Graduate Student Handbook
2024-2025

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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Welcome!

Welcome to the Dartmouth Chemistry Graduate Program. The faculty look forward to working with you as you continue your education as chemists. You will find your graduate education to be an interesting and exciting transition from student to independent scientist. You will begin by enrolling in courses and taking exams, much like you did as an undergraduate. At the end, you will present a thesis describing your own research that contributes to the body of new chemistry knowledge.

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

The faculty have devoted their professional careers to the education of students and look forward to working with you to make your graduate education as successful as possible. The goals of a chemistry graduate education are to become a professional chemist and to demonstrate your ability to conduct independent research, as certified by a thesis on your own original research. However, the effort and methods of realizing these goals may not be clear and should be examined and, if need be, adjusted during the years of graduate study. This Handbook introduces you to those requirements and aspects of your graduate education that can be described. There is another important dimension of your graduate education, however, and that is your own personal growth, for which a path cannot be written down.

This Handbook has been prepared by the *Graduate Student Advisory Committee* (**GSAC**) which is a committee of the Chemistry faculty with responsibility for ensuring that the graduate program operates smoothly and effectively. The faculty members of GSAC make sure that degree requirements are met and provide you with advice and counsel about your education. All members of GSAC are available for your questions and they welcome your suggestions on any matter, whatsoever. One member of GSAC will serve as your initial advisor until you have been matched with a research advisor. Advice and assistance, of course, are not limited to this formal route through GSAC. You will find that every member of the faculty, your fellow graduate students and the departmental staff are available to answer your questions.

Diversity and Inclusion

The Dartmouth Chemistry Department welcomes students, faculty and staff of all backgrounds. In our community, every individual, regardless of gender, gender identity, sexual orientation, race, ethnicity, socio-economic status, disability, nationality, political or religious views, or position within the institution, is respected and valued. To increase diversity in our faculty and staff, we recruit, retain and support people from underrepresented groups, and we encourage an environment of collaboration, open communication and trust, which welcomes diversity and respects differences of opinions.

Logistics

The Chemistry Department Office is 102 Burke Laboratory, located up one flight of stairs at the 41 North College Street entrance.

The Department Administrator and the Administrative Assistant, who supports graduate affairs, can answer most questions about the Department, the College and Hanover. The Department Administrator will set up your electronic access to Burke Laboratory and manage your stipend. The Administrate Assistant 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.

At the north end of the ground floor of Burke is the loading dock and the Procurement office, where supplies are received and obtained. Your research advisor will explain how to place orders through Procurement or over the web.The Procurement staff is available to answer your questions and help you place orders. A stockroom with many common scientific research items is located in the Remsen building of the Geisel School of Medicine, north of Burke and across College Street.

At the south end of the ground floor of Burke is the Ross Magnetic Resonance facility (004) and the Instrument Core Laboratory (010A). These laboratories house the department's shared NMR spectrometers and ESR spectrometer and many of the other instruments that you may use in your research.

The Department uses two large, ground-floor classrooms, 006 and 007 Steele Hall, for many of its classes and research lectures. Chemistry also has a medium-sized classroom on the top floor, 315 Steele. This floor also has 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 seminar rooms and 315 Steele are made by the Administrative Assistant.

Dartmouth has a distinguished history in computing and has a network that links personal computers to the Internet, either via Ethernet or the campus Wi-Fi networks. You will have free access to the Dartmouth electronic mail system and to other features, such as library resources over the Dartmouth Network. Likewise, smartphones and tablets can connect securely to the wireless network.

The offices of the Guarini School of Graduate and Advanced Studies are located on the first floor of Anonymous Hall, just north of Burke across College Street. The Dean of the Guarini School and the Dean's assistants can help you with many issues outside of the Chemistry Department. For example, financial assistance may be available, should the need arise. You should read the Graduate Handbook provided by Guarini (available at: http://graduate.dartmouth.edu/academics/graduate-registrar). That resource and this Handbook are important references that are updated annually.

Stipend, Vacations, Outside Employment, Fellowships, Internships

The monthly stipend for Chemistry graduate students begins on September 1 of the first year in the program and the first check will be sent to the Chemistry 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.

The Department provides each student with a stipend for twenty terms of graduate education, normally five consecutive years, as they make progress toward their Ph.D. degree. Support beyond sixteen terms will be provided 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 that will allow completion of the thesis within approximately one additional year. Support is provided beyond twenty terms only if the student's research advisor has funds available for this purpose. Students may arrive early and begin research during the summer if a faculty member is willing to guide their efforts and provide financial support, although this does not obligate either to the matching of research advisor. Due to visa issues, international students who arrive early must enroll for the Summer term, which will count as the first of their twenty terms of support.

The stipend for each term is the same for all graduate students and includes funds to cover living expenses, as well as a full tuition scholarship, health access fees and health insurance, if the student is covered by the Dartmouth Student Group Health Plan. The source of these funds varies from student to student and from year to year. Dartmouth graduate stipends are subject to federal and state income taxes, to the extent required by law. Anyone with significant non-Dartmouth income should consult the Guarini School 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 applications for fellowships.

Detailed information about health and wellness support can be found here: https://graduate.dartmouth.edu/student-support/health-and-wellness-support and information about health insurance policies for Dartmouth students can be found here: https://students.dartmouth.edu/health-service/fees-insurance/insurance/dsghp-information

Graduate study is not a clock-punching activity for students engaged in chemistry research. You may find evenings and weekends in the laboratory to be some of your most productive periods and many find that weeks between the academic terms provide the best research time of the entire year. The Department and Guarini policy guarantees graduate students a total of **two weeks of vacation per year**, in addition to time off for regular College holidays, such as Thanksgiving, Christmas and New Year. (Note that the period between the last day of one academic term and the first day of the following academic term is not a holiday period, except for any official College holidays.) Implementation of this policy is left to each student and their research advisor. Note, however, that teaching duties frequently begin before the start and extend beyond the end of an academic term. So, be sure to check with your teaching supervisor before planning a vacation. Finally, keep your research advisor informed of any vacation plans.

