

The Chemistry Major's Handbook

Content and images by Jon Hamlow, UMM Class of 1994

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I. Introduction

What is chemistry? Chemistry explores the fundamental nature of matter: what it is, what it does, and why. Through the ongoing search for these answers, the question, "what is chemistry" is continually asked and the answer is continually changing. The study of chemistry is the search for this answer and is intimately related to fundamental questions in biology, chemistry, geology and many other disciplines. That is why chemistry has earned the nickname "the central science."

This web handbook has several purposes: to give you a concise reference guide to the Chemistry and Biochemistry majors at the University of Minnesota, to help you design a program of study, to create awareness about special opportunities offered and to help you deal with the special challenges provided by the study of chemistry and biochemistry.



A. So You Want To Be A Chemistry or Biochemistry Major. The University of Minnesota, Morris, offers several degree choices in the Chemistry discipline, including: the Bachelor of Arts (B.A.) degree in chemistry, a chemistry B.A. focused on biochemistry (for all intents and purposes, a biochemistry B.A.), and a chemistry major with licensure in secondary education (Chemistry grades 9-12). Many students also pursue the chemistry or biochemistry major before going to medical school or further studies in engineering, pharmacy, toxicology, law...you name it!

UMM's Chemistry/Biochemistry program is challenging. It could even be called difficult. The study of chemistry requires diligence and hard work. The rewards are considerable: the study of Chemistry/Biochemistry provides rigorous thinking skills and a degree that is highly marketable in a diverse array of fields. Enough of the lecture -- let's go! (*Return to Table of Contents*)

B. The Advisor. If you have chosen to study chemistry and do not have an advisor from the chemistry/biochemistry faculty, it is a good idea to change your advisor (through the Advising Office) as soon as possible. A word of advice: Don't short-change yourself by only seeing your advisor for mandatory planning sessions. Your advisor is an excellent source of information on questions from how to pass your classes to how to get a summer job. Your advisor is also a good source of recommendations for graduate school or jobs - so get to know your advisor, so your advisor knows you.

C. UMM Faculty. With that in mind, learn about the fine folks who teach and advise budding chemists here at UMM.

<i>Physical & Theoretical Chemistry</i> Joe Alia	<i>Organic & Organometallic Chemistry</i> Nancy Carpenter	<i>Analytical Chemistry</i> Jenn Goodnough
<i>Inorganic Chemistry & Materials Science</i> Ted Pappenfus	<i>Organic & Biochemistry</i> Tim Soderberg	<i>Physical Chemistry & History of Chemistry</i> Jim Togeas

D. Facilities

1) *Chemistry.* UMM's Chemistry facilities are located in the Science and Math building. You can take a virtual tour, but here are some helpful hints for chemistry/biochemistry students:

- The chem. lounge is Sci 3005. It is a great place to hang out and study with other students in chemistry classes, and is generally open until about 11 p.m. This is also where chemistry drop in tutoring is held, and many chem. profs hold their review sessions here.
- The chem. computer lab (Sci 3110) is for use by chemistry students, and has chemistry drawing software, word processing, chemistry modeling programs and access to the internet.



2) *The Library.* Briggs Library has the following resources of special interest to chemistry and biochemistry students.

On-Line Catalogs and Search Engines:

- 1) SUMMON gives access to Briggs Library holdings.
- 2) MNCAT gives access to the complete holdings of the U of M system; a huge number of specialized texts can be conveniently borrowed through interlibrary loan.
- 3) WorldCAT has listings from the libraries worldwide.
- 4) Library of Congress

Online Databases: In addition, there are several specialized databases for searching the

chemistry and biochemistry literature that are of special interest to chemistry students:

- ACS Web Editions
- Science Direct
- Pubmed
- SciFinder Scholar

You'll be introduced to these databases in your chemistry classes, and they are accessible through the Briggs Library web page. If you get stuck while trying to negotiate these sites, just ask a friendly librarian for help.

