

GRADUATE STUDENT HANDBOOK

UNIVERSITY OF MICHIGAN
DEPARTMENT OF CHEMISTRY

Ann Arbor, Michigan

Updated, September 2010

<http://www.umich.edu/~michchem/graduate/GradHand.pdf>

TO OUR STUDENTS

This handbook is intended to serve as a consolidated source of information and as a guide for the Chemistry faculty and graduate students of the University of Michigan to the guidelines relating to graduate study in the Department of Chemistry. Graduate students should also refer to the *University of Michigan Bulletin* which outlines the Rackham Graduate School guidelines for graduate study at the University. In addition, the Rackham Graduate School publishes its own Graduate Student Handbook.

The Department of Chemistry Graduate Student Handbook contains information concerning the organization of the Department, its personnel, and their duties. We hope you will find it helpful and convenient for reference.

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WHERE TO GO FOR INFORMATION

Graduate Student Handbook

This Handbook is to be used as a guide to the rules and regulations that govern the graduate program both here in the Department of Chemistry as well as the University of Michigan. As a student you must familiarize yourself with requirements of the Department and the Graduate School. Throughout the Handbook references are made to Graduate School rules/regulations which can be found in their entirety in The University of Michigan Bulletin, Rackham Graduate Student Handbook on their website: <http://www.rackham.umich.edu/StudentInfo/Publications/GSH/html/contents.html>

Chemistry Intranet

On the chemistry homepage, there is a link to the Intranet. The intranet houses resources for all faculty, staff and students. This is where you should to access the electronic timekeeping system, and the IT ticket system. Once you click on the link you will be prompted to sign in with your unickname and password.

Graduate Mailboxes

Every graduate student will have their own mailbox located in Room 1416. In addition to receiving U.S. mail, you will also receive campus mail. Any messages from faculty, Academic Services staff, Technical staff or the Rackham Graduate School will be put in your mailbox. *We only leave messages in your mailbox - we don't call your residence.* Please get in the habit of checking your mailbox every day. Many problematic situations can be avoided by checking your mailbox daily for messages.

Graduate Bulletin Board

This board is located in the 1500 complex outside the Graduate Studies office. Information on fellowships, scholarships and grants offered *outside* the University are posted here. Announcements for organic cumulative exams and English Language Institute exams are posted here as well along with job listings and tutoring positions.

Graduate Advisors

For academic counseling your first year, you will be assigned an advisor that is typically a member of the Graduate Committee, a departmental committee that oversees the graduate program. There are three times

during your first year where the Graduate Committee will provide official academic advising, but you may contact your advisor at any time for advice or to schedule an appointment. After your first year, your Research Advisor (dissertation mentor) is your primary resource for academic advising as well as your mentor for your thesis project. In addition, Laura Labut and Anna Stryker of the Student Services office are an excellent resource for academic questions and assistance with conflict resolution, as is the Graduate Committee.

Administrative Complex

The offices of the Chair, Assistant to the Chair, Director of Laboratories, Manager of Academic Services, and Coordinators of Undergraduate and Graduate Studies are located in 1500. The student services staff can provide help to graduate students in the areas of graduate insurance, graduate student instructor appointments, graduate records and admissions, recruiter visits, resume writing, and job opportunities. The Administrative staff can help with building problems, room reservations and seminar postings. All room reservation requests can be sent to chemreservations@umich.edu and supply and key requests will be handled by Mike Kelly in the Business Office (1521 Chem).

Shapiro Science Library

Graduate students are encouraged to use services and resources provided by the Shapiro Science Library. As a part of the MLibrary system, the Shapiro Science Library strives to support research, teaching, learning and scientific inquiry in chemistry and other science disciplines. Many online resources and services are available to you at <http://www.lib.umich.edu/shapiro-science-library>. The Chemistry print collections are located on the 3rd and 4th floors of the Shapiro Library Building along with excellent places for study and research. If you need any assistance for your information inquiry, please contact the Chemistry Librarian, Ye Li, at lye@umich.edu or ask a librarian on <http://www.lib.umich.edu/ask-librarian>.

DEPARTMENTAL STAFF

Administration

Chair

Assoc. Chair-Undergraduate

Assoc. Chair-Graduate

Assoc. Chair-Research & Facilities

Administrative Manager

Assistant to the Chair

Secretary

Research Grants Manager

Carol Fierke

Brian Coppola

Melanie Sanford

Michael Morris

Open

Alice Forney

Michael Kelly

Gary Smith



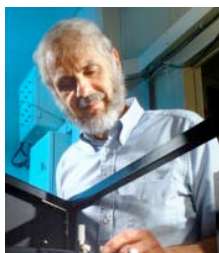
Carol Fierke



Brian Coppola



Melanie Sanford



Michael Morris



Alice Forney



Michael Kelly



Gary Smith

Student and Academic Services

Laura Labut	Manager, Academic Services	1500h	7-2990
Anna Stryker	Coordinator, Graduate Student Services	1500i	4-7278
John Velner	Coordinator, Graduate Human Resources	1500j	7-2859
Bev Lange	Coordinator, Undergraduate Student Services	1500	7-2858
Debra Buck	Student Services Admin Assoc.	1500	7-2857



Laura Labut



Anna Stryker



John Velner



Bev Lange



Debra Buck

Laboratories and Facilities

Tracy Stevenson, Director of Laboratories 1500c 5-2724
Richard Giszczak Safety Officer, Chem Waste Coord. 1608 3-4527
Laurie MacDonald Lab. Assist. /Safety and Waste 1614 4-7325



Tracy Stevenson



Richard Giszczak



Laurie MacDonald

CHEMISTRY GRADUATE STUDENT COUNCIL

The Chemistry Graduate Student Council (GSC) deals with academic and other issues of concern to graduate students in this Department. It serves as a tie between the faculty, graduate students, and staff. In addition to their academic responsibilities, the GSC also sponsors social events for faculty, graduate students, staff and their families from time to time. Any student interested in being on GSC should contact the present members for further information. The current officers are:

Brannon Gary-President
Kevin Hartman-Treasurer

GRADUATE FACULTY

Last Name	First Name	Office	Phone #	Uniqname
Al-Hashimi	Hashim	4028a	615-3361	hashimi
Andrews*	Philip	1198 NIB	763-3130	andrewsp
Ashe	Arthur	2521	764-8487	ajashe
Banaszak Holl	Mark	4545	763-2283	mbanasza
Bartell	Lawrence	1543	764-7375	lbart
Bartlett	Bart	2813	615-9279	bartmb
Biteen	Julie	-	-	jsbiteen
Blinder	S. M.	3547	764-7336	sblinder
Brooks	Charles	2006A	647-6682	brookscscl
Carlson*	Heather	2555 CCL	615-6841	carlsonh
Carroll	Kate	LSI 4401	615-2739	katesc
Carroll*	Mary Anne	SpRes1521b	763-4066	mcarroll
Chen	Zhan	4809	615-4189	zhanc
Coppola	Brian	2403	764-7329	bcoppola
Coucovanis	Dimitri	2744	764-7339	dcouc
Curtis	David	3533	478-1011	mdcurtis
Dunietz	Barry D.	2000d	647-4495	bdunietz
Fierke	Carol	4525	936-2678	fierke
Francis	Anthony	-	-	afrancis
Geva	Eitan	2000b	763-8012	eitan
Glick	Gary	2819	764-4548	gglick
Goodson III	Theodore	4819	647-0274	tgoodson
Gottfried	Amy	A868	647-9540	acgottfr
Griffin	Henry	4807	764-1438	hcg
Hakansson	Kristina	4521	615-0570	kicki
Jones	Paul	3529	N/A	prjones
Karbstein	Katrin	4541	615-2867	kkarbst
Kennedy	Robert	4815	615-4363	rtkenn
Kerner	Nancy	3541	763-5372	nkerner
Kopelman	Raoul	4744	764-7541	kopelman
Koreeda	Masato	2525	764-7371	koreeda
Kubarych	Kevin	4813	764-7528	kubarych
Kuczkowski	Robert	3403	764-7540	kuczkows
*Kuroda	Kenichi	2223 Dental	936-1440	kkuroda
Lawton	Richard	3521	764-7377	richy

Lehnert	Nicolai	2807	615-3673	lehnernn
Lim	Mi Hee	LSI 4403	647-0204	mhlm
Lohr	Lawrence	3529	764-3148	lloh
Longone	Daniel	3537	N/A	no email
Lubman*	David	MSRB 1 A510B	647-6945	dmlubman
Maldonado	Stephen	4533	647-4750	smald
Mapp	Anna	2815	615-6862	amapp
Marsh	E. Neil G.	4537	763-6096	nmarsh
Matzger	Adam	2823	615-6627	matzger
McNeil	Anne	2817	615-5204	ajmneil
Meyerhoff/Acting Chair	Mark	3306	763-5916	mmeyerho
Montgomery	John	3819	764-4424	jmontg
Morris	Michael	4811	764-7360	mdmorris
Nagorny	Pavel	-	-	nagorny
Nolta	Kathleen	A860	763-5901	nolta
Nordman	Christer	3547	764-7326	cnordman
Pecoraro	Vincent	3823	763-1519	vlpec
Penner-Hahn	James	4022	764-5257	jeph
Ramamoorthy	A.	4024	647-6572	ramamoor
Rasmussen	Paul	4807	764-1438	pgrasmsn
Ruotolo	Brandon	3549	615-9582	bruotolo
Sanford	Melanie	2811	615-0451	mssanfor
Sension	Roseanne	4529	763-6074	rsension
Sharp	Robert	3525	764-7331	rrsharp
Sherman*	David	4036 LSI	615-9907	davidhs
Sipowska	Dotie	3545	764-8527	dotie
Soellner	Matthew	3813	615-2767	soellner
Szymczak	Nathaniel	-	-	nszym
Vedejs	Edwin	3817	615-2177	edved
Walter	Nils	4821	615-2060	nwalter
Wiseman	John	3521	764-2529	wisemanj
Wolfe	John	3811	763-3432	jpwolfe
Woodard*	Ronald	4569 CC Little	764-7366	rww
Zellers*	Edward	SPH2/M6224	936-0766	ezellers

GRADUATE DEGREE PROGRAMS

This section provides information on the requirements for the degree of Doctor of Philosophy. A description of all graduate courses in chemistry is provided later in this section. The requirements stated here include those set by the Department and those set by the Rackham School of Graduate Studies. Students are urged to consult the current University of Michigan Bulletin as well as the Handbook for Doctoral Candidates and the Rackham Graduate Student Handbook.

