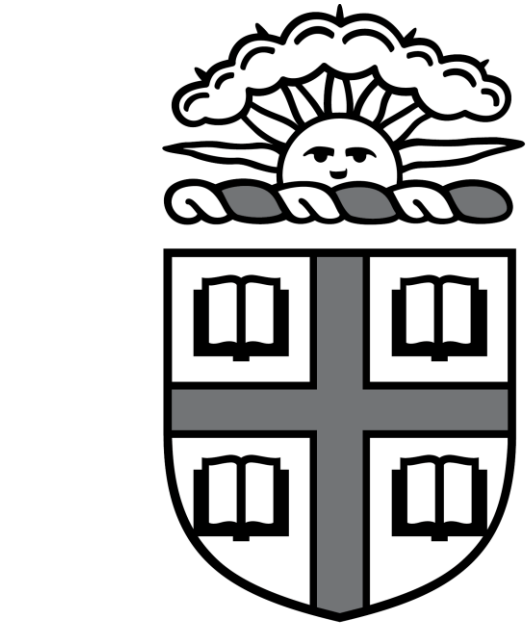

BROWN

Department of Chemistry

Graduate Student Handbook

2025-2026

Revised August 2025

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The History of the Department of Chemistry

Chemistry at Brown University traces its origins to the appointment of the first professor of chemistry in 1811. The field developed slowly during the first half of the nineteenth century with one or two chemists on the faculty. The chemistry department was at that time, located in Rhode Island Hall. The pace quickened in 1862 with the construction of Rogers Hall to house the work of the Department. John Howard Appleton **(**1844-1930), joined the faculty during this era, and remained the dominant force in the development of chemistry at Brown until his retirement in 1914. John Howard Appleton or 'Johnny App' as he was affectionately known, was associated with this university and department in a variety of capacities for many years. He held appointments as Instructor 1863-68, Professor of Chemistry Applied to the Arts 1868-72, and as the inaugural Newport Rogers Professor from 1872 until his retirement in 1914. An excellent scholar and teacher, he authored 12 books on various aspects of chemistry. The friends and family of Professor Appleton endowed the Appleton lectureship to the Brown University Chemistry Department in 1922.

The modern history of the department began in 1923 with the construction of the Metcalf Chemical Laboratory. The Metcalf family patronage of chemistry at Brown continued 15 years later with the construction of the Metcalf Research Laboratory. The two buildings were linked in 1963. In 1982 the Chemistry Department moved into its present research quarters; a newly constructed, $18 million research facility shared with the Department of Geology. Metcalf Chemical Laboratory continued to house the instructional laboratories and classrooms of the department until the construction of MacMillan Hall in 1998.

Important figures in the development of the department during the period following 1923 included: Samuel T. Arnold, who joined the department in 1913 and served as Dean of the College (1930-1946), Dean of the University (1946-1949), and Provost (1949-1956); Robert F. Chambers, who joined the department in 1916 and served as Chair for many years until his death in 1946; Charles A. Kraus, who joined the department in 1924, and remained active for many years after his retirement in 1946; and William Walker Russell, who was a member of the faculty from 1926 until his retirement in 1965. During and following this period, many well-known chemists have served on the faculty, including Lars Onsager (1928-1933), W. A. Noyes (1929-1938), R. M. Fuoss (1932-1936), P. C. Cross (1938-1949), Leallyn B. Clapp (1941-1983), Donald F. Hornig (1946-1956, 1970-1977), Robert H. Cole (1947- 1990), John Ross (1953-1965), J. F. Bunnett (1958-1965), William T. King (1960-1981), Richard Eisenberg (1966-1973), Eugene Stevens (1966-1977), Julian H. Gibbs (1960-1979), and Edward A. Mason (1967-94).

Graduate work in chemistry was instituted in 1887, with the first master's degree awarded in 1891 and the first doctorate in 1903. **As of June 2025, 1002 PhD, 187 MSc, and 222 MA degrees have been earned in Chemistry.**

Department of Chemistry Faculty Roster 2025-2026

Yusong Bai, Assistant Professor
Amit Basu, Professor
Ou Chen, Associate Professor
Matthew Coley-O'Rourke, Assistant Professor
Sarah Delaney, Chair, Vernon K. Krieble Professor
Eunsuk Kim, Professor
Megan Kizer, Assistant Professor
Benjamin McDonald, Assistant Professor
Jesse Morin, Associate Teaching Professor
Charles Morton, Assistant Teaching Professor
Jerome Robinson, DGS Associate Professor
Christoph Rose-Petruck, Professor
Brenda Rubenstein, Vernon K. Krieble Professor
Emily Sprague-Klein, Assistant Professor
Richard Stratt, Newport Rogers Professor
Shouheng Sun, Vernon K. Krieble Professor
Lai-Sheng Wang, Jesse H. and Louisa D. Sharpe Metcalf Professor
Li-Qiong Wang, Teaching Professor
Peter Weber, Jesse Houghton Metcalf Professor
Paul Williard, Professor
Ming Xian, Jesse Houghton Metcalf Professor
Matthew Zimmt, Professor

Our Vision of a Brown Chemistry PhD

This handbook describes the sequence of graduate study requirements (milestones) and the professional responsibilities of students in the Chemistry PhD program.

The Doctor of Philosophy (PhD) is a research degree that is conferred in recognition of an individual's ability to discover, analyze, and disseminate knowledge. Specific to our Chemistry Program are the abilities to define unique research questions, utilize modern methods to pursue these questions in a group-based science setting, and communicate the resultant findings to an array of audiences. At Brown, we view the process of becoming a productive and independent chemical researcher as a skill and identity-building process that prepares individuals to pursue a variety of careers in the modern, knowledge-based economy. The process of earning a PhD is analogous to that of an apprentice learning a craft or trade. Under the guidance of an experienced researcher, their research advisor(s), students learn key professional responsibilities and satisfy a sequence of program milestones. This is effectively an intellectual transformation that occurs through a journey of challenge, self-discovery, and personal growth. **PhD students undergo a Scientific Identity Development process, wherein they develop a unique combination of knowledge, skills, and interests.**

Developing a Scientific Identity

The faculty, students, and staff of the Chemistry Department, as well as the broader Brown community, are dedicated to maintaining an inclusive learning environment that stimulates and facilitates the development of an individual's unique scientific identity. This identity is a portfolio of knowledge, technical skills, experiences, and interests that will serve the future endeavors of a PhD graduate. From a scientific and technical perspective, this identity will include the knowledge and skills to individually and collaboratively:

- Identify critical scientific questions in one or more disciplines;
- Formulate hypotheses and experiments (both wet and dry) to address those questions;
- Collect, process, and interpret data at the highest level;
- Communicate the context, relevance, and meaning of research findings to a variety of audiences;
- Recognize the connections among various fields of chemistry and other science;
- Pursue science with the highest of integrity; and
- Identify career paths that leverage skills and talents.

The representative set of skills and core competencies needed to meet this objective are outlined in Table 1.

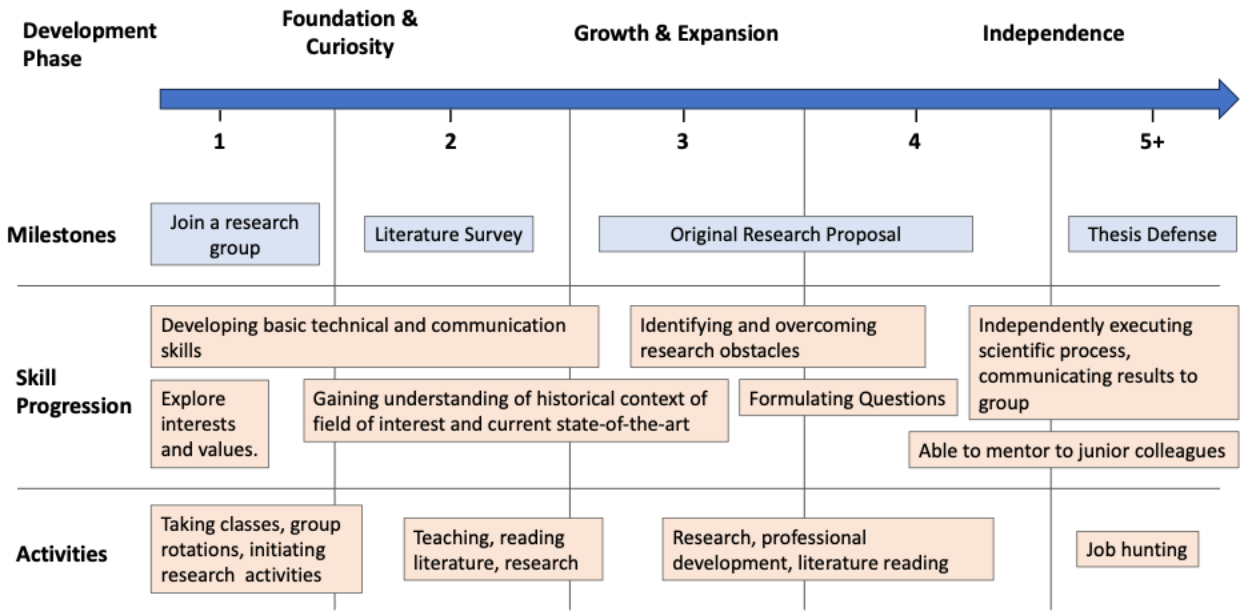
Table 1. Core Competencies and Skills Our Students Expect to Develop
Adapted from Michael F. Verderame, Victoria H. Freedman, Lisa M. Kozlowski, and Wayne T.

1	**Broad Discipline Knowledge**	Understanding of general chemical concepts that link disciplines together. *Can one engage in a productive dialog with researchers in the chemical sciences*?
2	**Deep, Field Specific Knowledge**	Hold a knowledge base of one's specific field of interest that encompasses historical developments, current state of the art, and modern experimental tools used to operate in this field. *Is one familiar with the cutting edge of intellectual inquiry in the field and how it came to be?*
3	**Critical Thinking Skills**	Application of the scientific method, understanding of how to design and interpret experiments. *Can one independently define and develop an experimental plan to answer a scientific question?*
4	**Experimental & Technical Skills**	Ability to adapt and deploy experimental protocols specific to one's field. *Can one identify and implement available scientific tools to answer a scientific question?*
5	**Analysis Skills**	Ability to deploy modern data analysis and interpretation methods specific to one's field to interpret scientific data.
6	**Collaboration and Team Science Skills**	Openness to collaboration, self and disciplinary awareness, and the ability to integrate information across disciplines.
7	**Communication Skills**	Ability to fluently communicate with a variety of audiences/stakeholders in oral, written, and graphical formats. *Can you develop and deliver a compelling narrative to your audience, be it field experts, generalists, or lay people?*
8	**Leadership Skills**	Manage interpersonal dynamics, including mentor/mentee and peer to peer. Organize and plan, make decisions, solve problems, and manage conflicts. *Are you able to manage different personalities and resolve potential conflict for the betterment of all involved?*
9	**Survival Skills**	Develop personal characteristics such as motivation, perseverance, and adaptability, that help one thrive in science.

		Participate in professional development activities and foster networking skills.
10	**Responsible Research Conduct**	Knowledgeability and adherence to responsible research principles, ethical decision making, moral courage, and integrity.

The development and progression of these core competencies is expected to be dynamic and evolve as a function of student experiences. The combination of coursework, thesis milestones, and research activities are expected to provide the experiences that drive this progression. Meeting these aims is a gradual and sometimes challenging process, and regardless of your background, requires dedication throughout your PhD. Based on previous education literature, **we view students as developing these skills in three key scientific self-identity phases, along which we have aligned our PhD program milestones, as depicted in Figure 2 below.**

Figure 2. Timeline for Individual Development



Academic Integrity

Chemistry graduate students are expected to follow Brown University's academic code and adhere to the highest levels of academic and professional integrity. The *Brown University Academic Code, Graduate Student Edition* governs the academic conduct of graduate students:

https://graduateschool.brown.edu/academics-research/rules-regulations/academic-code

As stated in the Academic Code: "A student's name on any exercise...is regarded as assurance that the exercise is the result of the student's own thoughts and study, stated in his or her own words....". This Academic Code applies to all Chemistry coursework, Ph.D. milestone materials (e.g., literature review, research proposal defense, original research proposal, and dissertation), as well as proposals, presentations, and manuscripts.

Artificial Intelligence (AI) Policy

Preparing materials for Ph.D. milestones (e.g., literature review, research proposal defense, original research proposal, and dissertation), as well as proposals, presentations, and manuscripts, develop the ability to critically analyze scientific literature, formulate and articulate cogent arguments, and effectively communicate research to a range of audiences. Preparing these materials is more than a task, but rather a way of developing skills expected of Ph.D. scientists.

This policy encompasses the use of artificial intelligence (AI) tools (e.g., ChatGPT). These tools **do not meet the criteria of authorship**, and is a policy shared by the American Chemical Society (ACS) and other organizations (https://researcher-resources.acs.org/publish/aipolicy). This means that **AI cannot be used to construct first drafts**, and all later uses must be discussed with your advisor and properly attributed. An example of appropriate use of AI includes assistance with spelling/grammar/usage (e.g., editing) or routine search function, while an inappropriate use includes direct use of substantial content generated by AI (e.g., paragraphs of text, graphics, unvalidated references or summaries). An exhaustive compilation of all (in)appropriate uses of AI is not possible, and ultimately, each individual is responsible for their own work and ensuring it meets the specified criteria put forth by any organization (e.g., University, Funding Organization, Journal), including the *Brown University Academic Code, Graduate Student Edition*.

For Ph.D. milestones, if you use AI tools, please save the first draft of your work before any AI tools have been used. You will submit this first draft along with the final AI-edited version. In addition, a standalone document must be submitted with the milestone that describes how the AI tool was used and a log of AI prompts. These policies extend to graduate-level coursework unless other guidelines are provided by your course instructor.

