



Department of Chemistry

# Graduate Student Handbook 2019-2020



*Graduate Student Advisory Committee  
Department of Chemistry  
Dartmouth College  
Hanover, New Hampshire 03755*

*<http://chemistry.dartmouth.edu/sites/chemistry/files/handbook.pdf>*

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# Table of Contents

<i>WELCOME!</i> .....	2
<i>LOGISTICS</i> .....	3
<i>STIPENDS, VACATIONS, AND OUTSIDE EMPLOYMENT</i> .....	4
<i>GRADUATE STUDENT ORGANIZATION</i> .....	5
<i>ACADEMIC MATTERS</i> .....	6
<i>THE MASTER'S DEGREE : M.S.</i> .....	6
<i>THE DOCTOR'S DEGREE : PH.D. IN CHEMISTRY</i> .....	6
<i>THE DOCTOR'S DEGREE: PH.D. IN CHEMISTRY-MATERIALS</i> .....	7
<i>HONOR PRINCIPLE</i> .....	8
<i>INFORMATION TECHNOLOGY POLICY</i> .....	10
<i>THE BREADTH REQUIREMENT</i> .....	11
<i>COURSES</i> .....	13
<i>TEACHING</i> .....	14
<i>RESEARCH SUPERVISOR AND RESEARCH COMMITTEE SELECTION</i> .....	16
<i>PROGRESS REPORTS AND RESEARCH COMMITTEE MEETINGS</i> .....	17
<i>GRIEVANCE PROCESS</i> .....	19
<i>SPECIAL ARRANGEMENTS TO CARRY OUT RESEARCH IN OTHER DEPARTMENTS</i> .....	20
<i>SPECIAL ARRANGEMENTS FOR STUDENTS IN OTHER DEPARTMENTS</i> .....	21
<i>SAFETY</i> .....	22
<i>QUALIFYING EXAMINATIONS</i> .....	23
<i>OTHER REQUIREMENTS</i> .....	25
<i>RESEARCH PROPOSAL</i> .....	26
<i>RESEARCH SEMINAR</i> .....	27
<i>OTHER SEMINARS</i> .....	28
<i>SEMINAR PRESENTATION HINTS</i> .....	29
<i>THESIS</i> .....	31
<i>IMPORTANT DEADLINES AND DATES</i> .....	32

**Welcome!**

**W**elcome to the graduate program in the Chemistry department! As faculty members, we look forward to working with you as you continue your education as chemists. You will find the graduate education experience an interesting and exciting transition from student to independent scientist.

You will begin by enrolling in courses and by taking examinations very much as you did as an undergraduate; at the end, you will present a thesis describing some of your own research which contributes to the body of new knowledge in chemistry.

Actually, the process is not the simple progression that the foregoing statement might imply. While you are taking courses, you will also be serving as an apprentice teacher in undergraduate courses, and some of you will be discovering new knowledge in your first weeks in a research laboratory. Above all, a productive chemist never loses the attitude of an inquiring student.

The process of education is something to which we faculty members devote our professional careers, and we look forward to working with you in every way we can to make the process a success for us all. While the goals of having your graduate years be satisfying and productive are clear, the methods of realizing those goals are elusive and need to be reexamined continuously. This Handbook is meant to introduce you to those parts of the process which can be described on paper, and thus to make it easier for you to add those most important dimensions of personal growth that can never be written down.

This brochure has been prepared by the *Graduate Student Advisory Committee (GSAC)* which is a subset of the Chemistry faculty carrying the main responsibility for seeing to it that the graduate program operates smoothly and effectively. The members of GSAC are responsible for making sure that degree requirements are met and for giving you advice and counsel regarding the conduct of your own education. All members of GSAC, particularly the Chair, are available to you at any time for advice or questions, and they welcome your suggestions on any matters whatsoever. One member of GSAC will serve as advisor to each student until a research supervisor has been selected. Advice and assistance, of course, are not limited to this formal route through GSAC. You will find the entire faculty, your fellow graduate students, and all of the supporting staff in the department available to answer inquiries.

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## **Logistics**

The Department Office is in the chemistry building, 102 Burke Laboratory, at the top of the stairs just inside the 41 North College Street entrance.

James Almond-Goerlitz, the Department Administrator, and Administrative Assistant Phyllis Ford, who serves as the department's secretary for graduate affairs, can answer most miscellaneous questions about the department, the College, and Hanover. James will set up your electronic access to Burke Laboratory and manage your stipend. Phyllis will assign you a mailbox and introduce you to our administrative procedures. The main office is also the source of common stationery supplies such as writing pads, pencils, and pens.

On the ground floor of Burke is the Burke Stockroom, which serves primarily chemistry but also other departments in the Fairchild Science Center. Your research supervisor will explain to you how you place orders through the stockroom or over the web, or check out stocked research supplies. The stockroom staff is available to answer your questions and help you place orders.

At the other end of the hall from the Stockroom, at the base of the main stairway, is the Electronics Shop and the departmental magnetic resonance (NMR/ESR) facility. This room houses the department's shared NMR spectrometers that many of you will use for routine NMR.

The department uses two large, ground-floor lecture rooms, 006 and 007 Steele Hall, for many of its teaching and research lectures. Steele also houses a medium-sized classroom, 315 Steele, on the top floor. This floor also holds many of the department's undergraduate instructional labs. Burke has two seminar rooms, 220 and 309, that are used for small classes, research group meetings, and other purposes. Reservations to use these small rooms and 315 Steele are scheduled through the Department Office.

Dartmouth has long had a computing network linking personal computers to the Internet, either via Ethernet or the campus Wi-Fi networks. Computers are available in all research groups, libraries, and offices. You will have free access to the Dartmouth electronic mail system and to other features, such as library access, available over the Dartmouth Network. While Dartmouth once used Apple Macintosh personal computers in far greater number than Windows machines, today either can be used over the network, and the mix of platforms across the campus today is very heterogeneous. Likewise, smartphones and tablets can connect securely to the wireless network.

You should also be aware of the Graduate Studies Office located in room 437 of 37 Dewey Field Road. The Dean of Graduate Studies and the Dean's assistants can help you with all sorts of problems that transcend departmental jurisdiction. For example, they can arrange for long or short term loans should the need arise. You should also read the Graduate Handbook that office provides and keep it and this Handbook available for reference throughout the year. (Both are updated annually.)  
Link: <http://graduate.dartmouth.edu/academics/graduate-registrar>

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## **Stipends, Vacations, and Outside Employment**

Stipends normally begin on the day you are required to be on campus for your first year. Your first check will be sent to the department. For direct deposit of your stipend to your local bank account, see the instructions here: <http://www.dartmouth.edu/~control/faq/pay-direct-deposit.html>

It is the intent of the department to provide a stipend during twenty terms of graduate work. Usually, this will mean five consecutive years. Support beyond sixteen terms will be provided only if the department is convinced, on the basis of a review and recommendation by the student's Research Advisory Committee, that the student is making progress which will allow completion of the thesis within approximately an additional year. Support is only provided beyond twenty terms if the student's research supervisor has research funds available for that purpose. Note that if you arrived at the start of the Summer term, rather than the Fall, and if you were enrolled as a student that term, it will count as the first of your twenty terms of departmental support.

The stipend comprises a full tuition scholarship, your health access fees and health insurance each term if you are covered by the Dartmouth Student Group Health Plan, and an amount to assist you with living costs. The sources of these funds vary from student to student and from year to year. Graduate student stipends at Dartmouth are subject to state and federal income taxes to the extent required by law. Anyone with significant non-Dartmouth income should consult the Graduate Study Office for current tax regulations. Every student who enrolls in the graduate program accepts the responsibility to cooperate in efforts to acquire funds for her or his stipend through application for fellowships or participation in federal work-study programs.

Graduate study is no more a clock-punching activity than research is for a faculty member. You will probably find evenings and weekends in the laboratory some of your most productive periods, and many of us find that quiet interludes in the building during some of the regular undergraduate holidays provide the best research time of the entire year. However, the official departmental policy is that **graduate students are entitled to a total of two weeks' vacation per year**, in addition to any time off during regular College holidays, such as Thanksgiving, Christmas, and New Year's vacation. (Note that the period between the last day of one academic term and the first day of the following term is never entirely a College holiday period.) Implementation of the policy is left to each individual and the research advisor. Please note that teaching duties frequently extend into both the beginning and end of undergraduate term breaks; be sure to check with your teaching supervisors before planning a holiday. Please keep your research supervisor informed of all vacation plans.