Chemistry & Biochemistry Periodical Holdings in Briggs Library. The following journals are available either on line or on paper through Briggs Library:

- Accounts of Chemical Research
- Angewandte Chemie (International Edition)
- Chemical Reviews
- Journal of Chemical Education
- Journal of the American Chemical Society
- Journal of the Chemical Society, Chemical Communications
- Nature
- Proceedings of National Academy of Sciences
- Science
- Analytical Chemistry
- Biochemistry
- Environmental Science & Technology
- Inorganic Chemistry
- Journal of Biological Chemistry
- Journal of Chemical Physics
- Journal of Organic Chemistry
- Journal of Physical Chemistry (A and B)
- Organometallics
- Chemical Society Reviews

Briggs has many other holdings, all of which are listed on (of all things) the "Journal Finder" on their home page.

II. Degrees in Chemistry, etc.

A. Options

1) Majors and Minors. Information on the classes required for a major in chemistry (both a traditional and biochemistry subfield are offered) or a minor in chemistry are listed on this web site. Selecting the correct timing for each class is something that should be worked out with you and your advisor, and needs to be tailored to the goals and flexibility you require. You should be asking questions like: am I preparing for teaching high school chemistry, would I like to teach college chemistry someday? Am I preparing for another program, like Chemical Engineering, medicine, dentistry or pharmacy? Am I interested in going to Veterinary school or Law school? How many majors do I want and how many years do I want to spend on my undergraduate education?

2) Engineering Programs. The Institute of Technology (IT) on the Twin Cities campus offers a program in Chemical Engineering and other engineering disciplines (aeronautical, civil, environmental, mechanical, etc.). Consult the IT web site and your advisor about doing preparatory work for entering an engineering program.

3) *Health Sciences*. The Twin Cities is one of several institutions around the country that provides advanced degrees in the areas of health care. Links to their very informative web sites are given below.

- School of Medicine
- School of Dentistry
- School of Pharmacy
- School of Physical Therapy
- Veterinary Medicine

4) *Dual-degree Program*. If you are interested in obtaining a B.A. degree from UMM in Chemistry, but would also like to complete your B.S. degree in, say, biomedical engineering from the IT on the Twin Cities campus, you can work with a faculty advisor to take the right combination of classes and get a head start on your undergraduate career. (*Return to Table of Contents*)

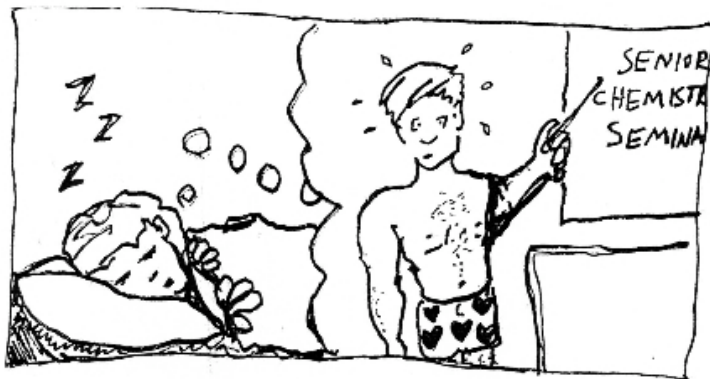
B. FAQs About the Majors

1) *Completion in Four Years*. Despite popular myth, it is still very possible to get a BA in four years, but it requires attentive planning and avoiding dropping or failing classes (duh!).

2) *Registration*. Everything you need to know about registration can be found on the Registrar's website. With the possible exception of this little tip -- don't register any later than necessary. Having your required class fill up (classes can only accept a limited number of people) because you slept through your scheduled registration time is a leading cause of high blood pressure at UMM.

3) *Directed Studies in Chemistry*. These are student-faculty designed courses of study, most frequently taken as independent research projects. If you would like to study a chemistry related topic in-depth or do a special project, speak with a favorite faculty member about doing a directed study. A word of advice -- plan well ahead, there's paperwork involved and professors often fill up their work schedules pretty far in advance.