Graduate study is a full-time occupation and outside employment reduces the time and attention that a student can devote to their graduate study, prolonging the time to complete the Ph.D. requirements. Therefore, the Guarini School prohibits outside employment for enrolled students (https://graduate.dartmouth.edu/employment-policy). 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 the Guarini School.

Students may request a temporary leave of absence from the Guarini School for reasons such as illness or family issues and these are normally granted. Students who are interested in a leave of absence should discuss the request with their research advisor, Committee and GSAC, who will make an official request to the Guarini School. (Note, there is a requirement to maintain health insurance during a leave.) International students should contact OVIS for advice on how a leave may affect their visa status.

The department encourages students meeting specific eligibility criteria to apply for a variety of graduate fellowships that can help defray the cost of the student's graduate stipend. Applications for fellowships must be discussed with the research advisor in advance of the application. If the fellowship has implications on the student's time away from campus or involves teaching release, such fellowships applications must be approved in advance by the student's research advisory committee and GSAC.

A student wishing to apply for or explore the possibility of an internship during the PhD studies should first initiate discussion and seek approval for this plan from the research advisory committee. Advance notice and open communication is emphasized to make appropriate arrangements for accepting and pursuing an internship during PhD studies, through an appropriate advance request of a leave of absence.

Graduate Student Organization: Internal

The Chemistry Council is an organization within the Department that was established to work with the faculty on behalf of graduate students and postdocs. This organization has at least two co-chairs and works directly with the Chair of the Department to ensure the needs of the graduate students are met. All incoming and current graduate students are automatically members of the Council, which is part of on-going efforts by faculty, staff, postdocs and graduate students to build and sustain a Chemistry community. The mission statement of the Chemistry Council is as follows:

"The Dartmouth Chemistry Council is open to all graduate students and postdoctoral fellows in the Chemistry Department. The Chemistry Council is governed by two co-chairs and an executive board consisting of the following positions: president, vice president, treasurer, secretary, and communications coordinator. These positions give the graduate student body representation in our department and bridge the gap between students and faculty. The purpose of our group is to foster a sense of community through hosting department wide social events. The Chemistry Council is dedicated to creating a supportive environment for members of our community, that allows for students and postdoctoral fellows to have a safe space to voice their concerns and ideas. Our main objective is to support students and postdoctoral fellows by establishing a friendly and encouraging environment and to enrich their experiences beyond the laboratory."

The Bylaws of the Council can be found on the Chemistry Council page of the Chemistry Department website. Current co-chairs and executive board members are listed and available to advise, should questions or concerns arise.

Graduate Student Organization: External

The Dartmouth Graduate Student Council (GSC) is organized by the Guarini School with faculty and student representation from each graduate program, as well as representatives from the Thayer School of Engineering and The Dartmouth Institute.
The GSC has a website with many additional resources that you might find useful. (http://sites.dartmouth.edu/gsc/; select options under the RESOURCES menu)
There are a variety of graduate student organizations that can be found with links at the GSC website (https://www.gsc.dartmouth.edu/active-organizations).

International Student Resources

The Office of Visa and Immigration Resources (OVIS) is a key resource with advisors for international students. https://ovis-intl.dartmouth.edu/about/schedule-appointment.
International students should contact OVIS for details about work restrictions and other employment-related matters.

Academic Matters

Your academic progress will be monitored by GSAC and your Research Advisory Committee. Continued enrollment in the program is contingent on satisfactory progress and performance in research, teaching, course work and degree requirements.

If a Research Advisory Committee decides that a student is not making satisfactory progress in the program and recommends probation or separation from the program, the recommendation will be shared with the student and GSAC. While the Committee or the Dean of the Guarini School may initiate a probationary period, separation from the Chemistry Graduate Program requires a vote of the faculty on a recommendation by GSAC.

Graduate degree requirements are found in the *ORC* (*Organization, Regulations and Courses*) (https://dartmouth.smartcatalogiq.com/current/orc/) and are given below, followed by detailed comments on the various requirements. The *ORC* contains and a wide range of other useful information, including course descriptions. Information about the courses that are taught in the current year are available at the Registrar's website: http://www.dartmouth.edu/~reg.

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 graduate offerings in Chemistry and allied areas that 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 course Chemistry 140 or any course in the Chemistry 260 series, nor may courses numbered below 100 count in the eight-

course total.
2. The student must complete a satisfactory thesis based on independent original research 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.

The Doctor's Degree: Ph.D.

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 **two** of the four topical areas of biological, inorganic, organic, and physical chemistry.
2. Passing a Ph.D. qualifying examination consisting of a written proposal on the student's Ph.D. research and an oral defense of that proposal by the end of the spring term of the second year.
3. 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.
4. Presentation before the Department of a lecture on the thesis topic during the student's fourth 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 their 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 five years. It is not necessary to earn a Master's degree as a prerequisite to the doctorate.

Honor Principle

Dartmouth operates on a system of academic honor. The following statements from the Dartmouth College Student Handbook apply to all aspects of graduate study, including assignments and examinations in courses and rules for use of library and computing materials.

