individual study with lecture course instructor to explore topics in greater depth through supplemental readings, papers, or other activities. May be repeated for a maximum of 4 units. Individual honors contract required. Honors content noted on transcript. Letter grading.

193A. Journal Club Seminars: UC LEADS and MARC (2)
Seminar, three hours. Designed for juniors/seniors in undergraduate research training programs such as UC LEADS and MARC or those who have strong commitment to pursue graduate studies in natural sciences, engineering, or mathematics. Weekly reading and oral presentations of research or research papers selected from current literature. Letter grading.

193B. Journal Club Seminars: Chemistry and Biochemistry (2)
Seminar, three hours. Limited to undergraduate students. Discussion of readings selected from current literature in particular field. P/NP grading.

194. Research Group Seminar (1)
Seminar, three hours. Advanced study and analysis of current topics in physical, organic, or inorganic chemistry or biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. P/NP grading.

196A. Research Apprenticeship in Chemistry and Biochemistry (2 to 4)
(Formerly numbered 199A.) Tutorial, three hours per week per unit. Limited to juniors/seniors. Entry-level research apprenticeship for upper division students under guidance of faculty mentor. Consult department for additional information regarding requirements, enrollment petitions, and written proposal deadlines. May be repeated for a maximum of 8 units. Individual contract required. P/NP grading.

196B. Research Apprenticeship in Chemistry and Biochemistry (2 to 4)
(Formerly numbered 199B.) Tutorial, three hours per week per unit. Enforced requisite: course 196A (8 units). Limited to juniors/seniors. Research apprenticeship for upper division students under guidance of faculty mentor. Consult department for additional information regarding requirements, enrollment petitions, and written proposal deadlines. May be taken for a maximum of 4 units. Individual contract required. P/NP or letter grading.

199. Directed Research in Chemistry and Biochemistry (2 to 4)
(Formerly numbered 190.) Tutorial, three hours per week per unit. Enforced requisite: course 196A (8 units). Limited to juniors/seniors. Supervised individual research under guidance of faculty mentor. Culminating report required. May be repeated for a maximum of 12 units. Individual contract required. P/NP or letter grading.

Graduate Courses

201. Scientific Proposal Writing (2)
Lecture, three hours. Designed for graduate biochemistry and molecular biology students. How to write scientific proposals to be submitted to funding agencies. How to develop curricula vitae, put together grant proposals, and critique proposals. Letter grading.

202. Bioinformatics Interdisciplinary Research Seminar (4)
Seminar, two hours; discussion, two hours. Concrete examples of how biological questions about omics data map to and are solved by methodologies from other disciplines, including statistics, computer science, and mathematics. May be repeated for credit. S/U or letter grading.

203A. Research Ethics Seminar (2)
(Formerly numbered 203.) Seminar, 90 minutes. Limited to students supported by UCLA program in Cellular and Molecular Biology Predoctoral Training. Required of all first- and second-year students in program. Informal discussions on case histories for responsible conduct of research. May be repeated for credit. S/U grading.
203B. Ethics in Chemical Research (2)
Seminar, one hour. Discussion of ethics in graduate education, teaching, and chemical research, including issues such as conflicts of interest, plagiarism, intellectual property, sexual harassment, and other topics related to ethical conduct of research. S/U grading.

204. Student Research Seminar (2)
Seminar, one hour. Limited to students supported by UCLA program in Cellular and Molecular Biology Predoctoral Training. Research seminar presented by second- and third-year students. S/U grading.

M205A. Introduction to Chemistry of Biology (3)
(Formerly numbered M206.) (Same as Pharmacology M205A.) Lecture, three hours. Chemical biology teaching language and techniques of biology. Structure of biological molecules, kinetics and thermodynamics of biological systems, catalysis and electron transfer, genomics, proteomics, and metabolomics. S/U or letter grading.

M205B. Issues on Chemistry/Biology Interface (2)
(Same as Pharmacology M205B.) Seminar, one hour. Requisite: course M205A. Selected talks and papers presented by training faculty on solving problems and utilizing tools in chemistry and molecular biology on chemistry/biology interface (CBI). S/U grading.

206. Chemistry of Biology Seminar (2)
Discussion, three hours. Limited to students supported by UCLA program in Chemistry/Biology Interface Predoctoral Training. Current research topics at interface of chemistry and biology. May be repeated for credit. S/U grading.

207. Organometallic Chemistry (4)
Lecture/discussion, three hours. Requisite or corequisite: course C243A. Survey of synthesis, structure, and reactivity (emphasizing a mechanistic approach) of compounds containing carbon bonded to elements selected from main group metals, metalloids, and transition metals, including olefin complexes and metal carbenes; applications in catalysis and organic synthesis.

C208. Mass Spectrometry for Chemists and Biochemists (2)
Lecture, one hour; laboratory, four hours. Requisite: course 153A. Introduction to principles and practice of organic and inorganic mass spectrometry. Topics include EI, CI, ICPMS, GC/MS, LC/MS, ES, MALDI, MS/MS protein identification, and proteomics. Concurrently scheduled with course C108. S/U or letter grading.