Graduate study is a full-time occupation, and outside employment is likely to reduce the time that a student can devote to graduate study to a level that will necessarily prolong the period required to satisfy the Ph.D. requirements. Therefore, Dartmouth's graduate program (see the graduate studies handbook at <https://graduate.dartmouth.edu/employment-policy>) prohibits outside employment for enrolled students.

Exceptions may be granted in cases of academic or professional benefit or documented financial hardship. Any exception will normally not exceed eight hours per week and must have the written prior approval of the graduate student's research advisory committee, GSAC, and the Dean of Graduate Studies. In unusual cases, with written prior approval from these committees and the Dean, students may request a temporary leave of absence to pursue outside employment opportunities.

## **Graduate Student Organization**

Each department has one graduate student elected as a representative to a graduate student advisory group, which meets with the Dean of Graduate Studies. This same student normally acts within the department as a clearing house for certain kinds of interchange between the faculty and the graduate students.

The Graduate Student Organization has a web site that has many additional resources that you might find very useful. Go to <http://sites.dartmouth.edu/gsc/> and select an option under the RESOURCES menu on that page.

Actually, the community of chemists is sufficiently small that formal organization is seldom called into play, but on occasion faculty committees want a relatively formal level of input from graduate students, and in such cases the graduate representative may be asked to help make the appropriate arrangements. Groups of graduate students, for example, are always asked to interview prospective candidates for faculty employment in the department and to express their evaluation of such candidates.

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## **Academic Matters**

Your academic progress will be monitored by GSAC and your Research Advisory Committee, and continuation in the program is always contingent on your satisfactory performance in research, teaching, course work, and examinations.

If at any time a Research Advisory Committee wishes to recommend probation or separation of a student from the program, that recommendation will be shared with the student and with GSAC. While the Committee or the Dean of Graduate Studies may initiate a probationary period, separation from the program will be made only by vote of the faculty upon recommendation by GSAC.

Formal degree requirements, as given in the Dartmouth web publication known as the *ORC (Organization, Regulations and Courses)*, are given below, followed by detailed comments on various of the requirements. *ORC* course listings for the current year are also available through <http://www.dartmouth.edu/~reg>.

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### **The Master's Degree: M.S.**

The general requirements for the Master's degree are given in the *ORC*. These requirements, together with the specific requirements of the Department of Chemistry, normally allow completion of the degree in two years.

The specific requirements are as follows:

1. Each student must pass with a grade of P or better eight courses from the offerings in chemistry and allied areas which have been chosen in consultation with the advisor and approved by GSAC. Chemistry 256 and one term of Chemistry 257 may count. Up to four courses may be in graduate level research, but they may not include the Colloquium courses (140 and the 260 series), nor may courses numbered below 100 count in the eight-course total.
  2. The student must complete a satisfactory thesis and pass creditably an oral examination upon this thesis.
  3. In the course of this training, the student must gain experience in teaching, including completion of Chemistry 256.
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### **The Doctor's Degree: Ph.D. in Chemistry**

A student will be admitted to candidacy for the doctorate when she or he has satisfied the following requirements:

1. Completion, by the start of the Fall term of the student's second year in the program, through an appropriate combination of Dartmouth courses or performance on diagnostic entrance examinations, of a breadth requirement in three of the four topical areas of biological, inorganic, organic, and physical chemistry.
2. Passing by the end of the spring term of the second year, a Ph.D. qualifying examination consisting of a written proposal for the student's Ph.D. research and an oral defense of that proposal.
3. Presentation before the Department of a lecture on the thesis topic by the end of the student's fourth year.
4. Submission and oral defense of an original research proposal in an area removed from the student's own thesis research, by the end of the student's third year.

The candidate will receive the doctorate upon:

1. Satisfactory completion of an original thesis project of high quality and substantial significance and approval of the thesis embodying the results of this research.
2. Successful defense of this thesis in an oral examination.

A candidate for the doctorate will take various courses in chemistry and allied fields that are pertinent to the area of study. He or she will also participate actively in undergraduate teaching, including completion of Chemistry 256. It is anticipated that a graduate student will normally complete all of the requirements for the doctorate in approximately four years. It is not necessary to earn a Master's degree as a prerequisite to the doctorate.

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***The Doctor's  
Degree: Ph.D.  
in Chemistry-  
Materials***

The department offers a Ph.D. in Chemistry-Materials that is more focused in materials science. The degree requirements for this course of study are outlined below.

A student will be admitted to candidacy for the doctorate after satisfying the following requirements:

1. Completion, by the start of the Fall term of the student's second year in the program, through an appropriate combination of Dartmouth courses or performance on diagnostic entrance examinations, of a breadth requirement in three of the four topical areas of biological, inorganic, organic, and physical chemistry.
2. Successful completion, by the end of the student's third year in the program, of four core courses satisfying the breadth requirement in Materials Chemistry, and a minimum of three elective courses selected from the Chemistry-Materials elective course list.
3. Annual presentation of a Research in Progress lecture to the Materials Chemistry Group, and submission of an annual research progress report to the student's Research Advisory Committee.
4. Submission and oral defense of an original research proposal in an area removed from the student's own thesis research.

The candidate will receive the doctorate upon:

1. Satisfactory completion of an original thesis project of high quality and substantial significance, and approval of the thesis embodying the results of this research.
2. Successful defense of this thesis in an oral examination.

A candidate for the doctorate will take additional courses in chemistry and allied fields as required for their area of study. He or she will also participate actively in undergraduate teaching, including completion of Chemistry 256. Students are required to attend research discussion meetings as well as seminars designated by their research director as Materials Seminars. It is anticipated that a graduate student will normally complete all of the requirements for the doctorate in approximately five years. It is not necessary to earn a Master's degree as a prerequisite to the doctorate.

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## **Honor Principle**

Dartmouth operates on a system of academic honor. The following statement from the Dartmouth College Student Handbook applies fully to all aspects of graduate study, including such matters as problem assignments and rules for use of library and computing materials as well as examinations.

*Fundamental to the principle of independent learning is the requirement of honesty and integrity in the performance of academic assignments, both in the classroom and outside. Accordingly, Dartmouth operates on the principle of academic honor without proctoring of tests and examinations. A student who submits work which is not his or her own forfeits the opportunity to continue at Dartmouth.*

*The Honor Principle depends on the willingness of students, individually and collectively, to maintain and perpetuate standards of academic honesty. Each student accepts the responsibility not only to be honorable in his or her own academic affairs but also to support the principle as it applies to others.*

*A student who becomes aware of a violation of this Principle is bound by honor to take some action. He or she may report the violation, speak personally to the student, exercise some form of social sanction, or do whatever is appropriate under the circumstances. If he or she stands by and does nothing, he or she threatens both the spirit and the operation of the principle of academic honor.*

The Honor Principle applies not only to individual student actions, but it also has implications for faculty and Teaching Assistant interactions with students. The guidelines below represent the faculty's view of a Teaching Assistant's role in supporting the Honor Principle at Dartmouth. Faculty and TAs in each course should discuss these guidelines at the outset of each course to ensure that there is no confusion about the roles, duties, and responsibilities of the teaching staff regarding this important aspect of academic life.

Teaching Assistants play an important role in the Department's teaching efforts. TAs often work closely with the faculty in the evaluation of material submitted for a grade. Generally, such material is assumed to be covered by the broad principles of Academic Honor embodied in the Academic Honor Principle as stated in, for instance, the *ORC*. The material is assumed to be entirely the work of the individual submitting it unless collaborations (as is common in collecting lab data) and/or other sources specified as acceptable references by the instructor are acknowledged. The Department views this Principle as a serious compact between students and faculty, and both sides of the compact implicitly agree to accept various responsibilities that go along with it. One such responsibility is the assumption that we all play by the rules. Consequently, exams are not closely monitored. Another is the assumption that unreported knowledge of a suspected violation of the Honor Principle is itself a violation. Consequently, it is important that guidelines for action are stated clearly in case such a suspicion arises.

It is incumbent on the teaching staff of any course to discuss among themselves and with their students the various graded portions of the course and the role played by the Honor Principle in each of them. Examples include laboratory notebooks, term papers, and homework as well as exams. Any limits on student collaboration must be made clear to all involved: students and teaching staff.

Should a suspected violation of the Honor Principle turn up in the course of routine grading, there are several steps that must be taken. ***These steps are not optional; they are integral to the Honor Principle itself.*** Faculty guidelines include consultation with colleagues to verify or refute the suspicion, optional consultation with the student or students involved, and, based on these steps, forwarding evidence supporting the suspicion to the College-wide Committee on Standards. A Teaching Assistant uncovering a suspected violation in the course of routine grading must immediately bring the suspicion to the attention of the faculty member in charge of the course. It is inappropriate for a Teaching Assistant to confront or otherwise question a student directly, and it is further inappropriate for the TA to penalize the student or students in any way. Teaching Assistants are, of course, encouraged to respond to student questions regarding the Honor Principle's application to any assignment and to be alert to situations that have the potential to lead to an Honor Principle violation. In this Department, the most common such situation involves student collaboration in labs, and the instructors of the course must be clear among themselves at what point student collaboration ceases and individual work begins.