Departmental requirements for graduate degrees are administered by the Graduate Committee, a committee of seven faculty members representing the various clusters. This Committee has been delegated the authority by the faculty to interpret rules and requirements and, when the circumstances warrant, to grant exceptions upon formal appeal. In the first year, each student will be provided formal academic counseling by a member of the Graduate Committee. The Committee is also a resource for any questions or concerns regarding progress to the Ph.D. and can assist with conflict resolution.

Course elections for each term must be approved either by the Graduate Committee or research advisor. Each student's status is reviewed by the Graduate Committee after each term and an appropriate report is transmitted to the student when needed. NOTE: Failure to follow the approved registration can place your standing in the Ph.D. program in jeopardy. Do not make unapproved changes in your schedule.

Requirements for the Ph.D. Degree

The degree Doctor of Philosophy is the highest degree conferred by the University. It is a research degree. It is never conferred solely as a result of study, no matter how faithful, extending over any prescribed time period or for any amount of course work or research accumulated. The degree represents more than merely the sum of semesters in residence and of credits for courses taken. The length of residence and the plan of study are of secondary importance. The degree is granted solely upon evidence of general proficiency and of distinctive attainment in the special field chosen by the candidate. The degree is granted particularly upon a recognized ability for independent and insightful investigation as demonstrated in a thesis based upon original research combined with creative scholarship and presented with a high degree of literary skill.

Graduate School Requirements

The basic requirements for the degree of Doctor of Philosophy set by the Graduate School and the Department include:

- 1 Minimum residence and fee requirements.
- 2 An overall 5.0 (B) grade point average in the graduate student's record.
- 3 B- grade in cognate courses. Check current Rackham requirement
- 4 Appointment of a Dissertation Committee to oversee the student's program and progress in research.
- 5 Completion of a public seminar in the second year of graduate study
- 6 Recommendation by the Department of specialization for admission to candidacy (Candidacy Exam).
- 7 Approval of the written dissertation by the Dissertation Committee and the Graduate Dean and a final oral examination by the Committee (Thesis Defense).

Registration Information

The residency (time enrolled as a graduate student in our program) requirement for the Ph.D. degree provides for a minimum of seven terms of study and research beyond the bachelor's degree. A student is considered full-time with registration of 8 hours per term and one must be registered as a full-time student during the all Fall and Winter terms unless on an approved leave of absence. Spring/Summer you are not required to register unless you are defending your dissertation sometime between May and August.

In electing Chemistry 990 (pre-candidate research) the number of hours taken for credit may range from one to eight per term as approved by the advisor; but a student must register for a total of 8 hours per term prior to candidacy. For Chemistry 995 (candidate research), the number of registration hours is fixed at eight and the candidacy tuition fee is fixed (at an amount less than the regular pre-candidate full-time fee). After passing candidacy, a candidate may register for one "free" course in addition to 995 without incurring an additional fee. This "free" course can be taken for credit or audited.

Registration is required of any person using University facilities (classes, laboratories, libraries, computing center, consultations with faculty, etc.) in progress toward a degree with the exception of Spring/Summer terms. During spring/summer you only need to register if you defend between May and August.

Leave of Absence Policy

Effective Fall 2010, Ph.D. students may request a temporary leave of absence when certain life events prevent continued active participation in their degree program. [Rackham's Leave of Absence Policy](#) enables students to officially suspend work toward their degree for a limited time.

Students may request a leave of absence as early as six months prior to the term the leave is to start. A leave will be granted to students for illness (either physical or mental) or injury, to enable them to provide care or assistance for family or dependents, to allow them to meet military service obligations, or for other personal reasons.

The Leave of Absence Policy, a checklist for Ph.D. students, and a checklist for faculty and staff are available at the following site:

http://www.rackham.umich.edu/current_students/doctoral_students/phd_students/leave_of_absence/.

They provide guidance and information about how the process supports academic planning and protects students' privacy.

Departmental Requirements

Departmental requirements are directed primarily towards giving students practice and skills in research, discovery, problem solving and creative learning, particularly in their area of interest. The requirements governing examinations and basic courses are designed to test and solidify the fundamental background of the student in the main branches of chemistry while still encouraging an early start in research.

Examinations

Organic Cumulative Exams and Organic Proposition

Each student specializing in organic chemistry will take monthly cumulative exams (CUMES) during the fall and winter terms. Students should begin these exams upon entering the program and continue taking the cumulative exams until five exams have been passed. The subject matter of the cumulative exams is correlated with the organic seminars, lectures and current literature and is intended to cover a wide range of subjects. Each exam is given by an individual organic faculty member and a list of exam dates is posted on the Graduate bulletin board. An Organic student's progress in the cumulative exam system will be reviewed during the Candidacy meeting but the cumulative requirement need not be finished at the time the Candidacy meeting is held.

After the completion of the cumulative exams and after admission to candidacy, organic students must submit a written Research Proposition (of no more than ten pages) to the organic faculty. The Proposition consists of the identification and solution of an original research problem in Organic Chemistry. It will be judged both on the nature of the problem chosen and

the proposed solution. Acceptable propositions are presented to the faculty periodically throughout the year. The research proposition is designed to be an opportunity for students to try out their ability to be creative, search the literature for new ideas and what was done previously, practice mechanism and problem solving and presentation skills, and to become effective and confident in their ability to defend their own research ideas. Specific details regarding this requirement will be provided as a student begins their third year of study.

Candidacy Exam

Each Chemistry graduate student is subject to an oral candidacy examination by his/her Dissertation Committee. The Graduate Committee holds a yearly information session on preparing for this exam in the fall term. This examination is held in the second year of enrollment and must be completed by the end of the Winter term (end of May).

In preparation for the candidacy exam, each student should formulate a candidacy committee consisting of their dissertation advisor, two additional Chemistry faculty members and one faculty member whose primary appointment is not in the Department of Chemistry (the cognate member). You should choose your committee in concert with your dissertation advisor and once the committee has been constituted, make sure to notify Anna Stryker in the Student Services office so that the appropriate forms can be completed. This should be done by January of the student's second year.

As part of the candidacy exam, each student must submit a written proposal to his/her Dissertation Committee. The proposal should be sufficiently detailed so that the nature of the research problem and the direction of the effort is defined and characterized, but not more than ten double-spaced typed pages (excluding all text and graphics (sections a-d) EXCEPT literature references).

The proposal should contain:

- a) Background
- b) Specific Project Goals
- c) Research Plan
- d) Preliminary Data
- e) Literature References

Proposals not written in this format will not be accepted. The proposal should be distributed to the student's Dissertation Committee at least two weeks prior to the exam.

At the Candidacy Exam, students present a brief summary of their research proposal; this may include preliminary research results but should not be a seminar-style presentation. Students will be examined on knowledge of the background subject areas and on their research plans. Students are expected to have a good understanding of the goals, directions, importance, and pathways of the proposed research. Students should be prepared to propose alternatives and discuss background material concerned with that proposal. Students should also show that they are making reasonable progress towards their doctoral research. The Dissertation Committee will determine a Chair (other than the research advisor) for the meeting and that Chair will be responsible for the conduct of the exam. The research advisor will be present, but will not participate in the examination except in limited consultation.

The Committee also reviews the student's course work, progress in organic cumulative exams (for organic students), and any progress reports. The Committee determines what additional courses, reports or other study are required if, for any reason, the examination is not satisfactory. The Committee may decide to re-examine the student at a later time or recommend dismissal from the program. A subsequent review by the student's research advisor as to whether any additional requirements have been met does not necessarily require another meeting of the Dissertation Committee with the student. Students should inform the Graduate Office when their candidacy exams are scheduled. A report to the Dissertation Committee will be prepared and given to the research advisor before the exam takes place.