210. Scientific Glassblowing (1)
Laboratory, one hour. Instruction in safe handling and manipulation of scientific glassware. Introduction to basic glassblowing techniques such as bending, annealing, and fire-polishing of glass. Proper cutting of glass and repairing of cracks. S/U grading.

C213B. Physical Chemistry: Molecular Spectroscopy (4)
Lecture, three hours; discussion, one hour; tutorial, one hour. Requisite: course 113A. Interaction of radiation with matter, microwave spectroscopy, infrared and Raman spectroscopy, vibrations in polyatomic molecules, electronic spectroscopy, magnetic resonance spectroscopy. Concurrently scheduled with course C113B. Independent study project required of graduate students. S/U or letter grading.

C215A. Quantum Chemistry: Methods (4)
Lecture, four hours; discussion, one hour. Requisites: course 113A, Mathematics 31A, 31B, 32A, 32B, 33A. Recommended: knowledge of differential equations equivalent to Mathematics 135A or Physics 131 and of analytic mechanics equivalent to Physics 105A. Course C215A or Physics 115B is requisite to C215B. Students entering course C215A are normally expected to take course C215B the following term. Designed for chemistry students with serious interest in quantum chemistry. Postulates and systematic development of nonrelativistic quantum mechanics; expansion theorems; wells; oscillators; angular momentum; hydrogen atom; matrix techniques; approximation methods; time dependent problems; atoms; spectroscopy; magnetic resonance; chemical bonding. May be concurrently scheduled with course C115A.

C215B. Quantum Chemistry: Methods (4)
Lecture, four hours; discussion, one hour. Requisites: course 113A, C215A or Physics 115B, Mathematics 31A, 31B, 32A, 32B, 33A. Recommended: knowledge of differential equations equivalent to Mathematics 135A or Physics 131 and of analytic mechanics equivalent to Physics 105A. Students entering course C215A are normally expected to take course C215B the following term. Designed for chemistry students with serious interest in quantum chemistry. Postulates and systematic development of nonrelativistic quantum mechanics; expansion theorems; wells; oscillators; angular momentum; hydrogen atom; matrix techniques; approximation methods; time dependent problems; atoms; spectroscopy; magnetic resonance; chemical bonding. May be concurrently scheduled with course C115B.

C215C. Advanced Quantum Chemistry: Applications (4)
(Formerly numbered 215C.) Lecture, three hours; discussion, one hour. Requisite: course C215B. Topics in quantum chemistry selected from molecular structure, collision processes, theory of solids, symmetry and its applications, and theory of electromagnetic radiation. Concurrently scheduled with course C115C. S/U or letter grading.

215D. Molecular Spectra, Diffraction, and Structure (4)
Lecture, three hours; discussion, one hour. Requisites: course C215B, Physics 131. Selected topics from electronic spectra of atoms and molecules; vibrational, rotational, and Raman spectra; magnetic resonance spectra; X-ray, neutron, and electron diffraction; coherence effects. S/U or letter grading.

218. Physical Chemistry Student Seminar (2)
Seminars presented by staff, outside speakers, postdoctoral fellows, and graduate students. May be repeated for credit. S/U grading.

219C. Seminar: Research in Physical Chemistry -- Physical Chemistry of Complex Fluids (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.
219A. Seminar: Research in Physical Chemistry -- Advanced Topics in Physical Chemistry (2 to 4)
Seminar, three hours. Each course encompasses a recognized specialty in physical chemistry, generally taught by a staff member whose research interests embrace that specialty. S/U or letter grading.

219B. Seminar: Research in Physical Chemistry -- Advanced Topics in Physical Chemistry (2 to 4)
Each course encompasses a recognized specialty in physical chemistry, generally taught by a staff member whose research interests embrace that specialty. S/U or letter grading.

219D. Seminar: Research in Physical Chemistry -- Computer Simulation in Chemistry (2)
Seminar, three hours. Advanced study and analysis of current topics in chemical physics. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219E. Seminar: Research in Physical Chemistry -- Dynamics of Molecule-Molecule and Molecule-Surface Reactions (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219F. Seminar: Research in Physical Chemistry -- Reaction Mechanisms (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219G. Seminar: Research in Physical Chemistry -- Spectroscopy of Isolated Molecules, Complexes, and Clusters (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219H. Seminar: Research in Physical Chemistry -- Spectroscopy and Imaging (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219I. Seminar: Research in Physical Chemistry -- Single-Molecule Spectroscopy in Biology (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219J. Seminar: Research in Physical Chemistry -- Statistical Mechanics of Disordered Systems (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219K. Seminar: Research in Physical Chemistry -- Cosmochemistry (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219L. Seminar: Research in Physical Chemistry -- Modern Methods for Molecular Reactions and Structure (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219M. Seminar: Research in Physical Chemistry -- Kinetic, Thermodynamic, and Interfacial Effects in Materials (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219N. Seminar: Research in Physical Chemistry -- Nanoscience (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219O. Seminar: Research in Physical Chemistry -- Single-Molecule Spectroscopy in Biology (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219P. Seminar: Research in Physical Chemistry -- Theory and Applications of Magnetic Resonance Spectroscopy and Imaging (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