> *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. Dartmouth operates on the principle of academic honor without proctoring of examinations. Any student who submits work which is not their own, or who commits other acts of academic dishonesty, violates the purposes of the College and is subject to disciplinary actions, up to and including suspension and separation.*
>
> *The Academic Honor Principle depends on the willingness of students, individually and collectively, to maintain and perpetuate standards of academic honesty. Each Dartmouth student accepts the responsibility to be honorable in the student's own academic affairs, as well as to support the Principle as it applies to others.*
>
> *Any student who becomes aware of a violation of the Academic Honor Principle is bound by honor to report the violation to an appropriate authority, such as an instructor, department or program chair, academic dean, or the Office of Community Standards and Accountability. If Dartmouth students stand by and do nothing, both the spirit and operation of the Academic Honor Principle are severely threatened.*

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. Faculty and TA's should discuss these guidelines at the outset of each course to ensure there is no confusion about the roles, duties and responsibilities of the teaching staff about this important aspect of academic life.

Teaching Assistants play an important role in the Department's teaching efforts. TA's often work closely with the faculty in the evaluation of material submitted for a grade. Such material is covered by the broad principle of academic honor embodied in the Honor Principle, as stated in the *ORC*. The material is assumed to be entirely the work of the student submitting it, unless collaboration (as is common in collecting lab data) and/or other sources, which are specified as acceptable by the instructor, are acknowledged. The Department views this Principle as a serious compact between students and faculty, and both sides implicitly agree to accept various responsibilities that go along with it. Since all members of the Dartmouth community have agreed follow the Honor Principle, exams are not closely monitored. Further, 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 important for the teaching staff of any course to discuss among themselves, and with their students, the various graded portions of the course and how the Honor Principle applies to each of them. Examples include laboratory notebooks, term papers and graded homework, as well as exams. Any limits on student collaboration must be clear to everyone involved, including the students and the teaching staff.

Should a suspected violation of the Honor Principle turn up during grading, several steps must be taken. ***These steps are not optional and 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 who uncovers a suspected violation during routine grading must bring the suspicion to the attention of the faculty instructor immediately. It is inappropriate for a Teaching Assistant to confront or otherwise question a student directly and it is 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 how the Honor Principle applies to any assignment and to be alert to situations that have the potential to lead to an Honor Principle violation. In Chemistry, a common situation involves student collaboration in laboratory. The instructors of the course must be clear among themselves at what point student collaboration ceases and individual work begins.

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 website listed above.

Breadth Requirement

While a graduate education in chemistry is appropriately focused on original research in a specific area of chemistry, a basic knowledge of the terminology, concepts, theories and issues of modern chemistry broadly is a necessary component of any post-baccalaureate education. Two degree requirements directly address this need, the Breadth Requirement, described here, and Research Colloquium lectures, which expose students to contemporary research across all areas of chemistry.

The Breadth Requirement includes four broadly defined areas of chemistry: biological, inorganic, organic and physical chemistry. Depending on the faculty member who will become the student's research advisor (see below) and their research, one of these areas will become the student's *primary research area*. All students are required to demonstrate basic knowledge in two of the four areas of chemistry, with the primary research area one of the two. This requirement is satisfied by successful performance on diagnostic exams given upon entrance to the Program or successful completion of basic knowledge courses taken at Dartmouth.

Basic Knowledge

During the week before Fall term registration, all entering graduate students will take five diagnostic exams, one in general chemistry and one in each of the areas of biochemistry, inorganic chemistry, organic chemistry and physical chemistry, to assess their preparation and background for graduate-level courses and TA placement. All five 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 aimed at the typical undergraduate course level and widely used across the country. If a student does not pass the general chemistry exam, they will be strongly encouraged to fill knowledge gaps on their own or by auditing a general chemistry course in the Fall term. Students who do sufficiently well on one (or more) of the specialized exams (excluding general chemistry) will have satisfied the basic knowledge component of the Breadth Requirement for that area (or those areas).

For those students who do not demonstrate a basic knowledge in at least two of the four areas, GSAC will develop an academic plan consisting of a course or courses that will complete the basic knowledge requirement for that area or areas. Normally these are undergraduate courses numbered below 100, which do not carry graduate credit. These courses are graded on an A, B, C, D, E basis, with a grade of C+ or higher required to fulfill the basic knowledge requirement.

Students are not permitted to withdraw from these basic knowledge courses solely on the basis of poor academic performance. If the student's primary research area is among these areas, the plan may include undergraduate courses to prepare the student for the specialized knowledge requirement described below.

The basic knowledge component must be satisfied in two of the four areas before the start of the Fall term of the second year in the program. As shown on the calendar of Important Deadlines and Dates on the last page, if needed, the diagnostic exams are offered at the end of Spring term of the first year and again before the start of Fall term of the second year, should a student fail to satisfy this requirement through coursework.

Graduate Courses

Graduate coursework is an important component of a graduate education leading to the preparation of a thesis on original research. Graduate courses should be selected on an individual basis to provide the foundation and background for an individual research trajectory. The Specialized Knowledge requirement is the mechanism to provide this piece of your graduate education.

The initial course selections for the Fall term of the first year will be made in consultation with a GSAC advisor and will be based on the student's interests and the goal of satisfying the course component of the Breadth Requirement, if needed. The student will also register for Chemistry 256 (Graduate Instruction in Teaching) and Chemistry 140 (Graduate Research Colloquium).

Course selection in all subsequent terms, which will include graduate courses to satisfy the Specialized Knowledge requirement, will be made in consultation with the research advisor. In every Fall, Winter and Spring term, the student will register for Chemistry 140 (Graduate Research Colloquium) and a course in the Chemistry 260 (Graduate Research Colloquium) series in the student's primary research area. (Note, these courses count for only partial credit toward the minimum three-course academic schedule.) In addition, the student will register for the appropriate Chem 29X (Graduate Research) course (297 = 1 credit, 298 = 2 credits, 299 = 3 credits) every term, including the Summer, to fill their schedule with three course credits.