Yearly Evaluation

All students from the second year to the completion of the Ph.D. degree requirements participate in a yearly evaluation of their progress towards the degree with their dissertation advisor. In the spring of each year, students and faculty will receive via email the evaluation form, instructions for completing the form, and a deadline by which it must be submitted to the Graduate Committee. The form is completed jointly by the student and advisor and reviewed by the Graduate Committee. The goal of this process is to assist students and advisors in overcoming any barriers to success and to facilitate open communication about degree requirements.

Data Meeting

Four to six months prior to the final thesis defense each student must have a Pre-Defense Dissertation Committee Meeting. The student must present a detailed discussion of his/her data in a clear and logical fashion, including major conclusions, and a detailed outline of the thesis. PowerPoint presentations are preferred at the meeting, but slides or overheads may be used as appropriate. More than one such meeting may be required before actual writing of the thesis begins. Please notify Student Services (Anna

Stryker) once the date for the data meeting is determined such that the appropriate paperwork can be prepared.

Course Requirements

Departmental requirements for course work fall into two categories: (a) those specified by the Department and applying generally to all students, and (b) those specified by the student's area or by his/her Dissertation Committee and applying individually in terms of special field and interest.

A first year graduate research course (rotations) will be required of all chemistry students. In addition to the research course, six graduate level courses are required. The Graduate School requires four credit hours (usually two courses) of cognate coursework (i.e., outside the Chemistry Department or cross-listed courses). In general this translates to students taking a total of six courses, two cognate courses and four chemistry courses during the course of the first two years. The various clusters have individual course requirements as listed below:

Analytical chemistry: students are required to take 2 semesters of the Research Rotation course, plus three to four advanced analytical courses numbered above 600 (Chem 646, 647, 648, 649, 755).

Inorganic chemistry: students are required to take Chem 507, 616, 2 semesters of the Research Rotation course, and take one of the following: Chem 511, 515 or 710-716 (Special Topics).

Organic chemistry: students are required to take Chem 540, 541 and 543 in addition to either Chem 542 (organic spectroscopy) or Chem 515 (organometallic chemistry) plus 2 semesters of the Research Rotation course. The organic faculty require that graduate students specializing in organic chemistry achieve grades of B or better in Chem 540 and 541.

Chemical biology: Students are expected to take Chem 501/502, 2 semesters of the Research Rotation course, and either 2 additional chemistry and 2 additional cognate courses OR 4 additional chemistry courses, Chem 525/526 are taken as cognates by registering for MCDB 525/526. Note that Chem 501/502 can be taken as cognates or as chemistry classes by registering as ChemBio501/502 or Chem501/502, respectively.

Materials: the curriculum requires two courses from the offerings of analytical, biological, inorganic, organic, or physical chemistry. Both courses must be from the same area. Chemistry 511 (Physical Methods); one course in synthetic Chem 538 (Organic Chemistry of Macromolecules) or physical polymer Chem 535 (Physical Chemistry of Macromolecules) either of which could be counted as a cognate; one material chemistry cognate (MSE 550 or Physics 440 or other approved course) plus 2 semesters of the Research Rotation course. One additional course is required to complete the six course total.

Physical chemistry: four graduate-level courses in physical chemistry (or

appropriate substitutes) plus 2 semesters of the Research Rotation course are required. Each student should, in the first year, propose a program of courses acceptable to the physical graduate committee advisor (possibly in consultation with the prospective research supervisor).

Requirements for All Areas

Students entering with previous graduate credit from other universities in the U.S. may be excused from some of the preceding chemistry course requirements by petitioning the Graduate Committee, but in any case, the minimum requirement will be one graduate lecture course in the student's major field in chemistry and one in any field in chemistry.

The cognate course requirement may be satisfied by transfer of credit from a previous graduate record, unless such courses have been applied towards a previously awarded degree.

The Graduate Committee and the student's Dissertation Committee both are charged with the responsibility to see that the individual student has a program of course work that is both broadly supportive of his/her specialized field of study and also indicative of the breadth and range of interest which the graduate student may need to call upon.

One of the requirements of the Department is for a student to be "in good standing." This means that the student must maintain a grade point average of B- or better. This average must be achieved by the end of the second term. Credit in research rotation and research courses and seminar courses do not count in the GPA. Grades in both research and rotation courses accepted by the Graduate School are S (satisfactory) and U (unsatisfactory).

An Incomplete grade may be assigned to a student only if the unfinished part of the student's work is small, the work is unfinished for reasons acceptable to the instructor, and the student's standing in the course is a "B-" grade or higher. Grades of Incomplete can be changed to letter grades only if the incomplete work is made up within three weeks from the start of the full term beyond the term for which the "I" was given. Otherwise the grade of "E" will be permanently recorded on the student's record. Check in the Bulletin for specific information on the incomplete policy. "I" or "E" grades are not accepted for research rotation (Chem 597) and research courses (Chem 990, 995).

Seminars

Participation in the departmental seminars is required. In addition to presenting a seminar, all students are minimally expected to regularly attend the seminar series associated with their area of interest. However, seminars relevant to a person's interest and/or research (e.g., materials chemistry or biologically related chemistry) may appear in either series. The serious student will take advantage of all learning opportunities, and the seminar

series represent excellent sources of up-to-date results and ideas.

Students must present one seminar usually in the second year of his/her graduate career. It is necessary to register for 2 credit seminar course numbered Chem 800-805 during the term in which the seminar is to be given. A grade of "Satisfactory" or "Unsatisfactory" is given on the presentation. The student should contact the area coordinator at the beginning of the term to arrange for the seminar date and to discuss the format and topic of the seminar. (Students, please arrange your seminar time with the faculty member in charge of seminars.)

Research Requirements

Choice of Research Advisor The choice of a Research Advisor generally occurs after the second term of enrollment. The formal steps preceding the choice include:

1. All first year graduate students are required to take two terms of the research rotation course, one in the fall and one in the winter (Chem 597) to gain practical lab experience.
2. The purpose of this rotation course is to acquaint the students with the research efforts of the faculty they are primarily interested in. Rotation assignments are to help you decide which lab you may want to join at the end of the first year. It is possible on rare occasion for a graduate student to select the same lab for both terms. However, this is only possible if the student holds a research master's degree from another institution or has spent one continuous year in a research position. In addition, the request must be approved by the Faculty Advisor, Graduate Committee and Chair of the Department. Graduate students are strongly encouraged to gain research experience in two different labs.
3. At the time of the first term counseling, each student should discuss with the graduate advisor his/her research focus and interests. A Research Advisor form will be in the counseling packet.
4. All incoming first year students are required to attend the Graduate Research Awareness Seminar Program (GRASP) given by faculty according to the published schedule.
5. During the first year, all students will interview at least five professors (each student should interview all assistant professors in their field of interest as well). This will allow incoming students to meet potential research advisors and allow them to become aware of the research going on in the department. Toward the end of the fall term, the student should decide on the second rotation.
6. Until a research advisor is officially selected, the student should discuss

any questions or problems with his/her Graduate Committee advisor or the Chair of the Graduate Committee. After the research advisor is chosen, questions regarding course work, academic concerns, and career objectives and goals should be directed to the research advisor. However, the members of the Graduate Committee are always available for consultation.

7. Near the end of the Winter term, after the interview and rotation processes have been completed and the student has decided on his/her choice for Ph.D. advisor, he/she should turn the completed research advisor form into the Graduate Office.

8. Formal approval by the Department Chair is required before the student is admitted to the research advisor's group.

The student and the Research Advisor are jointly responsible for fulfilling the Departmental and Graduate School requirements for the Ph.D. degree. The Advisor's responsibilities begin at the time of his/her agreement to accept the student into his/her group. In addition to supervising the research, the Research Advisor is expected to guide the student on course elections, examinations, independent study pertinent to his/her general development as a scientist, and any other matters affecting his/her general progress toward a degree.

At the end of the second term of a student's first year, the Graduate Committee will meet to discuss if the first year student will be recommended for formal approval for the Doctoral Research Program. A major requirement necessary for approval is to achieve a 5.0 grade average in an approved selection of courses.

The student will be notified in writing about his/her advancement to the Doctoral Research Program by the Graduate Committee. With notification of the approval, he/she may register for Chemistry 990 (Dissertation Research-Pre-candidacy) in the upcoming Fall term along with any remaining classes to be taken.

Forming a Dissertation Committee A Dissertation Committee should be assembled by each graduate student in consultation with his/her Research Advisor before the start of the second year. The composition of the Committee should be reported to the Graduate Office as soon as it is formed so it can be recorded at the Graduate School. The Research Advisor serves as chair and shares with the Committee the responsibilities of guiding the student toward the doctoral degree. All Dissertation Committees must consist of at least three members in addition to the Research Advisor. At least two of the Committee members must be from the student's home department. At least one member (cognate) must be out of the Department (such as Biological Chemistry, Chemical Engineering, Mathematics, Physics, Pharmacy, Materials Science and Engineering, etc.).

Functions of the Dissertation Committee

A meeting of the Dissertation Committee is required by the Department before the student can be admitted to candidacy. The Research Advisor and student are responsible for calling the meeting. For all students, the meeting is an examination and must be taken by the end of the Winter term (before the end of May) of the second year.

The Dissertation Committee consults with the student and the Research Advisor as may be appropriate with respect to the student's development, as indicated by his/her course work, seminar participation, and experience in examinations, cumulative organic exams, and research performance.