219Q. Seminar: Research in Physical Chemistry -- Complex Fluids: Composition, Structure, and Rheology (2)
Seminar, three hours. Advanced study and analysis of current topics in physical chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.
C223A. Classical and Statistical Thermodynamics (4)
Lecture, four hours; discussion, one hour. Requisite: course 110B or 115C. Recommended: course 113A. Presentation of fundamentals of classical thermodynamics. Principles of statistical thermodynamics: probability, ensembles, partition functions, independent molecules, and the perfect gas. Applications of classical and statistical thermodynamics selected from diatomic and polyatomic gases, solid and fluid states, phase equilibria, electric and magnetic effects, ortho-para hydrogen, chemical equilibria, reaction rates, the imperfect gas, nonelectrolyte and electrolyte solutions, surface phenomena, high polymers, gravitation. May be concurrently scheduled with course C123A.

C223B. Classical and Statistical Thermodynamics (4)
Lecture, four hours; discussion, one hour. Requisite: course 110B or 115C. Recommended: course 113A. Presentation of fundamentals of classical thermodynamics. Principles of statistical thermodynamics: probability, ensembles, partition functions, independent molecules, and the perfect gas. Applications of classical and statistical thermodynamics selected from diatomic and polyatomic gases, solid and fluid states, phase equilibria, electric and magnetic effects, ortho-para hydrogen, chemical equilibria, reaction rates, the imperfect gas, nonelectrolyte and electrolyte solutions, surface phenomena, high polymers, gravitation. May be concurrently scheduled with course C123B.

M223C. Nonequilibrium Statistical Mechanics and Molecular Biophysics (4)
(Formerly numbered 223C.) (Same as Physics M215D.) Lecture, three hours. Requisites: courses C215B and C223B, or Physics 215A. Fundamentals of nonequilibrium thermodynamics and statistical mechanics applied to molecular biophysics. S/U or letter grading.

225. Chemical Kinetics (4)

C226A. Computational Methods for Chemists (4)
Lecture, four hours; laboratory, four hours. Preparation: programming experience in either BASIC, Fortran, C, C++, Java, or Pascal. Requisites: course 110A, Mathematics 33B. Theoretical, numerical, and programming tools for constructing new chemical applications, including simple force fields and resulting statistical mechanics for simple molecules, simple ab-initio methods for organic molecules and nanotubes, and classical dynamics and spectroscopy. Concurrently scheduled with course C126A. S/U or letter grading.

228. Chemical Physics Seminar (2)
Seminars presented by staff, outside speakers, postdoctoral fellows, and graduate students. May be repeated for credit. S/U or letter grading.

229. Introduction to Physical Chemistry Research (2)
Lecture, 90 minutes. Designed primarily for entering graduate physical chemistry students. S/U grading.

M230B. Structural Molecular Biology (4)
(Same as Molecular, Cell, and Developmental Biology M230B.) Lecture, three hours; discussion, one hour. Requisites: Mathematics 3C, Physics 6C. Selected topics from principles of biological structure; structures of globular proteins and RNAs; structures of fibrous proteins, nucleic acids, and polysaccharides; harmonic analysis and Fourier transforms; principles of electron, neutron, and X-ray diffraction; optical and computer filtering; three-dimensional reconstruction. S/U or letter grading.

M230D. Structural Molecular Biology Laboratory (2)
(Same as Molecular, Cell, and Developmental Biology M230D.) Laboratory, 10 hours. Corequisite: course M230B. Methods in structural molecular biology, including experiments utilizing single crystal X-ray diffraction, low angle X-ray diffraction, electron diffraction, optical diffraction, optical filtering, three-dimensional reconstruction from electron micrographs, and model building. S/U or letter grading.

232. Stereochemistry and Conformational Analysis (4)
Lecture/discussion, three hours. Requisite or corequisite: course C143A. Molecular symmetry, chirality, prochirality, stereochemistry in vinyl polymers, atropisomerism, diastereomeric interactions in solution, conformations of acrylic and cyclic molecules.

235D. Seminar: Research in Organic Chemistry -- Modern Photochemistry and Biooxidants (2)
Seminar, three hours. Advanced study and analysis of current topics in organic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

235E. Seminar: Research in Organic Chemistry -- Theoretical and Physical Organic Chemistry (2)
Seminar, three hours. Advanced study and analysis of current topics in organic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

235F. Seminar: Research in Organic Chemistry -- Synthetic Methods and Synthesis of Natural Products (2)
Seminar, three hours. Advanced study and analysis of current topics in organic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

235G. Seminar: Research in Organic Chemistry -- Organometallic Chemistry and Organic Synthesis (2)
Seminar, three hours. Advanced study and analysis of current topics in organic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

235I. Seminar: Research in Organic Chemistry -- Fullerene Chemistry and Materials Science (2)
Seminar, three hours. Advanced study and analysis of current topics in organic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.
235K. Seminar: Research in Organic Chemistry --
Organic Chemistry in Organized and Restricted Media
(2)
Seminar, three hours. Advanced study and analysis of
current topics in organic chemistry. Discussion of current
research and literature in research specialty of faculty
member teaching course. S/U grading.