Chemistry courses numbered above 100 carry graduate credit and are 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. Those courses where the student receives a grade of LP or NC may not be used to satisfy the course requirement for the Master's degree or the specialized knowledge requirement. Students should consult the instructor whenever they are unsure about their standing or performance in a course. Courses numbered over 100 in other departments may carry graduate credit and questions about them should be directed to the student's research advisor or GSAC.

Penalties for unsatisfactory performance in a graduate course (grade of LP or NC) are discussed in the Guarini School's Graduate Student Handbook, available at http://graduate.dartmouth.edu/policy/satisfactory-progress.

Specialized Knowledge

The specialized knowledge requirement provides exposure and knowledge at a more advanced level in the student's primary research area through graduate coursework. To satisfy this requirement for the Ph.D. in Chemistry, students must pass with a grade of P or higher at least *three graduate-level courses in their primary research area* or in a closely allied area, approved by GSAC or the student's research advisor, and *one additional graduate-level course in a different area of chemistry*. The latter course continues to build the breadth of your graduate education but at a more advance level. At least two of these four courses must be taught in the Chemistry Department. By the end of the second year, the student should have taken at least two of these courses, with all four normally completed by the end of the Fall term of the third year. In consultation with their advisor and Research Advisory Committee, students are encouraged to take additional graduate courses that enhance and support their research.

Teaching

Experience as a teaching assistant is a degree requirement for all graduate students in Chemistry. Graduate students benefit from such experience by acquiring new chemical knowledge and developing their teaching skills, which are valuable whether or not they seek a career in academia. Undergraduates benefit from their interaction with graduate student teaching assistants in several ways. Since graduate students are still close to their own undergraduate experience, they can be uniquely effective in helping undergraduate students learn the techniques of problem solving and laboratory skills. Further, graduate students serve as important role models for undergraduates, some of whom will undertake an honors research project and go on to chemistry graduate school.

When graduate students serve as a teaching assistant, they have many of the responsibilities of the faculty, including a position of authority over their students. Consequently, graduate students must avoid personal relationships with undergraduate students they are supervising or might reasonably expect to supervise in the future. See the **Policy on Consensual Relationships and Conflict of Interest** at the Guarini School website: http://graduate.dartmouth.edu/services/undergradrel.html.

The teaching requirement for the Ph.D. is four terms of teaching, with a typical term requiring 15–20 hours per week of teaching-related activity in one course during a ten-week academic term. In a general chemistry course, for example, this typically involves two four-hour laboratory sessions each week, plus grading laboratory work, answering questions and helping to grade midterm and final exams. GSAC aims to make the total graduate teaching assignments for each student as equitable as possible, recognizing that no two courses require the same TA effort.

Students will be assigned to additional TA terms in their third to fifth years if their research advisor lacks sufficient research funds to provide their stipend. If this is the case, the student will be expected to TA for two terms for each year of departmental support for their stipend beyond the second year. Students will be informed as soon as possible if they will be required to serve as a TA beyond the minimum of four terms.

In the Fall term of the first year, graduate students enroll in Chemistry 256 (Graduate Instruction in Teaching). This course covers fundamental issues they will encounter as a teacher. Students who are judged to lack sufficient proficiency in English upon arrival must take a course in English as a Second Language, beginning in the Fall term of their first year. In such a case, the final grade for Chemistry 256 will not be assigned until adequate proficiency in English has been demonstrated. If English proficiency has not been achieved by the end of the Fall term, the student may not begin their teaching assignments and 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 will be asked to state their preferences for TA assignments. Such requests are taken into account, along with faculty requests, the need for continuity in some courses and the goal of giving each student a variety of TA experience. Students enroll in Chemistry 257 (Supervised Undergraduate Teaching in Chemistry) each term they serve as a teaching assistant. This course is graded and an evaluation of the student's performance as a TA will become part of their file.

Students with a particular interest in developing their teaching experience should discuss this interest with their research advisor and the Chair of GSAC.

Research Advisor and Research Advisory Committee

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

Selection of a research advisor requires a mutual agreement between the advisor and the student, as well as the approval of the Department. Students may be admitted to the graduate program with a condition, stated in the letter of admission, that the student will work in a specific research area or in one or more specific research groups. During the first eight weeks of the Fall term, students are strongly encouraged to speak with at least three faculty of the Department about possible research opportunities in their group. Each faculty member will generally have a few areas of research with interesting projects that are 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 found later in this Handbook. The research funding of the student's advisor may affect the total number of terms that a student serves 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 they contemplate working.

In early November, first year graduate students will provide GSAC with a ranked preference of three possible research advisors. The faculty will meet at the end of the Fall term to review the students' preference for advisors. Final assignments to research advisors will be made by the faculty, taking into account these preferences, other relevant issues (e.g., sources of financial support) and any conditions in the student's offer letter. The research advisor and thesis research will determine the student's primary research area.

After a graduate student has been assigned a research advisor, the student will consult with their advisor to nominate to GSAC three possible faculty members for their Research Advisory Committee (RAC), which is charged with monitoring progress in the program and offering advice for the student's research. With these nominations in hand, GSAC will select two faculty members to serve on the student's RAC with the student's advisor. (Note, in some cases, to provide additional expertise, one or two additional individuals may be included on the RAC.) Research faculty may choose to serve on RACs to provide additional expertise and student mentoring. Since GSAC must ensure that these committee assignments are evenly distributed among the faculty, a student's first choices cannot be guaranteed. However, at least one faculty member that GSAC assigns to the RAC will have expertise in the student's primary research area. A member of the Committee other than the research advisor will serve as the Chair.