In the aggregate, three formal recommendations (and three meetings) are required of the Committee: (1) one for admission to candidacy which is made on a departmental form specifically approving the total program of courses or indicating remaining expected courses (this form is available in the Graduate Office); (2) one for a pre-defense informational meeting to discuss if the student has gathered enough data to write a thesis satisfying the requirement of scientific merit and (3) one for acceptance of the dissertation certified on the form supplied by the Graduate School. The information needed by the Committee comes from such consultations as its members may have with the student and, more formally, from:

Summary of the student's academic record

Progress Reports of the research submitted by the student

Meeting of the Dissertation Committee held prior to the student's admission to candidacy

Later information comes from:

Pre-Defense Data Meeting

Review of the written dissertation

Final meeting of the Dissertation Committee ("thesis defense") for approval of the dissertation and the degree

Meetings of the Dissertation Committee should not be scheduled during registration, examination, or vacation periods.

Candidacy Oral Examination

Admission to candidacy should occur as soon as possible, and is required to take place before May 31st of the second year. Early candidacy is advantageous to be eligible for reduced tuition (75% or less of the resident full-time fee) and for certain grants and fellowships administered by the

Graduate School or the Chemistry Department. As a requirement for good academic standing, students must advance to candidacy before the beginning of the Fall term of the third year.

Before admission to candidacy can be recommended, the following requirements need to be met, although not necessarily in the order shown:

Pass course requirements as specified by the Department and by the Dissertation Committee.

Pass the cognate course requirement.

Achieve 5.0 grade point average (excluding research courses).

Choose a Research Director.

Have a Dissertation Committee appointed.

Pass the oral examination.

Be formally recommended for candidacy by the Dissertation Committee.

Dissertation

The regulations governing the preparation of the dissertation are given in the *Handbook for Doctoral Candidates* (<http://www.rackham.umich.edu/>) distributed by the Graduate School. The subject matter of the dissertation is to be presented at a Departmental seminar (Thesis Colloquium) in the last term of the student's residence. The student is responsible for setting up his/her thesis defense in consultation with his/her Dissertation Committee. All doctoral applicants must satisfy the Rackham fee hour requirement of 68 credits.

The Department requires that the student present a detailed outline of the dissertation before actual writing begins at a Pre-Defense Committee meeting (Data Meeting). At this point, if the Committee agrees, the candidate will then begin putting the thesis together. The dissertation must be submitted in draft form (i.e., before the final typing and final reproduction of figures) to the members of the Dissertation Committee for their suggestions. Modifications are much easier to make at this stage. One copy of the dissertation in its final form (but not bound) is submitted to the Chemistry Recorder in the Office of Academic Records and Dissertations (0120 Rackham), along with two copies of the abstract and one extra copy of the title page, plus a receipt for the thesis publication fee. The total number of copies to be prepared for final distribution should include one for the University Library, one or more for the Research Advisor and perhaps other members of the Dissertation Committee, one for the donor of any funds awarded to the student in the form of a graduate student fellowship, granted in support of the research, and as many copies as the student wants.

Deadlines

The Graduate School establishes two kinds of deadlines related to finishing the degree requirements. The first is related to the payment of tuition fees. The student must pay the full candidacy fee in the term in which the final examination is held, but a grace period is allowed under which the examination may be held within about 30 days after the end of the term without paying additional fees. The exact dates and conditions of the grace period are posted each term in 1500 Chemistry and appear in the Handbook for Doctoral Candidates (<http://www.rackham.umich.edu/>).

The second kind of deadline relates to the “Commencement” at which the degree is formally granted. About seven weeks before the Commencement the original submission of the dissertation is required; about three weeks before the Commencement the final approval by the Dissertation Committee and the final submission of the dissertation are required. The exact dates of these deadlines also appear in the Handbook for Doctoral Candidates.

“Good Standing” Policy

A graduate student in the Department of Chemistry at the University of Michigan will be considered in “good standing” if he/she complies with all rules and regulations of the University, the College and the Department and performs the duties of his/her appointment as a GSI, GSRA or fellow in a professional and timely manner and if the following conditions are also met:

1. The student must maintain an overall GPA of greater than or equal to 5.00 for all academic courses taken, including cognate courses, throughout their residence in the program.
2. The student must take two terms of Graduate Research rotation course (Chem 597) and receive a satisfactory grade (S) in both terms.
3. The student must find a mentor who will agree to oversee their Ph.D. research by the beginning of the spring term (May 1) of their first year in residence.

Under special circumstances, and with the approval of the Graduate Committee, the student may elect to enroll in a third research rotation during the Spring term. If so, the student must finalize the choice of their mentor by July 1 of their first year in residence.

4. The student must achieve Ph.D. candidacy by May 31 of his/her second year in residence. This will involve the following sequence of events:
 - a) The student must assemble a suitable dissertation committee (faculty will sign form agreeing to serve on dissertation committee) by the end of the Fall term of the second year.

- b) The student must fulfill all minimum course requirements for a Ph.D. degree by the end of the Winter term of their second year.
- c) The student must prepare a written proposal for his/her Ph.D. research, and disseminate to his/her dissertation committee by the end of the Winter term of his/her second year. The student must then meet with his/her dissertation committee no later than May 31 of the second year in residence and take the required Oral Exam. In the event that the student does not pass the Oral Exam on his/her first attempt they will then not be in good standing. The student will have until August 31 of that year to take the exam again, pass and regain good standing status.
- 5 The student must receive Satisfactory (S) grades for all terms enrolled in Chem 895, Chem 990, or Chem 995. In addition, the student must receive a “Satisfactory” or “Marginal” assessment of progress by their Ph.D. mentor on their annual progress report that is to be prepared by the Student/Mentor each Spring term. If a student receives an Unsatisfactory grade in Chem 995 and/or on the yearly progress report, this will trigger an immediate meeting of the dissertation committee to review the student’s progress, and report back to the Graduate Committee. Based on this report, the Graduate Committee may determine that the student is not in “Good Standing” and recommend dismissal from the program. Or, the Graduate Committee may recommend that the student find a new mentor.
6. In addition to the general requirements cited above, the student must also fulfill all requirements (e.g., seminars, research proposals, cumulative exams, etc.) set by the sub-area of chemistry that they choose to pursue as a graduate student in our program.

Approved by Graduate Committee November, 2005

Revised June, 2006

Masters Degree

There is no formal Master’s degree program administered by the Chemistry Department, but any Ph.D. student who fulfills the M.S. requirements may apply for this coursework degree. The requirements for a Master’s degree are:

- 24 course credits, 15 of which are Chemistry credits
- “B” (5.0) cumulative grade point average
- Satisfactorily complete two graduate-level courses outside of Chemistry (cognate requirement is four hours of course credit).

The 24 credit hours may include up to 6 credit hours of graduate research (Chem 597)) provided that a thesis is presented and approved by the research

director and a representative of the Graduate Committee. In addition, seminar courses numbered 801-805 will be counted only once. Chem 990 and Chem 995 do not count towards the 24 credits for the Masters Degree. A formal degree application must be filed with the Graduate School when the degree requirements have been met in order for the degree to be awarded.

- Meet all Area Requirements.

□

□ The M.S. degree requires more credit hours in course work than is necessary or usual for the Ph.D. degree. It is distinguished from the Ph.D. degree by the fact that it is a degree related to course work. It is not considered to be on the pathway to a Ph.D. degree.

Science Education Ph.D. students who fulfill the following M.S. requirements may obtain the Dual Degree, Ph.D. in Science Education/M.S. in Chemistry:

□ A course plan, representing a focus in a sub-disciplinary area of Chemistry, arranged in consultation with the Chemistry MS advisor and in collaboration with other appropriate faculty members, as needed, that is approved by the Chair of the Graduate Committee in Chemistry and the Associate Dean for Academic Affairs in the School of Education. A completed Dual Degree (Ph.D./M.S.) Application from the Rackham School of Graduate Studies, which is approved by the Chair of the Graduate Committee in Chemistry and the Associate Dean for Academic Affairs in the School of Education.

- 24 course credits, 15 of which are Chemistry credits earned in at least 5 courses (400 and above, with at least 3 courses 500 and above)
- “B” (5.0) cumulative grade point average
- Satisfactorily complete 9 credits of graduate-level courses outside of Chemistry.

The M.S. degree in Chemistry requires more credit hours in coursework than is necessary or usual for the Ph.D. degree in Chemistry. It is distinguished from the Chemistry Ph.D. degree by the fact that it is a degree related to course work. It is not considered to be on the pathway to a Chemistry Ph.D. degree.

NOTE: Students entering with a Master’s degree from another institution cannot apply courses used to obtain the first M.S. toward a M.S. from Michigan. Furthermore, previous M.S. degree requirements must be substantially different from the Michigan M.S. degree requirements in order that a Michigan M.S. be awarded. An example of a substantially different previous M.S. degree is one based on a Master’s research thesis. The M.S. thesis must be presented before approval for a Michigan M.S. degree will be granted.

Eligible Science Education students should contact the Chemistry MS advisor: Professor Brian P. Coppola (bcoppola@umich.edu) for assistance in outlining an appropriate set of courses.