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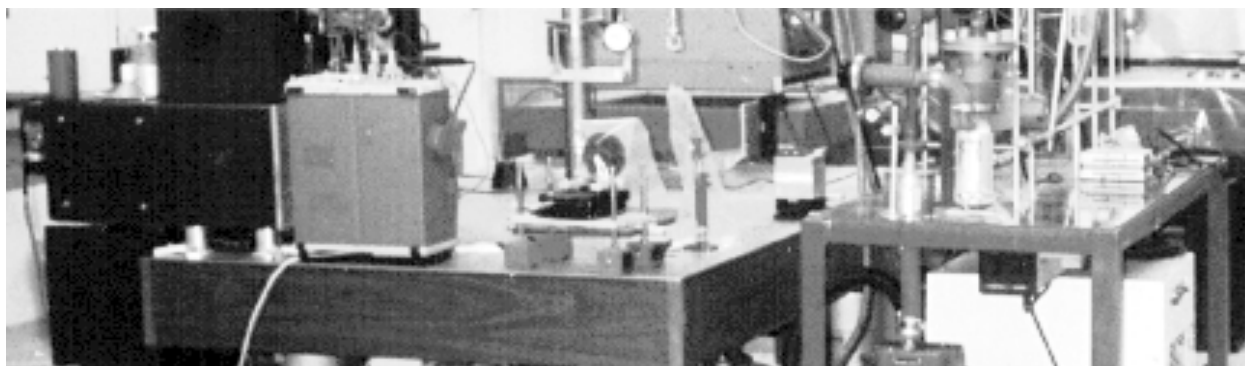
## **Information Technology Policy**

In addition to the Honor Principle, use of computer resources is governed by the Dartmouth College Information Technology Policy, available on the Dartmouth web site at <http://tech.dartmouth.edu/its/about/about-its/policies>. This policy begins:

*The Dartmouth College Information Technology Policy (the "Policy") set forth below contains Dartmouth's philosophy and requirements governing student, faculty, staff and alumni use of its information technology resources. Dartmouth College expects each member of the community to use Dartmouth's information technology resources, including connections to resources external to Dartmouth that are made possible by Dartmouth's information technology resources, responsibly, ethically, and in compliance with the Policy, relevant laws, and all contractual obligations to third parties. The use of Dartmouth's information technology resources is a privilege. If a member of the community fails to comply with this Policy or relevant laws and contractual obligations, that member's privilege to access and use Dartmouth's information technology resources may be revoked. The use of Dartmouth's information technology resources to send communications to Dartmouth or non-Dartmouth persons or entities typically identifies the sender as belonging to the Dartmouth community. Each member of the community should therefore recognize that any such communication may reflect on how Dartmouth is perceived by not only the Dartmouth community, but also the public at large.*

*By adopting the Policy, Dartmouth recognizes that all Dartmouth students, faculty, staff and alumni who use Dartmouth's information technology resources are bound not only by the Policy, but also by local, state, and federal laws relating to electronic media, copyrights, privacy, and security. Other Dartmouth policies that relate to this Policy and also apply to Dartmouth College students, faculty, staff and alumni (collectively, the "community") include the Dartmouth College Copyright Policy & Guidelines on copyrighted materials, the Dartmouth College Patent Policy, the Dartmouth College student handbooks and faculty handbooks, and the Dartmouth College Exempt and Non-exempt Staff Handbooks. Each member of the Dartmouth community is expected to be familiar with the relevant foregoing policies.*

Please take the time to review the entire policy at the web address listed above.



## **The Breadth Requirement**

While the Chemistry Graduate Program appropriately focuses on original research in a narrowly defined branch of chemistry, a working knowledge of the terminology, concepts, theories, and issues of modern chemistry is a necessary component of any post-baccalaureate education. Two Program requirements directly address this need:

the Research Colloquium lecture series, which exposes students to contemporary research talks across all of chemistry, and the Breadth Requirement, described here.

The Breadth Requirement addresses four broadly defined branches of chemistry: biochemical, inorganic, organic, and physical, and it has two components: a *basic knowledge* component and a *specialized knowledge* component. Admission to the program requires a student to specify the general area in which she or he intends to conduct degree-related research. For the purposes of this requirement, this area is called the student's *primary research area*.

All students are required to demonstrate basic knowledge in three of these four branches of chemistry (the primary area must be one of the three) through, as described in detail below, a combination of courses taken at Dartmouth, performance on diagnostic evaluation exams given on entrance to the program, and/or performance in courses taken before matriculation in the Program. In addition to basic familiarity in these areas, the specialized knowledge component emphasizes broad exposure at a more advanced level in the student's primary research area and entails graduate coursework in that area.

### **The Basic Knowledge Component**

During the week before Fall term registration, all entering students will be invited to take four diagnostic exams, one in each of the areas of biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. All four are multiple-choice exams provided by the American Chemical Society (ACS). Each consists of 60-70 questions, and the exams are timed for periods of typically 120 minutes. These exams are carefully aimed at the typical undergraduate course level, and they are widely used across the country. Students who do sufficiently well on one (or more) of these exams will have satisfied the basic knowledge component of the Breadth Requirement for that area (or those areas). In any areas *outside* the student's primary research area, diagnostic exam performance will be evaluated in the light of the student's performance in previous courses in each area as recorded on a transcript or transcripts from the student's previous institution or institutions (as used to apply for admission to the program). Outstanding prior performance will be considered favorably as the faculty evaluates satisfaction of the Breadth Requirement. Similarly, the one area that will be excluded from the basic knowledge component will be designated based on an evaluation of the student's ACS exam performance, background in that area, and primary research area.

The diagnostic exams will be given throughout that week, but a student can choose not to take any (or all) exams if she or he prefers to enroll in the corresponding courses, as described in the next paragraph. This choice is usually only appropriate for a student who has no experience in one of the areas and is certain to do poorly on the ACS exam.

For those areas in which a student does not demonstrate basic knowledge, GSAC will choose an academic plan of courses which must be passed with a grade of P or higher to complete the basic knowledge component. Note: graduate courses are graded pass-fail (HP, P, LP, F). When this grading scheme is applied to undergraduate courses, it formally makes them count for graduate credit. However, such courses will not count for the specialized knowledge requirement of at least three graduate level courses (see below).

Students will not be permitted to withdraw from these courses solely on the basis of poor academic performance. If the student's primary research area is among

these areas, the plan will generally include undergraduate courses that will prepare the student for the specialized knowledge component described below. If the student has not demonstrated basic knowledge in areas outside the primary area, the plan will generally include at least one course in each such area.

The basic knowledge component must generally be satisfied in all three of the four possible areas by the start of the Fall term of the student's second year. As shown on the calendar of Important Deadlines and Dates on the last page of this Handbook, the diagnostic exams are offered (if needed) at the end of the Spring term of the student's first year and again before the start of the following Fall term should a student fail to satisfy this requirement through coursework.

### **The Specialized Knowledge Component: Ph.D. in Chemistry**

All students in the Ph.D. in Chemistry program must complete with a grade of P or higher at least *three graduate level courses* in their primary research area (or in a closely allied area agreed to by GSAC or the student's Research Advisor) to complete the specialized knowledge component of the requirement. These courses need not be taken right away, and in many cases, our pattern of graduate course offerings will indicate an academic plan in which these (and often other) graduate courses will be taken during the first two years in the program.

### **The Specialized Knowledge Component: Ph.D. in Chemistry-Materials**

All students in the Ph.D. in Chemistry-Materials program must complete with a grade of P or higher four courses from either the Chemistry-Materials option (a) or option (b) required course list and three courses from the Chemistry-Materials elective course list. Chemistry 256 must be among the four required courses.

*Chemistry-Materials Required Course List. Chemistry 256 plus three from among:*

*Option (a):* Chem 101.4, 109, 101.7, 137 (or 101.3).

*Option (b):* Chem 101.4, 101.7 (or Engs 24), 137 (or 101.3), Engs 131.

*Chemistry-Materials Elective Course List:*

Chem 101.1 (or Phys 91), 101.2, 130, 131, 151, 152; Engs 91, 100 (or Phys 100), 130, 132, 135, 165; or other courses approved by the student's Research Advisory Committee.