Phases of Scientific Self-Identity Development and Related Chemistry PhD Program Milestones

Years 1-2: Foundation and Curiosity Phase

Termed the "curiosity phase," the initial 1-2 years of a PhD student's experience are intended to be a period of exploration of interests, priorities, and values via coursework, lab rotations, experimental work, and a literature review. These serve to establish a desired direction of focus, as well as a foundation upon which students will build their identities. Students are expected to develop basic technical and communication skills. In year 1, such communication skills include meeting with potential research advisors to understand their expectations, practices, and traits as advisors, and regularly communicating your research as part of your Colloquium class. In year 2, basic science reading, writing, and presentation skills will be developed in the course of writing a literature review of your given research area or topic and delivering an oral seminar to your committee. Concurrently, students will have begun research with their advisor and research group. Students are expected to begin developing the technical knowledge required to execute their research project. Professional development tasks include selection of a research advisor and committee, and attendance of departmental seminars and colloquia. Students will additionally serve as teaching assistants. This serves to improve communication and time management skills. At the conclusion of year 2, students are expected to have the foundation and direction to build their scientific identity.

Related Milestones: Coursework, Colloquium Course, Rotations, Literature Review

Years 3-4: Growth and Expansion Phase

During the growth and expansion phase, students build upon their foundations by becoming increasingly fluent in their chosen fields of study by immersing themselves in research, seminars, and scholarly literature. Engaging in research and with their fields enables students to grow into researchers who have mastered key techniques, literature, and ideas in their fields and can leverage those techniques and ideas to successfully develop and complete research projects. Often completing research projects necessitates recognizing and overcoming various research challenges that inevitably arise. It also involves strengthening communication skills with mentors, mentees, and colleagues, and developing personal resilience; these will become critical components of one's scientific identity. Along these lines, in Year 3, organic, inorganic, and chemical biology students will develop and defend research proposals regarding their current research that demonstrate their familiarity with their projects and related scientific literature; the research proposal defense moreover provides students with an opportunity to practice communicating their research to their peers and committee members. Students will subsequently draw upon their developing mastery of their fields to propose original research projects as part of their original research proposals. These proposals will encourage students to expand their knowledge beyond their current field of interest into other related areas, which will facilitate future collaborations and interdisciplinary endeavors. By the end of this phase, students are expected to have developed the skills needed to orchestrate research projects and have started to establish key components of their scientific identities.

Related Milestones: Research Proposal Defense (*except* Physical Chemistry students), Original Research Proposal, Professional Development

Years 4-5: Achievement and Independence Phase

During this last phase of their PhDs, students build upon their growing scientific identities to become fully independent researchers. Now able to develop their own research ideas and having forged their own research preferences and practices, students will work to conclude their PhD research and begin to seek post-PhD opportunities. Students will present the culmination of their research efforts in written form through their theses and defend these theses before a general audience in verbal form during their thesis defenses. They will start to forge connections with potential future employers by attending various professional development events and ultimately work toward securing their next position.

Related Milestones: Professional Development, Thesis Defense

The Chemistry Graduate Program and Curriculum

Chemistry PhD Program - Milestone Timetable

Year 1 - Fall Four courses (Colloquium + three chemistry graduate courses), attend seminars, rotations, group assignments, *some students will complete English as a Second Language (ESL) course	**Year 1 - Spring** Three courses (research + two chemistry graduate courses), research, attend seminars, *some students will complete ESL course	**Year 1 - Summer** Research, prepare *Literature Review* (all students)
Year 2 - Fall Research, teaching, attend seminars *Literature Review Seminar* (I, O, and CB students)	**Year 2 - Spring** Research, teaching, attend seminars *Research Project Defense* (I, O, and CB students) *Literature Review and Research Progress Seminar* (P students) **Admission to Candidacy**	**Year 2 - Summer** Research
Year 3 - Fall Research, teaching (possibly), attend seminars *Original Research Proposal* (I, O and CB students; P students years 3-4)	**Year 3 - Spring** Research, teaching (possibly), attend seminars	**Year 3 - Summer** Research
Years 4, 5 - Fall Research, teaching (possibly), attend seminars	**Years 4, 5 - Spring** Research, teaching (possibly), attend seminars	**Years 4, 5 - Summer** Research

I = inorganic chemistry PhD students
O = organic chemistry PhD students
CB = chemical biology PhD students
P = physical chemistry PhD students

The preparation and defense of the doctoral thesis is usually completed by the end of five years.

***English as a Second Language (ESL)**
All students required to take English language courses must attend and actively participate in these courses to maintain "good standing" in the department. Students' English language skills are tested three times during the first academic year; at the beginning of semester 1 to establish their English speaking and comprehension skills; again, at the end of semester 1 to determine improvement, and a third time at the end of semester 2. **The department requires a minimum test score of "3" by the end of semester 2 for continued financial support**.

Extension of Deadlines

The department recognizes that, for a variety of reasons, students may need an extension to a program deadline (including milestones and coursework). All such extensions must be made in collaboration with Student Accessibility Services (SAS). Students should contact SAS (SAS@brown.edu) to request an accommodation. It is important to note that accommodations are not retroactive and SAS recommends reaching out as soon as it is thought that accommodations may be needed.

Student Accessibility Services

Student Accessibility Services (SAS) coordinates and facilitates services for students (including graduate students) who may need accommodations or services due to a disability or medical condition. Students should contact Student Accessibility Services (SAS@brown.edu) to discuss their needs and begin the registration process. Requests for accommodations and services are evaluated individually, based on documentation and completion of the registration process. SAS staff are available for discussions and consultations should graduate students have questions.

Graduate Courses and Registration Procedures

First-year students (first semester): On arrival at Brown, first-year students take diagnostic examinations in the sub-fields of organic, inorganic, and physical chemistry, biochemistry, or mathematics/physics. These exams help determine the graduate courses in which you should enroll that accommodate your background and future research needs. Once graded, the Director of Graduate Studies (DGS) and/or graduate course advisors advises each student in the selection of appropriate first semester courses. **The chemistry PhD program does not require completion of a core set of courses.** A list of appropriate courses for first semester graduate students is provided in students' arrival packets, which includes all chemistry courses and potentially relevant offerings outside of the department.

Students will register for four graduate courses (three one-credit graduate chemistry courses and CHEM 2870 – Department Colloquia). **Graduate students should not register for CHEM 1140 or other designated undergraduate courses (CHEM 1150, 1160 or 1450 outside of approved CHEM 1560).** In appropriate cases and with approval of the DGS, students may substitute graduate level math, physics, engineering, or biology courses for graduate chemistry courses; typically, students register for at most one course outside the Chemistry Department in a semester. Students officially register for classes (days prior to the start of classes) using the online registration system, Banner: http://selfservice.brown.edu.
Note: International students also take an English proficiency exam. For students who receive a 3 or lower, enrollment in an English as a Second Language (ESL) course is required.

First-year students (second semester): Pre-registration for second semester courses occurs in late October, prior to graduate student assignment to research groups. First year students should discuss their selection of likely second semester courses with their DGS, potential research advisor, and/or graduate course advisor and then pre-register for at least three graduate courses: two one-credit graduate chemistry courses and CHEM 2870 – Department Colloquia. **Graduate students should not register for CHEM 1140, 1150, 1160, or 1450 because these are considered undergraduate courses.** In appropriate cases and with approval of the DGS, students may substitute graduate level math, physics, engineering, or biology courses for graduate chemistry

courses; typically, students register for at most one course outside the Chemistry Department in a semester.

Graduate students who are NOT in good standing after the first semester will be put on warning, and will be advised by the DGS and/or potential research advisor, prior to the start of semester 2, to identify appropriate courses. Any changes must be made during the registration period (first two weeks of the semester).

2nd - 5th Year Students: Graduate students should consult with their research advisor during pre-registration to select courses. All registration should be completed using Brown's registration system during the pre-registration period. All 2nd – 5th year students should register for a total of **three** credits per semester. Students registering only for research should choose a triple credit in their advisor's section of CHEM2970/2980/2981.

Course Changes. Course changes may be made during the registration period (the first two weeks of a semester) by securing approval of the instructors involved and the DGS (1st year students) or their research advisor (a student assigned to a research group must provide the Student Affairs Manager with written permission from the research advisor). Graduate students should never drop or add a course without permission of a DGS or their research advisor.

Questions concerning the appropriateness of a course registration should be brought to the attention of the Student Affairs Manager, Rose Barreira, or the DGS.

Department Seminars and Lectures

Students and faculty are **strongly encouraged** to attend the Department Colloquium and discipline-specific seminars each week. Attending seminars exposes you to cutting-edge research being undertaken at a variety of different institutions and helps students identify their future educational and career interests. Seminar notices are emailed weekly to the entire department and posted on the department website and on bulletin boards.

Departmental Colloquium: Fridays at 3 PM in MM 115
Attendance at colloquia will give graduate students exposure to the breadth of the field of chemistry. The colloquia introduce students to new techniques and discoveries, allow them to hear and meet current scientists in the field, and provide ideas that may be useful in one's own research. For all these reasons, attendance at the Friday colloquia is expected and attendance is monitored. **All first-year graduate students are required to attend the Friday Colloquium**.
Members of the Graduate Student Leadership Committee (GSLC) organize at least two colloquium speakers each academic year and the committee solicits nominations from the graduate student body. Guest speakers spend the entire day on campus meeting with faculty and students. Graduate students are encouraged to present their research to the colloquium speaker. Sign-up sheets to meet with the speaker are circulated via email to the graduate student body at the start of the semester.

The Department has three weekly scheduled seminars in physical, organic / chemical biology, and inorganic chemistry. These seminars give all graduate students opportunities to present their own research work and discuss topics of interest. Regular attendance and participation in seminars are an integral part of the graduate program; benefits accrue not only in research, but also in the

accumulation of the background knowledge necessary for post-graduate study and research proposals. Attendance is noted. Please check the weekly announcements.

Organic Chemistry Seminars: Tuesdays at 12 PM in GC 351
Organic chemistry graduate students present at this seminar series. In addition, invited guests frequently present their research at the weekly Organic Chemistry seminar.

Inorganic Chemistry Seminars: Thursdays at 12 PM in GC 351
Inorganic chemistry graduate students present at this seminar series. In addition, invited guests frequently present their research at the weekly Inorganic Chemistry seminar.

Physical Chemistry Tea Sessions - Thursdays at 3 PM in GC 351
Physical chemistry graduate students present at this seminar series. In addition, invited guests frequently present their research at the weekly Physical Tea Session.

Departmental Endowed Lectures

The Appleton Lecture

This endowed lecture, named in honor of Professor John Howard Appleton, is among the most significant events held annually in the Department of Chemistry. Typically, the Appleton Lecturer presents one seminar appropriate to the general public and a second seminar appropriate for a scientific audience. This two-day event includes a dinner to which senior graduate students and undergraduates are invited.

The Leallyn B. Clapp Endowed Lectureship

This endowed lecture was established in 1990 in memory of Professor Leallyn B. Clapp. Typically, the Clapp Lecturer presents one seminar appropriate for a general audience on issues of current scientific or educational interest and a second seminar appropriate for a scientific audience. This two-day event includes a dinner to which senior graduate students and undergraduates are invited.

Extra-Departmental Seminars

On campus seminars are held by Engineering, Math, Physics, and BioMed that might be of interest to Chemistry students. In addition, many seminars on topics of special interest are held within a short radius of Providence, including at institutions in and around the Boston area, at the University of Rhode Island, and at Pfizer and Yale in Connecticut. Seminar notices will be shared through the departmental listserv.

Rhode Island Section of the ACS

The local section of the American Chemical Society meets annually. The meetings consist of a social hour, dinner, and a technical talk, which, usually, is of broad interest. Meeting notices are mailed to members of the ACS and are posted in Chemistry. All graduate students are welcome to attend the social hour, dinner, and talk.

Teaching

Teaching is an integral part of graduate student education and an important aspect of our graduate program is to foster the development of our students as educators. All chemistry graduate students are required to train as teaching assistants for at least two semesters. This requirement is typically fulfilled during the second year. Students that are not supported on faculty research grants or by internal/external fellowships may also need to serve as teaching assistants beyond the second year. Teaching assistants direct laboratory sections, evaluate laboratory reports based on criteria and rubrics provided by faculty, proctor undergraduate exams, and grade undergraduate exams based on answer keys provided by faculty. Teaching assistant responsibilities are limited to a *maximum* of 20 hours/week but are usually considerably less time consuming. In the week prior to the start of each semester, teaching assistants meet with the faculty to learn about their teaching assignments and responsibilities. These meetings often include training to familiarize teaching assistants with the laboratories and experiments. The department encourages graduate students to hone their teaching abilities through discussions with faculty and other students, as well as through participation in activities at the Sheridan Center for Teaching and Learning (https://www.brown.edu/sheridan/sheridan-center). Teaching assistant professionalism and performance is tracked during the semester and formally evaluated/summarized at the end-of-semester Graduate Student Review. Refer to Appendix I for Expectations and Responsibilities of Teaching Assistants and Student Mentors in Undergraduate Courses.

Choosing a Research Advisor

Laboratory and Group Rotations:

Number of Rotations: 2

Duration of Rotations: 4 Weeks

Faculty Research Talks:

9/5/25 (Colloquium Seminar, MM115), 3:00-5:10 p.m.

9/9/25 (Colloquium Class, GC351), 3:30-5:00 p.m.

9/12/25 (Colloquium Seminar, MM115), 3:00-5:10 p.m.

9/16/25 (Colloquium Class, GC351), 3:30-5:00 p.m.