Policy on switching research advisor

On occasion, a student may wish to explore switching research advisor, if they feel there are compelling reasons that the original advisor is no longer a good match. This begins with informal discussions with GSAC and a potential new advisor. When possible, the original advisor and the RAC should be involved in these conversations.

The procedure to switch advisor, which occurs rarely, begins with a petition from the student to GSAC. The petition will be reviewed by GSAC and by the Research Advisory Committee (when appropriate). After this review, the student's request must be approved by the faculty, guided by the recommendation from GSAC and the Research Advisory Committee (when appropriate). If a petition is denied, a student will need the approval of the original research advisor to remain in their group.

Progress Reports and Research Committee Meetings

An important aspect of any career in scientific research is a periodic report to gauge progress, set new directions and invite comment from other experts. Chemistry graduate students learn this skill through regular progress reports to their Research Advisory Committee. Annual meetings with the Committee, where the content of the report is discussed, ensure the flow of information needed to keep them informed of your progress and provide you with the full benefit of their advice and counsel.

Annual Research Progress Report

By the end of the second week of each summer term (14 calendar days after the start of the term), graduate students will submit to each member of their Research Advisory Committee a written summary of five or fewer pages that cover the program requirements the student has satisfied, the courses the student has completed, the requirement(s) for the coming year and, most importantly, the status of the student's research. In addition to the scientific content, the technical writing in the report will be considered by the Committee, since effective written communication of scientific results is an important professional skill to develop and master. The details of auxiliary information, such as experimental procedures, analysis of compounds, design of apparatus, etc., may appear in an Appendix to the Report. Not all research advisors will request such information, so they should be consulted for the exact format.

Each report should include a summary of accomplishments during the previous period and a statement of research plans for the next six months. It should be remembered that progress in research may involve failure, so the report should include all of your efforts, whether successful or not. The annual report after the first year should describe the proposed research and its scientific context and importance, as well as research progress that has been made.

Meetings with the Research Advisory Committee

Each student will meet annually with her or his Research Advisory Committee to describe their research progress, as well as future research plans. The Progress Report described above will be the basis for much of the discussion at this meeting.

The student will meet with their Committee according to a schedule arranged by the Administrative Assistant (see the last page of the Handbook for the timeline). This meeting is intended to be a focused discussion and will be scheduled for 1 hour. The student should prepare for a 30-45 minute discussion with the Committee that is structured around a presentation by the student of their progress. The remaining time will be used for faculty discussion and feedback to the student. Following this meeting, the student will prepare a written summary for approval by the Committee. Once approved, this summary will be filed in the student's record.

In addition to these topics for the annual meeting, the program has annual Ph.D. degree requirements that should be discussed, as described below.

End of the First Year

At the first meeting, the student should provide a description of her or his research project and an initial plan of attack, as well as research progress in the first year, including progress since the report was submitted in early July. Preparation for the student's Qualifying Exam in the upcoming Winter term should be discussed and

any questions the student may have about this Exam should be addressed. The Qualifying Exam is described in detail in the section on this degree requirement.

End of the Second Year

The main purpose of this meeting is to provide a detailed description of research accomplished during the second year, including progress since the report was submitted in early July, and a clear definition of research plans for the next several months. The nature of the Research Proposal and its defense in the upcoming Winter term should be discussed. The Research Proposal is described in detail in the section on this degree requirement.

End of the Third Year

This meeting will be held after the student has presented their Research Seminar and the Committee will provide feedback on the student's presentation. The rest of the meeting should focus on research progress to date, including progress since the report was submitted in early July, and the research that remains to be done to complete the thesis. Normally, all requirements for the Ph.D. degree will have been completed by this meeting, except for the thesis itself.

End of the Fourth Year (and annually thereafter)

The student will provide a description of the additional research that must be completed before the thesis can be written. If, based on the student's progress, the Research Advisory Committee is convinced that the student can complete the thesis within a reasonable period of time, they will recommend continued stipend support for the fifth year.

General Requirement for Meeting Documentation

It is prudent that the issues and milestones discussed in the Research Advisory Committee meeting be documented to the satisfaction of everyone who attended. To this end, the student will provide a brief written summary of each meeting, whether an annual meeting or one held at another time (described below), to the members of the Research Advisory Committee. The Committee, in turn, will review this summary and approve or edit it, as necessary. The final summary, as approved by the student and the Committee, will become part of the student's file in the Department. Normally, this summary should be completed within two weeks following the meeting. Should the student fail to complete this summary, she or he will receive a grade of NC (No Credit) for their research course 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. The 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 they are important for the student's professional development.

Grievance Process

It is the goal of GSAC and the Research Advisory Committees to ensure that each student has a graduate experience that is supervised, fair and consistent. The Research Advisory Committee provides each student with a variety of expert 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 with the student or with the student's research advisor. Discussion within the Research Advisory Committee is the first step in resolving any grievance or program-related concern that might arise. 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 parties 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 consider the matter. Historically, the majority of concerns have been resolved through the Research Advisory Committee or through GSAC.

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

Special Arrangements to Carry Out Research in Other Departments

A student enrolled in the Chemistry Graduate Program 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:

The student may simply elect to transfer to the graduate program of the other department. If accepted by the new program, she or he may transfer after the Spring term of the first year and completion of two terms of teaching. The mutual obligations between the student and the Chemistry Department will cease as of that date.

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

The student is obliged to fulfill all of the requirements for the Chemistry Ph.D. degree, including four terms as a teaching assistant. Generally, a Chemistry graduate student whose research advisor is in another department will serve as a TA for two terms in the first year, with the two remaining terms determined by the Department's teaching needs and the student's research progress.

