

THE UNIVERSITY OF ARIZONA

**DEPARTMENT OF CHEMISTRY &
BIOCHEMISTRY**

**GRADUATE HANDBOOK
CHEMISTRY**

FALL 2016

CBC@UA!

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A. GENERAL DESCRIPTION OF THE CHEMISTRY GRADUATE PROGRAM

The major emphasis of the Ph.D. degree in Chemistry, after completion of all other degree requirements, is an original research project culminating in writing and defending a doctoral dissertation. With the help of the Research Director, the Dissertation Committee, and the departmental Graduate Program Committee (GPC), successful students complete the Chemistry graduate program with a solid training in contemporary chemical research, with an emphasis on academic scholarship, the creation of new knowledge, and the dissemination and defense of the product(s) of this research effort.

An alternate track which students may be placed into, or may choose to move into, is the Master of Science degree (M.S.), which involves less time and less course work commitment, but still involves an original research project, and training in research, culminating in writing and defending an M.S. thesis.

For those interested in the study of chemistry beyond the undergraduate level, but who are not interested in a career involving chemical research, the option of a Master of Arts degree (M.A.) is offered.

In addition, the program offers the opportunity for students to participate in an accelerated curriculum that leads to both the Bachelor of Science (B.S.) and Master of Science (M.S.) degrees in Chemistry. This curriculum follows the normal B.S. degree for three years, but adds two graduate level courses during their fourth year that are applied to the subsequent M.S. program.

It is important to realize that successful completion of a graduate degree program in Chemistry is your responsibility as a student. All of the necessary steps that are required to finally receive the degree are important. You should utilize resources the Graduate College makes available, including the Graduate Catalog and the Graduate College Handbook. This Chemistry Graduate Handbook is designed to assist you through the maze of graduate school requirements, but it is not all-inclusive. It is meant to be a useful guide, but does NOT serve as a contractual document.

The Research Director, along with the Dissertation Committee, will serve as guides and mentors to help train you as a scientist. Finally, the Graduate Program Coordinator and the GPC will do everything they can to keep you on track and to point you in the right direction. Nevertheless, you need to be focused and self-motivated to reach your goals.

Chemistry Ph.D. Program Timeline at a Glance

PRE-FIRST SEMESTER

Diagnostic Examinations	Qualifying Exams, prior to the start of the semester, help define the program of study for the first semester, identify deficiencies in background and possible pathways for remediation. Three exams must be passed by the end of the second semester, and a total of three attempts are allowed.
CBC Research Symposium	Held prior to the start of the semester, the CBC Research Symposium includes a poster session for new graduate students to familiarize themselves with research groups of interest.

FIRST SEMESTER

Course Work, Seminars	Course Work for the first semester is chosen in consultation with the GPC and is based on the projected Program of Study and performance on the Qualifying Exams. All students are expected to attend at least one weekly divisional or programmatic seminar as well as Departmental Colloquia.
Faculty Interviews	All students are required to interview individually with at least 6 faculty members. Begin individual interviews early and meet throughout the period from August-mid-October.
Research Director Selection	Students submit Report of Selection of Research Director form to the Graduate Program Coordinator by October 15, 2016 (for fall admits).
Research	Begin research when Research Director selection is approved (late October)

SECOND SEMESTER

Course Work and Seminars	Advised by Research Director. Submit Plan of Study to GPC by April 30 th . All students are expected to attend at least one weekly divisional or programmatic seminar as well as Departmental Colloquia.
Research	Continue research.
Evaluation of teaching performance – 1st Year	Your performance as a T.A. is considered to be a critical component of your training and your responsibility as graduate student at the University of Arizona

FIRST SUMMER

Research	Continue research.
Dissertation Committee	In consultation with Research Director, a Dissertation Committee must be selected by the first day of fall classes. Submit Proposed Dissertation Committee to the Graduate Program Coordinator and also record it in GradPath.

THIRD SEMESTER

Course Work and 1 st Seminar	Register for coursework according to Plan of Study. Attend appropriate divisional or programmatic seminars as well as Departmental Colloquia. Present seminars according to divisional or programmatic requirements.
Second Year Dissertation Committee Meeting	All students must meet with each committee member <i>individually</i> between May 30 and September 30 to discuss in particular their ideas for the oral proposal and to provide an informal status update on research, integration into their research group and any other questions / points of information necessary. Students must bring the 2 nd year meeting form and have it signed at the end of the meeting with each committee member.
Research	Continue research.
Written Comprehensive Examination	All oral proposals are due Nov 1 or the first Monday following. Faculty will return reviews prior to the last day of class in the Fall semester to provide students with enough time to improve the proposal or prepare for the oral exam. For Students starting in spring semester, the respective deadline is March 15.

FOURTH SEMESTER

Course Work and Seminars	Continue coursework as defined in accepted Plan of Study. Attend appropriate divisional or programmatic seminars as well as Departmental Colloquia. Present seminars according to divisional or programmatic requirements.
Research	Continue research.

Oral Comprehensive Examination

Schedule Oral Comprehensive Examination; examinations shall be scheduled for a date as soon as possible (ideally within six weeks) after passing evaluation of the Independent Research Proposal. **All students must take their oral examination no later than the end of the fifth semester.**

SECOND SUMMER

Research

Continue research. A written Annual Research Summary is due to your Dissertation Committee and the Graduate Program Coordinator on July 31.

REMAINING SEMESTERS

Course Work and Seminars

Make sure courses in Plan of Study have been completed and required seminars have been presented. Attend appropriate divisional or programmatic seminars as well as Departmental Colloquia.

Research

Continue research. A written Annual Research Summary is due to your Dissertation Committee and the Graduate Program Coordinator on July 31.

FINAL STEPS

Fourth Year Committee Meeting

Schedule a meeting with your Dissertation Committee to take place during the spring semester of your fourth year in residence. Prepare presentation on research progress and distribute written dissertation outline.

Seminar

Schedule and give final seminar as required by your division.

Dissertation

Complete dissertation, including proofreading, prior to delivery to Dissertation Committee members.

Final Oral Defense Examination

Schedule dissertation defense (final oral). Submit Announcement of Oral Defense Examination at least **two weeks** prior to oral. A penultimate draft of your dissertation should be given to your committee members at this time.

Submission of Dissertation

The revised dissertation must be submitted to the Graduate College within one year of the final oral examination. (Normally this should be done within a matter of days or weeks). **Continuous registration is required until the dissertation is submitted.**

ALL REQUIREMENTS FOR THE PH.D. DEGREE IN CHEMISTRY MUST BE COMPLETED WITHIN 5 YEARS OF PASSING THE ORAL COMPREHENSIVE EXAM.