The specialized knowledge component of the Breadth Requirement must be completed by the end of the Fall term of the student's third year in the program. GSAC will adjust this schedule appropriately for students entering the program at times other than the Fall term, but in no case will a student have more than nine terms in residence to complete this requirement (unless our annual course schedule, which is beyond the student's control, dictates a one or two term extension).

GSAC periodically reviews the progress of all students and discusses progress with each student. Failure to complete either component of the Breadth Requirement in the allotted time or a pattern of failure (such as failing grades, failure to show sufficient commitment to research, or withdrawing from courses due to academic difficulty) will lead GSAC to recommend to the Department that the student leave the program.

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## **Courses**

Course work is regarded as an important component of an educational experience which focuses on the preparation of a thesis and, most importantly, on the research to which that thesis testifies. In keeping with this philosophy, course work should be selected on a very individual basis. The specialized knowledge component of the Breadth Requirement and the Teaching Requirement (described on the next page) both address course selection issues.

Initial course selections will be made in consultation with GSAC and will be based on each student's interests together with the goal of satisfying the Breadth Requirement's course component. After satisfying the basic knowledge component of the Breadth Requirement, students will select courses in consultation with their research supervisor or GSAC advisor in a way that addresses the specialized knowledge component.

It is certainly not possible to give any universally applicable advice regarding course choices, but perhaps two rather different generalizations will be useful:

The Ph.D. degree testifies to research ability, not accumulated course credits. Therefore, course selections should be made judiciously and with the design of supporting a developing research capability. Remember that there will be many more interesting courses than you will have time to take; so, select carefully.

Or, on the other hand:

The topic of your graduate thesis is not likely to be the area of your life's work. Your intellectual and professional development will depend on your flexibility and your ability to grow. The opportunity to take course work outside your central field of interest is quite unique to this stage of your career—use it wisely.

So there you have it. Pick the linear combination that applies to you.

Courses in chemistry numbered above 100 carry graduate credit and will be graded on either an HP, P, LP, NC [high pass, pass, low pass, no credit (= fail)] basis or a simple CT (credit) or NC (no credit) basis. Whether or not such courses satisfy explicit graduate program requirements varies from student to student and depends on the degree the student is seeking. Courses numbered over 100 in other departments may carry graduate credit as well, and questions about them should be addressed to the student's advisor or directly to GSAC.

Courses numbered below 100 never carry graduate credit. Many of these courses can be used to satisfy the Breadth Requirement in lieu of a satisfactory performance on the diagnostic exams. For undergraduates, these courses are graded on an A, B, C, D, E basis, but, as mentioned above, graduate students will receive HP, P, LP, or F grades. Grades of LP or NC may not be used to satisfy either the Breadth Requirement or the course requirement for the Master's degree. You should consult your instructor whenever you are unsure of your standing or performance in any course.

Penalties for unsatisfactory performance in graduate courses (LP, F or NC grades) are discussed in the Graduate Student Handbook available currently at <http://graduate.dartmouth.edu/policy/satisfactory-progress>.

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## Teaching

Experience as a teaching assistant is a regular degree requirement for all graduate students in Chemistry and in most other departments at Dartmouth. Graduate students benefit from such experience by acquiring chemical knowledge and by developing teaching skills. Such skills are valuable whether or not you seek a career in teaching. Undergraduates benefit from the presence of graduate student teaching assistants in several ways. First, of course, there simply isn't enough faculty time available to give undergraduates the individual attention they need and deserve. Equally important, however, is the fact that graduate students, still close to their own undergraduate experience, frequently are uniquely effective in helping students learn techniques of problem solving and laboratory skills. Finally, graduate students serve as important role models for undergraduates, many of whom will eventually do honors research projects and go on to chemistry graduate school.

Graduate students serving as teaching assistants (and thus as an extension of the regular faculty) have many of the responsibilities of the faculty, and they share with the faculty a position of authority over their students. Consequently, graduate students must avoid personal relationships with undergraduate students they are either supervising or might reasonably be expected to supervise in the future. See the **Policy on Consensual Relationships and Conflict of Interest** on the Graduate Studies' web site: <http://graduate.dartmouth.edu/services/undergradrel.html>.

The teaching requirement for the Ph.D. is measured in terms of teaching terms, with a typical term of service requiring 15–20 hours per week of teaching-related activity in one course during a ten-week academic term. In a First Year course, for example, this might involve two four-hour laboratories each week, plus grading laboratory notebooks, answering questions, and helping grade midterm and final exams. We try to make total career teaching assignments equitable, recognizing that no two courses are really alike.

Dartmouth recognizes the value of the teaching assistant experience in graduate education, and it provides the department with stipend funds, known as Dartmouth Fellowships, or DFs, to support its teaching mission. We expect each student to complete at least four units of TA duty (three, if the student is in the M.D./Ph.D. program). Normally, students are supported on DF funds during their first six terms (typically fall/winter/spring in year 1 plus summer/fall/winter in year 2), and four TA terms will be assigned during the first two years.

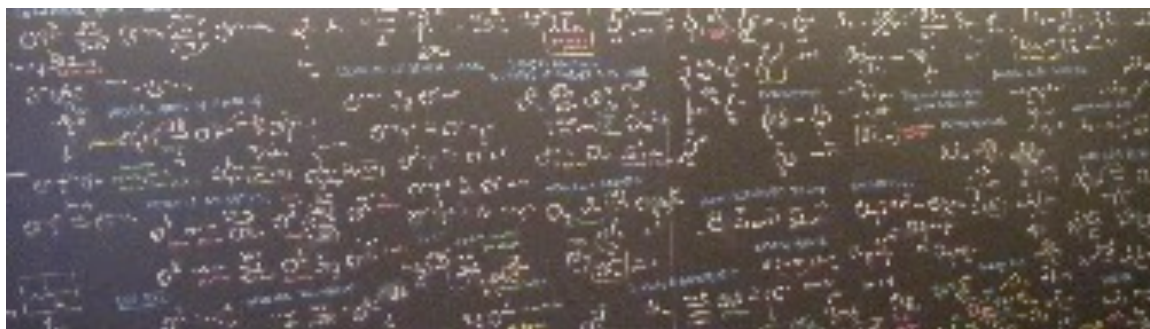
Students will be assigned to more TA terms in subsequent years if their research advisor lacks external research grant funds to provide a research assistantship (RA) stipend. Beyond the second year in the program, students supported on DF funds will be expected to serve as a TA during one of every two terms of DF support. Students will be informed as soon as possible of any TA terms they may be required to serve beyond the minimum of four. While students may serve as a TA for more than four terms, the stipend amount is the same for a DF term or an RA term. Students who have been awarded a special fellowship provided by an external agency, such as a National Science Foundation Graduate Fellowship, will be paid at that fellowship's rate for the duration of the fellowship and will generally serve their four TA terms during their first two years.

*Note: students entering in fall 2016 will complete at least three units of TA duty, instead of the normal four. This change will be assessed after three years, after which it will automatically expire unless the faculty decide to retain it. Update December 2018: students entering in fall 2019 will complete four TA terms. The wording above has been edited slightly to reflect current plans for stipend support (now 6 terms). Requirements for students entering in 2016-2018 remain the same.*

In the fall of the first year, graduate students enroll in Chemistry 256, Graduate Instruction in Teaching. This course covers fundamental issues you will encounter as a teacher. Students may be judged upon arrival to lack proficiency in English. In such cases, they will be obliged to take a course in English as a Second Language, beginning in the fall term of their first year. A final grade for Chemistry 256 will not be assigned until adequate proficiency in English has been demonstrated, and such students may not begin their teaching assignments. If English proficiency has been achieved by the end of the Fall term of the first year, a student will be placed on probation; if proficiency has not been demonstrated by the end of the Winter term of the first year, the student may be separated from the program. After the first year, students are asked to state their preferences regarding assignments, and such requests are taken into account, along with faculty requests, the requirements for continuity in some courses, and the goal of giving each student a variety of experiences. A student enrolls in Chemistry 257, Supervised Undergraduate Teaching in Chemistry, in each term she or he serves as a teaching assistant. This course is graded, and a formal evaluation of each student's performance will become part of the student's file.

Advanced students with a particular interest in developing teaching experience may make special arrangements with a faculty member. Students interested in such an arrangement should discuss it with their research supervisor and with the Chair of GSAC.

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**Research  
Supervisor  
and  
Research  
Committee  
Selection**

Students are urged to begin thinking about possible areas of research activity and an appropriate research supervisor as soon as possible. This is obviously an important decision which should be made very carefully and on the basis of all information available.