A faculty advisor in another department is obligated to provide stipend support, health insurance and research support from her or his research funds. The Chair of the other department must acknowledge this financial responsibility in writing before a Chemistry graduate student can be assigned to a research advisor in another department. This acknowledgment is required **before** the Chemistry graduate student begins research in the other department. If that department cannot guarantee this support, assignment to the research advisor in the other department will not be possible.

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

A student enrolled in the graduate program of another department may request in her or his first year to carry out their thesis research in the Chemistry Department with a member of the Chemistry faculty as their research advisor. Such an application should be made to the Chair of the Chemistry Department by the end of the Winter Term of the student's first year in their graduate program for approval by the Department.

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 led by Environmental Health and Safety (EHS), has developed the following guidelines for the safe operation of our facilities. In addition to these general statements, graduate students must read and follow the Chemical Hygiene Plan, a copy of which is found in each research and teaching laboratory.

- *Adherence to the safety rules is **not** optional. It is important that a clear and consistent policy is followed by all members of the Department. The Chemistry Department Safety Policy is found in the Chemical Hygiene Plan, which has been approved by vote of the faculty. That we have such a plan is not optional, as it is required by law of all chemistry departments. All principal investigators, research workers, 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.*

- *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 be consulted for any unusual hazardous waste disposal requirements or other hazards in your research lab. In general, all chemical waste should be considered hazardous and 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 EHS personnel, who make periodic inspections of research and teaching laboratories and issues reports of their findings to those responsible for each lab. All deficiencies found by these inspections must be corrected immediately.

In case of workplace-related injury, the state-run Workers' Compensation (WC) program defines who is covered by WC. In New Hampshire, anyone who receives remuneration for providing a service is presumed to be an employee under the WC statute. Graduate students, whether their stipend is paid by an external research grant or Dartmouth funds, are presumed to be Dartmouth employees for WC purposes.

Qualifying Examination (Year 2)

Students in the Chemistry Graduate Program must fulfill several requirements for the Ph.D. degree. One of these is a Qualifying Examination, which has two components, a written thesis proposal and an oral exam. The purpose of this requirement is to assess the preparation of the student to perform independent, high quality research. The Exam will focus on the preliminary research results that the student has obtained towards the 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 Committee will generally consist of three faculty, the student's Research Advisory Committee (excluding the student's research advisor or co-advisors) plus one member of the Graduate Student Advisory Committee (GSAC). Prior to the Exam, GSAC will request an assessment from the research advisor of the student's progress toward the degree. In the oral exam, the student will discuss their research and answer the Committee's questions at the chalkboard, using no more than five slides to show details (figures, schemes, tables, etc.) from the thesis proposal.

Instructions for the Written Thesis Proposal.

The thesis proposal is limited to seven pages (including figures and references). The proposal should be formatted with 1-inch margins, single-spacing and 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. It should clearly state the overarching goal(s) of the research and hypothesis being tested, and should be organized into clearly labeled sections:

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

The deadline for submitting the thesis proposal is the **first day of the Winter term** in the student's second year. GSAC will then assign one of its members to serve on the student's Qualifying Exam Committee and schedule a date for the oral exam, normally in the Winter term.

Instructions for the Oral Exam.

The purpose of this Exam is to establish whether the student has sufficient knowledge and ability to independently execute Ph.D.-level research in a timely manner. The student should reserve 2 hours for the examination, including 90 minutes for the oral exam and 30 minutes for faculty discussion and discussion with the student about the outcome. The student will prepare a short (no more than 10 minutes) presentation containing 5 or fewer slides (font size no smaller than 16) to describe their research project. Title slide may be included and does not count towards the 5-slide limitation. The research advisor will not be present at the oral exam, but students are encouraged to discuss the content of their presentation with their advisor before the Exam. The student will give their presentation uninterrupted, followed by questions from the Committee. Questions will be inspired by the presentation but can also probe other relevant topics in chemistry.

The GSAC representative will complete an exam rubric in consultation with the Committee. The rubric template will be provided to students and advisors in advance of the Exam. The rubric will record the outcome of the exam (Pass/Fail) and a detailed rationale for the outcome. It will be shared with the student and advisor, and forwarded to GSAC to be included in the student's file. The Chair of the Research Advising Committee will prepare for the student and the advisor a follow-up summary describing both strengths

and weaknesses of the student's thesis proposal and oral exam.

Criteria for Assessment of the Qualifying Exam

Understanding of the Research Problem

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

General Knowledge of Chemistry

Essential concepts and underlying chemical principles related to the research will be examined. This may include topics from undergraduate and graduate courses, such as experimental quantities measured, how a 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 the 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 with the overarching hypothesis 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, useful and good quality?
- *References.* Is the proposal appropriately referenced?

After the oral exam, the Committee will provide a pass/fail grade for the oral defense and provide feedback to the student using the rubric. Should the written component judged to be lacking, the Committee will give the student detailed guidance for its revision, including a point-by-point critique. A revision of the document, along with a "response to reviewers' comments" describing the changes that were made, should normally be returned to the Committee within two weeks. Both a passing grade on the oral exam and approval of the (revised) thesis proposal are required to pass the Qualifying Exam. When necessary, a second oral exam will be scheduled and further revisions may be required. Students who fail a second oral exam will not advance to Ph.D. candidacy but may be able to complete a Master's degree (see below).

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 indicated below may result in a student being placed in unsatisfactory academic standing.

In the student's second year:

First day of the Winter term
Deadline for the student to submit the written thesis proposal (background, progress and plans) to GSAC.

End of the Winter term
Deadline for completion of the oral exam.