B. EXPECTATIONS OF STUDENT & FACULTY

1. WHAT THE FACULTY EXPECT FROM THE STUDENTS

The faculty expect the students in this program to abide by the University of Arizona Academic Code of Conduct and the Academic Code of Integrity, as summarized in Section C of this Handbook. Failure to do so, at any time, may be grounds for dismissal from the graduate program, and from The University of Arizona. In addition, the faculty's expectations of the graduate students in this program are:

Research

- (a) to discover and enthusiastically pursue a unique topic of research in order to participate in the construction of new knowledge in your chosen field, and in the application of that knowledge to the solving of new problems in the chemical sciences,
- (b) to learn the research methods and historical knowledge basis of the discipline -- honoring the scholarship of those who came before you and learning what is needed to form viable research hypotheses,
- (c) to keep appropriate records of your research design, results and interpretation – this includes laboratory notebooks, regular digital backups, etc.,
- (d) to communicate regularly with faculty mentors and the masters/doctoral committees, especially in matters relating to your research and your progress within the degree program,
- (e) to exercise the highest integrity in all aspects of your work, especially in the tasks of collecting, analyzing and presenting research data,
- (f) to work responsibly toward completion of the degree in a timely fashion,
- (g) to mentor other students in the Department and individual research group and foster the regular exchange of research ideas and teamwork between group members.

Teaching

- (a) to participate enthusiastically in appropriate training and evaluation for all instructional roles you are assigned,
- (b) to perform (as opportunities arise) an appropriately sequenced variety of teaching duties relevant to your career expectations and likelihoods,
- (c) to devote the same seriousness to undergraduate instructional duties that you would expect from your own instructors.

Professional Development/Program Progress

- (a) to develop, to the extent possible, a broad network of professional relations,
- (b) to contribute, wherever possible, to the discourse of the scholarly discipline through conference presentations, publications, collaborative projects, and other means,
- (c) to seek out a range of faculty and peer mentors that can help you prepare for a variety of professional and career roles and responsibilities,
- (d) to take responsibility for keeping informed of regulations and policies governing your graduate studies and to complete all required paperwork and other degree obligations in a timely fashion.

Community

- (a) to create, in your classrooms and laboratories, an ethos of collegiality and collaboration,
- (b) to realize your responsibilities as an individual and professional representative of both the university as a whole, and the department or program in which you are studying,
- (c) to assist graduate student peers in their own professional and scholarly development.

2. WHAT THE STUDENT SHOULD EXPECT OF THE RESEARCH DIRECTOR AND HIS/HER DISSERTATION COMMITTEE

In general, you should expect your Research Director/Dissertation Committee to:

- (a) be willing to meet with you regularly,
- (b) be someone with whom you can talk freely and easily about research ideas, and your professional development
- (c) provide timely feedback on the quality of your work and the direction of your dissertation project
- (d) be someone you can trust to look out for your professional interests,
- (e) be willing and enthusiastic in giving you credit for the work you do,
- (f) be willing to tell you when your work does or does not meet the standards he/she has set for their research program,
- (g) be willing to help you graduate in a reasonable time frame, with a dissertation which tells a complete story, and is representative of Ph.D. level research at all of our peer institutions,
- (h) have an active, well-functioning research group for additional support when you are encountering difficulties.

It is unreasonable to expect one person to have all of the mentor qualities that you desire. You should therefore choose Dissertation Committee members who complement the strengths of your advisor.

3. WHAT THE STUDENT SHOULD EXPECT OF THE DEPARTMENT

- (a) Support as either a GTA or GRA for typically a minimum of five years, contingent upon your satisfactory academic progress and good standing in the department (as defined in Section F in this handbook).
- (b) Opportunities to develop skills beyond your specialty through seminars, short courses in department facilities, and interactions with renowned researchers,
- (c) Opportunities to provide feedback to the department and to review policies to ensure the quality of the department,
- (d) Classes begin and end on time,
- (e) Faculty are available for questions and office hours in a timely manner,
- (f) Faculty will provide prompt feedback on exams, quizzes, coursework, etc.

FALL 2016 INCOMING GRADUATE STUDENTS

Program	First	Last	School
CHEMPHD	Christopher Robert	Apostol	University Of Arizona
CHEMPHD	Anthony	Baldo	University Of California-Los Angeles
CHEMPHD	Nathan	Bamberger	Carleton College
BIOCPHD	Claudia	Barahona	Univ Autonoma De Nuevo Leon
CHEMPHD	Laura	Basantes	Universidad San Francisco de Quito USFQ
CHEMPHD	Jacob	Bernal	University Of Arizona
CHEMPHD	Thomas	Blackburn	Wesleyan University
CHEMPHD	Sarah	Blask	John Carroll University
CHEMPHD	Kyle	Carothers	Manchester College
CHEMPHD	Erik	Chavez	Northern Arizona University
CHEMPHD	Xiaoxiao	Chen	University Of Arizona
CHEMPHD	Clayton	Curtis	Manchester College
CHEMPHD	Ameen	Ghavam	Colorado School Of Mines
CHEMPHD	Tyler	Herman	Lawrence University
CHEMPHD	Michelle	Herridge	Missouri State University
CHEMPHD	James	Keener	University of California - Merced
BIOCPHD	Zekun	Liu	Georgetown University
CHEMMS	Kexin	Li	University Of Arizona
CHEMMA	Andrew	McDonald	University Of Arizona
BIOCPHD	Agata	Orlinski	Central Connecticut State University
CHEMPHD	Daniel	Plewa	University Of Arizona
CHEMPHD	Alyssa	Pollard	Emory University
CHEMPHD	Munaum	Qureshi	University Of Texas At Austin
CHEMPHD	Deseree	Reid	University Of Montana
BIOCPHD	Stephen	Smith	Brigham Young University
CHEMPHD	Jennifer	Tashiro	University of Arizona
BIOCPHD	Kristiane	Torgeson	California Polytechnic St U-San Luis Ob

Spring 2017

CHEMPHD	Alexander	Marciniak	University Of Bremen
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C. ACADEMIC CODE OF INTEGRITY AND CODE OF CONDUCT

Graduate Students in the Department of Chemistry and Biochemistry, University of Arizona are expected to have read, and understand, at least, the Academic Code of Conduct for the University of Arizona and the code of conduct sections (5-301 to 5-308) of the Arizona Board of Regents Policy Manual.