Rotation Selection Due: 9/22/25, 5 PM (students provide their top 2 choices in ranked order)

Rotation #1: 9/29/25 - 10/24/25

Rotation #2: 10/27/25 - 11/21/25

Research Group Preference Forms Due: 12/1/25

Research Group Assignment: By 12/31/25

Faculty may choose to present short research talks describing the ongoing activities and projects in their research labs shortly after the beginning of the semester. First year students will then begin two rotations. These rotations provide students with the opportunity to become more knowledgeable about specific research groups that they are most interested in joining. Students are expected to participate fully in two rotations, but those who are interested in participating in additional rotations may set up additional rotations with faculty members at their discretion (these could be before, during, or after the listed rotation periods). Individual research advisors will set

the expectations for rotators in their labs. Typically, these will include participation in research group meetings and interactions with graduate students, postdocs, and other members of a faculty member's research group; the rotation may also involve literature assignments and/or experimental work. Please note that discussing research projects and graduate training opportunities with a faculty member is the most effective means of conveying strong interest in joining that faculty member's group. Students will receive a "Research Group Selection" form where they will indicate their research group preferences. Students are expected to select faculty in whose group they rotated or faculty with whom they have spoken to about research. The student will indicate, in order of preference, at least two faculty members with whom they would be interested in conducting their graduate research. The department Chair, in conjunction with the selected faculty research advisors, determines student assignment to research groups. The pairing of students and faculty considers not only the wishes of the student and faculty, but also the availability of future financial support. The Chair informs each student of the group to which they have been assigned. The department will endeavor to make all research group assignments before the end of the calendar year taking into account graduate student selection priorities, faculty preferences and extant funding, graduate course performance and demonstration of the match between a student's scientific interests and the faculty member's research program. Students who remain unassigned to research groups after the initial assignments are made will be provided with the opportunity to seek an alternate research group throughout the second semester including with a faculty member whose primary appointment is not in the chemistry department. To remain in the PhD program all students are required to have a research group assignment by June 30th their first year in residence.

Graduate Student Evaluation

Graduate Student Review (twice per year)

The progress of each graduate student is evaluated by the Chemistry Department faculty in December and May of each academic year. At these reviews, the faculty discuss each student's performance in course work, research, teaching, literature review, RPD, ORP, and English language skills (ESL training). Students are expected to make good progress in all areas appropriate to their "year" as they work toward the PhD and will be assigned one of the following three academic standings: "Good," "Satisfactory," or "Warning" (see below). Following each Graduate Student Review, the faculty's assessment of each student's performance will be conveyed in writing to the student and to the Graduate School. Notably, for students assigned a status other than "Good" in May, the summer is an evaluable period and progress will be re-evaluated in August. If a student on "Warning" has not made significant progress they can be asked to leave the program at the end of August. For a student assigned a status of "Satisfactory" in May, progress will also be re-evaluated in August and the status will be assigned as "Good," "Satisfactory," or "Warning."

After the first semester, students must be assigned to a research group and have a research advisor to have "Good" academic standing; students without a research advisor will be on "Warning" A student must have a research advisor to return from a leave.

Students making good progress in all areas appropriate to their "years" in the program have an academic standing of "Good". A student who has not successfully completed the relevant milestones (course work, literature review, RPD, ORP, English Language Skills) or responsibilities (teaching) or has not advanced their research suitably will be assigned a standing

of “Satisfactory” or “Warning” depending on the severity of the deficiencies. The reasons for the status assignment are conveyed to the student in writing along with guidance for how to return to “Good”. A student on “Warning” from the preceding review who has made clear progress may have their status changed to “Good” or “Satisfactory”. If, in the view of the faculty, a student on “Warning” has not shown adequate improvement from the preceding review in all aspects of their professional development, the student’s status will be changed to “Termination” and the student will be withdrawn from the graduate program.

For more information about academic standing , see the *Graduate School Handbook*.

Performance Expectations for Graduate Program Milestones

Graduate Coursework

Performance Requirements - Year 1. In order to be in "good standing" students must demonstrate excellence in course work by earning an average grade of B or higher (≥ 3.0) in their non-research, approved graduate courses. CHEM 2870 does not count towards this.

First Semester: Graduate students are expected to enroll in four courses; the colloquium course (CHEM 2870), along with three other chemistry graduate courses that must be approved by their graduate course advisor. Please see *Graduate Courses and Registration Procedures* for further details.

Second Semester: Graduate students are expected to enroll in three courses; the colloquium course (CHEM 2870), along with two other chemistry graduate courses that must be approved by their graduate research advisor. Please see *Graduate Courses and Registration Procedures* for further details.

Students whose first semester course grade average is a B or higher (GPA ≥ 3.0 in their non-research, approved graduate courses; CHEM 2870 does not count towards this) are in "good standing" and can be assigned to a research group at the end of semester 1. Students whose first semester course grade average is below a B (GPA ≤ 3.0) will be assigned a status of "warning".

Students entering semester 2 with a status of "warning" must achieve a grade average of B or higher in their *combined* first and second semester non-research, approved graduate courses in order to continue in the program beyond semester 2. CHEM 2870 does not count towards this. Students are unable to register for independent research, CHEM 2980.

Students entering semester 2 with "warning" status for grades and who achieve a B average or higher in their combined first and second semester non-research courses, will remain on warning at the end of semester 2, for lack of adequate research progress. Continuing into the summer, these students must demonstrate sufficient research progress to remain in the program. Student progress will be evaluated in mid-August; if a student has not made significant progress in research, they can be asked to leave the program. Students entering the summer semester without a research advisor, will have until June 30th to find one. If the student is not successful in finding a research advisor by that date, the student will be withdrawn from the program ("termination" status) following the summer evaluation period in mid-August.

Students entering semester 2 in "good standing" but earning semester 2 grades in non-research, approved graduate courses (CHEM 2870 does not count towards this) that lowers their cumulative grade point average below B, will be placed on probation with "Warning" status at the end of semester 2. The student's research advisor, DGS, and course instructors for which the student earned a grade of C or lower will collectively decide on and provide objectives that must be accomplished during the summer; these objectives could include but are not limited to supplemental coursework, reading assignments, presentations, examinations, or research-based objectives. The student will also be expected to meet deadlines for the literature review that fall during the probationary period. Progress will be re-evaluated in mid-August. If, in the view of the departmental faculty, the objectives are not satisfactorily completed the student's status will be changed to "termination" and the student will be withdrawn from the graduate program prior to the start of the fall semester.

English as a Second Language (ESL)

The department requires a minimum test score of "3" by the end of semester 2 for continued financial support.

Research - Years 2 and Beyond

The most important component of a student's doctoral education is independent research. Without a strong record of independent research and analysis, there is no PhD. In order to be in "good" academic standing and continue in the graduate program, students must have a research advisor, pass their milestones, and demonstrate excellence in research and any teaching responsibilities. The majority of a student's research education and training as a professional scientist occurs through interactions with their research advisor, thesis committee members, and research group. These discussions should make clear to each student those aspects of their research that are progressing well and those aspects that require improvement. Faculty provide formal assessment of student research progress at the Graduate Student Review following each semester.

Thesis Committee

Each student has a Thesis Committee that tracks student performance and progress toward the PhD. Students are empowered to assemble their committee but are expected to discuss potential committee members with their research advisor. The committee should include the research advisor and at least two other faculty. At least two members of the committee should be tenure-track, research-active faculty from the Chemistry Department. Additional committee members may be added in consultation with your research advisor. The Thesis Committee interacts with the graduate student at a number of graduate program milestones, during which it assesses the student's progress toward becoming an independent scientist and provides them with multiple opportunities to engage in scientific dialogue and to receive feedback, comments, and suggestions. All students are responsible for assembling their Thesis Committee (after consultation with their research advisors or the DGS) by the end of semester 2. Students are responsible for asking faculty to serve on their Thesis Committee. Once all members of the committee have agreed to serve, the student should email the names of their committee to the Student Affairs Manager. Students are strongly encouraged to interact with their committees beyond formal committee meetings to help establish a community of mentors who can support them throughout their PhD and beyond with advice, support, and recommendations.

Literature Review, Research Project Defenses, and Original Research Proposals (Years 2-3)

During semester 3, all students submit a literature review relevant to their current project. Literature reviews will be presented at department seminars (e.g. Inorganic Chemistry Seminar, Organic Chemistry Seminar, or Physical Chemistry Tea Session– Appendix II). The literature review is designed to provide continued stimulus for independent study and to encourage familiarity with the current chemical literature. This literature review and oral presentation will be good preparation for the semester 4 milestones of a Research Project Defense (RPD) (Organic/ Inorganic/Chemical Biology students – Appendix III) or a Tea Session presentation (Physical/Theoretical). Please see the Graduate Student Handbook for the details and deadlines of these semester 4 milestones. Inorganic and Organic students must successfully complete and defend a Research Project Defense (RPD - below and Appendix III) during their fourth semester, and develop and defend an original research proposition (ORP - below and Appendix IV) during their fifth semester in the program. Physical chemistry students must develop and defend an

Original Research Proposal between their fifth and eighth semesters that should be successfully defended by the end of the eighth semester. Information about the RPD and ORP is provided in Appendix III and IV respectively.

Admission to Candidacy for the PhD

Chemistry graduate students are admitted to candidacy for the PhD at the end of semester 4 having completed the required milestones. Following admission to candidacy, students must advance their research, prepare, submit and defend their PhD thesis and professionally perform all assigned teaching responsibilities.

Conference Travel Funds (Graduate School)

If you wish to attend a conference or travel to collaborate with others, please consult with your advisor for funding opportunities. Funding is also available on a competitive basis through the Graduate School. Please see the Graduate School website for more information and to apply.

Conference Travel Fund: Doctoral students can apply to the Graduate School for up to $700 per year (June 1 through May 31) to attend a conference at which they present a poster or seminar.

Doctoral Research Travel Grant: Doctoral students can apply to the Graduate School for up to $1,000 per year (June 1 through May 31) to cover travel and related expenses for scholarly research. Given funding limitations, an application does not guarantee support.

International Travel Fund: Doctoral students can apply to the Graduate School for $600-$1,000 per year to support travel and expenses to present at a conference or conduct research. The awards are based on the distance of travel from Providence, RI. Given funding limitations, an application does not guarantee support.

Conference Travel Funds (Chemistry Department)

William R. Potter Chemistry Graduate Student Conference Travel Grants
The William R. Potter Fund provides grants to graduate students specializing in chemistry to support their travel to and participation in national chemistry conferences at which they present thesis research. All Chemistry graduate students and graduate students whose doctoral studies are directed by a Chemistry faculty member are eligible to apply after completing one year in the program.

Requirements for Organic Chemistry and Chemical Biology Graduate Students

Literature review (Summer and Semester 3)
All students will write a brief review of the literature that is relevant to their current project. This review should provide the reader with an introduction to the field, as well as identify important questions and challenges in the field. More information about the Literature Review can be found in Appendix (II).

Research Project Defense (RPD) (Semester 4)
Each student must present a research project proposal and defense in semester 4, typically the spring of their second year in the program. This consists of a written report in the format of a proposal, followed by an oral examination by the student's Thesis Committee.

The written research project report must be submitted to the committee by **February 1**. The student will then make an oral presentation of their research progress and future plans. This presentation must be **completed by March 30**. The responsibility for scheduling the RPD in a timely fashion lies with the student; please notify the Student Affairs Manager of the scheduled defense.

After the oral examination, the committee will approve, reject, or recommend revisions of the RPD. If the committee does not approve the RPD, the department will not guarantee support after Semester 4, and the student will be asked to leave the program. If revisions are requested, these must be submitted within two weeks of the date of the oral examination. Successful completion of the RPD is required in order to remain in good standing within the graduate program. **Students on academic warning as a result of poor Literature Review performance must provide compelling evidence of excellence in the execution and analysis of their research during their RPD in order to continue on into Semester 5**.

For more information on the preparation of RPDs, please refer to Appendix III.

The combination of literature review and RPD in Year 2 encourages the student to engage actively with their individual research project at an early career stage and focuses attention on both research accomplishments and the critical analyses that accompany execution of experiments.

Original Research Proposal
See Appendix IV for information about the original research proposal.

Seminar Presentations
Organic Chemistry graduate students are required to give at least three departmental seminars. The first is presented in the first semester of the second year of graduate study and is based on the literature review. The subject of the second seminar, presented in the first semester of the fourth year, is the candidate's thesis research. The third is the thesis defense presentation.

Requirements for Inorganic Chemistry Graduate Students

Literature review (Summer and Semester 3)

All students will write a brief review of the literature that is relevant to their current project. This review should provide the reader with an introduction to the field, as well as identify important questions and challenges in the field. More information about the Literature Review can be found in Appendix (II).

Research Project Defense (RPD) (Semester 4)
Each student must prepare and defend a research project proposal in their fourth semester. The Research Project Defense consists of a written report in the format of a proposal with preliminary data presented and analyzed to support the project ideas, followed by an oral examination by the student's Thesis Committee. The written research project report must be submitted to the committee by **February 1**. The student will then make an oral presentation of their research progress and future plans. This presentation must be **completed by March 30th**. The responsibility for scheduling the RPD in a timely fashion lies with the student; please notify the Student Affairs Manager of the scheduled defense.

The proposal must be prepared in accordance with the guidelines for ACS PRF Type-DNI "Starter" Grants. **Submissions, which do not satisfy these criteria, will be returned for revision.** Questions about the requirements should be directed to the research advisor or committee members.

The RPD provides students the opportunity to present their early research accomplishments and to formulate future research plans. The RPD provides a valuable opportunity for students to improve their written and spoken communication skills and independent research abilities.

After the oral examination, the committee will approve, reject or recommend revisions of the RPD. If revisions are requested, these must be submitted within two weeks of the request. If the committee does not approve the RPD, the department will not guarantee support after Semester 4, and the student will be asked to leave the program. **Students on academic warning as a result of poor literature review performance must provide compelling evidence of excellence in the execution and analysis of their research during their RPD in order to continue into Semester 5**.

Original Research Proposal
See Appendix IV for information about the original research proposal.

Seminar Presentations
Inorganic Chemistry graduate students are required to give at least three departmental seminars. The first is presented in the first semester of the second year of graduate study and is based on the literature review. The subject of the second seminar, presented in the fourth year, is the candidate's thesis research. The third is the thesis defense presentation.