End of the Spring term
Deadline for completion of a second oral exam (if needed).

June 15
Deadline for all students to successfully pass the 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 can be satisfied), in which case financial support will end on August 31.

Other Requirements for the Ph.D.

A graduate student's Research Advisory Committee may decide that competence in a particular area is important for the student's professional development. If this is the case, the Committee may require the demonstration of proficiency in the area as part of satisfactory progress toward the Ph.D. degree. This may require graduate or advanced courses in Chemistry or other programs at Dartmouth. In such a case, the Committee will inform the student no later than the end of the Spring term of the second year about the nature of the competence, the method by which it can be achieved, and the time by which it should be completed.

Research Proposal (Year 3)

The Ph.D. degree testifies to the demonstrated ability to carry out independent research. An important component of this ability is the insight and originality to identify a valid research problem and prepare a plan to address it. To develop this skill and encourage this habit of thought, each student is required to submit and defend an original Research Proposal in an area not closely related to her or his thesis research. The topic should be approved in advance by the student's research advisor but, beyond this, the proposal should be an independent effort by the student.

The Proposal involves the preparation of a short (5 pages maximum) written description of a substantive unsolved chemistry problem, including a procedure to address the problem. A list of references is excluded from this page limit. The Proposal is then presented and defended before the Research Advisory Committee, which will evaluate its merits and deficiencies. (Note, the page limit is often waived for revised versions, which may be longer than the initial 5 pages.)

Students are encouraged to refer to online resources for graduate NIH and NSF fellowships for samples of high-quality research proposals. The following link may be useful in this regard.

https://www.niaid.nih.gov/grants-contracts/three-new-f31-sample-applications

In addition, students are encouraged to take advantage of proposal writing workshops organized by Dartmouth's GrantGPS:

https://www.dartmouth.edu/gps/events/upcoming_events/index.php

The Proposal must be submitted by the **first day of the Winter term** in the student's third year. GSAC will then schedule the oral defense, normally in the Winter term. After the defense, the Committee will provide the student with a pass/fail grade and written feedback on both the written and oral aspects of the Proposal. Should the written proposal be judged to be lacking, the Committee will give the student detailed guidance for its revision, including a point-by-point critique. Revision of the proposal, along with a "response to reviewers' comments" describing the changes that were made, should normally be returned to the Committee within two weeks. Both a passing effort on the oral exam and approval of the (revised) proposal are required. When necessary, a second oral exam will be scheduled, and further revisions may be required. If a second presentation shows no significant improvement, the degree 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. The stipend will resume upon satisfactory completion of the requirement.

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, in which case financial support will end on August 31.

Research Seminar (Year 4)

The ability to clearly and effectively communicate scientific concepts and convey the background, rationale, results, conclusions and importance of scientific research are important skills for a professional chemist. To help develop these skills, each student is required to present a Research Seminar on her or his thesis research during the fourth year in the program. The Research Seminar will be presented to the entire Department, typically at a Graduate Research Symposium organized by GSAC late in the Fall term, Typically, the seminar will be 15 minutes long, with 5 minutes for questions, similar to an oral research presentation at a national meeting of the ACS. The format and date for the Research Seminar will be determined by GSAC and coordinated by the Department.

The Seminar should be prepared with care, as 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. The research of one scientist or group of scientists is inevitably related to the research of other scientists, and your research will almost certainly fit within the context of other research done either in your group here at Dartmouth or elsewhere.

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

The Seminar will be evaluated by the Research Advisory Committee at an annual meeting with the student subsequent to the Seminar. The Committee will consider the depth of the student's understanding and ability to clearly communicate her or his original research. Should the Committee find the presentation to be lacking, written comments on the deficient areas will be provided to the student, with the understanding that a second presentation should address those areas in depth. If a second Seminar shows no significant improvement, then the requirement will have been failed. If there is improvement, the requirement will have been passed or a third presentation may be required, as the Committee sees fit.

Other Seminars

A continuing exposure to a wide range of research presented in the departmental seminars, as well as developing skills in presenting one's own research, is an important part of a graduate education.

The weekly Chemistry Department 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 across the whole field of chemistry. **Attendance at the Colloquium (at least 2/3 each term) is required for all students in the Chemistry Graduate Program.** It is designated as a graduate course, Chemistry 140 (Chemistry Research Colloquia), for which all graduate students should register each term, except the Summer term.

Additional meetings of Chemistry 140 may be held on Tuesday mornings at 10:30 AM or Wednesday afternoons at 4:00 PM. These time periods may be used for special seminars or student presentations, such as the Research Seminars. Chemistry graduate students are **strongly encouraged** to attend all presentations by their fellow graduate students, including Research Seminars, described above, and Ph.D. thesis seminars.

Each student will present a full-length seminar as part of their Ph.D. thesis defense. This is an open seminar and is normally followed by the closed oral defense of the thesis with the Thesis Examination Committee.

In addition to Chemistry 140, every graduate student should enroll in one of the courses in the Chemistry 260 (Graduate Research Colloquium in Chemistry) series every Fall, Winter and Spring term. These seminar courses in topical areas of chemistry (260, organometallic chemistry; 261, materials chemistry; 262, organic chemistry; 263, bioinorganic chemistry; 264, biophysical chemistry; 265, computational, modeling and theoretical chemistry) provide a valuable setting for students to gain practice in their presentation techniques, discuss contemporary research topics and share research progress with peers in their research area. The selection of a course in the Chemistry 260 series is guided by the research advisor.

Seminar Presentation Hints (Professor John Winn)

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 roomfull.

• 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!