Code of Academic Integrity for the University of Arizona:

<http://deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity>

Arizona Board of Regents Policy Manual:

<http://www.azregents.edu/policymanual/default.aspx>

D. GRADUATE PROGRAM COMMITTEE (GPC) - STRUCTURE AND FUNCTION

The GPC has several important roles with regard to overseeing the Graduate Program. These include advising new students, monitoring student progress, and recommending awardees for fellowships. The committee consists of faculty members, graduate students who have passed their Oral Comprehensive Examination, and staff members. One of the goals of the committee is to help you tailor an academic program that fits your needs prior to your selection of a Research Director and Dissertation Committee who will guide the research component of your training. The GPC also tracks each student during his or her entire time in the program and meets regularly to discuss student progress. ***If you have a problem that cannot be solved by your advisor, or are unsure about what you need to do to meet departmental or Graduate College requirements, you can talk to one of the faculty, staff, or student representatives on the GPC at any time.***

The following people are serving on the GPC in 2016-2017:

GPC MEMBERS	ROOM	PHONE	E-MAIL
Dr. Oliver Monti, Chair	OC 216	626-1177	monti@email.arizona.edu
Dr. Indraneel Ghosh	CSB 410	621-6331	ghosh@email.arizona.edu
Dr. Nancy Horton	BSW 349	626-3828	nhorton@email.arizona.edu
Dr. Brooke Massani	Keck	621-3395	bbeam@email.arizona.edu
Dr. Jon Njardarson	CSML 442	626-0754	njardars@email.arizona.edu
Dr. Anne Padias	KOFF 201	621-9978	anne@u.arizona.edu
Dr. Jeanne Pemberton	CSB 302	621-8245	pembertn@email.arizona.edu
Dr. Andre Sanov	CSML 230	626-8399	sanov@email.arizona.edu
Ms. Lori Boyd	CHEM 223	621-4348	lboyd@email.arizona.edu
Students Reps			
Melissa Fairley	OC 108D	626-3387	fairley@email.arizona.edu
Lindsay Guzman			lindsayguzman@email.arizona.edu
Adam Meier	CSML 206		Meiera09@email.arizona.edu
Maggie Scavello	BSW 350		Mscavello91@email.arizona.edu

GRADUATE ADVISOR'S OFFICE

The Graduate Program Coordinator is responsible for keeping all records relating to your academic progress, though you should ensure that you retain duplicates where possible. All the various forms you will need during your career as a graduate student may be obtained from the Graduate Program Coordinator or the Graduate College.

E. FINANCIAL ASSISTANCE WHILE PURSUING THE PH.D. OR M.S. DEGREES

Most full-time students in good standing (as defined in Section F of this handbook) in the Ph.D. program in the Department of Chemistry and Biochemistry are provided with some form of financial assistance, typically in the form of an assistantship. Assistantships provide a stipend as well as health care and tuition benefits. The purpose of the assistantship is to provide moderate financial support that requires you to perform suitable tasks that are aligned with your degree program. Generally, financial assistance during the first year is provided in the form of a teaching assistantship for the academic year (approximately August 15 to May 15) and a research assistantship for the summer (May 15 to August 15). The summer research assistantship is generally paid by the student's Research Director. Otherwise, the student may be employed as a teaching assistant in the summer school program. Both In-state and Out-of-state tuition are waived for all teaching and research assistants, though all students are responsible for mandatory fees. A limited number of University Fellowships are available and are awarded competitively. Students should meet regularly with their Research Director and/or teaching supervisor to ensure that their performance is satisfactory. Unsatisfactory performance can result in removal from the program or loss of eligibility for financial support. Adequate performance in our graduate program is a full-time commitment and students are expected to perform all programmatic requirements to ensure that they are making progress towards their degree (coursework, research, etc.) as well as perform all assigned tasks defined for the assistantship. .

Registration for at least 12 units of graduate level credit (audit credits do not count) is required for having an assistantship.

1. TEACHING ASSISTANTSHIPS (TA)

While it is true that the teaching assistantship is a mechanism for supporting students during their graduate training, it can and should be an integral part of the training itself. As a TA you will have the opportunity to further consolidate your understanding of basic chemical principles, develop a formal, professional style of speaking and presentation of technical materials, and learn how to interact with a variety of personalities on a professional level.

Responsibilities and duties of a teaching assistant:

As a condition of a teaching assistantship, TAs are required to perform up to 20 hours of assigned tasks in addition to programmatic degree requirements. Your actions as a TA reflect on all of us. It is expected that all TAs will demonstrate the utmost in professional behavior.

Students awarded a teaching assistantship must attend the Department of Chemistry and Biochemistry Orientation and Training, Red Cross Multimedia Standard First Aid Course, successfully complete TATO (TA training on line); Lab Safety Training and on line FERPA (Family Educational Rights and Privacy Act of 1974) training. Additionally, students must demonstrate suitable proficiency in the English language. Students must provide written evidence of satisfactory completion of each of these requirements. This is required once and is typically accomplished during the weeks prior to the first semester of graduate school.

A Guide for General Chemistry Teaching Assistants (TAs)

Department of Chemistry and Biochemistry

The University of Arizona

Fall 2016

The General Chemistry courses at the UA follow a curriculum known as “Chemical Thinking.” This curriculum has been designed to introduce students to chemistry as a powerful way of thinking rather than as a static body of knowledge. Essential questions in the discipline are used to guide the presentation and discussion of content, emphasizing conceptual understanding of core concepts and ideas. Both in the lecture and in the laboratory, students are actively engaged in activities that ask them to analyze data, model chemical systems, and generate evidence-based explanations. Through these activities, students are expected to develop a basic understanding of how chemical thinking is useful in addressing critical problems in many areas of interest to modern societies, including environmental issues, human health, and energy demands. TAs play a central role in implementing core components of the “Chemical Thinking” curriculum. They are expected to actively engage students in the construction of their own understanding in the laboratory, in the lecture class, and during tutor hours.

General TA Workload Breakdown

0.5 FTE

Teaching 2 labs a week:	6 hours
Preparation:	1 hour
Staff meetings:	2 hours
Tutor/office hours	2 hours
Lab grading	4 hours
Exam proctoring/grading	2 hours
Lecture attendance	3 hours
	= 20 hours/week

0.25 FTE or Student Assistants (SAs)

Teaching 1 lab a week:	3 hours
Preparation:	1 hour
Staff Meetings:	2 hours
Office/Tutor hours:	1 hour
Lab Grading:	2 hours
Exam proctoring:	1 hour
	=10 hours/week

I. Laboratory Responsibilities

Description of Specific Duties

You will either be assigned to teach a general chemistry 151 or 152 lab and this handbook is specifically written for TAs of these courses. Most TAs are put on a half-time (0.5 FTE) position which equates to 20 hours per week for this position (please see the detailed breakdown above). This handbook will describe in detail most of your required duties and our expectations of your performance for this role but a brief run-down of your responsibilities for these 20 hours is that you will teach 2 labs per week with a maximum of 24 students in each lab. You will grade lab reports, proctor and

grade lecture exams (4 midterms and one final), tutor 2 hours per week in Koffler 202, attend weekly staff meetings, and attend lectures.