Requirements for Physical Chemistry Graduate Students

Literature review (Summer, Semester 3, Semester 4)

All students will write a brief review of the literature that is relevant to their current project. This review should provide the reader with an introduction to the field, as well as identify important questions and challenges in the field. All second-year physical chemists will present a "Tea Session" based on the Literature Review in semester 4. In this seminar students present their literature review AND present their progress in research. This combined literature review presentation and progress in research presentation is a pass/fail milestone, as decided by the Thesis Committee. Upon successful completion of this milestone, students advance to candidacy.

Physical Tea Session Presentation

Physical Chemistry graduate students are required to give at least three departmental seminars. The first is presented in the second semester of the second year of graduate study and is based on the literature review and the candidate's progress in research. The subject of the second seminar, presented in the fourth year, is the candidate's thesis research. The third is the thesis defense presentation.

Original Research Proposal

Physical Chemistry graduate students normally prepare and defend their original research proposal between semesters 5 and 8. See Appendix IV for information about the original research proposal.

The Thesis

The central theme of graduate education is the completion of a doctoral dissertation, or thesis, embodying original research. Most of a graduate student's time will be devoted to thesis research, particularly after the first year. In the following sections, some of the procedures related to thesis research are discussed.

Defense of the Thesis

When a student has completed a written dissertation in a form considered acceptable by the research advisor (this need not be the final version, but it should be the finalized draft), one copy should be provided to each of the Thesis Committee members at least two weeks before the scheduled defense time. Although it is not required, a reader from outside the Chemistry Department may be invited to participate in evaluating the thesis. An electronic copy of the thesis, along with a brief abstract, should be deposited with the Graduate Student Program Coordinator for the convenience of any other members of the faculty who may wish to read the thesis prior to the oral examination**. For a degree that is to be awarded in May, the Graduate School deadline for submission of the thesis and all associated forms and documents related to the completion of a PhD is the first business day in May.** In the usual case, a thesis will be approved subject to minor revisions suggested by the advisor, committee members, and readers. In the rare case that readers request substantial alterations, the thesis advisor and student must come to an agreement on what must be done, with the mediation of the Department Chair if necessary.

The student should consult with the Student Affairs Manager and the thesis committee members to set a time and place for the oral examination. **Normally, the thesis defense cannot be scheduled earlier than two weeks following submission of the final draft in order to give the readers ample time to review the thesis.** A presiding officer, often the thesis advisor, will be designated for the examination. Arrangements will be made by the Student Affairs Manager and will then be reported to the Graduate School, which will confirm the date and time with all concerned.

After the defense of the thesis, the Student Affairs Manager will return the *Report of the Final Examination* to the Graduate School. The candidate can still make final corrections to the thesis and then should submit the final thesis, which should include the student’s name, advisor’s name, and graduation year, to the Graduate School by the required deadlines. A finalized electronic copy of the thesis should also be provided to the Student Affairs Manager.

Prizes and Awards

There are five major prizes and awards given to chemistry graduate students in May. The recipients of each award are discussed and voted on by the faculty. In addition to the public recognition of achievement, some prizes carry a monetary award.

Potter Prize
Students completing theses judged to be of outstanding merit are eligible for the Potter Prize. This prize, awarded annually, goes to the best chemistry PhD dissertation of the year.

William T. King Prize
The King Prize recognizes outstanding performance as a teaching assistant during the academic year. The prize may be awarded annually to one or two graduate students whose efforts as a teacher and facilitator of chemical learning go beyond normal expectations.

Sigma Xi Award for Excellence in Graduate Research
The Sigma Xi Award for Excellence in Graduate Research recognizes outstanding research accomplishments during a graduate student's career. Students in their last year of graduate study are eligible.

Dissertation Fellowship
Each academic year the department endeavors to provide one or two dissertation fellowships. Students in their last year of graduate study are eligible for nomination.

Elaine Chase Leadership and Service Award
This award recognizes the student whose extraordinary leadership and service contributions during her/his years at Brown improved the department or the academic and educational experiences of students.

Post PhD Placement

Our alumni pursue a variety of careers in science and beyond. In order to facilitate your transition to life after the PhD, it is important that you take advantage of professional development opportunities including attending *Chemistry Career Series* presentations (see below), networking events, and career fairs frequently hosted at Brown. It is also important that you continually evaluate and re-evaluate your own goals over the course of the PhD and seek out opportunities that further those goals. While the Department and University have established some career programming, it is ultimately each student's responsibility to research and plan ahead regarding their own future careers.

Placement of PhDs is accomplished in a number of different ways, through:

1. Faculty and Alumni contacts with industry, government laboratories, and other universities;
2. Contact Brown Career Lab for CV and cover letter writing tips; https://www.brown.edu/campus-life/support/careerlab
3. Following up notices of job openings appearing in C&E News;
4. Web resources (e.g., www.chemjobs.net/chemjobs.html/LinkedIn).
5. Interviews with industrial representatives visiting Brown or at scientific meetings;
6. Letter-writing campaigns by the student.
7. Networking with alumni, campus visitors, and other speakers.
8. For those interested in business and technology transfer, attending business and entrepreneurship events at the Nelson Center for Entrepreneurship.
9. For those interested in teaching, attending Sheridan Center for Teaching and Learning events.

A student's job chances may well depend on their ability to expand areas of interest and knowledge outside the immediate area of the thesis.

Department Student-Advisor Expectations

Graduate school is about training you to ask and address new questions and discover your passion. Having honest and open discussions with your advisor is an important part of your training. As a graduate student, you own your education. That means not only being responsible for your dissertation, but also actively getting the training you need and seeking guidance from your mentor(s), who will support you as partners in your training. We embrace the following expectations for both students and advisors in the Department. Additional expectations and more specific mentor-mentee compacts may be developed between students and advisors in individual research groups.

Student Expectations

- Take the primary responsibility for the successful completion of my degree.
- Meet regularly with my advisor and provide them with updates on the progress and results of my activities and experiments.
- Work with my research advisor to discuss course work, select a committee, and develop a thesis/dissertation project.
- Initiate requests for feedback and seek advice from my advisor, committee, and other mentors.
- Engage in active communication with my mentor, lab mates, and collaborators. I will respond in a timely fashion to all requests regarding my graduate research, teaching, and other milestones.
- Be knowledgeable of the policies and requirements of my Home Program and University.
- Adhere to the departmental doctoral program guidelines as outlined in this Handbook.
- Attend and participate in required lab meetings, seminars, and journal clubs.
- Keep up with original literature in my field.
- Be a good lab citizen, maintaining a safe and clean space and working collegially with everyone. Understand and meet laboratory obligations and responsibilities.
- Maintain a detailed, organized, and accurate lab notebook.
- Discuss policies on work hours, sick leave, and vacation with my advisor.
- Discuss policies on authorship and attendance at professional meetings with my advisor.
- Pursue professional development opportunities that will acquaint me with post-PhD opportunities.
- Attend all mandatory laboratory safety training, maintain a safe working environment, and promote a culture of safety.
- Maintain the highest standards of scientific and personal integrity.
- Respect and abide by the Brown University Academic Code Graduate Student edition.

Advisor Expectations

- Be committed to advisee's education and training as a future member of the scientific community.
- Be committed to helping plan and direct advisee's research project, allowing advisee to take ownership of their research while setting reasonable goals and establishing a timeline for completion.
- Provide regular and honest feedback regarding research, teaching, and other

milestones on an ongoing basis.

- Establish clear communication and mentorship expectations with each student, including potentially developing individual mentor/mentee compacts and individual development plans.
- Be committed to improving as a mentor.
- Be open, encouraging advisee to come to you with concerns and helping to find acceptable solutions to problems as they arise.
- Guide advisee through the program's requirements/deadlines.
- Advise and assist advisee with thesis committee selection.
- Lead by example and facilitate advisee's training in complementary skills needed to be a successful scientist, such as communication, writing, management, and ethical behavior.
- Discuss authorship policies, acknowledge advisee's scientific contributions to the lab, and work with advisee to publish their work in a timely manner prior to graduation.
- Maintain the highest standards of scientific and personal integrity.
- Attend all mandatory laboratory safety training, maintain a safe working environment, and promote a culture of safety.

Student Rights and Responsibilities

As a member of the Chemistry Department and the Brown University community there are expectations regarding your behavior. It is your responsibility to be aware of the Principles of the Brown University Community. These can be found at the Student Rights and Responsibilities web site: https://www.brown.edu/offices/student-conduct/code/rights. You should also be aware of what is described in the most current graduate student union (GLO) agreement (**2023-2026**).

Time Away from the Lab

As PhD students receive continuous 12 month funding, you are expected to continue making degree progress and to fulfill the duties of your given appointment during the fall, spring, and summer periods. You are eligible for time off during official University holidays (employee holiday schedule, but without the *Employee Appreciation Days*). There are also a variety of leaves outlined in the Graduate School Handbook (e.g., medical, personal, parental, etc), which should be discussed with a your research advisor or DGS. Additional time off should be discussed and cleared with a student's research advisor (varies from individual groups, but 2-3 weeks may be deemed reasonable), and it is imperative to inform the Student Affairs Manager of the anticipated time away from the University, especially if travelling outside of the country.

Social Events and Related Committees

The Department and the Graduate Student Leadership Committee (GSLC) host a number of social events planned and coordinated by the graduate students. These include monthly social gatherings, a Fall poster session, a Holiday Party, and a Welcome picnic/cook-out in August.

Senior graduate students are invited to dinners honoring the invited guests following Appleton and Clapp Lectures.

Graduate Student Leadership Committee (GSLC)

The GSLC is a group of ~8-10 graduate students from various lab groups throughout the department. The committee works to build community among our graduate students and postdocs by hosting events such as a weekly Journal Club and monthly socials. The committee comprises students from each year of graduate study, years 2-5.

Diversity and Inclusion Action Committee

The Chemistry Diversity and Inclusion Action Committee is a committee of students, staff, and faculty committed to advancing diversity and inclusion within our department. Historically, the committee has organized Department Climate Surveys, cultural festivals, hosted speakers from a wide range of backgrounds, and fostered discussions.

Coalition of International Students

The Coalition of International Students is a student group dedicated to fostering inclusion for International Students and more generally promoting intercultural exchange and understanding in the Department. The group regularly hosts cultural festivals, including Diwali and Chinese New Year celebrations, and dialogues regarding International Student affairs. The Coalition of International Students additionally helps students find the advice and support they need regarding Visa and other International Student policies.

Chemistry Careers Alumni Speaker Series

A seminar series focused on bringing back Brown Chemistry alumni (primarily Brown Chemistry Ph.D. alumni, ~3-6 / year) from varied professional careers and backgrounds to enhance professional development, career preparedness, and networking. Students interested in a particular career path or area, or general suggestions and questions should email Prof. Robinson (jerome_robinson@brown.edu).

Graduate Student Faculty Committee

The Brown Chemistry PhD Program aims to create a strong support network for its students. To do so, we have established a faculty committee that assists with graduate student affairs and is available for consultation upon request. You should always feel free to approach members of this committee if you ever have concerns.

Sarah Delaney, Department Chair (GC 201). Oversees the departmental administration, presides over the chemistry department faculty meetings, and is responsible to the University administration for the overall operations of the Department of Chemistry.

Jerome Robinson, Director of Graduate Studies (GC 341). Provides necessary information and guidance for student course/research group selections, supports students' fellowship/award applications, guides students regarding their academic needs, and leads discussions regarding and finalizes grading of student performance after each semester. Also oversees several departmental programs focused on professional development and career pathways, such as the *Chemistry Career Series* (& *Distinguished Alumni Series*), *Graduate Student Ambassador Program*, and *Chemistry Career Planning Workshop*. Please feel free to schedule an appointment via email.

Ou Chen, Officer of International Student Affairs (GC 343). Serves as a point of contact at the faculty level to support and provide useful information to international students in the Department. Serves as a bridging point of contact between Brown OISSS and international students in the Department.

Ming Xian, Organic Chemistry Advising (GC 447). Advises incoming organic chemistry graduate students regarding course work, rotations, and research group selections.

Eunsuk Kim, Inorganic Chemistry Advising (GC 327). Advises incoming inorganic chemistry graduate students regarding course work, rotations, and research group selections.

Megan Kizer, Diversity and Inclusion (GC 325). Oversees the Department Diversity and Inclusion Action Committee and related seminars, trainings, and climate surveys.

Yusong Bai, Physical Chemistry Advising (GC 347). Advises incoming physical chemistry graduate students regarding course work, rotations, and research group selections. Please feel free to schedule an appointment via email.

Administrative and Support Staff and Facilities

Departmental Administrators and Non-Academic Staff

The Chemistry Department has a Chair and, at any one time, approximately 20 non-academic staff that oversee and perform the various operations of the department. Following is a listing of the current non-academic staff and brief job description.

Sarah Delaney, Chair (GC 201). Oversees the departmental administration, presides over the chemistry department faculty meetings, and is responsible to the University administration for the overall operations of the Department of Chemistry.

Sheila Quigley, Academic Department Manager (GC 201). Assists the Chair in day-to-day management of the department, oversees instructional, research and general departmental expenditures to ensure that they stay within the budgeted amounts, responsible for faculty appointments (including all postdoctoral researcher and visiting faculty), building access, and manages non-academic staff.

Olanda Estrada dos Santos, Manager of Finance and Research Administration (MM 212). Responsible for all department financial activity, payroll and research grants pre award and post award management.

Rose Barreira, Student Affairs Manager (GC 203). Responsible for maintaining the records of incoming, present and former graduate students, processing of graduate student applications, and scheduling the graduate student orientation week. Assists in financial management of the department.

Kim Keenan, Administrative Assistant (GC 201). Provides general administrative support to faculty for Chem. 330, 350 and 360.

Melissa Shein, Seminar and Programming Coordinator (GC 201). Provides general administrative support to faculty. Coordinates departmental faculty searches and department seminar series.

John Geleney, Manager, Undergraduate Laboratories (MM 217). Responsible for the setup of the undergraduate laboratories. Works directly with Teaching Assistants to assure that these laboratories operate as smoothly and safely as possible. **Fred Guerzon** assists Mr. Geleney in operating the MacMillan Labs.