4) *Laboratory Classes*. Lab classes are much more than just a supplement to lecture. They are an integral component of your education in chemistry and provide hands-on experience of "real world" chemistry. Skills you learn in laboratory are skills you will use in industry or future work. Take labs as seriously as lectures.



5) *The Seminar*. The seminar is your last required chemistry class at UMM. It begins in the second semester of your junior year when you take Chem 3901 to start thinking about that seminar you'll give during your senior year. The "senior seminar" involves getting up in

front of a your peers and professors and delivering a presentation on a timely project in chemistry. This may be literature research or it might be the results of a research project you participated in during college or on a summer job or internship. Everything you need to know about the seminar, pretty much, will be told to you your junior year in Chem 3901. In the meantime, remember that it's impossible to get a medical excuse due to stage fright. The best way to find out what the seminar is all about is to attend one (they're held on Thursday afternoons at 4 p.m.; the schedule is posted on this web site). Throughout the year you will see posters for seminars within the science building, and as they invariably note, all are welcome. Plus, you get free tasty treats. (*Return to Table of Contents*)

C. Surviving Your Classes

No one gets through college without occasionally struggling in their classes. College is considerably more difficult than high school. So, here are a few sage words of timely advice for your consideration.

1) *Attendance*. Generally, chemistry classes do not require you to attend class. The simple fact is that if you make a habit of skipping class, it will have a detrimental effect on your grade. You are responsible for whatever you miss if you miss class. One more thing -- don't even think about skipping labs unless you have a really, really, really good excuse. Don't say we didn't warn you; enough said.

2) *The Academic Assistance Center*. If you knew everything, you wouldn't be in college. Yes, it is strange, but true. Furthermore, being confused is not dumb, it's normal. Being afraid or unwilling to get help when you are having trouble in your classes is dumb. The Academic Assistance Center (AAC) is open weekdays in Room 362, Briggs Library, and provides a variety of ways to get academic help. Do you know the 10 Keys to Success, or about how you learn to learn? If not, check out their website for more information.

Tutors. The AAC can provide you with a peer tutor in a specific class. All you need to do is go to the AAC and fill out a form (you can even do it on-line). The peer tutors are upperclass students who have been there and done that, and they can really help facilitate your learning in a particular class.

Other Services. The AAC offers, workshops on reading and study skills, computer software to assist learning, and English language support for students for whom English is a second language.

Drop-in Tutoring (for math and chemistry). This drop-in service for math tutoring is located on the third floor of Briggs Library, and is open most evenings to provide help with math. Chemistry drop-in tutoring is offered in Sci 3005; check the AAC website for the most up-to-date schedule.

3) *Notes and Old Tests*. Some professors keep notes and old tests online as study aids. Ask your professor if these resources are available for your perusal.

4) *Incompletes*. Let's face it -- stuff happens. Sometimes you may need to take an incomplete in a class. First talk to your advisor, then talk to your instructor. The "rules and regulations" for taking incompletes can be found in the UMM Bulletin.

5) *Grading Guidelines*. Each professor has his or her own guidelines for grades, generally this is found in the course syllabus. See the "Uniform Grading Policy" of the University of Minnesota for the University policy governing grading. If you find the guidelines for the class unclear, be sure to have your professor clarify them.

6) *Repeating Courses*. So you didn't do as well as you wanted to in one of your courses? It's true – you can repeat courses. See the UMM Catalog for more information. A word to the wise -- repeating courses is time consuming and costly to the student.