If you are a quarter time (0.25 FTE) TA you will teach 1 lab per week, grade lab reports, tutor one hour per week in Koffler 202, proctor lecture exams (4 midterms and one final), and attend weekly staff meetings (please see the detailed breakdown above).

Failure to perform your duties may lead to termination of this paid position and leave you in poor standing in the program. Termination of this position may lead to expulsion from the program. There will be 3 lead (mentor) TAs available to answer any questions you may have, address any concerns, and provide you with feedback as the semester progresses. These are some of our top TAs and I recommend you get to know them and respect any guidance they may provide you.

Preparation for Laboratory – Staff Meetings

You will attend mandatory weekly staff meetings on Fridays from 8:00 – 10:00 AM. The meetings will provide an overview and address important details for running the upcoming week's laboratory activities. There are two parts to each meeting. The first handles administrative details, introduces and offers guidelines on using the presentations (that serve to organize and structure the lab activities), addresses various aspects of grading, and discusses difficulties you may face and the resolution of these problems. The second half is a hands-on session conducted in an actual general chemistry teaching lab. Here you will perform a truncated version of the experimental work design to give you first-hand experience with the key and/or problematic steps. A pooling of the TA experimental results will follow, with reflection and discussion of data trends, difficulties encountered, and strategies for better facilitation. These meetings are a required part of your position as TA.

Teaching Laboratory Sections

It is imperative that you start and end your lab section(s) on time. Please arrive 5 - 10 minutes before the session starts. Do not allow your students into lab until the previous lab section has exited. Once in lab, check the lab-lecture area computer, HDTV and PowerPoint presentation status (you want to avoid embarrassing, time-wasting technical glitches). Carefully survey the lab, checking that everything is clean and orderly on ALL the main and side benches and ALL the hoods. Notify the on-duty prep-room attendant of any issues such as missing equipment, student lockers left unlocked from the previous section, supplies running low, chemistry in need of refilling, or chemical spills in need of attention. It is not your responsibility to restock the lab or find replacements for missing/non-functional equipment, but *it is* your responsibility to promptly notify the prep-room of any deficiencies so the matter can be corrected without delay.

If you are going to be late for your lab be sure to call the TSO (621-2555) so we can make the proper accommodations.

It is important to the program that you maintain teaching these labs in a learner-centered format and not in a traditional lecture style. You should guide or coach your class and have them provide the answers to questions. Defaulting to lecturing is easy to do and being prepared is the best way to combat this and continue with a classroom that focuses on the student learning and not the teaching.

Office Hours/Tutoring

These are technically the same thing and will be held in Koffler 202 at times to be assigned based on the schedule cards you fill out and give the TSO. You will have 2

hours per week (0.5 FTE) or 1 hour per week (0.25 FTE) in this room. It is expected that you are able to answer questions for both 151 and 152, independent of the current course you are teaching. Student questions range from homework assignments, lab related, report related, or lecture related material. Tutoring is done on a first-come-first-serve basis and you will help any and all students who come in with questions, not only your lab students. There is a sign-in/out sheet in the TSO for you to fill out each time you tutor. If you fail to do so you will receive an email from the TSO.

You are required to run your tutor/office hours in Koffler 202. This location cannot be changed.

Grading Lab Reports

Over the semester, you will grade three types of written lab assignments: worksheets, reports and proposals. There are specific rubrics for each and the Friday staff meetings will discuss the implementation of said rubrics. Just as we expect prompt submission from students, so we expect prompt grading from TAs. To be specific, all graded lab worksheets, reports and proposals **MUST BE** returned to your students *at the beginning of lab the following week*. It is vital that you make sure this happens. Avoid procrastination; it is strongly recommended that you complete the grading early on. In this way, if you have an emergency or encounter distractions planned or not, the grading will be behind you and your obligations to the students and the program met. After returning a graded assignment to your section, several brief overall comments to the entire class on *what could have been done better* and *what was done well* and the section's average should be given. Please keep in mind, when discussing grading, whether it be to the entire class or an individual student, avoid speaking in terms of taking points away, rather, use a more positive construction of where points were earned and what could be done to increase this in future work.

Assessment of Your Teaching

There will be several assessments of your teaching throughout the semester. The mentor TAs and/or Dr. Tori Hidalgo will be periodically, and without notice, stopping by your labs to do a formative assessment of your performance. There will be a follow up meeting regarding their observations that will take place with Dr. Tori Hidalgo and the TA who did the observing.

In addition, you will do a mid-semester evaluation based on your student's comments of their experience in lab up to that point.

Finally, there is an online summative assessment your students will do at the end of the semester, which is administered by the University TCE (Teaching Course Evaluation) team.

All of the above will be considered in an end of semester summative assessment and evaluation of your performance that is a committee based decision. The outcome of this meeting will determine future teaching assignments as well as the possibility of promotion. Letters of concern, probation, and termination will also be decided at this time.

II. Lecture Responsibilities

Attending Lecture

You will be assigned one lecture class to attend each semester you teach. You are responsible for attending every lecture in that section for the duration of the term. If you are unable to attend a class for some reason, you must email the professor and let them know in advance.

Your primary role in lecture is to help facilitate the student groups as they work on the in-class activities each professor will give. You should not spend more than 5-10 seconds without talking to a student, whether it be to answer a question or ask a group how they are doing. You should help guide the students with leading questions to either help them get started on an activity or redirect a group who is starting to branch into a different direction. We would like 100% of our students to be actively engaged in the activities. Although we know this isn't realistic, it is our ultimate goal, and we rely on you and the preceptors to help us achieve it.

Attending the lecture will also allow you to see where your students are in terms of the subject; helping you streamline your prelab lectures to use the appropriate terminology etc. and not get overly advanced in these discussions. It is important that you stay at the pace of the students learning and not go beyond what they have been introduced to. In my experience, this is one of the hardest parts of being a general chemistry TA. You have much more chemistry knowledge than your students and it can be hard at times to not answer questions in a way that is more advanced than the students' current understanding of the material. This will lead to a lot of frustration in your class. Going to lecture will also help you assist them better during tutor hours, brush you up on the subject (you will be asked questions from general chemistry during your second year oral exam), and will greatly help with the lecture exam grading you will be doing.

Proctoring Lecture Exams

There are 5 exams total to be proctored during the course of the semester, four 90 minute midterm exams which are held Friday's from 5:00 – 6:30 PM in a room TBD, and one 120 minute final exam on a day and time TBD. You will hand out exams, walk around being mindful of possible cheating, answer student questions that may arise during the exam, and help sort the exams once the test has ended. You are required to be at every exam given in a semester.