235L. Seminar: Research in Organic Chemistry --
Supramolecular and Macromolecular Chemistry (2)
Seminar, three hours. Advanced study and analysis of
current topics in organic chemistry. Discussion of current
research and literature in research specialty of faculty
member teaching course. S/U grading.

235M. Seminar: Research in Organic Chemistry --
Organic Solid-State Chemistry (2)
Seminar, three hours. Advanced study and analysis of
current topics in organic chemistry. Discussion of current
research and literature in research specialty of faculty
member teaching course. S/U grading.

235N. Seminar: Research in Organic Chemistry --
Target- and Diversity-Oriented Synthesis of Natural
Products and Product-Like Molecules (2)
Seminar, three hours. Advanced study and analysis of
current topics in organic chemistry. Discussion of current
research and literature in research specialty of faculty
member teaching course. S/U grading.

235O. Seminar: Research in Organic Chemistry --
Polymer Chemistry and Biomaterials (2)
Seminar, three hours. Advanced study and analysis of
current topics in organic chemistry. Discussion of current
research and literature in research specialty of faculty
member teaching course. S/U grading.

236. Spectroscopic Methods of Organic Chemistry (4)
Lecture, three hours. Requisite or corequisite: course
C243A or consent of instructor. Problem solving using
proton and carbon 13 nuclear magnetic resonance, infrared
spectroscopy, and mass spectrometry; new techniques in
NMR, IR, and MS, with emphasis on Fourier transform
NMR.

C240. Bionanotechnology (4)
Lecture, three hours. Requisites: courses 30C, 110A. Basic
physical, chemical, and biological principles in
bionanotechnology; materials and strategies for top-down
and bottom-up fabrication of ordered biologically derived
molecules, characterization and detection techniques, and
biomimetic materials and applications at nanoscale.
Concurrently scheduled with course C140. S/U or letter
grading.

241A. Special Topics in Organic Chemistry (2 to 4)
Requisite or corequisite: course C243A. Each course
encompasses a recognized specialty in organic chemistry,
generally taught by a staff member whose research
interests embrace that specialty.

241B. Special Topics in Organic Chemistry (2 to 4)
Requisite or corequisite: course C243A. Each course
encompasses a recognized specialty in organic chemistry,
generally taught by a staff member whose research
interests embrace that specialty.

241C. Special Topics in Organic Chemistry (2 to 4)
Requisite or corequisite: course C243A. Each course
encompasses a recognized specialty in organic chemistry,
generally taught by a staff member whose research
interests embrace that specialty.

241D. Special Topics in Organic Chemistry (2 to 4)
Prerequisite or corequisite: course C243A or equivalent or
consent of instructor. Each course encompasses a
recognized specialty in organic chemistry, generally taught
by a staff member whose research interests embrace that
specialty.

242. Organic Photochemistry (4)
Lecture/discussion, three hours. Requisite or corequisite:
course C243A. Interactions of light with organic molecules;
mechanistic and preparative photochemistry.

C243A. Structure and Mechanism in Organic Chemistry
(4)
Lecture, three hours; discussion, one hour. Requisites:
courses 30C and 30CL (may be taken concurrently), 110B,
and 113A, with grades of C- or better. Mechanisms of
organic reactions. Acidity and acid catalysis; linear free
energy relationships; isotope effects. Molecular orbital
theory; photochemistry; pericyclic reactions. May be
concurrently scheduled with course C143A. S/U or letter
grading.

C243B. Organic Chemistry: Mechanism and Structure
(4)
Lecture, three hours; discussion, one hour. Requisite:
course C243A. Mechanisms of organic reactions; structure
and detection of reactive intermediates. May be
concurrently scheduled with course C143B.

244A. Organic Synthesis: Methodology and
Stereochemistry (4)
Modern synthetic reactions and transformations involving
organic substrates. Special emphasis on regents useful in
asymmetric induction and stereoselective synthesis of
structurally complex target molecules.

244B. Strategy and Design in Organic Synthesis (4)
Lecture, three hours. Requisite or corequisite: course
C243A. Theory behind the planning of syntheses of
complex molecules from simpler ones. Organic reactions
and their use in the synthetic process. Reasoning and art
involved in organic synthesis.

C245. Theoretical and Computational Organic
Chemistry (4)
Lecture, two hours; discussion, one hour; computer
laboratory, one hour. Requisites: courses 30C, 113A.
Applications of quantum mechanical concepts and methods
to understand and predict organic structures and
reactivities. Computational modeling methods, including
laboratory experience with force-field and quantum
mechanical computer calculations. Concurrently scheduled
with course C145. S/U or letter grading.