The selection of a research supervisor is one that requires a mutual agreement between the supervisor and the student as well as the approval of the department. Students may be admitted to our graduate program with a condition, stated in the department's letter offering admission, that the student will work in a specific research area or in one or more specific research groups. If the offer letter does not specify such a condition, we require students to talk to at least three members of the department during the first eight weeks of the Fall term regarding possible research activities. Each faculty member will generally have several possible areas of research with interesting problems available for graduate students. Occasionally, students may wish to carry out all or part of their thesis research in another department. Special arrangements for such research can be made, and general guidelines are given later in this Handbook. At the start of the fall term of the student's first year in the program, GSAC will provide each entering class with a list of research groups that are able to accept new students in that year. The type of stipend funds available through any one group can affect the total number of terms a student will serve as a teaching assistant, as described in the previous section on Teaching. Students should feel free to discuss stipend sources with any faculty member with whom the student contemplates working.

The faculty will meet as a group at the end of the fall term to review students' individual rankings of potential research supervisors, and final assignments to research groups will be made by the faculty taking into account those rankings along with other departmental concerns such as sources of financial support and any conditions made in the letter offering admission.

After a graduate student has been assigned a research supervisor, the supervisor in consultation with the student will nominate to GSAC at least three additional faculty members to serve on a Research Advisory Committee charged with the responsibility of observing progress and offering advice on the student's research work. One member of this committee, not the research supervisor, will act as chair of the committee. Since it is the duty of GSAC to ensure that these committee assignments are somewhat evenly distributed among the faculty, a student's first choices cannot be guaranteed.

**Policy on students switching research advisors**

On occasion, students may wish to explore the possibility of switching research advisors, if there are compelling reasons that the original choice is no longer a good fit. The process should start with informal discussions with GSAC and a potential new advisor. When possible, the original advisor and Research Advisory Committee should also participate in these conversations.

The formal advisor-switching procedure, which occurs rarely, begins with a petition from the student to GSAC. A possible change requires agreement between the student and the new supervisor, as well as the availability of funding in the new group to support the student (at least one year of funding in hand, beyond the department/TA support at the start of the program, is required). This financial constraint would not be required for students supported by external fellowships.

Student petitions will be reviewed by GSAC and by the Research Advisory Committee (where appropriate, for a more senior student). After this review, transfer requests must

be approved by the department faculty, guided by recommendations from GSAC and the Research Advisory Committee (where appropriate), and by the financial requirements above. If a petition is rejected, a student will need the approval of the original research advisor in order to remain in that group.

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### ***Progress Reports and Research Committee Meetings***

An important aspect of any research career is the periodic reporting needed to gauge progress, set new directions, and invite comment from other experts. In your graduate career here, you will learn how to do this through periodic progress reports directed to your Research Advisory Committee. Periodic meetings with this Committee will ensure the proper flow of information needed to keep them informed of your progress and to allow you full benefit of their advice and counsel.

### **The Research Progress Report**

By the end of the second week of each summer term, the student will submit to each member of her or his Research Advisory Committee a written summary of five or fewer pages covering the program requirements the student has satisfied to that date, the courses the student has completed, the requirement(s) due in the coming year, and the status of the student's research. In addition to the scientific content, the prose aspects of technical report writing will be considered by the Committee, since effective written communication of scientific results is an important professional skill to master. The details of auxiliary information, such as experimental procedures, analyses of compounds, design of apparatus, etc., should appear in Appendices to the report. Not all research groups will require such Appendices; your Research Advisor should be consulted as to the exact format.

Each report should include a statement of the direction planned for research in the next six months as well as a recapitulation of the previous period's accomplishments. It is to be remembered that failures often constitute progress in a research setting. For students who have made only very limited research progress in year 1, the first report should be simply a statement of the proposed research, placing it in scientific context.

### **Meetings with the Research Advisory Committee**

Each year, each student will meet with his or her Research Advisory Committee for the purpose of describing what has been achieved as well as future research

plans. The Research Progress Report described above will be the basis of discussion for much of this meeting.

In consultation with the student's Committee members, a meeting of the student and the full Committee shall be scheduled for a date no later than the end of September of the year in question. This meeting is intended to be brief; typically a half hour should suffice, and rarely should more than an hour be required. Following this meeting, the student will prepare a written summary for approval by the full Committee. This summary, once approved, will be filed in the student's permanent record.

In addition to these general topics for each meeting, each year's meeting has specific areas of concern as described below.

### **End of the First Year**

At this first meeting, the student should provide a description of his or her research project and an initial plan of attack as well as any research progress to date. Plans for scheduling the student's Qualifying Exam should also be discussed, and any questions the student might have about this Exam should be answered as well. The usual schedule for preparation for and holding the Qualifying Exam is discussed in detail on the section below on this Exam.

### **End of the Second Year**

The main purpose of this meeting is to provide a detailed description of research accomplished during the second year and a clear definition of research plans for the next several months. The timing and nature of the Third Year Research Proposal and Presentation requirements will be discussed, and a target date for this presentation should be agreed to.

### **End of the Third Year**

This meeting should focus entirely on the research progress to date and the research remaining to be done. Generally, all requirements for the Ph.D. degree will have been completed by this meeting except for the research seminar and the thesis itself.

### **End of the Fourth Year (and annually thereafter)**

If required, the student will provide a detailed description of the additional research that must be completed to bring the research project to a point at which a thesis can be written. If, on the basis of this review, the student's Research Advisory Committee is convinced that the student's progress is such that they can complete the thesis within a reasonable period of time, they will recommend continued stipend support in the following year.

### **General Requirement for Meeting Documentation**

It is to the advantage of all involved that the various issues and milestones discussed in each Research Advisory Committee meeting be documented to the satisfaction of everyone at the meeting. To this end, the student will provide a written brief summary of each meeting (whether a regular annual meeting or one called at another time as described below) to all members of the Research Advisory Commit-

tee. These members, in turn, will review this summary and approve or edit it as necessary. The final summary, as approved by the student and Committee, will become part of the student's permanent file in the department. Normally, this summary should be completed within two weeks following the meeting in question. Should the student fail to complete this summary, he or she will be subject to receiving a grade of NC (No Credit) for the research course elected during the term of the meeting.

### **Provision for Additional Meetings**

Additional meetings of a Research Advisory Committee may be called by any member or by the graduate student. A Research Advisory Committee may make oral or written reports to GSAC or the department on the student's progress as it sees fit or at the request of the department. The Research Advisory Committee may also set other requirements for a student when it believes that meeting these requirements is important for the student's professional development.

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**Grievance  
Process**

It is the aim of GSAC and the Research Advisory Committee structure to provide each student with a supervised, fair, and consistent graduate experience. The Research Advisory Committee exists to provide each student with a variety of expert research consultants and points of view, as described in the previous section. In addition, the Committee can act as a sounding board for any conflicts, misunderstandings, or concerns that might arise in the mind of the student or the student's research director. Discussion within the Research Advisory Committee is the first step in resolving any grievance or program-related concern that might arise, but should questions or concerns remain, the formal grievance process outlined here is available to ensure that equitable and unbiased consideration is given to any concern.

Should the Research Advisory Committee be unable, for whatever reason, to provide a resolution that is satisfactory to all concerned, the grievance will be brought to the attention of GSAC and the Chair of the Department. (Should the Chair be directly involved in the grievance in question, GSAC alone will meet.) The majority of concerns have been historically resolved through the Research Advisory Committee or through GSAC.

If a satisfactory resolution cannot be reached within the department, the Dean of Graduate Studies (perhaps joined by the Associate Dean of the Sciences if appropriate) will meet with all directly involved in the grievance in an attempt to reach a mediated resolution.

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**Special  
Arrangements  
to Carry Out  
Research in  
Other  
Departments**

A student enrolled in the Graduate Program of the Department of Chemistry may decide during the first term to carry out research in another department, and he or she is welcome to do so. Such a decision should be communicated in writing to the Chair of GSAC by the end of the Fall Term. Two situations can be distinguished:

In the first, the student may simply elect to transfer to the other department. If he or she is accepted by the new department, he or she may transfer after the Spring term of that first year, and the mutual obligations between him or her and the Chemistry Department cease as of that date.

Alternatively, he or she may choose to continue toward an advanced degree in the Chemistry Graduate Program but to conduct his or her dissertation under the supervision of a member of another department. If accepted by that professor, the student must submit to the Department of Chemistry the title and a brief description of his or her dissertation topic, together with a program of course work. Provided that the dissertation is substantially chemical in nature, approval by the Chemistry Department may be expected. One member of the Chemistry Department will be designated as the associate research supervisor, and it would be well for the student to work out such an arrangement before submitting the request to the department.