Grading Lecture Exams

Lecture exams have two parts: around 60% multiple choice questions and around 40% free answer questions. You will be responsible for grading the free answer portion of all exams. Immediately following the Friday exams all TAs and course instructors will meet to grade. At this time you will receive a rubric and specific instructions. Typically the grading needs to be finished by 12:00 PM the Monday following the exam.

III. Tutor/Office Hours

Part of your job description, as previously stated, is to hold tutor/office hours for 2 hours each week. This will begin on the Monday of the second week of classes and will be scheduled for you based on the schedule cards you submit to the TSO. There is a sign-in/out sheet in the TSO you are to fill in each time you tutor. If you fail to do so you will receive an email you are required to respond to. These are to be held in Koffler 202 only. **There are no exceptions to this rule.** You will have questions that can be broken down into two, broad categories: Lecture and Lab.

Lecture Based Questions:

Your role as a tutor is to help guide students to an answer, not answer the question for them. Often you will have students sit down and expect you to work through their homework for them. **DO NOT DO THIS!!!** You are there to provide guidance with questions regarding lecture material and it is expected that you ask leading questions to help the students find the answer themselves, not just answer any question they have for them.

It is expected that you can (and will) answer questions from both sections of general chemistry (151 and 152) independent of which course you are currently teaching.

Lab Based Questions:

You should be able to answer any and all lab based questions that are asked; however, unlike for lecture, if you have not taught the lab for one of the courses it is best to default these questions to someone who has/is. Unlike the lecture, the labs contain experiments that are probably new to you (synthesizing biodiesel fuel for example) and you are not expected to answer these questions until you have taught the course at least once. It is also best to lead students to their actual TA with questions regarding lab reports or worksheets if they are not your student.

IV. Top TA Traps

It is highly encouraged that you review this checklist and evaluate your teaching habits periodically through the semester. The mentor TAs are available to help you with any troubles you may be having.

General Management:

- Excessive use of lecturing in place of guided inquiry or facilitated group work.
- Preoccupation with posturing – behaving in a way intended to impress at the expense of student learning (the erudite peacock effect).
- Not comprehending or ignoring student questions.
- Not paying attention to the student’s engagement.
- Not interacting with students at their eye level.
- Using sarcasm, or any verbal and/or non-verbal behaviors that students may perceive as demeaning or unduly condescending.
- Adversarial relationship with students – competition over knowledge, ultimatums to gain compliance, statements that students perceive as threatening, etc.
- Failing to manage your lab time wisely – running out of time or having to skip activities.

In-Class Group Activities:

- Assisting or spending too much time with a subset of student pairs.
- Not circulating while listening to and watching all the student pairs before interacting with one.
- Not calling on individual students to explain what the group (pair) have concluded.
- Not assessing your class and diagnosing which pair(s) are having the most difficulty with the material and/or cooperating with one another.

Lab Sessions:

- Failing to carefully read the project guide and/or associated technical guides.
- Being unfamiliar with the project resources and procedural details.

- Not reviewing (running through) the PowerPoint presentation in preparation for the session.
- Permitting pairs that finish early to leave rather than confirming their learning and understanding with leading questions and encouraging further work to build confidence in their claimed result(s).

TA Duties:

- Putting off the grading.
- Not actively participating in staff meetings.
- Being tardy to lab and/or staff meetings.
- Letting lab out late (running beyond the allotted time).

V. Miscellaneous

Professional Development Course (a.k.a. Professional Development, 495/595c)

All first time TAs and first year graduate students are required to attend a once a week course aimed at helping you develop your teaching skills, inform you of some graduate policies (if you are a graduate student), and guide you through your first semester teaching in the department. This course will also keep you up to date on some departmental policies and will give information such as picking a research director, fellowship and CV writing etc. These meetings are Wednesday mornings from 8:00-8:50 in Chem 209. It is a one credit, pass/fail course and is required by the department.

Mentor TAs

There are 3 mentor TAs each semester. These TAs are handpicked based on experience and performance. They are intended to be a source of information for you and should be the first place you go when questions arise or you have any concerns regarding your class. I strongly encourage you to take advantage of their knowledge and experience. They are also the people who will be performing formative assessments and be present during any follow-up meetings.

2. RESEARCH ASSISTANTSHIPS (RA)

Students who have been offered financial assistance are eligible to be paid as graduate research assistants by the Research Director. (A RA during the first year of graduate study must be approved by the Department Head.) Continuation in these research assistantships is based upon availability of research funds and adequate performance of the students in making progress toward completion of their degree program.

F. DEPARTMENTAL AND GRADUATE COLLEGE POLICIES

1. Registration Policy

- a) All students who are accepted into the graduate program in the Department of Chemistry and Biochemistry are expected to have completed one year of **PHYSICAL CHEMISTRY** during their undergraduate studies. Students who lack the physical chemistry requirement are occasionally admitted into the program with the understanding that they will remedy the deficiency during their first year of studies at the University of Arizona by taking CHEM 480a, and CHEM 480b or CHEM 481 or a course recommended by the GPC.
- b) Full-time students must take the appropriate number of graduate level units during a Fall or Spring semester in order to be eligible for either a research or a teaching assistantship. Consult with the Graduate Program Coordinator. Summer registration is not required at this time.
- c) Graduate students intending to drop classes with a W grade are advised that this is only allowed in exceptional circumstances and with explicit permission by the GPC. Failure to comply means that the student will no longer be in good standing (as defined in Section F of this handbook).
- d) The Graduate College requires registration each fall and spring from original matriculation until all degree requirements, including submission of the final copy of the thesis or dissertation, are completed.

2. Academic Probation Policy

At the end of the first semester:

- a) Full-time graduate students who are placed on academic probation according to Graduate College or Department of Chemistry and Biochemistry rules,* may be recommended for Departmental financial support for a second semester, during which time the **academic probation must be removed**. These appointments are based upon availability of funds and the department's needs for teaching assistants.

*Graduate College rules require a GPA of 3.00 or better in ALL graduate courses; The Department of Chemistry and Biochemistry rules require a grade of B or better in all graduate courses approved by the GPC as counting toward the Ph.D. degree, as well as a minimum GPA of 3.00.

Students whose GPA falls below 3.0 as calculated by the Graduate College OR the Department of Chemistry and Biochemistry may be placed on academic probation or be dismissed from the program depending on the severity of the GPA deficit. Students on academic probation have one semester in which to bring their GPA up to 3.0. No student will be allowed more than one semester on academic probation.

Continuing Graduate Students:

- a) Continuing graduate students who have not previously been on academic probation, but whose cumulative GPA by Graduate College and/or Departmental rules falls below 3.00, and are therefore placed on academic probation, may be eligible for Departmental support as a Teaching or Research Assistant during the

subsequent semester, depending upon the support available and the student's overall record.