Chronology of Ph.D. Degree

	Year 1			Year 2			Year 3	Year 4	Year 5-6
	Fall	Winter	Spring/ Summer	Fall	Winter	Spring/ Summer			
Summer research (option)	Fall research rotation	Winter research rotation	Full-time research						
		Choose lab for Ph.D.		Identify candidacy committee members	Candidacy exam (end of spring term)			Data meeting	Submit and defend thesis
	2 courses	2 courses		2 courses, give departmental seminar					
	<i>Organic students: take and pass 5 cumulative exams before advancing to candidacy.</i>						<i>Organic students: submit and defend an original research proposal</i>		

First Year

Fall/Winter: Take two courses per semester and perform research rotations in two different labs

Spring/Summer: Identify lab for Ph.D. research, full-time research

Second Year

Fall/Winter: Take one course per semester, perform research in Ph.D. lab, present 2 credit student seminar

Fall/Winter: Assemble candidacy committee, prepare for and pass the candidacy exam

Spring/Summer: Full-time research

Third and Fourth Years

Continue full-time dissertation research

Fourth/Fifth Years

With the dissertation committee have the Data Meeting.

The Data Meeting is a "pre-defense" and ensures student is on track to graduate within six months

Write and defend thesis

Current Graduate Course Offerings

The titles, credits, prerequisites and descriptions of courses offered by the Chemistry Department are given on the following pages. Consult the current Time Schedule for availability.

Descriptions of Authorized Courses

The offerings in any given term should be checked in the current time schedule. The entries below give the course number, title, and hours credit, prerequisites and description of each course offered by the Chemistry Department. Chemistry courses cross-listed with other departments may be counted as a cognate course.

NOTE: The prerequisite courses listed below refer to the undergraduate chemistry courses taught in the Department and are meant for undergraduates intending to take graduate courses. Graduate students should have completed similar undergraduate courses or performed well on area qualifiers. To compare your undergraduate course with Michigan's, check the Undergraduate Handbook for prerequisite course description.

501 Chemical Biology I. (3hrs.) Introduces student to breadth of material contained within the inherently interdisciplinary "Chemical Biology" arena. Includes protein/RNA folding, catalysis, and electron transfer proteins.

502 Chemical Biology II. (3hrs.) Prereq. 501. Second semester of introduction to "Chemical Biology". Includes photosynthesis, proteases, signaling pathways, and carbohydrates.

505 Nucleic Acid Biochemistry. (3 hrs) In depth class that introduces students to structure and function of nucleic acids, their interactions with proteins and their roles in biological systems.

507 Inorganic Chemistry. (3 hrs.) Prereq. 461 or 397. Generalizations of the periodic table and their relationship to classical and modern concepts of atomic and molecular structure. Inorganic stereochemistry including concepts of crystal chemistry, silicate chemistry, coordination theory, ligand field theory, catalysis, acid-base theory, reaction mechanisms, organometallic chemistry and a detailed consideration of selected groups of the periodic table.

511 Materials Chemistry. (3 hrs.) Prereq. 461 or 397. This course will present fundamental concepts in materials chemistry. The main topics to be covered include Structure and Characterization, Macroscopic Properties, and Synthesis and Processing.

515 Organometallic Chemistry. (3 hrs.) Systematic consideration of modern aspects of organometallic chemistry including main group and transition metal complexes. The structure and binding in organometallic compounds is covered. Particular emphasis is placed on applications of

homogenous organometallic catalysis in polymer synthesis, industrial processes and synthetic organic chemistry.

520 Biophysical Chemistry I (3 hrs.) This course is the first of a two-term biophysical chemistry series Biophysics 520/521. The course offers an overview of protein, nucleic acid, lipid and carbohydrate structures.

521 Biophysical Chemistry II (3 hrs.) Prereq Chem 463/Biochem415/Chem 420 / permission. This course is the first of a two-term biophysical chemistry series Biophysics 520/521. The course offers an overview of protein, nucleic acid, lipid and carbohydrate structures.

535 Physical Chemistry of Macromolecules. (2 hrs.) Prereq 461. Physical chemistry of macromolecules, including the theory for the experimental methods used for the study of macromolecular solutions.

536 Laboratory in Macromolecular Chemistry. (2 hrs.). Prereq. 535/Phys 418/permission. Experimental methods for the study of macromolecular materials in solution and in bulk state.

538 Organic Chemistry of Macromolecules. (3 hrs.). The preparation, reactions, and properties of high molecular weight polymeric materials of both natural and synthetic origin. Two, 2-hour lectures.

540 Organic Principles. (3 hrs.). Physical Organic Chemistry. Principles of chemical bonding, mechanisms of organic chemical reactions and stereochemistry. The important types of organic reactions are discussed. Basic principles are emphasized and relatively little attention is paid to the scope and synthetic applications of the reactions.

541 Advanced Organic Chemistry. (3 hrs.). Prereq. 540. Synthetic Organic Chemistry. The scope and limitations of the more important synthetic reactions are discussed within the framework of multi-step organic synthesis.

542 Application of Physical Methods to Organic Chemistry. (3 hrs.). Applications of infrared, ultraviolet, nuclear magnetic resonance spectroscopy, optical rotatory dispersion, mass spectrometry and other physical methods to the study and identification of the structure and reactions of organic compounds.

543 Organic Mechanisms. (2 hrs.). Propose and write reasonable mechanisms for organic reactions, including complex multi-step processes.

555 Molecular Modeling and Simulations. (3 hrs.) Familiarize students with some of the most important computational methods in the molecular sciences. Includes lecture-type presentations of scientific background of methods and computational laboratory using common software packages.

565 Nuclear Chemistry. (3 hrs.). The properties of the nucleus and an overview of techniques for studying such properties. Radioactive decay

processes, nuclear models, nuclear reactions, and interactions of radiation with matter; applications of nuclear techniques to non-nuclear problems.

567 Chemical Kinetics. (3 hrs.). A general course in chemical kinetics, useful for any branch of chemistry where reaction rates and mechanisms are important. Scope of subject matter: practical analysis of chemical reaction rates and mechanisms, theoretical concepts relating to gas and solution phase reactions.

570 Molecular Physical Chemistry. (3 hrs.). Prereq. Permission of Instructor. Designed for non-specialists lacking a solid background in physical chemistry. Meets along with Chem 461. Should not be elected by students specializing in physical chemistry. Applications of wave mechanics to exactly solvable problems. Elementary applications of operators, symmetry and group theory. Electronic structure of atoms and molecules. Principles of molecular spectroscopy.

571 Quantum Chemistry. (3 hrs.). Constitutes with 576 a full course for students specializing in physical chemistry. Review of quantum mechanics from a postulational viewpoint; variational and matrix methods, time-independent and time-dependent perturbation theory; applications to molecular systems including potential energy surfaces and reaction pathways.

575 Chemical Thermodynamics. (3 hrs). Prereq. Permission of instructor. Designed for non-specialists lacking a solid background in physical chemistry. Meets along with Chem 463. Should not be elected by students specializing in physical chemistry. A discussion of chemical phase equilibria, the treatment of solutions and chemical reactions by classical thermodynamics, the applications of electrochemical cells in studying chemical reactivities, utilization of molecular and atomic spectra in statistical-mechanical calculations.

576 Statistical Mechanics. (3 hrs.). Constitutes with 571 a full course for students specializing in physical chemistry. The foundation of equilibrium statistical mechanics and applications to problems of chemical interest. Included are discussions of imperfect gases and liquids, mixtures, solids, quantum statistics, surface chemistry and polymers.

580 Molecular Spectra and Structure. (3 hrs). Review of atomic spectra; rotational, vibration-rotation and electronic spectra of diatomic and simple polyatomic molecules; deduction of molecular parameters from spectra.

597 Intro to Graduate Research (3 hrs) First year only. Practical hands-on experience in a faculty's lab.

616 Advanced Inorganic Chemistry. (3 hrs.). Prereq. 507 and 570. The application of theoretical principles to the experimental observations of modern inorganic chemistry: ligand field and molecular orbital theory of complex ions, structural chemistry, magnetic properties, ESR, Mossbauer

spectra, NQR.

646 Separation Processes. (3 hrs.). Prereq. 545/permission. Requirements for analytical and preparational separations. Pertinent phase rule considerations; theoretical plate concepts; efficiency calculations for multistage processes; nature of adsorption. Theory and practice of (a) precipitation and crystallization, (b) volatilization and distillation, and (c) extraction, partition and distribution processes, especially ion-exchange, liquid-liquid extraction and various types of adsorption and partition chromatography (gas, paper, thin-layer, etc.)

648 Spectroscopy. (3 hrs.). 447 or equivalent/permission. Theory, practice and application of spectrochemical techniques for analysis and research with emphasis on emission and absorption spectroscopy in the principal regions of the electromagnetic spectrum.

649 Electroanalytical Chemistry. (3 hrs.). Prereq. Permission. Fundamentals of modern electroanalytical methods including potentiometry, ion-selective electrodes, gas sensors, voltammetry, amperometry, conductimetry, chemically modified electrodes, pulsed voltammetric techniques, and biosensors. Instrumentation associated with these methods is also examined.

668 Principles of Molecular Symmetry and Solid State Chemistry. (2 hrs.). Prereq. permission. The use of group theory in the discussion of molecular symmetry, crystal symmetry, and the symmetry of operators and eigenfunctions. Discussion of lattices, space groups, selection rules and normal modes in crystals; motions and interactions of molecules in condensed phases, excitons in molecular crystals and aggregates.