The student is obliged to fulfill within the Chemistry Department all of the other requirements for the Chemistry degree program including the teaching experience. Generally, a chemistry graduate student who is assigned to a research group in another department will serve as a TA during two terms of the student's first year in the program, and he or she will be supported on a Dartmouth Fellowship during all of that year. The additional two terms of TA service will occur after the first year at times determined by the department's teaching needs and the student's research progress. The student will be supported on a Dartmouth Fellowship during those two terms, but except for these two teaching terms, the financial obligation of the Chemistry Department to the student will typically terminate on June 30 of his or her first year. *Note: students entering in fall 2016 will complete at least three units of TA duty, instead of the normal four. This change will be assessed after three years, after which it will automatically expire unless the faculty decide to retain it. For these students, the "additional two terms" above will be instead an additional one term.*

The host department will support -- from departmental or other funds -- any Chemistry graduate students under supervision by one of its faculty members should s/he cease to be able to provide stipend support, health insurance and research support from his/her research grant(s). The chair of the host department must acknowledge this financial responsibility in writing before a Chemistry graduate student can be assigned to a research group in another department. This acknowledgment is required **before** a Chemistry graduate student begins doing research, even in a rotation, in a different department. If the host department cannot guarantee this support, then placement of a chemistry student there will not be possible.

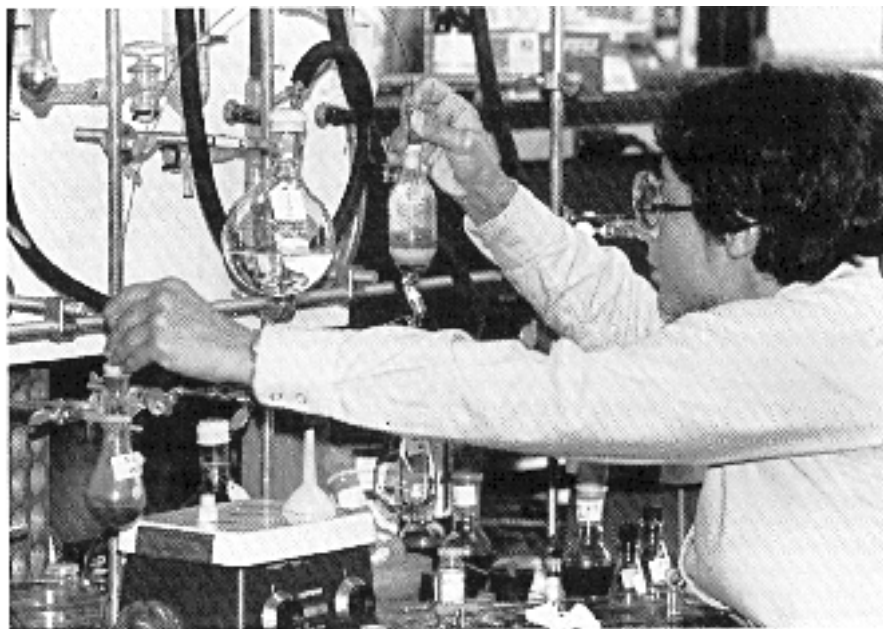
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***Special  
Arrangements  
for Students in  
Other  
Departments  
to Carry Out  
Research in  
Chemistry***

A student enrolled in the Graduate Program of another department may decide in his or her first year to apply to carry out thesis research in the Chemistry Department. Such an application should be made to the Chair of the Chemistry Department by the end of the Winter Term for approval by the department.

The student is obliged to fulfill, in addition to the requirements of his or her own program, an appropriate teaching requirement within the Chemistry Department. This requirement will be chosen with the individual's circumstances in mind.

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## Safety

There are numerous Federal and State laws and regulations that govern laboratory activities ranging from hazardous waste disposal to personal safety. The department, in conjunction with campus-wide safety efforts, has devised the following guidelines for safe operation of our facilities. In addition to these general statements, you must read and follow the Chemical Hygiene Plan, a copy of which will be issued to you shortly after your arrival.

- *Adherence to the safety rules is **not** optional, and it is important that a clear and consistent policy is followed by all members of the Department. The Chemistry Department Safety Policy is contained in the Chemical Hygiene Plan, which has been approved by vote of the faculty. That we have such a plan is not optional; it is required by law of all Chemistry Departments. All principal investigators, research workers, stockroom personnel, and teaching assistants must have access to a copy of this plan and are expected to read it and comply with it. Changes to this plan within the constraints of prevailing federal and state safety laws cannot be made without Departmental approval in the form of a faculty vote.*
- *The safety policy requires appropriate eye protection, footwear, and skin protection. The appropriate level of protection may vary according to the nature of the research conducted in any particular lab, but general protective measures must be followed as detailed in the Chemical Hygiene Plan itself.*
- *Responsibility for enforcing safety rules in undergraduate teaching labs rests with the lab instructor and the teaching assistants.*
- *Responsibility for enforcing safety rules in research labs rests with the faculty member in charge of that laboratory.*
- *Experienced workers in any teaching or research lab should also take leadership roles and help to educate other workers by example.*

Your research advisor can assist you in the selection and purchase of appropriate safety equipment for specialized needs, and she or he should also be consulted for any unusual hazardous waste disposal requirements or other hazards your research lab may have. In general, all chemical waste should be considered hazardous in that specific disposal protocols must be followed. Specific disposal and collection protocols for non-aqueous solvents vary according to the nature of the solvent.

The chemistry department works closely with Dartmouth's Environmental Health & Safety department. This department makes periodic inspections of research and teaching laboratories and issues reports of its findings to those responsible for each lab. All deficiencies found by these inspections must be corrected immediately.

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## **Qualifying Examinations**

Students in the Ph.D. program in the Department of Chemistry must fulfill several requirements. One is a Qualifying Examination, which has two components: 1) a written thesis proposal, and 2) an oral defense. The purpose of this requirement is to evaluate the preparation of the student to perform independent, high quality research. The exam will focus on the preliminary results that the student has obtained towards their Ph.D. and probe the student's understanding of the background and principles of that research, as well as fundamental understanding of chemistry. The Qualifying Exam will be administered by a group of at least three faculty: the student's Research Advisory Committee (excluding the student's research advisor) plus one member of the department's Graduate Student Advisory Committee (GSAC). GSAC will request assessment of the student's progress toward the degree from the research advisor before the exam. In the oral exam, students will answer the committee's questions at the chalkboard and can use no more than three slides to show details from the written document (charts, figures, schemes, tables, etc.).

**Instructions for the Written Thesis Proposal.** The written thesis proposal is limited to seven pages (including figures and references). The proposal should be formatted with 1-inch margins, single-spaced, with 12-point Times New Roman or 11-point Arial font. This document should be prepared independently, without assistance from the research advisor or other faculty. This document should clearly state the overarching goal(s) of the research and hypothesis being tested, and should be organized into clearly labeled section headings:

1. Background and Significance
2. Specific Aims
3. Research Design and Methods
4. Results and Discussion
5. Concluding Remarks
6. References

The deadline for turning in the written document is the first day of the winter term in the student's 2<sup>nd</sup> year. GSAC will then assign a committee member to serve on the student's qualifying exam committee and will schedule a date for the oral exam, normally in the winter term.

### **Instructions for the Oral Exam.**

#### **Criteria for the Assessment of the Second-Year Qualifying Exam**

The purpose of this exam is to establish if the student has sufficient knowledge and ability to independently execute Ph.D.-level research in a timely manner. The examining committee will assess the student on the basis of the following criteria.

#### **Understanding of the Research Problem**

- Can formulate research goals in terms of hypotheses
- Knows what to do, how, and why
- Knows the background literature and recent progress in the field: what approaches have others taken (techniques, results, synthetic strategies) to address similar problems?

#### **General Knowledge of Chemistry**

Essential concepts related to the project and the underlying chemical principles will be tested. This may include topics from undergraduate and graduate courses, including things like experimental quantities measured, how the technique works, reaction mechanisms, bonding etc. Some fundamental (every chemist should know) questions will also be asked.

### **Potential To Be Productive in Research**

Are the skills to obtain and *independently* analyze research results in place?

- Is it likely that this student will make sufficient progress in research in the next three years to produce a Ph.D. thesis and publications?

### **Scientific Writing.**

- **Logic and Organization.** Is the written document logically organized, such that the overarching hypothesis is clearly connected to measurable scientific outcomes?
- **Quality of Writing.** Is the writing clear, grammatically correct, and free of spelling errors?
- **Quality of Figures.** Are the figures and images scientifically correct and good quality?
- **Integration of References.** Is the proposal appropriately referenced?