- b) Probationary status **must** be removed in the semester immediately following its incurrence.
- c) A student may be on probationary status for no more than one semester during their entire graduate program. A second instance of probationary status will result in loss of eligibility for continued Departmental financial support and the student will be counseled to withdraw from the program.

3. Grade Replacement Option

Graduate students are not eligible for grade replacement.

4. Teaching Probation Policy

- a) It is expected that graduate students who are employed as TA's by the Department of Chemistry and Biochemistry will make every effort to perform their duties to the satisfaction of the Department and the University of Arizona. TA performance will be reviewed each term by the TA Evaluation Committee*, which will make its recommendations known to the Department Head and/or others the Department Head shall designate.
- b) In the event that the performance of a TA is deemed unsatisfactory in any term, the TA may be placed on teaching probation to alert the TA that improvement in performance of teaching duties is expected. The TA will be informed in writing of the TA's specific teaching deficiencies. Such improvement will be measured in the next term in which the student is employed as a TA. In the event that the deficiencies are remedied, the probationary status of the TA will end. In the event that deficiencies are not remedied, the TA will become ineligible for support as a TA in the Department of Chemistry and Biochemistry at The University of Arizona.
- c) A TA may be placed on teaching probation only once. In the event that the performance of a TA is deemed unsatisfactory in any two terms, the TA will become ineligible for support as a TA in the Department of Chemistry and Biochemistry at The University of Arizona and may be counseled out of the program.

* The TA Evaluation Committee will consist of such faculty, staff, and student members designated by the Department. Current procedures are available from committee members and the Teaching Service Office (Koffler 201).

5. Continuous Enrollment

Master's Continuous Enrollment Policy

A student admitted to a Master's degree program must register each fall and spring semester for a minimum of 3 graduate units, from original matriculation until all degree requirements are met. If the degree program requirements are to be completed in the summer, the student must register for a minimum of 1 unit of graduate credit during that term.

Doctoral Continuous Enrollment Policy

A student admitted to a graduate degree program must register each fall and spring

semester for a minimum of 12 graduate units from original matriculation until the completion of all course requirements, written and oral comprehensive exams, and 18 dissertation units. When these requirements are met, doctoral students **not** on financial assistance and/or needing to maintain appropriate visa status must register for a minimum of 1 unit each semester until final copies of the dissertation are submitted to the Graduate Degree Certification Office. Students receiving teaching or research assistantships/associateships must register for at least 12 units. If degree requirements are completed during summer or an intersession, the student must have been registered during the preceding semester.

6. Time Limitation

By Graduate College rules, all requirements for the degree of Doctor of Philosophy must be completed within **5 YEARS** of passing the Oral Comprehensive Exam, whether the student is supported financially, or not. Should a student not finish within that time period, he/she may be allowed to re-take the Comprehensive Exams (both written and oral) with the permission of the program, then proceed to complete other requirements. This in no way implies that the Department of Chemistry and Biochemistry is bound to financially support the student for more than five years from the start of their program.

7. Good Standing

A student is in good standing if and only if **all** of the following conditions are fulfilled:

1. GPA at or above 3.0 and earn a grade of B or better in all required major coursework
2. Working under a CBC approved research director (except for first semester in Chemistry, first two semesters in Biochemistry and BCP)
3. Satisfactory performance in all teaching duties
4. Due dates for independent proposal and oral exam are met unless prior approval from the GPC is obtained

A student in bad standing has one full semester to remedy this status. This means:

Student falls into bad standing in	Status needs to be remedied by
Fall	End of Spring term
Spring	End of Summer term
Summer	End of Fall term

Failure to remedy a status of bad standing by the stated deadline results in dismissal from the program. Note also that graduate students intending to drop classes with a "W" grade are advised that this is only allowed in exceptional circumstances and with explicit permission by the GPC. Failure to comply means that the student will no longer be in good standing.

While in bad standing, consequences include, but are not limited to, reduced priority for assistantship funding, ineligibility for Departmental awards and fellowships, and the possibility of dismissal from the Ph.D. program.

8. Leave of Absence Academic Leaves

Academic LOAs (i.e. leaves to take course work at another university, for research, field work, internships, professional development, etc.) are handled on a case-by-case basis by the student's Department and the Graduate College

Medical Leaves

With appropriate documentation from their medical provider, graduate students in degree programs may be granted a Medical Leave of Absence by the Dean of the Graduate College.

Personal Leaves

Graduate students in degree programs may be granted a Leave of Absence for a maximum of one year throughout the course of their degree program by the Dean of the Graduate College. LOAs are granted on a case-by-case basis for compelling reasons, including birth or adoption of a child, personal or family reasons, military duty or financial hardship. Students will maintain their status without reapplying to the Department and the Graduate College at the expiration of the LOA.

Retroactive Leave of Absence

A retroactive leave request is any request made after the last day of finals in the semester. If a student does not request a leave by the last day of finals, he/she would need to apply for readmission to the program. Under extraordinary circumstances, LOAs may be granted retroactively. In such cases, students will be readmitted without reapplying to the department and the Graduate College.

G. COURSEWORK FOR THE Ph.D. DEGREE IN CHEMISTRY

1. Total Credits

- a) A minimum of 63 units of graduate credit, 510-level or above, are required for a Ph.D. in Chemistry.
- b) A total of 45 graded and ungraded units and 18 dissertation units comprise the 63 overall credits.
- c) At least 18 units must be in courses for which a letter grade (A,B,C,D,E) is awarded. A 'B' or better must be earned in each graded course that is to be counted towards the Major and Minor requirements for graded courses. Note: the Graduate College requires a minimum of 18 graded units, but for some Chemistry programs of study more graded units may be required.
- d) If a 'C' is received in a major or minor course, the student must: 1) repeat the course, or 2) take a different course at the discretion of the division in question and receive at least a 'B' in that replacement course. The GPC must be advised of, and approve of, this change. Note that this does not automatically remediate the GPA, which must be raised to a minimum of 3.0.
- e) The ungraded course work (approx. 27 units) is mostly comprised of seminar, group meetings, college teaching, or research opportunities.
- f) Under exceptional circumstances and on explicit petition to the GPC, students may take up to two (2) units of "Advanced Seminar" (696e) for a letter grade. (See following pages in this section for detailed programs of study that satisfy these overall requirements).

2. Transfer Credits

It is a Departmental policy that no more than 6 units of graduate credit may be transferred from another institution. All transfer credit must be approved first by division affected, which will compare the content of the course with similar courses taught in our program. The approval process then moves to the GPC, and then finally the Graduate College. The Graduate College determines if the courses are eligible for transfer. You must obtain the Transfer Credit Form from the Graduate College and submit it to that office before the end of the first year of study for courses to be reviewed.

3. Professional Development

Two unit of Professional Development (Chemistry 595a and 595b) with a grade of S or P is required of graduate students the first two semesters in residence.