Ken Talbot, Technical Supervisor - Machine Shop (GC 213). The Machine Shop provides technical support, instrumentation design and fabrication for research groups**.** Some machine and hand tools are available for student use in the student shop adjacent to the main machine shop. Please consult Machine Shop personnel for instruction before the start of any project. **Randy Goulet** assists Mr. Talbot in providing Machine Shop services to the department. Students wishing to use equipment in the student machine shop or in the glass shop should contact Mr. Talbot.

Joshua Nolan, Electronics Technician (GC 321). The Electronics Technician is available to assist in the design and fabrication of electronic circuits associated with the test and measurement research projects as well as service and repair electronic equipment in the Chemistry Department. The electronics shop is open to the students and faculty for the design fabrication of electronic equipment.

Adrienne Roehrich, PhD, Facility Supervisor (MM 212). Responsible for the maintenance and supervision of the high field NMR spectrometers in the department, which are located in GeoChem 410. Responsible for maintaining and supervising the use of the mass spectrometry facility, which is located in GeoChem 408.

Additionally, the Facility Supervisor provides routine and advanced NMR training sessions and is available for consultation regarding any NMR related questions. New students are required to undergo NMR training prior to obtaining access to the NMR spectrometers. If problems develop while you are using an NMR spectrometer, please report it to the supervisor as soon as possible and document the occurrence in the logbook located next to each spectrometer. Emergency contact information is located next to each spectrometer. Detailed information on how to run routine and advanced NMR experiments and information on NMR training sessions is located at:
http://www.brown.edu/academics/chemistry/facilities/instrumentation/nmr.html

For routine MS analysis, contact the MS Specialist to discuss specific research needs. Each user will complete a "Request for Mass Spectrometry Analysis" form (available in GC 408) with detailed information about a particular mass spec sample. FAB, EI or ESI high resolution mass spec (HRMS) measurements are performed by the MS Specialist. MALDI, bench-top ESI and GC-MS instruments are available for graduate students and postdocs to carry out analysis on their own. In these instances, a short training session is required before signing up for blocks of time to use the instrument. Additional Mass Spectrometry information is located at:
http://www.brown.edu/academics/chemistry/facilities/instrumentation/massspec.html

Departmental Services

Copy Machines. The department copy machines are located in GC 257. This copier is a full function copy machine equipped with a collator, stapler, fax and PDF functions. The use of transparencies is not allowed on this copier. Access to the copier requires the use of your ID card. For maintenance and service problems, contact Eric Friedfeld (x3-3179). **Copy machines are to be used for departmental purposes only.**

Mail. Incoming mail is distributed to the boxes outside of GC249 daily. Outgoing mail may be placed in the tray atop the mailboxes. The department will pay the postage on mail directly related to research, but not for personal mail.

Keys and Card Access. Each student is issued a lab/office key and card access to the GeoChem and MacMillan buildings. See Sheila Quigley (GC 201) for after-hours building card access and GeoChem keys. See John Geleney (MM 217) for keys allowing access to the NMR in MacMillan Hall. Keys no longer needed should be returned promptly. Any loss of a key should be reported immediately.

Lounge. GC 349 is the departmental lounge. The department provides a microwave oven, and refrigerator. **Please do your part to keep the lounge area neat and clean.** The only regularly scheduled time that the lounge will not be available is Wednesdays from 4-6 PM during the academic year. In addition, some research groups use GC 349 for group meetings.

Pets in the Department. It is the policy of the Department of Chemistry that pets or other animals are prohibited from all laboratories, offices, seminar rooms, and classrooms at all times. This prohibition does not apply to trained service dogs in accordance with relevant Federal, State, and University regulations.

University Services

Graduate students will occasionally have need of services or supplies not available in the Department. Some possible sources within the University are mentioned below.

The **Bio-Med stockroom** carries some items not found in the chemistry stockroom. Please talk with Olanda Estrada or your research advisor concerning purchasing privileges at the Bio-Med stockroom.

The University offers **extensive computing resources**, from personal computers to work stations to mainframes, as well as links to remote supercomputing facilities. A description of some of these resources is listed in the "Computing in the Chemistry Department" section of this handbook. For further information, contact chem-it @ brown.edu.

The **Facilities Management Response** number is x 3-7800. They should be called for building related problems after-hours. During business hours, please contact Sheila Quigley (x3-9618).

Support Services for Graduate Students

When facing challenges, graduate students should consult their graduate advisor, the DGS, or the Department Chair (in that order), if at all possible. The Ombuds Office also provides confidential listening and advice. Deans from the Graduate School are also available for consultation, as are Counseling and Psychological Services and Student Accessibility Services. An additional listing of support services for graduate students can be found at the Graduate School's Graduate Student Resources page.

The Chemistry Department supports and adheres to the Graduate School grievance procedures. These procedures outline a clear process by which formal complaints, grievances, and appeals can be made.

Graduate study is a years-long process. To support our students more fully, Brown provides a variety of trained staff members to assist students through the academic, professional, and personal difficulties which may arise. These people are Dean Maria Suarez (Associate Dean of Student Support, x 3-1802; maria_suarez@brown.edu), staff at Counseling and Psychological Services (x 3-3476), and the Office of the Chaplain (x 3-2344). These individuals engage in confidential discussions of matters that may be affecting students' lives and work.

In some cases, circumstances may lead to the development of or trigger physical, psychological, sensory or learning disabilities. Brown University's office of Student Accessibility Services (SAS) offers assistance to undergraduate, graduate, and medical students with disabilities. The office provides counseling, guidance in the development of self-advocacy skills and other services.

SAS also assists in determining what accommodations can be made to help students achieve their educational goals. The office does not impose accommodations on students. However, if a student wishes to seek accommodations, the first step is to register with the SAS office. All conversations and interactions with the office are confidential. Students with questions about registering and / or accommodations are encouraged to contact SAS for a confidential review of the available options https://www.brown.edu/campus-life/support/accessibility-services/

Maria Suarez, Associate Dean of Student Support in the Graduate School, is dedicated to serving master's and PhD students. She can also assist with the medical leave process and answer any questions about other types of leave. Her office is located at Horace Mann 110, and she can be reached at maria_suarez@brown.edu or at 401-863-1802).

The LGBTQ Center and the Sarah Doyle Center for Women and Gender both support students around issues of gender and sexuality. The LGBTQ Center provides assistance with recording a lived or chosen name change into University systems to support T* students. https://www.brown.edu/campus-life/support/lgbtq/transbrown/name-email-and-id-card-change The center is located in 321 Stephen Robert '62 Campus Center.

Safety and Security Guidelines

The most up to date information related to safety at Brown University is located at the Environmental Health and Safety (EHS) website:
http://www.brown.edu/Administration/EHS/
This website details information relating to safety guidelines, regulations and training. It is each student's responsibility to carefully read the Chemical Hygiene Plan and Laboratory Safety Manual: http://www.brown.edu/Administration/EHS/lab/chp/

An Occupational Safety and Health Administration (OSHA) standard titled "Occupational Exposures to Hazardous Chemicals in Laboratories" was enacted in 1991. This standard requires all organizations with laboratory employees to implement exposure control programs and to convey chemical health and safety information to laboratory employees working with hazardous chemicals.

The standard's intent is to ensure that laboratory employees are apprised of the hazards of chemicals in their work area, and that appropriate work practices and procedures are in place to protect laboratory employees from chemical health and safety hazards. The manner in which Brown University is complying with each of the elements in OSHA's Laboratory Standard is detailed in the Chemical Hygiene Plan & Laboratory Safety Manual (CHP). A copy of the CHP has been sent to each Laboratory Supervisor responsible for a research or teaching laboratory in which hazardous chemicals are handled. In addition, a copy of this standard and its appendices may be obtained by visiting the OSHA's web site at http://www.osha.gov/

The aim of the following information is to highlight and not replace safety information presented on the EHS website: **http://www.brown.edu/Administration/EHS/**.

Accident Prevention

A gram of prevention in a chemistry laboratory is worth at least a kilo of cure. Careless work or uninformed practices can lead to explosions, electrical shocks, poisonings and other accidents. It is up to each individual to take steps to minimize danger and understand what to do in the case of an accident or emergency. Furthermore, teaching assistants are responsible for the safety of the students working under their supervision. Do not silently tolerate unsafe conditions or practices. If you feel that a situation is dangerous, bring it to the attention of the individual involved, the research group leader or a member of the department Safety Committee.

The detailed standards for chemical exposures, machinery guards, etc. are available on the Environmental Health & Safety website: **http://www.brown.edu/Administration/EHS/**. A wide variety of resource books are also available in the stockroom, GC 221. Material Safety Data Sheets (MSDS) can be obtained from chemical suppliers for all chemicals purchased and at the following URL: http://www.brown.edu/Administration/EHS/lab/msdsindex.htm.
The Office of Environmental Health and Safety strongly recommends that each person read the MSDS of the product that they are using prior to working with it. Extensive references are also available regarding the prudent and safe handling and disposal of chemicals.

DO NOT JEOPARDIZE YOURSELF OR OTHERS THROUGH IGNORANCE. When carrying out a procedure for the first time or working with unfamiliar materials, take the time to familiarize yourself with the properties of the materials you are handling and the recommended procedures for their use and eventual disposal. Each research worker is responsible for being familiar with the following points, and for applying the rules and precautions in a thoughtful way.

ALL EMERGENCIES SHOULD BE REPORTED TO PUBLIC SAFETY AT 401-863-4111.

Chemical Spill Guidance - In the event of a chemical spill, the following action should be taken:

1. Immediately alert all personnel to evacuate the room.
2. Once everyone is out, close the door behind you.
3. Move to a nearby phone and contact Brown University Public Safety at 401-863-4111.
4. Tend to injured or contaminated personnel.
5. Stay in the general area, a safe distance away, and wait for emergency responders.
6. Make a point to introduce yourself to emergency response personnel so that if they have any questions they know who you are.

Non-Emergency Situations -To report non-emergency situations to EHS staff or to request assistance from EHS staff during normal business hours, please contact **401-863-3353**.
All accidents or injuries occurring should be reported to Sheila Quigley, Department Coordinator (x 3-9618). In addition, any accidents that occur in the undergraduate laboratories (Macmillan Hall) must be reported immediately to John Geleney, Manager of the Undergraduate Labs (x 3-2737) - regardless of how minor it may seem.

Lab Safety Basics

Each lab is equipped with a Chemical Hygiene Plan (CHP) specific to that lab's environment, equipment and usage. When you join a research group, you will be required to read this plan and sign an acknowledgement that you have understood and will abide by its requirements. Basic lab safety requirements are outlined in Appendix III. Please familiarize yourself with your research labs CHP immediately.

As a member of the Chemistry Department, you are required to take lab safety, hazardous waste materials and other training courses appropriate for your research area through the Environmental Health and Safety. Log on to: http://brown.traincaster.com/ to register for the mandatory safety trainings. The Environmental Health and Safety will provide email notifications when trainings need to be updated. It is imperative that you comply with their requests.

Safety Training Guide

Type/ Requirement	Attendance Interval	Contact

Laboratory Safety Training is required for any individual working (paid or unpaid) in a Brown University laboratory	Initial training required within the first 3 months of assignment and every 5 years thereafter or as otherwise specified.	Chemical Hygiene Officer 3-1737
Hazardous Waste Training is required for ALL individuals who generate and/or handle hazardous waste in a research or teaching laboratory	Initial training required within 30 days of assignment and annually thereafter or as otherwise specified.	Environmental Specialist 3-1610
Radiation Safety Training is required for ALL employees who work with radioactive materials or x-ray machines	Initial training is required prior to working with radioactive materials and every five years thereafter or as otherwise specified.	Radiation Safety Officer 3-1738
X-ray Safety Training is required for ALL employees who work with x-ray machines	Initial training is required prior to working with and x-ray machine and every five years thereafter or as otherwise specified.	Radiation Safety Officer 3-1738
Laser Safety Training is required for any operator or user of a class 3b or 4 lasers	Initial training and baseline eye exam is required prior to working with a Class 3b or 4 laser and every five years thereafter or as otherwise specified.	Radiation Safety Officer 3-1738
Biosafety Training is required for any person who works in a Brown University laboratory with microbial agents pathogenic to humans and/or animals	Biological Safety Training Initial Biosafety Training is required within 3 months of initial assignment to a laboratory and every five years thereafter	Biosafety Officer 3-3087

Working Alone

Faculty, **Postdoctoral Associates and Graduate Students** may work alone in areas other than offices provided the following minimum safety criteria. EHS policy states: Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous. **Undergraduates**. Under no circumstances is an undergraduate permitted to perform laboratory work without immediate supervision by a faculty member or other authorized person.

Unattended Reactions. Reaction safety cards are available to print and laminate so you can alert others of potential hazards and instructions for unattended reactions.

Water hoses. All water hoses on distillation apparatus must be secured with copper wire or (preferably) clamps. If a reaction must be run overnight unattended, automatic shutdown valves and switches must be installed.

Emergency telephone numbers. Contact public safety for all emergencies; 3-4111. Each laboratory must have posted an Emergency Telephone Number Card listing whom to call in case of emergency.

Personal Safety Equipment

Eye Protection

Rhode Island State law **requires** all workers in laboratories (including students and visitors) to wear adequate eye protection. Goggles, which give complete protection, are best, and should be worn in all situations known to be hazardous. Ordinary safety glasses with side shields should be worn at all other times in the laboratory. If you normally wear prescription glasses, you should have safety glasses ground to your prescription. In experiments involving any suspected risk of explosion, a safety shield should be used in addition to goggles. Lanyards for safety glasses are available in the stockroom.

Safety glasses are available from the stockroom or from our blanket vendors such as VWR and Fisher Scientific. Prescription glasses can be obtained from the EHS (4th floor, Brown Office Building).

Face shields for graduate research are available from the stockroom. These should be used in addition to your personal safety glasses when needed.