After the oral exam, the committee will provide a pass/fail grade for the oral defense. As in other research advisory committee meetings, the student will prepare a summary of the meeting for approval by the committee. Should the written component be deemed lacking, the committee will also give the student detailed guidance for its revision, including a point-by-point critique of it. Revision of this document, along with a “response to reviewers’ comments” describing the changes made should be returned to the committee within two weeks. Both a passing grade on the oral exam and approval of this revised document are required to pass the qualifying exam. When necessary, a 2<sup>nd</sup> oral exam will be scheduled, and further revisions may be required. *Students who fail a 2nd oral exam will not advance to Ph.D. candidacy, but may be able to earn a master's degree (see below).*

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### **Timeline for Completion of the Qualifying Exam**

The Qualifying Exam must be completed by June 15 of the student’s second year in the program. Failure to complete each step within the timeline documented below may result in a student being placed in unsatisfactory academic standing.

#### **In the student’s second year:**

##### **1<sup>st</sup> day of the winter term**

Deadline for the student to submit the full written research background, progress and plans document to GSAC.

##### **End of the winter term**

Deadline for completion of the oral exam.

##### **End of the spring term**

Deadline for completion of a 2<sup>nd</sup> oral exam (if needed).

##### **June 15**

Deadline for all students to successfully pass the entire Qualifying Exam. Failure to do so will result in dismissal from the Ph.D. program. However, the Qualifying Exam committee may determine that the student has likely made sufficient progress to write and successfully defend a Master’s thesis (assuming the course requirement for a Master’s degree has already been satisfied), in which case financial support will end on August 31.

**Other  
Requirements:  
Ph.D. in  
Chemistry**

While there is no formal requirement of demonstrated skill in reading technical literature in a foreign language, acquisition of such a skill or a skill in another area may be expected of certain students in the Ph.D. in Chemistry program, as explained below.

When it is the judgment of a graduate student's Research Advisory Committee that demonstration of competence in a particular discipline is important for that student's professional development, the Committee may require demonstration of such proficiency as part of satisfactory progress toward the Ph.D. degree. For example, a student of synthetic organic chemistry might reasonably be expected to develop a reading knowledge of chemical German, whereas a student of physical chemistry or chemical theory might reasonably be expected to demonstrate competence in some aspects of computer programming. In such cases, the research committee will notify the student no later than the end of the Spring Term of the student's second year as to the nature of the requirements, the methods by which they can be satisfied, and the time by which they should be completed.

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**Other  
Requirements:  
Ph.D. in  
Chemistry-  
Materials**

The Chemistry-Materials program has several additional requirements that must be completed before a degree will be awarded. At least once per year, a research-in-progress talk must be presented during these discussions by every enrolled graduate student. Prior to receiving the Ph.D. degree, students must present their research at a national professional society meeting (poster or talk) and have at least one research manuscript accepted for publication in a professional, refereed journal.

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## **Research Proposal**

The doctorate degree should testify to a demonstrated ability to carry on independent research. An important component of that ability is the development of the chemical insight and originality required to identify and isolate a valid research project. To help develop this skill and to encourage this habit of thought, each student is required to submit an original research proposal in an area not closely related to his or her thesis research. The topic chosen should be approved in advance by the student's research advisor. The research advisor may give occasional advice, but beyond this the work should represent an independent effort by the student.

The proposal involves a short written description (3-5 pages) of a substantive unsolved problem, including a proposed method of attack on the problem. The proposal must be presented and defended before the Research Advisory Committee, which will evaluate its merits and deficiencies. (Note, however, that sometimes the page limit is waived for revised and final versions that may thus be longer than the initial 3-5 pages.) The Department office keeps a collection of recent research proposals, and once yours has been accepted, you should file a copy in the collection. This collection can be perused in advance to give you a feeling for the scope and range of these proposals.

**The written proposal must be turned in by the 1<sup>st</sup> day of the winter term in the student's 3<sup>rd</sup> year.** GSAC will then schedule the oral defense, normally in the winter term. After the oral exam, the committee will provide a pass/fail grade for the oral defense. Should the written proposal be deemed lacking, the committee will also give the student detailed guidance for its revision, including a point-by-point critique of it. Revision of this document, along with a "response to reviewers' comments" describing the changes made should be returned to the committee within two weeks. Both a passing grade on the oral exam and approval of this revised document are required. When necessary, a 2<sup>nd</sup> oral exam will be scheduled, and further revisions may be required. If a second presentation shows no significant improvement, the requirement will have been failed.

Failure to complete the research proposal requirement by June 15 of the third year will normally result in cessation of the stipend as of that date. Upon satisfactory completion of the requirement, the stipend will resume.

Failure of the proposal requirement will result in dismissal from the Ph.D. program. However, the committee may determine that the student has likely made sufficient progress to write and successfully defend a Master's thesis (assuming the course requirement for a Master's degree has already been satisfied), in which case financial support will end on August 31.

## **Research Seminar**

The doctorate degree should testify to a demonstrated ability to carry out independent research. An important component of that ability is the development of the chemical insight and originality required to identify and describe a valid research project. To help develop this skill and to encourage this habit of thought, each student is required to present a Research Seminar on his or her thesis research. This Research Seminar will be presented to the entire department, typically on either a Tuesday morning or a Wednesday afternoon, selected by GSAC. Your seminar should be 25 minutes, with 5 minutes for questions, so that 2 students can present in a 1-hour period.

This seminar should be prepared with care; the communication of scientific research to peer scientists is an important skill to develop and master. The presentation should put the research in its appropriate scientific and historical context. Research generally flows from one researcher or group of researchers to another, and your research will almost certainly fit in the context of other studies done either in your research group here at Dartmouth or elsewhere.

The seminar should then describe the approach you are taking and any results, positive or negative, that you have attained. Any plans for your future research direction should be covered as well, keeping in mind that you will be addressing an audience of your peers as well as faculty experts. It is not necessary or desirable that you aim your talk at a level that only the experts will understand. Make it largely understandable to all.

A target date for the seminar will generally be agreed upon at the meeting with the Research Advisory Committee at the end of the second year. This target date must be *no later than November 1 of the fourth year. Failure to complete the research seminar requirement by the end of the fall term of the fourth year will normally result in cessation of the stipend as of that date.* Upon satisfactory completion of the requirement, the stipend will resume.

The seminar will be evaluated by the Committee which will consider the depth of the student's understanding of his or her original research. Should the Committee find the initial presentation to be lacking, written comments as to the deficient areas will be given to the student with the understanding that a second presentation should address those areas in depth. If a second presentation shows no significant improvement, the requirement will have been failed, but if there is improvement, the requirement will have been passed, or a third presentation can be called for, as the Committee sees fit.

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## **Other Seminars**

A continuing exposure to a wide range of materials presented in the departmental seminar programs, as well as the opportunity of developing and presenting several seminars, is an important part of graduate education.

The weekly Departmental Chemistry Colloquium is normally held every Thursday morning at 10:30 during the Fall, Winter, and Spring terms. It brings visiting scientists to the department on a regular basis, with topics ranging over the whole field of Chemistry. **Attendance at the Colloquium (at least 2/3 of the meetings) is required of all students in the Ph.D. in Chemistry program.** It is designated as a formal course, Chemistry 140, which should appear on every course registration card except in the Summer term.

Adjunct meetings of Chemistry 140 are reserved for Tuesday mornings at 10:30 and for Wednesday afternoons at 4:00 PM. These time periods are used primarily for student presentations, such as the Research Seminar, but outside or local faculty speakers may use them as the need arises. **Attendance is required of all Ph.D. in Chemistry students for all student presentations such as the Research Seminar described above, Ph.D. thesis defense presentations, etc.**

Each student will present a full length seminar as part of the Ph.D. thesis presentation and defense. This will be an open seminar, and it will normally be followed by the closed oral defense of the thesis before the Committee.

In addition to Chemistry 140, one or more of the courses numbered in the 260 series, Graduate Research Colloquium in Chemistry, should be elected by students in those research areas covered by these courses that are appropriate and approved by the research director. (Some of these courses may not be offered each term; consult your research director.) These courses provide a valuable setting in which students gain practice in seminar presentation techniques, meet to discuss common contemporary research topics, and share their research progress with their research area peers.

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## **Seminar Presentation Hints**

The Research Seminar is an important aspect of our Ph.D. program. The seminar is an opportunity for you to convey your impressions of your research to an audience; this is something you will do again and again throughout your professional career, whether in industry or academe. Possession of new knowledge has little utility unless you are able to communicate it effectively to your peers. Dissemination goes side-by-side with discovery in all of research.

It is easy to stand in front of a group of people and talk for 50 minutes; the hard part is to tell them something clearly and coherently during that time. This section gives you some guidance as to ways to improve the flow of new information. The bottom line is careful preparation and practice. All of the tricks of the trade and even years of experience cannot substitute for the improvement a talk always gains by at least one dry run.