247. Organic Colloquium (2)
Seminars in organic chemistry and related areas presented
by staff, outside speakers, postdoctoral fellows, and
graduate students. May be repeated for credit. S/U grading.

248. Organic Chemistry Student Seminar (2)
Seminars presented by staff, outside speakers,
postdoctoral fellows, and graduate students. May be
repeated for credit. S/U or letter grading.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
<th>Prerequisite</th>
<th>Grading</th>
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<tbody>
<tr>
<td>249A</td>
<td>Problems in Advanced Organic Chemistry (4)</td>
<td>Designed primarily for first-year graduate students as preparation for cumulative examinations. Problems in organic chemistry.</td>
<td>consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>S/U grading</td>
</tr>
<tr>
<td>249B</td>
<td>Problems in Advanced Organic Chemistry (2)</td>
<td>Designed primarily for first- and second-year graduate students as preparation for cumulative examinations. Problems in organic chemistry.</td>
<td>consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>S/U grading</td>
</tr>
<tr>
<td>251A</td>
<td>Advanced Topics in Biochemistry (2 to 4)</td>
<td>Prerequisite: consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>S/U grading</td>
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<tr>
<td>251B</td>
<td>Advanced Topics in Biochemistry (2 to 4)</td>
<td>Prerequisite: consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>S/U grading</td>
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<tr>
<td>251C</td>
<td>Advanced Topics in Biochemistry (2 to 4)</td>
<td>Prerequisite: consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>S/U grading</td>
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<tr>
<td>251D</td>
<td>Advanced Topics in Biochemistry (2 to 4)</td>
<td>Prerequisite: consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>S/U grading</td>
</tr>
<tr>
<td>251E</td>
<td>Advanced Topics in Biochemistry (2 to 4)</td>
<td>Prerequisite: consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>S/U grading</td>
</tr>
<tr>
<td>251F</td>
<td>Advanced Topics in Biochemistry (2 to 4)</td>
<td>Prerequisite: consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>S/U grading</td>
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<tr>
<td>251G</td>
<td>Advanced Topics in Biochemistry (2 to 4)</td>
<td>Prerequisite: consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>S/U grading</td>
</tr>
<tr>
<td>251H</td>
<td>Advanced Topics in Biochemistry (2 to 4)</td>
<td>Prerequisite: consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>consent of instructor. Each course encompasses a recognized specialty in biochemistry, generally taught by a staff member whose research interests embrace that specialty.</td>
<td>S/U grading</td>
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</table>

**M252. Seminar: Advanced Methods in Computational Biology (2)**

(Same as Human Genetics M252.) Seminar, one hour; discussion, one hour. Designed for advanced graduate students. Examination of computational methodology in bioinformatics and computational biology through presentation of current research literature. How to select and apply methods from computational and mathematical disciplines to problems in bioinformatics and computational biology; development of novel methodologies. S/U or letter grading.

**CM253. Macromolecular Structure (4)**

(Same as Biological Chemistry CM253 and Human Genetics CM253.) Lecture, three hours; discussion, one hour. Requisites: courses 110A, 153A, 153B, 153C, 156. Chemical and physical properties of proteins and nucleic acids. Structure, cloning, and analysis of DNA; biosynthesis and processing of RNA; biosynthesis, purification, structure, and analysis of proteins; correlation of structure and biological properties. Concurrently scheduled with course CM153G. Letter grading.

**CM255. Biological Catalysis (4)**

(Same as Biological Chemistry M255, Molecular, Cell, and Developmental Biology CM252, and Pharmacology M255.) Requisites: courses 110A, 153A, 153B, Life Sciences 3, Molecular, Cell, and Developmental Biology 100 or C139 or M140. Reaction mechanisms in molecular biology; experimental approaches for study of enzymes, including kinetics, isotopic labeling, stereochemistry, chemical modification, and spectroscopy; design of pharmacologically active agents and artificial enzymes. Drug metabolism and interactions addressed on a mechanistic level. Concurrently scheduled with course CM155. Graduate students required to write research paper and present oral report on it.