Thesis

The writing and successful defense of a thesis on original independent research is the final requirement for the Ph.D. degree and your final achievement as a graduate student. Take appropriate steps along the way to prepare for writing your thesis. Some students can write easily and well; some design their experiments so that all relevant contingencies have been explored and documented; some carry out and record literature searches that leave no questions unanswered. If this describes you, then you can safely defer the writing of your thesis until your research is finished. If you suspect deficiencies in one or more of these areas, then you should begin writing your thesis well ahead of time. The best preparation is to write units of your research as components of your thesis as you go along. It is suggested that you design your annual Progress Reports to serve this function; you may wish to supplement these Reports with additional summaries, reviews, etc. Even though these may not be used in your thesis because of changes in research goals, some of them may become the basis for whole chapters of your thesis. *All* of them, however, will provide you with practice that will help in the preparation of your thesis.

It is the student's responsibility to ensure that the thesis is written in acceptable scientific format using grammatically correct English. For the thesis format that is required by the Guarini School, follow the 'thesis guidelines' link on this page: https://graduate.dartmouth.edu/academics/graduate-school-forms/thesis-and-dissertation-forms. You can also find examples of Dartmouth Chemistry Ph.D. theses in the library or in the collection of theses directed by your research advisor.

While your research advisor and Committee members are willing to give advice on the overall organization of the thesis, they should not be considered the principal proofreaders. The thesis should not be submitted to them until you believe it is in satisfactory format. Each member of the Research Advisory Committee must certify in writing that the format and overall quality of the thesis are satisfactory before a date for the seminar presentation and defense of the thesis can be set. A "readability" form is available in the Chemistry Department office or on the Department's website (http://chemistry.dartmouth.edu/resources), on which you can collect signatures from your RAC. Acknowledging that your thesis is in the correct format and acceptance of your thesis in this form by your Committee does not, at this stage, constitute or imply their final approval. The date for the defense may not be sooner than two weeks after the approval by the RAC. Theses that are not in an acceptable format or contain an unacceptable level of grammatical or spelling errors may be returned for correction.

The defense of the Ph.D. thesis has two parts. First is an open departmental seminar, which is followed by an oral defense with the Ph.D. Examination Committee, This Committee must include three full-time Dartmouth faculty members, of which two or more must be from Chemistry, as well as an external member with a faculty-equivalent research appointment at another institution. The Ph.D. Examination Committee must be approved by the Guarini School, using the form found here: https://graduate.dartmouth.edu/academics/graduate-school-forms/thesis-and-dissertation-forms

Second is approval by the Ph.D. Examination Committee of the thesis, which must contain the revisions recommended by the Committee. These two parts of the examination will normally occur on the same day, but the seminar may be scheduled some days earlier than the oral defense, 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 the written thesis.

Summary and Schedule

1. Write the thesis using the required format (Guarini link).
https://graduate.dartmouth.edu/academics/graduate-school-forms/thesis-and-dissertation-forms

2. Work with your advisor so they can identify and invite an appropriate external examiner; arrange for Guarini approval of the Ph.D. Examining Committee with the 'PhD examination committee approval request' form at the same link.

3. Schedule the thesis defense with your Research Advisory Committee.

4. Timing:
   - Submit the thesis to your RAC for approval of its "readability" (**one week**) with the form here: https://chemistry.dartmouth.edu/resources.
   - After this approval, send the thesis to the external examiner **at least two weeks** before the scheduled defense. Note, this means you will need **at least three weeks** between submitting the thesis to your RAC and the thesis defense.
   - Give your public talk (1 hour) and answer questions in the private defense (normally 2 hours).
   - Bring to the defense several copies of the thesis title page printed on Dartmouth watermark bond paper (available in the Department office), so the committee can sign it. (Note, electronic signatures have been accepted under the circumstances of the COVID-19 pandemic, but this may change in the future.)
   - Make corrections and additions requested by the Ph.D. Examining Committee and print a final version of the thesis on the bond paper. You will likely need several copies, including one for yourself, your advisor and the library. The Department arranges for the binding of the thesis.
   - For details on submitting the final thesis and associated Guarini paperwork see: (https://graduate.dartmouth.edu/about/who-we-are/covid-19-guarini-updates/information-submission-thesis-dissertation-or-course-track), which is also accessible from the Guarini link above.

Important Deadlines and Dates

The chart below lists several important deadlines and dates for the requirements of the program. It is intended to be a quick reference. For details and specific information, refer to the appropriate section in this Handbook. Every box, except the frist two, should also include ***Make progress on research***!

	Summer Term	***Fall Term***	***Winter Term***	***Spring Term***
First Year	*Study for Diagnostic Exams*	*Diagnostic Exams before start of term, Chem 256, Rank research group choices by 8th week, or earlier*	*Generally, take courses, serve as a TA, begin research*	*Diagnostic Exams offered (if needed) following end of term*
Second Year	*Progress Report due 14 days after the start of the term*	*Diagnostic Exams offered (if needed) before start of term, Research Advisory Committee meeting (September)*	*1st day: Qualifying Exam Report submitted to GSAC,* *Complete Qualifying Exam*	*Complete Qualifying Exam (if needed)*
Third Year	*Progress Report due 14 days after the start of the term*	*Complete Graduate Course Requirement by end of term, Research Advisory Committee meeting (October)*	*1st day: Research Proposal submitted to GSAC,* *Complete Research Proposal defense*	*Complete Research Proposal defense (if needed)*
Fourth Year	*Progress Report due 14 days after the start of the term*	*Research Seminar completed by the start of Winter term, Research Advisory Committee meeting (December)*		
Fifth Year	*Progress Report due 14 days after the start of the term*	*Research Advisory Committee meeting (September)*		*Stipend after twentieth term in residence contingent on funds of the research advisor.*