Acid impervious aprons can be purchased from the stockroom. These are for graduate research only.

Fire Prevention

Do not wait until you have a fire to learn the location of fire extinguishers, safety showers, exits and fire alarms. Please note all laboratory doors must be closed at all times to ensure the proper operation of the fume hoods.

Location of Fire Alarms.

Fire alarm boxes are positioned throughout the building. Make sure you know where the one nearest your laboratory is located. Most laboratories also have heat detectors mounted on the ceiling, which trigger the fire alarm if heated. The alarm system, however triggered, summons Brown Security and the Providence Fire Department. It does NOT summon the Providence Rescue Squad. When an alarm sounds, stop what you are doing as quickly and safely as possible and leave the building by the shortest route.

Exit Routes.

Plan your exit routes in case of emergencies. Anticipate possible locked or blocked doors.

Use of Fire Extinguishers.

Learn the location of the nearest fire extinguisher and how to use it. These devices are typically located at the exit of the laboratory. If you have never used a fire extinguisher, read the instructions on an extinguisher now. Demonstrations of fire extinguishers are held in the fall in connection with teaching assistant orientations. Note: it is Brown University's policy that one is never required to use a fire extinguisher.

Metal Fires.
Treated sand for smothering metal or metal-hydride fires is available from the stockroom. Obtain some before using metal compounds such as lithium aluminum hydride, sodium or potassium borohydride, sodium, potassium, lithium, etc. Never use water on solvent or metal fires. Distillations using reducing metals must be carried out only in those hoods located near a 50 lb. Class D fire extinguisher. The hoods must be cleared of other flammables before beginning the distillation.

In Case of Fire

1. **Small Fires.** If the fire is confined to a wastebasket or sink, put it out with the appropriate fire extinguisher.

2. **Large Fires**. If the fire looks at all unconquerable with the use of only one fire extinguisher,
   a. Shout a warning and call Brown Emergency at x3-4111.
   b. Pull the nearest fire alarm.
   c. Send someone to meet the firefighters to show them where the fire is;
   d. Alert all people in the immediate area;
   e. Confine the fire by closing doors, and
   f. Then, if there is still time, try to extinguish it with available equipment. Always position yourself between the fire and an exit so your safety and exit strategy is assured.

3. **Refilling Used Extinguishers**. It is your responsibility to notify the stockroom of partially used or empty fire extinguishers for refilling. The University Fire Marshal's office requires a written statement of why the fire extinguisher was used.

Chemical and Other Common Hazards
Know the toxicity, flammability and explosive hazard of the chemicals you are working with before you begin work. Once you know what you are working with, it is your responsibility to take steps to ensure your own safety and that of others in the laboratory. The following books are kept in GC 221 and should be consulted for information on safe handling practices, safe and environmentally sound disposal, questions of toxicology, etc.:

1. "Prudent Practices for Handling Hazardous Chemicals in Laboratories"
2. "Safety. Sigma-Aldrich Library of Safety Data" NIOSH Registry of Toxic Effects of Chemical Substances"
3. "Dangerous Properties of Industrial Materials", Sax,
4. "Clinical Toxicology of Commercial Products", Gleason, et al,
5. "Hazardous Chemicals Data"
6. "Manual of Hazardous Chemical Reactions"

7. "Flash Point Index of Trade Name Liquids"
8. "The Merck Index"

Material Safety Data Sheets (MSDS) for individual chemicals are available upon request from suppliers and are typically available on their web sites. Additional references are available in the Environmental Health & Safety (EHS) office (4th floor, Brown Office Building) as well as their website: **http://www.brown.edu/Administration/EHS/**

Toxicity

It is your responsibility to consult the NIOSH Registry when signing out chemicals from the stockroom. A copy is kept at the sign-out window. Your signature is required in the appropriate space on the sign-out card. Any new or unknown substance not referenced in the chemical literature must be treated as potentially highly toxic.

Carcinogens

Many cancer-causing chemicals (carcinogens) and cancer suspect agents are under strict governmental control. A current list of those controlled includes the following compounds. Be aware that this list may be modified and updated and that the most accurate information is available through Brown's Environmental Health & Safety office.

Acetylamino fluorene	4-Dimethylaminoazobenzene
Acrylonitrile	Diphenylhydantoin(Phenytoin, Dilantin)
Aflatoxin B2, G1	Ethyleneimine (Aziridine)
4-Aminodiphenyl	Hydrazine
Arsenic (inorganic)	Melphalan
Auramine	Methyl chloromethyl ether (CMME)
Benzene	4,4-Methylene-bis (alpha chloroaniline) (MOCA)
Benzidine and salts	Alpha and Beta Naphthylamine
N,N-bis(2-chloroethyl)-2-naphthylamine	4-Nitrobiphenyl
Bis-(chloromethyl)-ether	N-Nitrosodimethylamine
Cyclophosphamide	2-Oxetanone, (Beta-Propiolactone)
1,2-Dibromo-3-chloropropane (DBCP)	Oxymetholone
3,3'-Dichlorobenzidine and salts	Phenactin
Diethylstilbestrol	Vinyl chloride (Chloroethylene)

Controlled compounds bear a warning label and require specific disposal procedures OSHA have set maximal concentrations (threshold limit values, TLV) for many controlled and uncontrolled compounds in air. These are published in the NIOSH Registry. Students should reduce exposure to these compounds by wearing gloves and working in a fume hood. Consult your advisor about specific compounds.

A complete list of category I carcinogens (principally those that have caused cancer in two or more animal species), regulated (controlled) carcinogens, teratogens (chemicals that cause birth

defects), poisons, and compounds with serious cumulative toxicity is available in the stockroom office.

Many other compounds have recently been identified as causally related to cancer or other important human and animal illnesses. Stockroom lists are continually updated, but the best precaution is to check the published literature (MSDS) on any compound in use. Avoid those that can be replaced by less dangerous ones, and use them only with proper precaution. If you find a potential conflict between your work and your health, point it out to your research advisor and to the Safety Committee so that something can be done to enable you to work safely.

Carcinogenic materials may not be used in the Undergraduate Instructional Laboratories. If you are aware of any violations of this rule, you should report this information to the department Chair.

Explosives
The possibility of explosion must be carefully considered. Any reaction that releases more than about 0.1 kcal of heat per gram of reactant is potentially explosive. The most common hazards are combustion reactions and reactions that produce nitrogen. Solvent vapors and dusts are particularly dangerous. The following compounds are listed as explosive. The use of these compounds in the Chemistry Department will be restricted:

- 2,4-dinitrophenylhydrazine
- Picric acid
- Hydrazine Hydrate
- Trinitrobenzene Acetyl peroxide
- Peroxyformic acid
- Azide salts and hydrazoic acid

Flammability
Do not work with open flames any more than necessary and when doing so clear the area of flammable material.

Storage of Chemicals
Flammable solvents should be kept in relatively small amounts and, whenever possible, stored in safety cans or approved solvent storage cabinets. Never leave glass jugs of solvents on the floor where they can be kicked accidentally. Use common sense on chemical storage. Store your hazardous materials well away from your workspace in a place where they are unlikely to be knocked from shelves or desks. **Always label all containers as to contents and if applicable show hazardous warnings.** This is even true of wash solvents used for cleaning and solvents in plastic spray bottles.

Disposal of Chemicals
According to State & Federal law all hazardous chemical waste must be collected, labeled, and packaged for disposal. All students and faculty are required to complete Hazardous Waste Training every year. Detailed information may be found at the EHS web site at: **http://www.brown.edu/Administration/EHS/**

Collection of large quantities of chemical waste should be done in 5-gallon or 16-gallon containers available in the chemistry stockroom. Collection of small quantities of hazardous waste should be done in clean and empty amber solvent bottles. Solid wastes can be collected in 1-gallon aluminum paint cans available in the chemistry stockroom. Sink disposal of hazardous waste is strictly forbidden. As soon as waste is added to a container, fill out an orange HAZARDOUS WASTE label (available in the stockroom) and affix it to the side of the container. Labels must be filled out accurately and completely. Abbreviated chemical names or formulas are NOT ACCEPTABLE only full chemical names or product names should be used.

Hazardous Waste containers must be stored in a secondary containment tray at all times to prevent accidental release or spills from occurring. Containers must be closed at all times unless ACTIVELY adding to the container. Once a container is full you should date it, put it back in the secondary containment tray to await pick-up. Full containers will be picked up by an EHS representative twice a week or as requested by calling x3-3353. If possible, neutralize or destroy any chemical hazard before collecting the waste. There are several Hazardous Chemical Disposal Guides available for reference in GC 221. The unlawful disposal of hazardous chemical waste is a serious offense. Please handle all chemical waste responsibly.

Gas Cylinders
Treat every gas cylinder as a potential bomb! When not in use, keep the caps on. Always have cylinders well secured to a firm support, whether full or empty.

Cylinder carts. Use only the cylinder carts with four wheels for transporting compressed gases. Eight carts are available. When not in use return to the central cylinder storage area in the stockroom.

Safety solvent storage cans with spring loaded caps and fire-retardant screens.

Electrical Circuits
Make sure that electrical apparatus is properly grounded. Insulate or enclose all current carrying parts, even if set-up is only temporary. If in doubt, contact the Electronics Technician. When trouble-shooting electrical apparatus, make sure that it is completely disconnected from the power source. But in the cases where it is necessary to work on live circuits, work on a wooden stool and on a wooden bench, and never put both hands in the vicinity of the circuit. Real damage from electrical shock occurs when the current passes through your torso; restricting the exposure to one hand significantly minimizes the danger.

High Pressure and Vacuum Equipment
All pressure and vacuum equipment requires intelligent use to avoid explosion or implosion. Any large glass vessels (Dewars, vacuum desiccators) must be wrapped or enclosed. If a reaction must be carried out in a closed system, a safety shield and other reasonable precautions are essential.

Lasers
The one rule to remember about laser safety if you are not actually doing such type of research is **DO NOT WALK INTO A ROOM WITH A LASER IN IT. KNOCK FIRST** and wait to be let in.

See the EHS Website for more information on Laser Safety:
http://www.brown.edu/Administration/EHS

Radioactive Chemicals and Radiation-Producing Apparatus.
To use radioactive materials a Radiation Safety License is necessary. This license is obtained with the help of the Radiation Safety Officer (x3-3353); you will be made aware of the various procedures which are required for the acquisition, handling, storage, and safe disposal of radioactive materials and be required to follow stringent record-keeping procedures associated with the above activities. In addition, any apparatus that is likely to emit or leak radiation such as x-ray generators or microwave generators must be reported to the Safety Office.

Housekeeping
Attention to the following rules will help prevent accidents:

- Keep benches, tables, hoods, floors, aisles and desks clear of all materials not being used.
- Keep a clear and adequate passageway to exits.
- Keep clear space around safety showers, fire extinguishers, fire blankets, eye fountains, and electrical controls.
- Keep floors clean of spilled ice, and other small debris that might be a tripping or slipping hazard.
- Clean up spills and dispose of the materials used to absorb the spill.
- Remove and dispose of broken glass.
- Use proper waste-disposal receptacles for solvent, glass, paper, etc.
- Keep chemical containers clean and properly labeled.
- Retain only the quantities of supplies needed for current work.
- Disassemble and return to storage surplus equipment.
- Hang clothing in its proper place; do not drape over equipment and workbenches.
- Syringe needles must be disposed of as broken glass, in the labeled containers. If chemical residues are present, they must be disposed of as solid waste. **Under no circumstances can they ever be disposed of in the wastebaskets**.

The Safety Committee
There is a standing Departmental Safety Committee with general responsibility for promoting good safety practices and acting as a liaison with the EHS lab safety staff.

The EHS staff makes frequent inspection tours of all labs and will report any problems to the PI/advisor in charge of that lab. Please remember to report any hazardous situations to your advisor, the Chemistry Department front office (GC201), or the EHS office ASAP.

In Case of Injury

If the injury is serious, call Brown Police and Security at x3-4111. Do NOT attempt to move the victim. **Pulling the fire alarm does NOT call the Rescue Squad**.

While waiting for outside help, administer first aid if you are qualified. First aid cabinets are located at various spots in the building, primarily by the freight elevator and bathrooms. Familiarize yourself with their locations and contents. Any shortages should be reported to the stockroom. The best first aid for chemical burns or splashes is continuous flushing with copious amounts of water (at least 10 minutes) regardless of the nature of the chemical. Even if a

contaminant is reactive with water, the mechanical action of flowing water will remove it from the body.

In cases of less serious accidents for which treatment is required, go to the Andrews House Infirmary on Brown and Benevolent Streets.

An Accident Investigation Report must be filled in for all accidents, including those that occur during Undergraduate Instructional Laboratories. These forms are available on the EHS website: **http://www.brown.edu/Administration/EHS/**

All accidents must be reported to the Department front office as soon as possible.

Security

Petty (and sometimes not so petty) thefts have been a serious problem in the department. Do not leave valuables - purses, wallets, cellphones, laptops, pocket calculators, etc. in plain view. Lock such things in desks whenever possible. If you see a suspicious or unfamiliar person, contact the Security Office, x3-3322 as well as the front office, GC201.

Laptops and other portable electronics are prime targets for theft and should never be left unattended in labs or offices. You may purchase a lockdown for your laptop at the bookstore but be aware that these are not foolproof. No lock is guaranteed against the efforts of a determined thief. When you are going to be gone from your workstation for any length of time, it is recommended that you take the items with you or put them away out of sight in a locked desk or file cabinet.

The University does not provide insurance coverage for damage or loss to your personal property, even if it happens on campus. For more information on security and individual insurance for personal property, please visit this website:
http://www.brown.edu/about/administration/insurance/

Only individuals associated with the department have a right to be in the building after hours. Do not let unidentified persons into the building. If you have guests in the department, you are responsible for their activities while they are on the premises. Never prop the outside doors open at night or open department windows.