D. Beyond Coursework

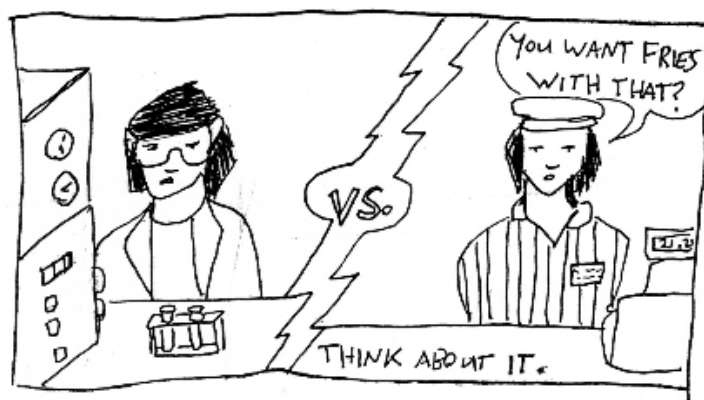
1) *Introduction*. In addition to classes, UMM has many extracurricular programs and jobs for students. These activities provide experience, expand horizons, and look good on a resume -- all the stuff advisors have been telling you about extracurricular activities since you were knee-high to a grasshopper.

2) *The Chemistry Club - American Chemical Society Student Affiliates Chapter*. The ACS offers memberships to students at special rates. Members receive periodicals, special member services, and a nifty membership card. UMM has a recognized ACS student affiliate branch. Talk to any chemistry faculty member about joining.

3) *On-campus Jobs in Chemistry*. Work-study jobs are a great way to get valuable experience and earn some spare cash to boot. Chemistry students who are work-study eligible can work as Teaching Assistants and Lab Assistants. Talk to Julie Kill (Sci 3120) about getting a work- study job. In addition, the Academic Assistance Center (see Section II.C) hires students to tutor courses.

E. Research

1) *During the school year*. While the major effort at UMM is on teaching undergraduates in the classroom, there are also opportunities for doing research during the school year. Chemistry faculty are actively involved in scholarly activity, aka research. If you would like to do research while at UMM, talk to your advisor about what areas of chemical research the UMM faculty are doing and whether you might be able to work on an on-going project, or design a new project for yourself. You may turn a research project into a directed study, or get paid to do research by signing up for a MAP (Morris Academic Partnership) or UROP (Undergraduate Research Opportunity) grant. Talk to your advisor and Sharon Van Eps about getting a UROP grant. Plan at least a couple semesters ahead of when you want to start, so you'll have time to choose the best option and apply to the appropriate places.

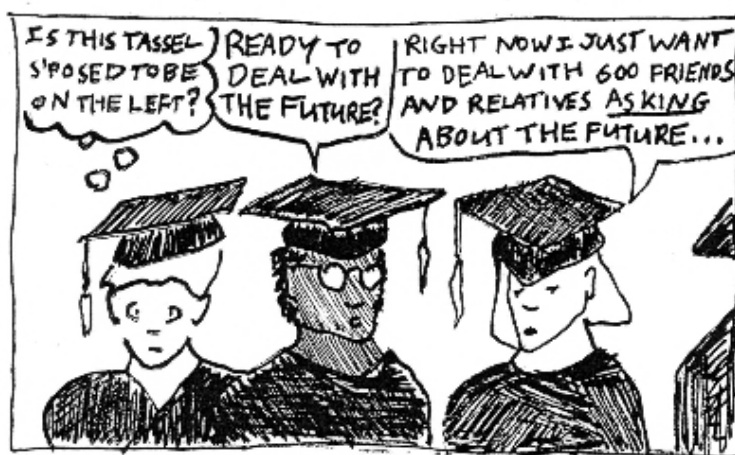


2) *Internships and Summer Research*. Many schools and companies offer summer internships to students. There are many reasons to pursue a summer internship, not the least of which is that it is an excellent way to find out what chemistry is like in the "real" world. Internships make you vastly more marketable when looking for jobs or trying to get into graduate school. They also give a taste of what a real chemist's work is like. Many internships will pay travel expenses and allow you to spend your summers in exotic locales, such as Iowa! Internships pay better than alternatives like flipping burgers, waiting tables

or selling encyclopedias. Internships will connect you with potential graduate schools, employers, and with peers who will broaden your horizons. Many students use summer research as the basis for their senior seminar (see section II.B.8) Many programs require you to prepare a presentation on your research findings anyway, making preparation for your seminar that much easier.