**256A. Seminar: Research in Biochemistry -- Biochemistry of Plasma Proteins (2)**

Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

**256B. Seminar: Research in Biochemistry -- Biochemistry of Protein Function (2)**

Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.
256C. Seminar: Research in Biochemistry -- Biochemistry and Molecular Genetics of Fungi (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256D. Seminar: Research in Biochemistry -- Transcriptional Control Mechanisms in Drosophila Embryogenesis (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256E. Seminar: Research in Biochemistry -- Current Topics in Prokaryotic Development (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256F. Seminar: Research in Biochemistry -- Nucleic Acid Structure Determination by NMR (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256G. Seminar: Research in Biochemistry -- Basic Mechanisms of Promoter Activation (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256H. Seminar: Research in Biochemistry -- Contractile Proteins in Muscle Contraction and Cell Motility (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256I. Seminar: Research in Biochemistry -- Biochemistry and Molecular Biology of Chlamydomonas (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256J. Seminar: Research in Biochemistry -- Literature of Structural Biology (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256K. Seminar: Research in Biochemistry -- Mechanism and Regulation of Transcription Termination in Eukaryotic Organisms (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256L. Seminar: Research in Biochemistry -- Advanced Topics in Structural Biology (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256M. Seminar: Research in Biochemistry -- Membrane Biophysics (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256N. Seminar: Research in Biochemistry -- Analysis of Protein Structure (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256O. Seminar: Research in Biochemistry -- Biochemistry and Function of Ubiquinone in Yeast and Higher Eukaryotes (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256P. Seminar: Research in Biochemistry -- Biomolecular Nuclear Magnetic Resonance Spectroscopy and Protein Structure (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256Q. Seminar: Research in Biochemistry -- RNA Processing and RNA Genomics (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256R. Seminar: Research in Biochemistry -- Mitochondrial Biogenesis and Link to Disease (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256S. Seminar: Research in Biochemistry -- Proteome Bioinformatics (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256T. Seminar: Research in Biochemistry -- Mitochondrial Biogenesis and Link to Disease (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

256U. Seminar: Research in Biochemistry -- Proteomics and Mass Spectrometry (2)
Seminar, three hours. Advanced study and analysis of current topics in biochemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.
257. Physical Chemistry of Biological Macromolecules
(4)
Lecture, one hour; discussion, one hour; laboratory, four hours. Requisite: course 153A. Theory of hydrodynamic, thermodynamic, and optical techniques used to study structure and function of biological macromolecules. S/U or letter grading.

258. Advanced Topics in Biochemistry and Molecular Biology (2)
Lecture, two hours. Critical analysis of experimental design and methods in biochemistry and molecular biology. In-depth analysis of literature in one or more areas of current research. May be repeated for credit. S/U or letter grading.

C259A. Mechanisms in Regulation of Transcription I (2)

C259B. Mechanisms in Regulation of Transcription II (2)
(Formerly numbered CM259B.) Second five weeks. Lecture, four hours. Requisite: course C259A. Eukaryotic general transcriptional apparatus; sequence-specific promoter recognition; mechanisms of transcriptional activation and repression, including role of chromatin structure; transcription factors as targets of signal transduction pathways; transcription factors in embryogenesis. Concurrently scheduled with course C159B. S/U or letter grading.

CM260A. Introduction to Bioinformatics and Genomics (4)
(Formerly numbered CM260.) (Same as Human Genetics M260A.) Lecture, three hours; discussion, one hour. Recommended requisite: Statistics 100A or 110A. Genomics and bioinformatics results and methodologies, with emphasis on concepts behind rapid development of these fields. Focus on how to think genomically via case studies showing how genomics questions map to computational problems and their solutions. Concurrently scheduled with course C160A. S/U or letter grading.

C260B. Algorithms in Bioinformatics and Systems Biology (4)
Lecture, four hours; laboratory, four hours. Enforced requisite: course C260A with a grade of C- or better. Recommended: Program in Computing 60, Statistics 100A, 110A. Development and application of computational approaches to biological questions. Understanding of mechanisms for determining statistical significance of computationally derived results. Development of foundation for innovative work in bioinformatics and systems biology. Concurrently scheduled with course C160B. S/U or letter grading.

C261A. Plant Biochemistry (4)
Lecture, three hours; discussion, one hour. Requisite: course 153C. Introduction to distinctive features of plant biochemistry. Topics include photosynthesis, nitrogen metabolism, plant cell wall metabolism, and secondary metabolism in relation to stress. Concurrently scheduled with course C161A.

262. Biochemistry and Molecular Biology of Protein Translocation Systems (3)
Lecture, two hours; discussion, two hours. Requisites: courses CM253, or 269A through 269D. Protein translocation into nucleus, mitochondrion, peroxisome, chloroplast, endoplasmic reticulum, and protein export in bacteria. Letter grading.

M263. Metabolism and Its Regulation (4)
(Same as Biological Chemistry M263.) Lecture, three hours. Requisites: course 110A, and one course from 153B, 153C, or 156, or Biological Chemistry 201A and 201B. Thermodynamic and kinetic aspects of metabolism; regulatory properties of enzymes; metabolic regulation; consideration of comparative aspects of metabolism in relation to physiological function.

C265. Metabolic Control by Protein Modification (2)
First five weeks. Lecture, three hours; discussion, one hour. Requisites: courses 153A, 153B, 153C. Biochemical basis of controlling metabolic pathways by posttranslational modification of proteins, including phosphorylation and methylation reactions. Concurrently scheduled with course C165.