4. Research Opportunities

All entering Chemistry students are required to take one unit of Chemical Research Opportunities (CHEM 695a) before selecting a Research Director (**see Section I**).

5. Chemistry Required Coursework in the Major and Minor areas

- a) A minimum of fifteen (15) units of graduate courses in the major, (the sub-discipline of specialization or division) are required for the Ph.D. in Chemistry. Some divisions require more coursework than this minimum (see summary tables in section H). Courses of study other than those shown in the summary tables (e.g. multidivisional courses of study) are possible with the approval of the student's dissertation committee and the GPC. These required courses provide the background necessary for taking the Oral Comprehensive Examination (see Section J) and for initiating independent research. The time required to complete the required coursework will depend upon your preparedness, as evidenced by

your performance on the Qualifying Examinations. For all full-time students, the required courses should be completed by the end of the second year (other rules apply to students admitted on a part-time basis; see Section M).

- b) For Ph.D. students in Chemistry who elect a minor in chemistry, a minimum of three units of advanced coursework outside the area of specialization, and for which a letter grade is awarded, are required.
- c) A minor in an area outside of chemistry must be approved in advance by the GPC and must satisfy all the coursework, written and oral preliminary exam requirements of the minor department.
- d) A 'B' or better is required in all graded courses to be counted towards the requirements of the major or minor. An average of 3.0 (B) is required for overall good standing (as defined in Section F of this handbook) within the program. If a 'C' is received in a major or minor course, the student must: 1) repeat the course, or 2) take a different course at the discretion of the division or program, and the GPC, and receive a at least a 'B' in that replacement course

6. Elective courses

Students are encouraged to broaden their knowledge through participation in courses beyond the minimum requirements. Elective graduate courses are offered on a regular basis to provide students the conceptual background to plan and execute original graduate research and to provide breadth in related areas of chemistry.

7. Chemistry Seminar

Regular attendance at seminar is expected of all students each semester. Up to ten (10) units of divisional seminar (CHEM 696) may be used to meet graduation requirements. Under exceptional circumstances and on explicit permission by the GPC, up to two (2) units of graded seminar (CHEM 696e) may be taken.

In addition to the CHEM696 class, students are required to present a minimum of 2 seminars to the department during their residency, as defined in the divisional or program requirements. The department encourages students to present more seminars than the minimum as a way to develop formal presentation skills and share research within the department.

It is the student's responsibility to contact the seminar coordinator for their division to schedule seminars. This should be done over the summer before the 2nd year and approximately 1 semester before their expected graduation.

8. Group Meeting

At least one unit of Exchange of Chemical Information (CHEM 695b) should be taken each semester in residence after joining a research group. Up to ten (10) units may be used to meet graduation requirements. The format for this course is set by individual Research Directors.

9. Dissertation Research

Independent Dissertation Research (CHEM 920) under the guidance of your Research Director and Dissertation Committee forms the heart of a Ph.D. degree in Chemistry.

H. Graduate Programs of Study and Worksheets

In conjunction with his/her Research Director, each student is responsible for developing a Plan of Study during their first year in residence, to be filed with the Graduate College no later than the student's second semester in residence. The Plan of Study identifies (1) courses the student intends to transfer from other institutions; (2) courses already completed at The University of Arizona which the student intends to apply toward the graduate degree; and (3) additional course work to be completed in order to fulfill degree requirements. The Plan of Study must have the approval of the student's Research Director and Department Head (or Director of Graduate Studies) before it is submitted to the Graduate College.

The following sections outline several possible tracks in the Chemistry graduate program, including special programs such as Biological Chemistry Program, Chemical Physics Program and Biological Physics Program. The tracks listed here constitute only some of the possible course combinations, and other combinations are possible in accordance with the student's interest. Students wishing to pursue a PhD with emphasis in

- Analytical Chemistry are strongly advised to take at minimum CHEM 521a and CHEM 526b in Fall and 528 in Spring.
- Biological Chemistry are strongly advised to take at minimum CHEM 565 in the Fall.
- Inorganic Chemistry are strongly advised to take at minimum CHEM 510 and CHEM 515 in the Fall.
- Organic Chemistry are strongly advised to take at minimum CHEM 545 and CHEM 550 in Fall and CHEM 541 in Spring.
- Physical Chemistry are strongly advised to take at minimum CHEM 580 and CHEM 582 in Fall and CHEM 680 in Spring.

In addition to these core courses, further courses either within the same track or from other tracks may be selected to meet the each student's specific interests and needs.

ANALYTICAL EMPHASIS

Major		Minor	Total Graded
CHEM 526b Fall	3	3 credits minimum choose courses to broaden general knowledge of chemistry or to focus on a secondary area that complements the major	
CHEM 527 Fall	3		
CHEM 528 Spring	3		
CHEM 521A Fall	3		
Choose either CHEM 522 or CHEM 525 Spring	3		
Major Courses Total (minimum):	15	Minor Courses Total (minimum) : 3	Graded Courses Total (minimum): 18

Other Courses

Group Meeting	Seminar	Other	Total units
695b 1 credit/semester (after joining a research group)	696a 1 credit/semester	595a/b Professional Development (Fall and Spring I), 2 credit 695a Research Opportunities (Fall I), 1 credit 696e graded seminar at discretion of GPC 900 Research 1-5 credits per semester	
Maximum counted toward degree: 10	Maximum counted toward degree 10		Ungraded total: 27

Graded (min. 18) and ungraded courses listed in above tables must equal at least 45 credits.
CHEM 920 Dissertation Research must be taken for a minimum of 18 credits. Total: 45+18=63

All students should register for at least 12 credits.
All students must earn a grade of B or better in all required major coursework.

INORGANIC EMPHASIS

Major		Minor	Total Graded
510 Fall only	3	3 credits minimum choose courses to broaden general knowledge of chemistry or to focus on a secondary area that complements the major	
514	3		
515	3		
6 credits chosen from 512, 513 (multiple times if different topics), 511A, 518 or course approved by committee	6		
Major Courses Total (minimum):	15	Minor Courses Total (minimum) :	3
			Graded Courses Total (minimum): 18

Other Courses

Group Meeting	Seminar	Other	Total units
695b 1 credit/semester (after joining a research group)	696b 1 credit/semester	595a/b Professional Development (Fall and Spring I), 2 credit 695a Research Opportunities (Fall I), 1 credit 696e graded seminar at discretion of GPC 900 Research 1-5 credits per semester	
Maximum counted toward degree: 10	Maximum counted toward degree 10		Ungraded Courses total: 27

Graded (min. 18) and ungraded courses listed in above tables must equal at least 45 credits.
CHEM 920 Dissertation Research must be taken for a minimum of 18 credits. Total: 45+18=63

All students should register for at least 12 credits.