Opinions differ, of course, as to what makes one speaker better and more informative than others, but the following are some general suggestions that may improve presentations:

- Expect to be nervous. And take comfort that a case of “butterflies” is a normal part of giving seminars, speeches, and lectures, even for the faculty! The nervousness will go away once you are into your talk, especially if you have the confidence that good preparation and practice will ensure.

- Assume your audience knows nothing about your topic unless you have good reason to know otherwise. A succinct introduction and an outline of your talk lets the listener know where you are and what to expect.

- Take your time in speaking. Look at the audience and gauge their level of puzzlement. Stand still as you talk, as if you were talking to one person and not to a room-full.

- Use visual aids with care and planning. The blackboard is a tempting open space when erased. Plan its use in advance—and do plan to use it (most valuably in answering questions). The blackboard forces you into a slower pace and allows you to show a step by step relationship in a way computer presentations can't. If you're going to put an outline on the blackboard, do so to one side, saving the middle for later use. WRITE BIG. Don't erase what you've just written. Anticipate that you may well need blackboard space to respond to questions at the end of your talk. Computer presentations can be magic or disaster. It is so easy to scan figures or tables from a text into a computer that one forgets that the Journal size was meant for one person to look at from a distance of 12", not for a roomful to look at from 12'. Fill the screen with a single figure or at most two figures. A computer is a great help if you use large type fonts and always remember to keep the text per screen to an absolute minimum. More than about 50 words per screen is usually too many. (There are about 290 words in this paragraph!) Color, if used carefully, can be a great visual aid. But don't use the whole spectrum of colors just because they are only a mouse-click away. Graphs of data, even qualitative trends shown graphically, are always better for a talk than tables of numbers. If an article has a table of lots of numbers and you care about only a very few of them, make your own table instead of copying from the article.

- Show interest in your talk. If you go to the trouble of making a slide, display it and linger over it for a while. Resist the “flash-card” syndrome of rapid-fire display. When pointing to some feature on the screen, use a pointer, point to the thing of interest, and keep the pointer *dead steady* on that item as you talk about it. You may be looking at the item of interest, but the audience needs that pointer for its visual cue. Laser pointers

aren't light sabers, and wooden pointers aren't marching band batons, post-hole diggers, or javelins. Use them to point, then **hold them steady** or put them down. Make use of everything you put on a slide. Don't assume the audience will read and absorb what you wrote without your help.

- Don't make up something just to "look good." If you don't know an answer to a question, or you don't fully understand some aspect of your talk, admit it freely! After all, the speaker can learn from the audience just as the audience learns from the speaker.

- In planning what to say about your topic, try to keep the Big Picture in mind. Especially for your Research Seminar, you will be presenting a topic of narrow scope. How does it fit in with other techniques/theories/methods? What led someone to consider your topic in the first place? What is its future? Why were you attracted to it? These are questions your audience will ask itself, and the answers are worth discussion.

- On the other hand, don't be so general as to be vague. Often, if discussing a new technique, it is invaluable to guide your audience through one or two examples from the literature in some detail and depth. A theoretical basis, if applicable and to the depth you understand it, should be given, but intuitive physical pictures often last far longer in a general audience's memory than do numerous equations. Similarly, synthetic schemes or mechanisms, biochemical cycles and processes, and the like should be discussed in generic form before applied to specific examples.

- Finally, remember that none of these rules are rigid. Seminar presentation can't be condensed to a flowchart of actions. How you choose to follow these general guidelines gives a certain personality to your talk. This choice is honed with experience and practice.

In preparing for your Research Seminar, you will naturally seek advice and guidance from your research advisor, fellow students, and so on. Get all the help you can in assembling the relevant literature, culling from this the major references, and selecting your own results for discussion. Avoid last-minute panic by getting a good head start, but don't let your life be consumed by preparation for the Seminar. You have other equally important things to do!

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## Thesis

The thesis represents the final documentation of your achievement as a graduate student. Certain mechanical requirements of format and style are set by the Graduate Studies Office, and a copy of these may be obtained from that office located in Wentworth Hall or at <http://graduate.dartmouth.edu/studentlife/thesis/gradthesis.pdf>. You can also see what a thesis is all about by looking at typical examples in the library or in the collection of theses directed by your research supervisor.

If there is any single injunction that might be appropriate, it is the recommendation that you keep in mind the eventual *need* for a thesis. Take appropriate steps along the way to prepare yourself for the grand moment when thesis writing time comes. Some students can write easily and well; some design their experiments so that all relevant contingencies have been explored and documented; some carry through and record literature searches which leave no questions unanswered. If you do all of these, you can safely forget about thesis writing until that time when your laboratory work is finished. If you suspect weaknesses in one or more of these areas, then you should give serious thought to the matter well ahead of time. **The best preparation is to write up units of your research as sort of mini-theses as you go along. You will be well advised to design your research reports to serve this function, and you may also wish to supplement these reports with additional summaries, reviews, etc.** Even though many of these will never be used in the thesis because of changes in research goals, some of them will turn out to be the basis for whole chapters in the thesis. And *all* of them will have provided the practice which will greatly help production of the real thing.

It is your responsibility to ensure that the thesis is written in acceptable scientific format using grammatically correct English. While your research advisor and committee members may be willing to give advice on the overall organization of the thesis, they should not be considered as the principal proofreaders, and the thesis should not be submitted to them until you think that it is in satisfactory format. Each member of the Research Advisory Committee must certify in writing that the format and overall quality of presentation of the thesis are satisfactory before dates for the seminar presentation and the final scientific defense of the thesis results can be set. A form is available in the departmental office or on the department's web site (<http://chemistry.dartmouth.edu/resources>) on which you can collect the appropriate signatures and acknowledge that you believe your thesis is in the correct format and understand that acceptance of your thesis in this form by your Ph.D. examining committee does not, at this stage, constitute or imply your Ph.D. examining committee's final approval of it. The date for the defense may not be sooner than two weeks after approval by the Research Advisory Committee. Theses which are not of acceptable format or which contain an unacceptable level of spelling or grammatical errors may be returned to you for further correction.

Final defense of the Ph.D. thesis will have two parts. The first will be an open departmental seminar followed by an oral defense before your Ph.D. Examination Committee (which must include three full-time Dartmouth faculty members of which a minimum of two must be from chemistry as well as an external member with a faculty-equivalent research appointment outside of Dartmouth College). The main office has a form to list proposed committee members that must be approved by the Dean of Graduate Studies. The second part is satisfactory completion, and approval by the Ph.D. Examination Committee, of the thesis embodying the research. These two parts of the final examination will normally occur on the same day, but the seminar may be scheduled some days earlier if such an arrangement is mutually convenient. Acceptance of the Ph.D. thesis requires unanimous approval by the Ph.D. Examination Committee of both the oral defense and written thesis.

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**Important  
Deadlines and  
Dates**

The chart below lists several important deadlines and dates for the various requirements of the program. This chart is intended to be a quick reference point. For details and specifics, refer to the appropriate section in this Handbook. Almost every box below should have *Make progress on research* added to it as well!

	<b>Summer Term</b>	<b>Fall Term</b>	<b>Winter Term</b>	<b>Spring Term</b>
<b>First Year</b>	<i>Study for Diagnostic Exams</i>	<i>Diagnostic Exams before start of term</i>  <i>Rank research group choices by 8th week, or earlier</i>	<i>Generally, take courses, serve as a TA, begin research</i>	<i>Diagnostic Exams offered (if needed) following end of term</i>
<b>Second Year</b>	<i>Progress Report due by end of 2nd week</i>  <i>Research Advisory Committee meeting</i>	<i>Diagnostic Exams offered (if needed) to complete Basic Knowledge requirement</i>	<i>1<sup>st</sup> day: Written research background/progress/plans document submitted to GSAC</i>  <i>Complete Qualifying Exam</i>	<i>Complete Qualifying Exam (if needed)</i>
<b>Third Year</b>	<i>Progress Report due by end of 2nd week</i>  <i>Research Advisory Committee meeting</i>	<i>Complete Graduate Level Course Requirement by end of this term</i>	<i>1<sup>st</sup> day: Written research proposal submitted to GSAC</i>  <i>Complete proposal defense</i>	<i>Complete proposal defense (if needed)</i>
<b>Fourth Year</b>	<i>Progress Report due by end of 2nd week</i>  <i>Research Advisory Committee meeting</i>	<i>Research Seminar target date by Nov 1, completed by end of the fall term</i>		
<b>Fifth Year</b>	<i>Progress Report due by end of 2nd week</i>  <i>Research Advisory Committee meeting</i>			<i>Stipend after twentieth term in residence contingent on external research funds of the student's research director.</i>