670 Principles of Magnetic Resonance. (2 hrs.) Prereq. 570/permission. Classical and quantum mechanical treatments of magnetic resonance phenomena. Included will be discussions of spin systems, rotating fields, electron-nucleus interactions, and relaxation phenomena. Experimental and theoretical aspects of nuclear magnetic resonance, electron spin resonance, 2-D NMR and the product operator formalism; chemical shifts, spin-spin coupling, hyperfine interactions, spin-lattice relaxation, and other topics.

673 Mechanism and Kinetics. (3 hrs.) Prereq. BC550 or Chem 526/permission. This will become a two part class within the winter semester, each accounting for 1 or 2 credits....This course will cover enzyme catalytic mechanisms and enzyme kinetics in depth. Ligand binding to macromolecules, transient kinetics, enzyme kinetics, kinetic isotope effects, structure-function analysis, protein structure, enzyme mechanisms and enzyme cofactors will be discussed. An emphasis will be placed on developing the key kinetic and thermodynamic concepts that govern the action of enzymes.

710-711 Special Topics in Inorganic Chemistry. (2 hrs.). Prereq. 507. The elements: main group elements, transition metals, organometallics.

720 Chemical Sciences at the Interface of Education Seminar.

743-744 Special Topics in Organic Chemistry. (2 hrs.,). Prereq. 541. Hetero-organic chemistry: open chain nitrogen compounds, organometallic compounds, heterocyclic compounds.

800-805 Individual Student Seminars. (2 hrs., 2 credits, all terms). Prereq. graduate standing. Every student is **required** to present a student seminar on a topic approved by research advisor. Each student must register for this in the term he/she expects to present it.

800 – Chemical Biology

801 – Analytical

802 – Inorganic

803 – Organic

804 – Physical

805 – Materials

990 Dissertation Research/Precandidacy. (1-8 hrs., 1-4 in half-term; every term). Prereq. by permission. This course number is used for doctoral research by students not yet admitted to candidacy.

993 Graduate Student Instructor Training Course. (1 hr). Graduate Student Instructor Training.

995 Dissertation Research/Candidacy. (8 hrs., 4 hrs. in half-term; every term). Prereq. by permission. This course number is used for doctoral research by students who have been admitted to candidacy.

Cognate Courses

The Graduate School requirement of at least four cognate credit hours total (outside the department and on the department approved list) is interpreted to allow courses in departments whose subject matter is related in some significant way to chemical professional interests. A list of approved cognate courses can also be found in 1500 Chem. Please consult with a Graduate Committee advisor or your Research Director for additional courses. See list below for the approved cognates. Check the time schedule for courses offered in a particular term. If there is a course that you would like to take that is not on this list, you must send an email to Anna Stryker with a paragraph stating why you would like to take the course and attach the syllabus for the course and a statement from your advisor saying they support your petition. The petition will then be taken to the Graduate Committee for approval and you will be notified of the decision. This must all be done BEFORE you register for the course.

Cognates are intended to enhance the scientific training of each graduate student. Exceptions to the approved cognate course list are made by the Graduate Committee. Courses from the following areas are usually approved

for cognate credit:

Atmospheric and Oceanic Science, Biology, Biological Chemistry, Chemical Engineering, Electrical Engineering and Computer Science, Environmental and Industrial Health, Geological Science, Macromolecular Science, Materials Science and Engineering, Mathematics, Medicinal Chemistry, Pharmacology, Nuclear Engineering, Physics, Statistics

COGNATE COURSES

(This is just a guide. These courses may/may not be available. Please consult the time schedule.)

ATMOSPHERIC AND OCEANIC SCIENCE

- 401 Geophysical Fluid Dynamics
- 451 Atmospheric Dynamics I
- 463 Air Pollution Meteorology
- 467 Biogeochemistry
- 479 Atmospheric Chemistry

BIOINFORMATICS

- 527 Introduction to Bioinformatics
- 551 Proteome Informatics

BIOLOGY

- 525 Chemical Biology I
- 526 Chemical Biology II

These two courses are cross-listed with the Chemistry department. To receive cognate credit for them, they must be elected as Biology courses.

BIOLOGICAL CHEMISTRY

- 501 Chemical Biology I
- 502 Chemical Biology II
- 515 Intro to Biochemistry
- 530 Structural Biology in Solution
- 550 Macro Mol Structure and Function
- 576 Signal Transduction (WI terms only)
- 577 Biochemistry Techniques
- 585 Cell Cycle Regulation
- 640 Post-transcriptional Gene Regulation
- 651, 652, 653 Recent Development in Cellular & Molecular Endocrinology
- 673 Kinetics and Mechanism

BIOPHYSICS

- 501 Chemical Biology I
- 502 Chemical Biology II
- 503 Macromolecular NMR Spectroscopy
- 520 Biophysical Chemistry I
- 521 Biophysical Chemistry II
- 602 Principles of Macromolecular Crystallography
- 608 Biophysical Principles of Microscopy

CELLULAR AND DEVELOPMENTAL BIOLOGY

- 680 Organogenesis of a Complex Tissue

CHEMICAL ENGINEERING

- 452 Applied Polymer Processing
- 470 Colloids and Interfaces
- 507 Mathematical Modeling in Chemical Engineering
- 508 Numerical Methods in Chemical Engineering
- 511 Rheology of Polymeric Materials
- 512 Physical Polymers
- 527 Fluid Flow
- 528 Chemical Reactor Engineering
- 538 Statistical and Irreversible Thermodynamics
- 542 Transport Phenomena
- 696 Selected Topics: Hydrogen Technology I: Production and Storage
- 697 Introduction to Chemoinformatics

EDUCATION

Learning Theory

- 831 Theory and Research on Learning and Instruction in Science
- 606 Developmental and Psychological Perspectives on Education
- 662 Learning and Development in Higher Education
- 708 Cognition and Instruction in the Classroom
- 710 Learning, Thinking, and Problem Solving
- 791 Foundations of Teaching and Learning

Assessment

- 695. Research and Educational Practice
- 705. Evaluating Educational and Social Programs
- 730 Methods of Classroom Research

Instructional Design

- 834 Designing Science Learning Environments
- 626 Principles of Software Design for Learning
- 833 Theory, Research, and Use of Technological Tools in Science Education

Other general classes

- 864 The American College Student

762 Curriculum in Postsecondary Education
640 Independent Study in Educational Studies

ELECTRICAL ENGINEERING AND COMPUTER SCIENCE

413 Monolith Amplifier Circuits
414 Introduction to Micro Electro Mechanical Systems (MEMS)
434 Principles of Photonics
435 Fourier Optics
459 Advanced Electronic Instrumentation
470 Computer Architecture
537 Classical Optics
598 Special Topics in Electrical Engineering and Computer Science
735 Special Topics in Optical Sciences

ENVIRONMENTAL HEALTH SCIENCES

506 Principles in Toxicology
574 Environmental Chemistry
584 Hazardous Waste: Regulation, Remediation and Work Protection
652 Evaluation of Chemical Hazards

GEOLOGICAL SCIENCE

422 Principles of Geochemistry
425 Environmental Geochemistry
426 Quantum Geology
455 Determinative Methods in Mineralogical and Inorganic Materials
458 X-ray Analysis of Crystalline Materials
473 Fundamentals of Organic Geochemistry
478 Geochemistry of Natural Waters
553 Thermodynamics and Phase Equilibria

HUMAN GENETICS

541 Molecular Genetics

MACROMOLECULAR SCIENCE/CHEMISTRY

518 Organometallic Chemistry
535 Experimental Methods of the Study of Solutions in Macromolecules
536 Laboratory in Macromolecular Chemistry
538 Organic Chemistry of Macromolecules

MATERIALS SCIENCE AND ENGINEERING

410 Biomedical Materials Considerations
412 Polymeric Materials
430 Thermodynamics of Materials
510 Materials Chemistry
511 Rheology of Polymeric Materials

512 Polymer Physics
514 Composite Materials
515 Mechanical Behavior of Solid Polymetric Materials
535 Kinetics, Phase Transformations and Transport
562 Electron Microscopy I

MATHEMATICS

404 Differential Equations
411 First Course in Modern Algebra
416 Theory of Algorithms
417 Matrix Algebra I
419 Linear Spaces and Matrix Theory
420 Matrix Algebra II
425 Intro to Probability
450 Advanced Math for Engineers
451 Advanced Calculus I
513 Intro to Linear Algebra
555 Intro to Complex Variables
556 Methods of Applied Math
590 Topology/Geometry

MECHANICAL ENGINEERING

599 Molecular Fundamentals of Energy Conversion

MEDICINAL CHEMISTRY

501 Chemical Biology I
502 Chemical Biology II
532 Bioorganic Principles
635 Advanced Topics in Medicinal Chemistry

MICROBIOLOGY AND IMMUNOLOGY

553 Cancer Biology
640 (Module I) Molecular and Cellular Immunology
641 (Module II) Molecular and Cellular Immunology: T Cell Immunology
642 (Module III) Molecular and Cellular Immunology: Molecular Recognition in the Immune System