Building Maintenance

Facilities issues, from burned out light bulbs and spill clean-ups to plumbing, electrical and air conditioning failures, should be reported to Sheila Quigley (x3-9618) for GeoChem and John Geleney (x3-2737) for MacMillan Hall. At night or on weekends you may contact the Department of Facilities Management directly at x3-7800 for problems that are emergencies or need immediate attention.

Computing in the Chemistry Department

Please follow these steps to connect to the internet in the Department of Chemistry and utilize University web services and software requiring a username and password. Use this link to access getting connected at Brown Chemistry.

Begin by activating your Brown Account. Visit myaccount.brown.edu and click "Activate Here" to set up your Brown username and email account.

To access Brown's secure **wireless network**, visit http://wifi.brown.edu on campus and log in with your username and password. To register your computer with the department's **wired network**, please complete the following steps:

1. Install Anti-Virus Software. Computers registered with the Chemistry Department must have Brown-approved anti-virus software installed. For Windows 10, this means having Windows Defender activated. For Windows 7/8 and Mac, please install required software.

2. Register your Computer with Brown Chemistry. Email chem-it@brown.edu with the following information:

Brand and model of your computer
Operating System
Room in which you will be using your computer
MAC address/Ethernet card address of your computer

Please remember that all Brown University computing resources, including Chemistry department file servers and printers, fall under Brown's Computing & Information Services Acceptable Use Policy. If you haven't already, please read this policy and familiarize yourself with your rights and responsibilities.

Questions?
To resolve issues with Brown-owned research computers, faculty/staff computers, printing or for general questions, contact chem-it@brown.edu. For assistance with scientific computing, use of or access to our cluster, or scientific software licensing questions, contact chem-it@brown.edu.

Helpful Links

If you want to:	Click here:
To register your personal computer for the wired network or to resolve an issue with a Brown-owned research computer, faculty/staff computer or printing	Contact chem-it@brown.edu
For assistance with scientific computing and for connecting to our cluster	Contact chem-it@brown.edu
Resolve an issue with your personal computer	https://ithelp.brown.edu or 401-863-4357
Connect remotely using Brown's VPN	http://vpn.brown.edu/
Install Brown-licensed software	http://software.brown.edu/
Change your login or email password	https://myaccount.brown.edu/
Connect to Brown's secure wireless network	http://wifi.brown.edu/

The Chemistry Stockroom

Requisitioning Stockroom Supplies

The Chemistry stockroom has over 600 items for common research needs. To place an order, please fill in the pertinent information on the Google Sheet found on the stockroom website: Brown Chemistry Stockroom. All forms and a searchable PDF of the inventory can also be found here.

Once your order is entered, it will be processed by the Stockroom Room Coordinator who will pick your items and email you when it is ready, this usually occurs within 24 hrs. Please let us know if your order is for **Research or Teaching** when filling in the Google Sheet. Research orders are paid for by the PI, Teaching is paid for by the Department.

Once the item is ready for pickup you can schedule a pickup time on the Google Calendar which is also found on the Stockroom Website.

If you need to make an appointment to browse the stockroom for other items such as office supplies for example, please contact the Stockroom Coordinator at Ext 3-3102.

Chemical Tracking

All chemicals purchased are tracked in the Chemical Environmental Management System **(CEMS)**/(Barcode Tracking System). When chemicals are purchased from the stockroom, the Stockroom Coordinator will transfer the barcode to your lab location, so please be sure to provide your lab room # when you place your order.

When chemicals are finished each group is responsible for updating the barcode # within the CEMS system to indicate that the item is now empty. **It is the responsibility of each lab to maintain the integrity of their data in this system.** Therefore, it is highly recommended that a regularly scheduled reconciliation of these barcodes is performed to ensure this data is accurate and up-to-date.

The CEMS system was developed by the University of New Hampshire and is maintained in an on-going collaboration between UNH and Brown University.

Vendor Order Requisitions

Many of your research supply needs can be found in the Chemistry Stockroom. Items not available in the stockroom can be purchased through our Web ordering portal. We work with many vendors annually for various types of products and services i.e., gas cylinders, sample analysis, electronics, specialty chemicals and glassware. A list of Brown University Strategic Suppliers can be found here: Brown Strategic Suppliers

If you need to order items from other vendors you can now add them to the system through the Web Portal using the “add new vendor” button.

You can access our Web Order Portal at this link. Brown Chemistry Stockroom
Login as Guest with no password. Click the Green Button to begin order. Fill out the form fully and hit Submit Button. If you have to stop the order for some reason, please click the Cancel **Button** to end the order without creating a blank record in our system.

Click on the "Outside Vendor Order Form," and fill in the following information:

The information you will need includes:

- Vendor name
- Select if it is for research, teaching or administration
- Product description
- Quantity required
- Size
- Catalog number
- Advisors name
- Phone # and Vendor URL and if adding a new vendor.

These items are ordered from our vendors on a daily basis. Most Preferred Vendor order items are received within two to five days, if the items are in stock. You will receive a notice of receipt via e-mail when the item you ordered is received in the stockroom. The items can be picked up from the Stockroom after you book a pickup time on the stockroom google calendar. Sometimes items are on back-order and can take up to several months to be received. You will be notified of back-order status and asked whether you want to proceed with the order or if you want to cancel and try to order the item from another vendor. Please keep a record of your order and if it appears to be taking too long to receive, contact any of the stockroom personnel to help you track it.

Finally, the CEMS System has a complete list of all MSDS sheets for the entire chemical inventory within GeoChem and MacMillan Hall. Please make sure to familiarize yourself with this feature so you know the hazards of the chemicals you work with.

Purchase Orders placed through Ordering Portal

Special items and all **equipment orders over $5,000.00** must be purchased through the University Purchasing Department using a Brown University Purchase Requisition. These are processed through our Financial Management System called Work Day.

Any items over $25,000 require a Sole Source Form or three competing quotes to submit the Purchase Order. These forms can be found on the Purchasing Website: Brown Purchasing Forms. You can place your Purchase Order Request through the Stockroom Ordering Portal using the Outside Vendor Order link found at Brown Chemistry Stockroom.

Please be sure to insert any quotes or sole source forms as PDFs in the system. Also make sure to complete the **justification field** for any orders being charged to Federal Grant Account number which usually begin with GR, as an example GR5260025.

Proper justifications are required for all orders. Details on what is required for a proper justification can be found here: Brown Chemistry Stockroom. Talk to your PI or our Manager of Finance and Research Administration if you need help with this.

As the requisitioning party you are required to supply correct order information. This includes complete vendor name and address, phone, fax and web address, current product information, catalog number, and pricing, as well as the **proper grant account number** paying for the purchase. **All orders must be approved by your research advisor prior to placing and must have proper justification for being charged to your grant account #.** It is your responsibility to get this approval from your advisor. Be sure you meet all the vendors' minimum order requirements.

Office Supplies

Daily office supply needs are located in GC 216A at the entrance to the stockroom. Please book a time with the Stockroom Coordinator to see what is available. Ext 3-3102
These office items are provided **for free for Chemistry Department personnel**. In addition, if there are any office items not found in the Stockroom, you may place orders through the Stockroom Ordering Portal with vendor: **W.B. Mason**.

Liquid Nitrogen

Liquid nitrogen can be dispensed by the liter from an LS-220 Dewar located in the Loading Dock GC 121. **Please use the insulated gloves located at the tank and your own eye protection.** Exercise caution while dispensing. Please use a Dewar to contain and transport liquid nitrogen. These transactions should also be logged **(item # 13-075)** on the clipboard next to the dewars for tracking purposes. If you have any questions about this process, please see any of the Stockroom personnel or a seasoned graduate researcher for assistance.

Dry Ice

Dry ice is kept in a storage cooler in GC 121 (Loading/Receiving Dock). There is a crusher located adjacent to the bin. A key is available from each lab or the stockroom to access the bin. Check with your PI for the location of this key. **Please be sure to use caution when using the ice crusher and remember to wear gloves and eye protection when shoveling the ice**. Make sure to enter the quantity taken on the clipboard next to the ice chest for tracking purposes. The item # for dry ice is **13-099**.

Cubed Ice

Ice machines are located in the south corridors of the third and fourth floors. **This ice is not intended for human consumption.**

Compressed Gas

Gas cylinders can be purchased, as needed using the Stockroom Ordering Portal with the Vendor: **Airgas Inc**. A list of the available gases can be found at **www.Airgas.com.** Cylinders ordered, if not specialty gases, will be received the following day. When received, the cylinders are stored in GC 121A (combustible gases) and 121B (inert gases). Your lab key will allow you access to

those rooms. If you have any specific specialty requirements, please discuss with the Purchasing Coordinator who can help Ext 3-1025.

There are several hand trucks in the receiving dock area for transporting the cylinders. Be sure to use the chain on the hand truck to firmly secure the cylinder before transporting it. When the cylinder is empty it must be stored in GC 121C (Empty Cylinders) for removal by the vendor.

OSHA regulations require that all cylinders be firmly secured while in use and in storage. Please use a cylinder harness in the lab and refasten the chain around those in storage when removing your cylinder from the full cylinder room. If you need further assistance with **specialty cylinders** or specific set ups, feel free to contact our **Air Gas Sales Representative**, at 774-271-2388 |Andrew.yentz@airgas.com. In addition, the stockroom staff can help answer questions.

Finally, please be aware that each cylinder ordered is paying a monthly rental fee, so if you have cylinders that are empty, or not being used that are inexpensive gases, it makes sense to return these cylinders to avoid wasting money on the monthly rental charges. Please be sure to bring all empty cylinders and dewars back to the loading dock, GC 121 so they can be returned ASAP.

Bulk Solvents

GC 217 located across from the elevator near the stockroom entrance is for the storage of bulk solvents and specialty fluids. We stock many 20 L cans of **100% ethanol, isopropanol, ethyl acetate, hexanes, dichloromethane, and acetone.** The inventory numbers are listed on each barrel as well as on the chalkboard near the stockroom check out table. Please bring an appropriate container to collect your solvent from the Bulk Room. We also sell 1- Gallon Plastic bottles in the stockroom if needed, **Item # 03-166.**

Only acetone, ethanol, ethyl acetate, and isopropanol can be dispensed in GC 217. EHS must approve any other chemicals. Please exercise extreme caution in this area, as the introduction of any source of ignition could be extremely dangerous due to the flammability of the vapors produced by these solvents. Please do not use cellular phones in this room. Please do not leave a bottle unattended while filling, and be sure to keep the containers in the secondary drip pans that are under the barrels. Grounding wires are attached to electrically ground the drums and should be attached to the metal vessels when dispensing.
The room is equipped with a Fire Suppression system in the case of fire. Please see any stockroom personnel if you are filling from this room for the first time to show you the proper procedure. Please also familiarize yourself with the laminated directions on the door of GC 217.

Resources

The Chemistry Stockroom has numerous catalogs and brochures of vendors and suppliers, and the stockroom personnel have a wealth of knowledge of where specific items can be procured. Always feel free to ask them for assistance if you are having difficulty finding something you need for your research. Various members of the faculty and staff also keep files of catalogs of equipment and chemicals of particular importance to their work. Finally, most of the major chemical vendors such as VWR, Fisher Scientific, Sigma Aldrich, etc. have extensive web sites that will help you in locating products and services you need. Always remember to shop your item across multiple vendors to make sure you are getting the best price possible. Also, **for any orders above $1000**

you should ask your sales rep for a quote to make sure they are giving you the best possible price. The more you save on each item, the further your research dollars will stretch. Please always ask the stockroom staff for help for any quotes as well.

APPENDIX I

Expectations and Responsibilities of Teaching Assistants and Student Mentors in Undergraduate Courses

As part of its mission, the Department of Chemistry at Brown University teaches a large number of undergraduate students in its teaching laboratories. Part of graduate students' professional training at Brown includes teaching in the laboratories. This document clarifies the expectations and responsibilities for two kinds of assistants, referred to as "teaching assistants" and "student mentors."

Briefly, teaching assistants help the undergraduates learn the techniques and theories behind the experiments. They also carry primary responsibility for the safe and orderly operation of the laboratories, and for enforcing rules for waste disposal. The mentors assist students in carrying out the experiments by facilitating the understanding of the experiments and providing peer leadership in an active learning environment.
Specific expectations and responsibilities of the teaching assistants and mentors are:

1. Teaching Assistants (TAs)

Teaching assistants are graduate students who assist faculty in the teaching of a course. Teaching is an integral part of the graduate school experience in Chemistry. Graduate students acquire teaching skills, learn about teaching techniques, and obtain an in-depth understanding of all the issues surrounding the teaching of Chemistry in the undergraduate curriculum.
The primary roles of teaching assistants are:

- Teach chemistry and chemistry laboratory methods to undergraduate students.
- Aid students in conducting and understanding of laboratory experiments and in the understanding of the course material.
- Ensure the safe operation of the laboratory. Enforce the usage of all protection measures appropriate for safe laboratory practice, such as wearing safety glasses or gloves, and the use of the fume hoods.
- Enforce all applicable laws and rules relating to the proper treatment of the chemicals and the waste produced in the experiments.
- Provide guidance to the student mentors.

Activities related to these roles include:

- Proctor and grade course examinations and laboratory quizzes.
- Grade laboratory reports and maintain accurate record keeping of grades.
- Hold office hours to assist undergraduates with course lecture and laboratory material.
- Attend training sessions for experiments and grading procedures.

Teaching Assistants must successfully complete the Laboratory Safety Training and the Hazardous Waste Training courses provided by the Office of Environmental Health and Safety, covering the key elements of the University's laboratory safety and hazardous waste disposal. These courses include issues related to chemical hazards, fire safety, elementary first aid, personal protective equipment, general guidelines for working with chemicals, and emergency procedures.

In certain cases, or, with the approval of the department chair or the Chemistry Department's Graduate Admissions Committee, students in a related science such as engineering, physics, biochemistry, or biology may serve as TAs or mentors.

All teaching assistants must be certified in English at an appropriate level.

2. Student Mentors

Undergraduate student mentors may assist faculty and graduate students in teaching a course. Undergraduate student mentors may assist in a laboratory.