3) *Getting an Summer Research position.* Usually, but not always, students first apply for summer internships for the summer after their sophomore year. The most important rule is to start early. Internship opportunities can be accessed through this website. Posters and other information about Summer Research can also be found at the top of the stairs in the atrium (on the bulletin board). In addition, the Career Center, located on the second floor of Behmler Hall, has listings of some internships. Apply for several to have the best chance of getting one. Most applications for internships are due from about late January through early March.

III. After Graduation



A. Graduate School

1) *What Is It?* Graduate school is the next step in education beyond your four-year undergraduate experience. Graduate schools offer programs for Master's and Ph.D. degrees in Chemistry. Grad school involves the intense, focused study of some area of chemistry, usually for about five years.

2) *Why Go?* The primary reason is interest. Students who have found an area of interest in chemistry go to grad school to pursue this interest. Although the benefits of going to grad school are considerable, it requires a level of discipline that will be difficult to maintain if you aren't really interested in what you're studying and self-motivated to learn.

3) *Benefits of Grad School.* Chemists with advanced degrees have more job opportunities, more upward mobility in jobs, and get higher salaries. If you want to teach in college, an advanced degree is a necessity. Finally, graduate students in chemistry frequently get paid to go to school, usually in the form of a tuition waiver and a paid teaching or research fellowship or scholarship. No more loans necessary!

4) *Choosing a School.* Many resources are available to you, including the chemistry/biochemistry faculty, all of whom went through graduate school at one point or another! They'll have lots of good advice about what to think about and how to get started on your search. Student Counseling in Behmler Hall has information about graduate schools. Some resources you may wish to examine are Peterson's Guide to Graduate Programs in the Physical Sciences and Mathematics and The ACS Directory of Graduate Research in the US.

5) *When to Start.* A year prior to when you want to begin graduate school is when to start applying. If you have a good GPA and GRE score (see section II.A.7) you may wish to apply earlier to be applicable for more scholarships and fellowships. To apply for Fall semester you should have all material for application completed and collected no later than the end of January.

6) *What You Need to Apply*

- 1) Application Form: Most are accessed online from the school you're applying to, and they typically include a short essay.
- 2) Transcripts: Send a current academic transcript when you apply to grad school, and a complete transcript as soon as one is available after you complete your undergraduate degree.
- 3) Letters of Recommendation: Usually three are required. Faculty and employers who are familiar with your research work are the best choices. It is reasonable to ask someone from whom you are soliciting a letter of recommendation if there is any reason why they could not write a supportive letter.

7) *GREs (Graduate Record Examinations)*

These are standardized tests required by some but not all graduate schools. Make sure you know which tests the schools you are interested in require. Check with Jane Kill at Student Counseling about taking these tests.

In addition, The American Chemical Society has many resources to help you out if you are interested in attending graduate school. (*Return to Table of Contents*)

B. Jobs in Chemistry/Biochemistry

Contrary to popular myth, there are many jobs available to the BA in chemistry. As with the search for a graduate school, the most important step is to start preparing early. The best resource for the job hunt is the Career Center in Behmler Hall. There you will find resources to help you write a resume, search for job openings, and perform your best at an interview, etc. The current job market is competitive...a job won't come and find you, so the successful job hunter is the one who starts looking early, is persistent and doesn't become easily discouraged.

C. Working vs. Grad School

Only you can decide whether to enter the job market with a BA or go on to grad school. There are pros and cons to both sides. If you are uncertain about grad school, or feel unprepared, you may wish to seek work and keep grad school as a future option. Although it may be difficult to leave the material benefits of a job behind and get into the swing of academia, many students have taken this option. Some companies even provide financial support to employees who choose to go back to school. Some students who can afford it take a year off to travel, or simply take time off to help them decide about future options. What is most important is that you decide what you want for yourself and use the resources available to help you realize your goals. The philosophy of teaching at UMM is not to impart orthodox rules, but to create problem-solving skills and dynamic, creative thinking in students. This applies to the decisions you make in your life, as much, if not more than, the questions you ask in the classroom. There is no right or wrong way to live your life – only the way you choose.