MOLECULAR CELLULAR DEVELOPMENTAL BIOLOGY

422 Cellular and Molecular Neurobiology
504 Cellular Biotechnology (also cross-listed with CDB, Bio.Chem., and Micro)

NUCLEAR ENGINEERING

441 Introduction to Nuclear Fission Reactors
442 Nuclear Power Reactors

538 Introduction to Plasmas and Fusion
511 Quantum Mechanics in Neutron-Nuclear Reactions
515 Nuclear Measurements Laboratory
522 Radiation Effects in Nuclear Materials

PHARMACOLOGY

611 Principles of Pharmacology
754 Physical Properties of Solids

PHYSICS

401 Intermediate Mechanics
402 Light
405 Intermediate Electricity and Magnetism
406 Statistical and Thermal Physics
411 Introduction to Computational Physics
417 Macromolecular and Biophysics I
441 Advanced Laboratory
451 Methods of Theoretical Physics
463 Introduction to Solid State Physics
644 Advanced Atomic Spectroscopy

STATISTICS

425 Introduction to Probability and Statistics
500 Statistics

Revised
9/10

FINANCIAL INFORMATION

Tuition

Payment of resident or non-resident tuition fees is determined by residency regulations given in detail in the University of Michigan Bulletin. Graduate students holding at least a quarter-time appointment as a Graduate Student Instructor or Research Assistant will have the full tuition waived. They will, however, be liable for the registration fee and student fees. Students who have completed all Ph.D. degree requirements except the dissertation and have been formally admitted to candidacy pay a flat tuition fee without regard to their residency status. The candidacy tuition fee is substantially less than the normal resident or non-resident fee. The required registration for non-candidates is nine credits. Candidates register for eight credits.

Financial Support

The Chemistry Department is committed to providing all graduate students 12 months of financial support for the four to five years of their graduate program tenure. Students must be making satisfactory progress toward the Ph.D. degree to be eligible for support. This support frees the student to concentrate on research and full-time study. Students receive aid through a combination of teaching and research assistantships, and fellowships that provide tuition, excellent health care benefits, and stipend.

Fellowship support may be in the form of a Fellowship awarded directly to the student by a national agency (e.g., NSF) or a Research Foundation, Research Fellowship awarded by the Fellowship Committee of the Department, or a University Fellowship, awarded on a competitive basis. Departmental resources for graduate student support are limited; a student can expect support from Departmental sources for not more than five years.

NSF Fellowships. Applications for nationally awarded NSF Fellowships should be sent to the Fellowship Office, National Academy of Sciences, National Research Council, 2101 Constitution Avenue N.W., Washington, D.C. 20418. The necessary forms may be obtained either from the Fellowship Office in Rackham, or <http://www.rackham.umich.edu/Fellowships/general.html>. All applicants for NSF, or other highly competitive national fellowships, should notify the Director of Academic Services (Room 1500h) before preparing their application in order to obtain assistance in making the application as competitive as possible (<http://www.nsf.gov/home/grants/grants/forms.htm>). Reword this... say that you need references, discuss with research or rotation advisor....

Rackham Predoctoral Fellowships. These fellowships are available only to students who have completed all requirements for the Ph.D. degree with the exception of their thesis research (candidates). Recipients must have been formally admitted to candidacy before the Fellowship is to begin. Selection of departmental nominees for the University-wide competition is made by the Chemistry Department Graduate Committee. These fellowships are relatively unrestricted and are awarded on the basis of scholastic record and the student's research achievements (<http://www.rackham.umich.edu/Fellowships/fellow.html>).

Fellowships Awarded by the Chemistry Department. These include Industrial, Rackham, and Endowed Fellowships in addition to Traineeships.

Chemistry Graduate Student Instructorships (GSIs). This appointment is made to qualified chemistry graduate students (and to those in closely-related fields) who have an aptitude and interest in teaching. The conditions of this appointment are governed by the agreement which exists between the Graduate Employees Organization (GEO) and the University. The standard halftime appointment calls for an average of eight contact hours per week and up to 20 hours per week for all teaching-related activities. These hours include, in addition to actual contact time, preparation, grading, attending staff meetings, office hours and similar duties. All Graduate Student Instructors are required to attend a Chemistry Department GSI training program. This is given the week before Labor Day. All international students are required to take a 3-week acculturation training course given in August (or May for eligible students) in addition to the GSI training.

Research Assistantships. Research assistantships are provided by a Research Director from grant funds under his/her supervision. In those cases where the student will be engaged in his/her dissertation research, full-time activity is expected; otherwise, conditions of the appointment are governed by the standard employment practices of the University.

Travel Bursary. The Rackham Graduate School provides up to \$500 for travel to domestic (\$1,000 for international) professional conferences and meetings. You can only receive one travel grant per fiscal year (July 1 – June 30). Refer to Rackham's website for detailed information and forms to apply for travel (www.rackham.umich.edu).

Stipend Payment Schedules

Stipends for teaching and research appointments are paid in four equal installments per term. Checks are available on the last working day of each month from the end of September until the end of April. They may be picked up at the payroll window on the first floor of the LSA Building, or, after completing the proper paperwork, directly deposited into your bank

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account. Full information is available on your appointment confirmation. Some fellowship payments are made by term and are paid in full at the beginning of term either by (1) direct deposit, or (2) check mailed to your local address. Training grant fellows are paid on a monthly basis at the end of each month. You may view your local address and update it in “Wolverine Access”, (wolverineaccess.umich.edu) and you may view your payment schedule and availability status via “Wolverine Access”. Please see the Manager of Academic Services if you have questions or problems with payments.

Supplementary Income

Appointment to a half-time assistantship or to an equivalent fellowship is intended to provide sufficient financial support to enable a student to devote full time to his/her graduate program. Consequently, a condition of the appointment is that no outside employment be undertaken other than tutoring. In conditions of unusual financial stress, such as may result from extra dependents or special circumstances, the student should discuss projected additional employment with his/her Research Advisor and the Chair of the Graduate Committee.

Tutoring

Tutoring not only offers the graduate student a chance to obtain a small supplementary income, but also offers a chance to better his/her teaching methods and to review the basics of a particular course. At the beginning of the semester, a questionnaire will be sent out to determine each graduate student's willingness to tutor and his/her preference for specific courses. A composite of the results will be made available to all undergraduate students. It should be stressed that there are no recommendations made on these sheets. The principal restriction on tutoring is that Graduate Student Instructors must not tutor students enrolled in the course in which they are teaching.

Loans

Loan funds administered through the Office of Financial Aid (2011 SAB) are available to meet the needs of any educational expense for students while enrolled in the University. The extent of this financial need must be clearly established by providing a complete statement of the applicant's financial resources and expenses for the academic year.

Loans are NOT available for any non-educational expense which is normally financed by a commercial lending institution, nor are they available for the repayment of previously incurred indebtedness. Short term loans are considered by the Office of Financial Aid.

Income Tax Liability

Current practice is subject to review by the IRS and may change at any time. Graduate Student Instructor and Graduate Student Research Assistantship stipends are considered remuneration for services performed and, as such, are subject to withholding and income tax. Under the income tax law of 1986, stipends for fellowships and other forms of student aid are subject to income tax and must be reported quarterly.

USE OF THE CHEMISTRY BUILDING

Keys

The issuance of keys to the Chemistry Building carries with it the following responsibilities:

1. Keys must be returned to the Key Office when no longer needed. Key deposits vary from \$5 to \$10.

Lost keys should be reported promptly to Tracy Stevenson, Room 1500c.

No duplicates are to be made or allowed to be made from keys issued to individuals.

The holder of a key must not permit the use of that key by unauthorized persons, nor must he/she use that key to admit unauthorized persons.

Building Use Regulations

The Chemistry Building customarily is open from 7:00 a.m. until 10:00 p.m. weekdays and from 6:30 a.m. to 6:00 p.m. on Saturdays. It is closed on Sundays and holidays. During times that the building is closed, the University Department of Public Safety (DPS) is responsible for the proper use of the building. They may request identification of all persons in the building during these hours, together with evidence of authorization for being in the building. DPS has the authority to request all unauthorized persons to leave the building at hours when the outside doors are locked. (A married person authorized to be in the building when it is locked may request an authorization card for his/her spouse). Department rules state that the doors to all offices and laboratories must be kept locked. This is necessary to prevent entry by unauthorized persons and reduce the possibility of theft.

Special Rooms

The Staff Instrument Shop, the “hands-on” instrument laboratories, and other rooms containing specialized equipment for general use require cooperative procedures. Before using equipment in such rooms for the first time, obtain instructions as to the proper operating procedures. Report any damage or malfunction to the designated person in charge of the equipment or the responsible staff member. At the conclusion of your work, clean up the area.

Classrooms

University regulations state that classes begin at ten minutes after the hour

and end on the hour. Teachers and other persons using classrooms should follow this schedule so that classes coming into the room can do so on time. It is expected for persons using the blackboards to clean them before leaving the room for another class.

Bicycles, Rollerblades

These items are for outdoor use and should not to be brought/worn into the building at any time.

Radios

At all times, radios and other sound equipment must be kept at a sufficiently low volume so that they do not become a nuisance. Similarly, conduct in the building should be such as not to interfere with classes or research activities in progress. The Chemistry Building is a place for study and research. Conditions which interfere with these objectives should not be allowed to develop.