The expectations and responsibilities of student mentors are as follows:

- Facilitate enrolled student understanding of course content.
- Encourage an interactive and stimulating learning environment.
- Facilitate communication among students, and between students and TAs.
- Tutor students in the material relating to the laboratory or the lectures.
- Provide leadership to their peers.

Mentors must have successfully completed the relevant chemistry course. They must also satisfactorily complete the Laboratory Safety Training and the Hazardous Waste Training courses provided by the Office of Environmental Health and Safety, covering the key elements of the University's laboratory safety and hazardous waste disposal. These courses include issues related to chemical hazards, fire safety, elementary first aid, personal protective equipment, general guidelines for working with chemicals, and emergency procedures.

Once per semester, teaching assistants are evaluated by the students in their lab section. All teaching evaluations are online.

APPENDIX II

GUIDELINES FOR THE PREPARATION OF THE LITERATURE REVIEW

All students will write a brief review of the literature that is relevant to their current project. This review should be between 3,500 and 4,000 words and provide the reader with an introduction to the field, as well as identify important questions and challenges in the field.

Prior to writing the review, you will submit a short abstract of the project, detailed outline, and complete annotated bibliography. The abstract is meant to briefly explain the project. The outline should have section titles, along with a list of articles to be discussed in each section. The bibliography for the review should not be longer than 30 papers. Papers cited may include:

1. up to 5 papers from the PI's research group
2. 20 - 25 primary literature papers from outside the research group organized by the student's view of how they relate to their current research objective
3. up to 2 recent review articles

References must be presented with full citations including titles of articles and full list of authors. Each reference should be annotated with a brief one-sentence justification for why this paper has been included in the bibliography. A few examples are given below, with the justification shown in italics. References should be formatted using the conventions of the journals commonly used in your research group/area.

> Grammel M, Hang HC: Chemical reporters for biological discovery. Nat Chem Biol 2013, 9:475-484.
> *An up-to-date survey of the chemical reporters and their applications.*
>
> Chen Z, Paley DW, Wei L, Weisman AL, Friesner RA, Nuckolls C, □ Min W: Multicolor live-cell chemical imaging by isotopically edited alkyne vibrational palette. J Am Chem Soc 2014, 136:8027-8033.
> *This paper demonstrated that isotopic substitutions of alkynes can be used for multicolor bioorthogonal Raman imaging.*
>
> Pejchal R, Doores KJ, Walker LM, Khayat R, Huang PS, Wang SK, Stanfield RL, Julien JP, Ramos A, Crispin M Depetris R, Katpally U, Marozsan A, Cupo A, Maloveste S, Liu Y, McBride R, Ito Y, Sanders RW, Ogohara C, Paulson JC, Feizi T, Scanlan CN, Wong CH, Moore JP, Olson WC, Ward AB, Poignard P, Schief WR, Burton DR, Wilson IA: A potent and broad neutralizing antibody recognizes and penetrates the HIV glycan shield. Science 2011, 334:1097-1103.
> *The first crystal structure of PGT128 in complex with a glycosylated outer domain of gp120. It reveals a novel mode of glycan antigen recognition highly valuable for vaccine design.*

Prior to submission, your review must be peer-reviewed by one of your classmates (another rising second year graduate student) and a senior graduate student. You will be asked to provide the names of these students.

Review format:
The review must be single spaced, with 1 inch margins and 12-point font. Pages must be numbered. The bibliography should be formatted as described above and include the one-sentence justifications.

Important Dates:
June 1 – Abstract, outline of review, and complete bibliography with one sentence justifications due to your committee and Graduate Student Program Coordinator.
August 15 – First draft of review due to peer reviewers; names of reviewers provided to Rose Barreira.
September 15 – Finished review due to your committee and Graduate Program Coordinator.

All documents should be submitted via email as .pdf files. Some committee members may ask for a .doc(x) file to make comments.

Oral presentation of review:
Organic Chemistry, Inorganic Chemistry, and Chemical Biology graduate students: Between September 15 and November 15 you will present a departmental seminar based on your literature review. These presentations will take place during the regularly scheduled Organic (Tuesdays) and Inorganic (Thursdays). Rose Barreira, the Graduate Program Coordinator will assist all students in scheduling the oral presentations. The talk should clearly state the objective of your research project and present the relevant background material for the project. You may elect to include some preliminary results from your own work, but this should be concise and take up no more than 5 slides. Your talk should be approximately 30 minutes. After the public portion of this seminar, your committee will meet with you privately. This meeting, the first between the student and their committee, is an opportunity for the committee to provide their feedback on your review and seminar; in some cases, the committee may suggest additional readings for the student to consider for their project, or to address deficiencies in understanding.

Physical Chemistry graduate students: In the spring semester (February 15-April 15) you will present a Physical Tea Session (Thursdays) based on your literature review and your progress in research. The talk should clearly state the objective of your research project, present the relevant background material for the project, and will describe your progress in research to date. Your talk should be approximately 45 minutes. After the public portion of this seminar, your committee will meet with you privately. This meeting, the first between the student and their committee, is an opportunity for the committee to provide their feedback on your review and seminar and to ask additional questions. For physical chemistry graduate students, this presentation and defense to the thesis committee is an evaluable milestone that must be passed in order to remain in "good standing" and advance to candidacy.

APPENDIX III

GUIDELINES FOR THE PREPARATION OF THE RESEARCH PROJECT DEFENSE (RPD)

Written Report

The written report for the RPD should contain the following 5 sections:

1. Abstract
2. Background and Significance (1-2 pages)
3. Progress Report--Experimental Results and Analysis (2-3 pages)
4. Research Proposal (4-5 pages)
5. Supporting Information (does not count towards 10 page total)

The total length of the report, excluding the supporting information, should not exceed 10 double spaced pages.

1. Abstract

Provide a one or two paragraph summary of the key findings and conclusions of the research described in the report.

2. Backgrounds and Significance

Briefly describe the background, significance, and justification for your project. This section should critically evaluate existing knowledge, and specifically identify the gaps in knowledge that your project is intended to fill. Much of the broader background for your project should have been addressed in your Semester 3 review, so the background of this section should only ***provide an update or fill in the gaps from the review***. A maximum of two pages is required for this section.

3. Progress Report

This section should describe the research results you have obtained to date. Provide an organized summary of the experiments or sets of experiments you have carried out. ***Clearly identify what questions are being asked or what hypotheses are being tested.*** This section is NOT intended to simply be a compendium of everything you have done since joining your research group. Rather, it must be a cogent presentation of your research as well as the analytical processes employed in responding to unanticipated and undesired results as they arose. The committee is interested in learning about WHAT you did as well as WHY you did it.

Regardless of whether your results are ready for publication or not, you should write with the clarity and focus that is expected for a published manuscript. Experimental and spectroscopic details should only be provided in this section if they are pertinent to the discussion. In general, experimental details should be provided in the Supporting Information.

4. Research Proposal

Provide a proposal for your research plan for the next two years. ***This should be broken down***

into individual specific aims, and each specific aim should be focused on a single hypothesis. Clearly articulate how the experiments that you propose to carry out will test the hypothesis. Discuss the potential difficulties and limitations of the proposed procedures and suggest alternative approaches to achieve the aims. Provide a timetable for achieving each specific aim.

5. Supporting Information

Experimental details for the experiments described in section 3 should be provided here. This section should use the guidelines from a top-tier journal in the field, which is appropriate for presenting the experimental results. Consult with your research advisor about the choice of standard, which is appropriate for your work, ***and clearly indicate this at the beginning of this section.*** Suggested journals included – J. Am. Chem. Soc / Science / PNAS / J. Org. Chem. / Langmuir / J. Phys. Chem / Biochemistry.

Format

The final proposal must be **double-spaced in 12-point font or larger, using 1" margins and no longer than 10 pages** including tables and figures, but excluding references. References must be presented with full citations including titles of articles and full list of authors.

Oral Report and Examination

You should prepare a 30–45-minute oral presentation of your research for the committee. Please contact Rose Barreira to schedule the RPD. While it is important for you to thoroughly understand the background of your research, the oral presentation is intended to focus on your own work and not extensively on the prior results in the field, which should have been covered in your semester 3 presentation. Thus, the RPD presentation should start with a ***very brief*** introduction to the problem at hand, but the bulk of the talk should present your own accomplishments and future research plans. It is very likely that the committee will interrupt frequently with questions, so the examinations should be scheduled for a two-hour time period. While your presentation should be semi-formal (PowerPoint presentation) you should also be prepared to go to the board to answer questions as they arise. The RPD is an evaluable milestone that must be passed in order to remain in "good standing" and advance to candidacy.

APPENDIX IV

GUIDELINES FOR THE PREPARATION OF THE ORIGINAL RESEARCH PROJECT (ORP)

The research proposal is an opportunity to define and present an **original idea** that is suitable for scientific investigation. In preparing the research proposal students must evaluate the feasibility and significance of a research problem. The quality of the proposal and its defense is used by the faculty as a measure of the progress of the student toward a doctorate in chemistry.

In order that students approach this experience in an unbiased way, **the research proposal should be concerned with a chemistry topic that is not directly related to research in their group**. If there are any doubts on the appropriateness of the topic, the student should consult their research supervisor or other faculty member for an opinion on the suitability of a particular idea. Specific assistance obtained from faculty or other sources, however, must be acknowledged in the proposal abstract.

ORP Deadlines: ORP abstracts should be submitted to the Thesis Committee and the Graduate Program Coordinator by the weekday closest to **September 7th.** Upon approval of the abstract, the student will prepare and submit a full proposal to the Thesis Committee and Graduate Program Coordinator. The student will schedule an ORP presentation and defense with her/his Thesis Committee. The full proposal must be submitted at least two weeks prior to the ORP defense. The ORP defense must be completed by **December 10th**.

There are three stages to this process: Proposal Abstract, Full Proposal, and Oral Defense.

Research Proposal Abstract

A project summary must be submitted to the Graduate Program Administrative Assistant and to members of the Thesis Committee.

The PhD committee will be made up of the student's research advisor plus two other faculty members that are in the area of research (see the list below). Students are responsible for requesting that individual faculty members serve on their committee and then notify the Graduate Program Administrative Assistant of the committee membership. A copy of the project summary should be provided to each faculty member that is on the PhD committee. The faculty will carry out a preliminary evaluation of the proposal on the basis of this summary statement.

The project summary must contain the following information:

1. A brief description of the significance of the project.
2. A **clear and concise list of specific aims and objectives.**
3. An overview of methods to be employed in order to achieve those specific aims.

4. A list of key references in ACS format. **References should include the complete titles of all articles, and a complete list of authors.**

The project summary must be single-spaced in 12-point font or larger, and it should be **no longer than 2 pages**, including tables and figures, but excluding references.
A project summary that does not provide sufficient detail about the proposed experiments will be returned without review, as will summaries that exceed the page limit. The results of this review will be transmitted to the student by the research supervisor.

Full Proposal

Once the project summary is approved, students should prepare the full proposal. The proposal should include sufficient information to permit evaluation without reviewers having to refer to the literature. Brevity and clarity are important indicators of the students' scientific communication skills. A successful proposal will answer the following questions: Why is the work important? What has already been done? What do you intend to do? How are you going to do the work?

The proposal should be a focused research proposal with a well-defined set of experiments, not an outline for a major multi-year, multi-person project. As a guideline, the proposal should encompass work that can be accomplished by a senior graduate student or post-doc in a year or two. While there are no formal restrictions on the scope of the proposal, a project that requires a full research group effort over several years is too ambitious due to the space and time constraints.

The proposal must be organized into the following three sections:

1. **Specific Aims.** State the specific purposes of the research proposal and the hypotheses to be tested. These must be clearly as well as concisely articulated, usually in no more than a few sentences per specific aim. Reasonable specific aims are not sweeping in scope, but neither do they dwell on the minutiae of the experiment.

2. **Background and Significance.** Sketch briefly the background to the proposal. State concisely the importance of the research described in the proposal by relating the specific aims to broad, long-term objectives and prior work in the field. While the space devoted to this section will vary, it is suggested that no more than 3 pages be devoted to the coverage of background and significance.

3. **Research Design and Methods.** Provide an outline of experiments and methodology that will be used to accomplish each specific aim. Potential experimental difficulties should be discussed together with alternative approaches that could achieve the desired aims.

Format

The final proposal must be **double-spaced in 12-point font or larger, using 1" margins and no longer than 10 pages** including tables and figures, but excluding references. References must be presented with full citations including titles of articles and full list of authors.

Submission

The final proposal should be submitted to your advisor and to the members of your PhD committee.

Oral Defense – Must be completed by the last day of classes of your fifth semester.

When the final version of the research proposal has been submitted, a time and date for the presentation should be arranged in consultation with the members of your committee and in consultation with Rose Barreira, the Graduate Student Program Coordinator to ensure that a room is available. **Allow at least 2 weeks between submission of the final version of the proposal and the date of the oral presentation.** Students should bring a copy of their proposal to the oral presentation. At the appointed time, students should present a brief (thirty minutes) description of their proposal and clarify any points that the examining committee may raise. Be prepared to discuss, at the oral defense, the resources, personnel, and time required for carrying out the experiments that are proposed.

In case a research proposition is found to be sub-standard, the student may be requested to write a paper or present a seminar in which the points raised during the oral presentation are explicitly addressed. In case of an unsatisfactory defense, an oral presentation of a second research proposition (on a different topic) may be requested, or in extreme cases the student may be asked to withdraw from the PhD program.

Following the ORP defense, the Graduate Affairs Manager will have the PhD committee enter their decision electronically on the "ORP Outcome" form. **In all cases, the oral defense must be completed satisfactorily by the end of the fifth semester in order for the department to certify that the student has successfully completed the preliminary requirements for the PhD.** The department does not guarantee financial support to any student that fails to satisfy the preliminary requirements within the required time.

Physical chemistry students refer to the "**Requirements for Physical Chemistry Graduate Students**, for submission deadlines.