266. Proteomics and Protein Mass Spectrometry (3)

M267A. Cell Biology (4)
(Formerly numbered M267.) (Same as Biological Chemistry CM267A, Human Genetics CM267A, and Molecular, Cell, and Developmental Biology CM223A.) Lecture, three hours; discussion, one hour. Recommended: course CM153G. Fundamental principles and experimental approaches in four areas of cell biology: cell cycle regulation, signal transduction, intracellular protein transport, and structure and function of cytoskeleton, including cell-cell and cell-substrate interactions. Letter grading.

M267B. Cell Biology Seminar (4)
(Formerly numbered M267.) (Same as Biological Chemistry CM267B, Human Genetics CM267B, and Molecular, Cell, and Developmental Biology M223B.) Seminar, two hours. Corequisite: course M267A. Student oral presentation and written analysis of primary research articles in cell biology. Letter grading.

268. Biochemistry Research Seminar (2)
Seminars presented by staff, outside speakers, postdoctoral fellows, and graduate students on topics of current biochemical research interest. May be repeated for credit. S/U or letter grading.

269A. Protein Structure (2)
269B. Biocatalysis and Bioenergetics (3)

269C. Nucleic Acid Structure and Catalysis (2)

269D. Mechanism and Regulation of Gene Expression (3)

C270. Biochemistry and Molecular Biology of Photosynthetic Apparatus (2 to 4)

271. Advanced Topics in Inorganic Chemistry (2 to 4)
Each course encompasses a recognized specialty in inorganic chemistry, generally taught by a staff member whose research interests embrace that specialty.

272A. Seminar: Research in Inorganic Chemistry -- Chemistry of Materials (2)
Seminar, three hours. Advanced study and analysis of current topics in inorganic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

272B. Seminar: Research in Inorganic Chemistry -- Metalorganic, Inorganic Biometalorganic Chemistry (2)
Seminar, three hours. Advanced study and analysis of current topics in inorganic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

272C. Seminar: Research in Inorganic Chemistry -- Inorganic Spectroscopy (2)
Seminar, three hours. Advanced study and analysis of current topics in inorganic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

272D. Seminar: Research in Inorganic Chemistry -- Bioinorganic Chemistry and Biology of Transition Metals and Oxygen (2)
Seminar, three hours. Advanced study and analysis of current topics in inorganic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

272E. Seminar: Research in Inorganic Chemistry -- Organometallic Synthesis and Chemical Vapor Deposition (2)
Seminar, three hours. Advanced study and analysis of current topics in inorganic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

272G. Seminar: Research in Inorganic Chemistry -- Issues in Chemical Education (2)
Seminar, three hours. Advanced study and analysis of current topics in inorganic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

272I. Seminar: Research in Inorganic Chemistry -- Organometallic Chemistry (2)
Seminar, three hours. Advanced study and analysis of current topics in inorganic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

272J. Seminar: Research in Inorganic Chemistry -- Reticular Chemistry (2)
Seminar, three hours. Advanced study and analysis of current topics in inorganic chemistry. Discussion of current research and literature in research specialty of faculty member teaching course. S/U grading.

C273. Advanced Inorganic Chemistry (4)
Lecture, three hours; discussion, one hour. Requisite: course 171 with a grade of C- or better. Systematic approach to modern inorganic chemistry, structure and bonding of inorganic molecules and solids, structure/reactivity relationships, vibrational spectra of complexes, electronic structure and ligand-field theory, mechanisms of inorganic reactions, bonding and spectroscopy of organometallic compounds, transition metals in catalysis and biology. Concurrently scheduled with course C172. S/U or letter grading.

C274. Inorganic and Metalorganic Laboratory Methods (5)
Lecture, two hours; laboratory, eight hours. Enforced requisites: courses 30CL and C172, with grades of C- or better. Synthesis of inorganic compounds, including air-sensitive materials; Schlenck techniques; chromatographic and ion exchange methods; spectroscopic characterization and literature applications. Concurrently scheduled with course C174. S/U or letter grading.

C275. Inorganic Reaction Mechanisms (4)
Lecture, three hours. Requisites: courses 110A, 110B, 113A, C172. Survey of inorganic reactions; mechanistic principles; electronic structure of metal ions; transition-metal coordination chemistry; inner- and outer-sphere and chelate complexes; substitution, isomerization, and racemization reactions; stereochemistry; oxidation/reduction, free-radical, polymerization, and photochemical reactions of inorganic species. May be concurrently scheduled with course C175. S/U or letter grading.
C276A. Group Theory and Applications to Inorganic Chemistry (4)
Lecture, three hours; discussion, one hour. Requisites: courses 113A, C172. Group theoretical methods; molecular orbital theory; ligand-field theory; electronic spectroscopy; vibrational spectroscopy. May be concurrently scheduled with course C176. S/U or letter grading.

C276B. Physical Methods in Inorganic Chemistry (4)
Lecture, three hours. Requisite: course C276A. Theory and applications of spectroscopic techniques, including magnetic resonance and vibrational and surface science methods, to inorganic compounds and materials. S/U or letter grading.