Emergency and Safety Regulations/Emergency Telephone Numbers

In case of emergency, use a campus-only phone and dial 911, give description and location of emergency. The Department of Public Safety can also be reached by dialing 3-1131. University-only telephones are located on the east wall of the lower Atrium and on the wall outside the Administrative Complex (1500).

Fires

The Department of Public Safety feels that we should report all fires, since what might appear to be a small fire could get out of control and a few minutes delay in calling might result in a serious situation. Under any circumstances, if an extinguisher is used, even partially, Tracy Stevenson (Room 1500c) or Richard Giszczak (Room 1608) should be notified immediately in order to have it refilled before it may be needed again.

Alarm System

The building has been equipped with an automatic dual-activated detection system which has both heat and smoke sensors. The systems may be activated by either type of sensor or by the manual operation of the lever at any of the standard red alarm boxes.

Upon activation of the system, warning horns sound continuously and the

Department of Public Safety responds by dispatching a campus police officer to investigate the cause of the alarm and by contacting the fire department, if necessary.

Response to the Alarm

Leave the building at once! Do not assume that it is a false alarm, do not attempt your own investigation. Class instructors should direct their students to the nearest exit.

If you have first-hand information, meet the firemen at the loading dock on the north side of the building; otherwise, stay away from the dock so that emergency vehicles and personnel can get to the building. When the warning horns shut off it is safe to re-enter the building.

Security

The Chemistry Building contains a large amount of dangerous and/or flammable substances and also a great deal of expensive and delicate equipment. It is therefore particularly vulnerable to petty thievery and to attempts at malicious mischief. Strangers, and particularly youngsters, can seriously injure themselves by wandering into hazardous areas. For these reasons, doors to individual office and laboratories should always be locked. If persons are found in areas where they appear to have no business, they should be questioned and directed to the location they are seeking. If they seem to have no valid reason for being where they are, they should be ushered out courteously but firmly.

Call DPS (763-1131) if the situation warrants further investigation.

Permission to be in the building during the hours when it is locked (10:00 p.m. until 7:00 a.m. weekdays; 6:00 p.m. Saturday afternoon until 7:00 a.m. Monday) is granted to members of the Chemistry Department. The presence of unauthorized individuals in the building after it is locked should be reported immediately to the Department of Public Safety at 763-1131. Particular care should be taken with keys to various rooms in the building and any loss should be reported immediately.

In the case of untoward events such as theft, arson, or vandalism, notify the Department of Public Safety, using any University phone dialing 911 immediately. Do not call the Ann Arbor Police. The Department of Public Safety will evaluate the situation and take additional action if necessary.

Injuries

First-aid treatment for injuries should be limited to common sense emergency treatment only. Examples might include severe cuts where profuse bleeding dictates the use of compresses or a tourniquet, chemical splashes which call for immediate flooding with water for 15 minutes

followed by washing the exposed area for an additional 15 minutes, chemicals in the eye which should be washed copiously with water (note the drench hoses which are located throughout the building in the laboratories), and moderate burns for which the best first aid is flooding with cold water to reduce the flesh temperature. If there is a relatively minor injury to any individual, notify Richard Giszczak immediately. His phone number is 763-4527 and his beeper number is 734-651-6289. If he is unavailable, notify Tracy Stevenson at 764-7316. If the injury has occurred after normal working hours and the individual requires medical attention, notify Public Safety for transportation to the Emergency Room. If, at any time, there is a life threatening injury, call the Department of Public Safety (x911) immediately for assistance. Then notify Richard Giszczak or Tracy Stevenson and appraise them of the situation. If an injury occurs after 5pm or on a weekend, a report will need to be filed with Richard Giszczak as soon as possible. If an injury that requires medical treatment happened to an employee during working hours, the individual will be taken to M-Works. If an injury happens to a student, the student will be taken to Health Services.

Emergency equipment, such as fire extinguishers, are located on each floor of the Chemistry Building. Please notify Tracy Stevenson, Room 1500c (Chair of the Chemistry Safety Committee) whenever you see safety equipment which is mislocated or in poor condition, or if you find a hazardous situation which cannot easily be remedied. No person is permitted to work in the building alone at any time in the conduct of experiments which could possibly cause burns, blindness or other physical disability. Some other person must be near enough to give first-aid and assistance in case of accident. Compliance with this rule often entails considerable cooperation in hours when only a few are working in the building. It also means that rear and side doors to research rooms in which work is going on should always be open to allow ready entrance and exit in case of accident.

General Precautions

The general accepted safety principles and practices for the department and specifically, for individual research laboratories are contained within the Chemical Hygiene Plans (CHPs) that are located within each respective research laboratory suite. Familiarization with the contents of this departmental safety manual (CHP) is essential to working safely in the Chemistry buildings.

Safety glasses or goggles are required to be worn in all laboratories, instrument rooms, chemical storage rooms and other areas where hazardous work is being performed. Under no circumstances are contact lenses to be worn in an eye protection area. Safety glasses, including prescription, are available at low or no cost to the individual from the Department of Occupational Safety and Environmental Health. See Rich Giszczak, Room

1608, to obtain the glasses.

Federal and State law requires that all containers in which chemicals are stored are to be properly labeled as to their contents, hazards associated with handling these materials and safety precautions that must be followed. Gas cylinders, which present a special physical hazard, must be securely fastened to benches, tables and/or walls with appropriate supports. When stored or not in use, gas cylinders need to have their safety caps in place. Under no circumstances are cylinders to be stored in the halls.

Hoods are critical to the safe operation of a laboratory and the well being of it's occupants. The proper use of the double sash, two speed hoods that are currently in place in the Department is important to provide a maximum level of safety. Correct operating procedures are posted on each hood and are described in the Chemical Hygiene Plan. Following these instructions carefully will insure proper usage of the hoods and maximum safety to the user.

Conservation of resources is critical to the Department and the University. Ensure that all water, nitrogen, electricity and other utilities are turned off when not in use. All non-rigid lines that carry fluids (water, nitrogen, etc.) are to be properly fastened with clamps or wire. Reinforced Tygon tubing is recommended.

If an experiment needs to be run overnight or through a weekend, a sign indicating that it is not to be disturbed must be attached. Security has been known to close water valves and turn off electricity to equipment left running after hours. Names, addresses and telephone numbers of persons to be notified in case of emergencies must be posted on the corridor doors of each laboratory.

Use common sense when working in a laboratory. Remove or repair any and all hazards, be they physical, electrical or chemical. A safe working environment requires a concerted effort by all parties. If there is a safety problem that needs to be resolved, notify Richard Giszczak (Room 1608) or Tracy Stevenson (Room 1500c).

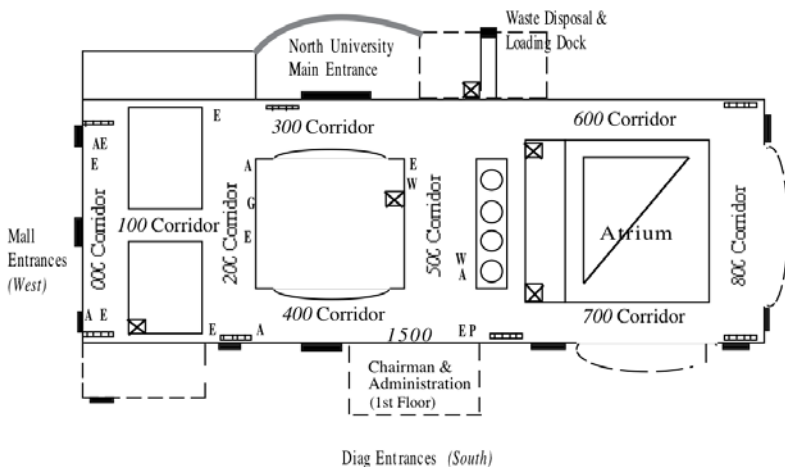
Maintenance

All maintenance items such as lights out, malfunctioning switches, plugged sinks, leaking radiators, etc., should be reported to the 1500 administrative complex. Floods should be reported immediately to Tracy Stevenson or, if after hours, call 647-2059 and report the problem.

Energy Considerations

Chemistry, as one of the most energy-intensive activities in the University, can contribute a great deal towards holding energy costs down. Everyone in the Department needs to help eliminate wasteful use of energy. Room lights, particularly in classrooms should be turned off when leaving; furnaces, pumps, heaters of all kinds and other items of equipment using electrical energy should not be left on for no purpose. Hoods, particularly in teaching laboratories, should be turned down or off when they are not needed. Hoods are high consumers of energy, not only because of the energy to operate the fans but also because they exhaust a large volume of tempered air outside the building. The cooperation of everyone in the building is necessary to keep growing energy costs within bounds.

930 North University Avenue



Chemistry Administrative Complex, Room 1500; Mail Boxes, 1500o, 1531;

The first digit gives the floor on which room is located.

The second digit gives the corridor on that floor.

The last two digits give the room number in that corridor.

(Three

digit numbers preceded by an “A” are found in the basement.)

The letters on the diagram indicate the locations of the following safety devices:

P - Emergency Phone **E** - Fire Extinguisher **A** - Fire Alarm **W** - Water Fountain

Stairway Elevator 

X