C277. Crystal Structure Analysis (4)
Lecture, three hours. Theory and practice of modern crystallography, with emphasis on practical experience in structure determination. Topics include crystallographic symmetry, scattering theory, data collection, Fourier analysis, heavy atom techniques, direct methods, isomorphous replacement, crystallographic refinement, error analysis, and common pitfalls. S/U or letter grading.

C278. Inorganic Chemistry Student Seminar (2)
Seminars presented by staff, outside speakers, postdoctoral fellows, and graduate students. May be repeated for credit. S/U or letter grading.

C279. Biological Inorganic Chemistry (4)
(Formerly numbered 279.) Lecture, three hours. Requisites: courses 153A (or 153AH), 171. Role of metal ions in biology. Topics include interactions of metal ions with proteins, nucleic acids, and other biological molecules; mechanisms of metal ion transport and storage; introduction to metalloenzyme; metalloproteins in electron transfer, respiration, and photosynthesis; metals in medicine. Concurrently scheduled with course C179. S/U or letter grading.

C280. Solid-State Chemistry (4)
Lecture, three hours. Requisite: course C172. Survey of new materials and methods for their preparation and characterization, with emphasis on band theory and its relationship to chemical, optical, transport, and magnetic properties, leading to a deeper understanding of these materials. Concurrently scheduled with course C180. S/U or letter grading.

C281. Polymer Chemistry (4)
Lecture, three hours; discussion, one hour. Requisites: courses 30B, 110A. Synthesis of organic and inorganic macromolecules, thermodynamic and statistical mechanical descriptions of unique properties of polymers, polymer characterization methods, and special topics such as conductive and biomedical polymers and polymeric reagents in synthesis. Concurrently scheduled with course C181. S/U or letter grading.

C282. Introduction to Inorganic Chemistry Research (2)
Lecture, 90 minutes. Discussion of current research in inorganic chemistry, designed primarily for entering graduate inorganic chemistry students. S/U grading.

C283. Evolution of Devices from Concept to Product (2)
Seminar, 90 minutes. Required of students in Materials Creation Training Program. Training in fundamental science and engineering to fabricate electrical, photonic, and microelectromechanical devices. Discussion of intellectual property issues and development of business plan. May be repeated for credit. S/U or letter grading.

C284. Materials Creation Training Program Brown-Bag Seminar (2)
Seminar, one hour. Required of students in Materials Creation Training Program. Research and literature seminar presented by graduate students conducting research in synthesis and characterization of materials and fabrication of electronic and photonic devices. S/U grading.

C285. Materials Chemistry Laboratory (5)
Lecture, two hours; laboratory, eight hours. Requisites: courses 30AL, 110A, 113A, 171. Materials synthesis and physical properties of complex materials. Combines synthetic skills with fundamental physical understanding and characterization in approximately equal proportions to relate materials synthesis to materials function. Concurrently scheduled with course C185. Letter grading.

M370A. Integrated Science Instruction Methods (4)
(Formerly numbered 279.) Lecture, two hours; discussion, one hour; laboratory, one hour. Preparation: one introductory lower division year (including laboratory) each of chemistry, life sciences, and physics and at least two Earth science courses, preferably one with field experience. Classroom management, lesson design, assessment, history of science education. S/U or letter grading.

M370B. Integrated Science Instruction Methods (4)
(Formerly numbered 279.) Lecture, two hours; discussion, one hour; laboratory, one hour. Requisite: course M370A or Earth and Space Sciences M370A or Physics M370A. Application of learning theory to science instruction and classroom management, including use of technology, collaborative learning, laboratory safety, ethical issues, field experiences, and professional development. S/U or letter grading.

375. Teaching Apprentice Practicum (1 to 4)
Seminar, to be arranged. Preparation: apprentice personnel employment as teaching assistant, associate, or fellow. Teaching apprenticeship under active guidance and supervision of regular faculty member responsible for curriculum and instruction at UCLA. May be repeated for credit. S/U grading.

400. Safety in Chemical and Biochemical Research (2)
Survey of safe laboratory practices for experimental research in organic, inorganic, and physical chemistry and biochemistry. Topics include laser safety, cryogenic hazards, high- and low-pressure experimentation, gas and carcinogen handling, chemical spills, fire extinguishing, and chemical disposal. S/U grading.

495. Teaching College Chemistry (2)
Seminar, two hours; discussion, two hours; 20 hours training during week prior to Fall Quarter. Course for teaching assistants designed to deal with problems and techniques of teaching college chemistry. S/U grading.
596. Directed Individual Study or Research (2 to 16)
To be arranged with faculty member who directs the study or research. May be repeated for credit. S/U grading.

597. Preparation for M.S. Comprehensive Examination or Ph.D. Qualifying Examinations (2 to 4)
S/U grading.

598. Research for and Preparation of M.S. Thesis (2 to 16)
Each faculty member supervises research of M.S. students and holds research group meetings, seminars, and discussions with the students.

599. Research for and Preparation of Ph.D. Dissertation (2 to 16)
Each faculty member supervises research of Ph.D. students and holds research group meetings, seminars, and discussions with the students.