All students must earn a grade of B or better in all required major coursework.

ORGANIC EMPHASIS

Major		Minor	Total Graded
550	3	3 credits minimum choose courses to broaden general knowledge of chemistry or to focus on a secondary area that complements the major	
541	3		
545	4		
Courses chosen from 542A, 542B, 640 or 546, 549b, 548 or course approved by committee	5		
Major Courses Total (minimum):	15	Minor Courses Total (minimum) : 3	Graded Courses Total (minimum): 18

Other Courses

Group Meeting	Seminar	Other	Total units
695b 1 credit/semester (after joining a research group)	696c 1 credit/semester	595a/b Professional Development (Fall and Spring I), 2 credit 695a Research Opportunities (Fall I) 1 credit 696e graded seminar at discretion of GPC 900 Research 1-5 credits per semester	
Maximum counted toward degree: 10	Maximum counted toward degree 10		Ungraded total: 27

Graded (min. 18) and ungraded courses listed in above tables must equal at least 45 credits.
CHEM 920 Dissertation Research must be taken for a minimum of 18 credits. Total: 45+18=63

All students should register for at least 12 credits

All students must earn a grade of B or better in all required major coursework.

PHYSICAL EMPHASIS

Major		Minor	Total Graded
580 Fall only	3	3 credits minimum choose courses to broaden general knowledge of chemistry or to focus on a secondary area in chemistry or a related department that complements the major	
582 Fall only	3		
587 Spring only	3		
680 Spring Only	3		
Elective course chosen from 581, 583, 682, 684, 686, 687, or course approved by committee	3		
Major Courses Total (minimum):	15	Minor Courses Total (minimum) : 3	Graded Courses Total (minimum): 18

Other Courses

Group Meeting	Seminar	Other	Total units
695b 1 credit/semester (after joining a research group)	696d 1 credit/semester	595a/b Professional Development (Fall and Spring I), 2 credit 695a Research Opportunities (Fall I) 1 credit 696e graded seminar at discretion of GPC 900 Research 1-5 credits per semester	
Maximum counted toward degree: 10	Maximum counted toward degree 10		Ungraded total: 27

Graded (min. 18) and ungraded courses listed in above tables must equal at least 45 credits.
CHEM 920 Dissertation Research must be taken for a minimum of 18 credits. Total: 45+18=63

All students should register for at least 12 credits
All students must earn a grade of B or better in all required major coursework.

CHEMICAL EDUCATION

The Ph.D. in Chemistry with a research component in Chemical Education is designed for individuals who intend to pursue careers in chemical education research or teaching at the high school, college, or university level. Graduate course work in chemistry is accompanied by courses in education and chemical education, which enable the graduate to undertake research in the teaching and learning of chemistry.

Major	Minor	Total Graded
15 credits minimum complete major course requirements in any of these subject areas: analytical, biological, inorganic, organic, or physical chemistry.	9 credits minimum choose courses to complete a minor in education or science education (must satisfy the requirements of the minor department).	
Major Courses Total (minimum): 15	Minor Courses Total (minimum): 9	Graded Courses Total (minimum): 24

Other Courses

Group Meeting	Seminar	Other	Total units
695b 1 credit/semester (after joining a research group)	696x 1 credit/semester	595a/b Professional Development (Fall I), 1 credit 695a Research Opportunities (Fall I), 1 credit	
Maximum counted toward degree: 10	Maximum counted toward degree 10		Ungraded total: min 21

Graded (min. 24) and ungraded courses listed in above tables must equal at least 45 credits. CHEM 920 Dissertation Research must be taken for a minimum of 18 credits. Total: 45+18=63

All students should register for at least 12 credits

All students must earn a grade of B or better in all required major coursework.

BIOLOGICAL PHYSICS PROGRAM (BPP)

The Biological Physics Program (BPP) is a multidisciplinary graduate training program that can be joined as a track through three departments: Biochemistry & Molecular Biophysics, Chemistry, or Physics. Additional admission requirements correspond to the home department. The degree is granted in Home Department with a focus in Biological Physics.

Major & Distributed Minor		Introduction to Research	Total Graded
Core courses in Biochemistry BIOC 565 Proteins and Enzymes BIOC 585A Biological Structure 1 X-Ray Crystallography BIOC 585B Biological Structure 2 NMR Spectroscopy	3 2 2	BIOC 795a 3 credits/semester Laboratory rotations during first and second semester in residence	
Core courses in Physics PHYS 530 Intro to Biophysics PHYS 531 Molecular Biophysics	3 3		
Core courses in Chemistry Chem 580 Intro to Quantum Chemistry CHEM 582 Statistical Thermodynamics	3 3		
Major Courses Total (minimum):	18		

Other Courses Required

Journal Club	Group Meeting	Seminar	Other	Total units
BIOC 595B 1 credit/semester (Required attendance for students in Biological Physics Program)	695b 1 credit/semester (After joining a research group)	696c 1 credit/semester	595a/b Professional Development 2 credit 695a Research Opportunities 1 credit 696e graded seminar at discretion of GPC	
Maximum counted toward degree: 10	Maximum counted toward degree: 10	Maximum counted toward degree 10		Ungraded total: 21

BIOLOGICAL CHEMISTRY PROGRAM (BCP)

The Biological Chemistry Program (BCP) is a multidisciplinary NIH-supported training program at the Chemistry-Biology interface. Students in the program must satisfy their home program requirements (Biochemistry, Chemistry or Pharmaceutical Sciences) and, as part of CBC, will receive a degree in either Biochemistry or Chemistry. Students in the BCP are expected to undertake graduate coursework in both Chemistry and Biology; undertake research rotations both inside and outside their home program; attend the weekly BCP research forum ("Journal Club"); assemble a thesis committee with representation from more than one program; and complete both the online ethics introduction offered during orientation and an ethics course. Students following the BCP path are eligible for our fellowships and may work with any faculty member in the BCPListed below are the approved BCP courses; however, other appropriate graduate courses that provide a foundation in Chemistry or Biology may be substituted with approval from the BCP Director.

Major & Distributed Minor		Introduction to research	Total Graded
BIOC 565 Proteins and Enzymes	3	BIOC 795a 3 credits/semester Laboratory rotations during first and second semester in residence	
BIOC 568 Nucleic Acids and Metabolic Biochemistry	4		
Plus one from the following PHSC 670 Principles in drug Discovery, Design, and Development CHEM 550 Synthetic & Mechanistic Organic Chemistry 510 Advanced Inorganic Chemistry 580 Introduction to Quantum Chemistry 523A Bioanalytical Chemistry 527 Analytical Separations	3		
Courses chosen from upper division chemistry or courses approved by committee.	6		
Major Courses Total (minimum):		Maximum counted toward degree: 6	Graded Courses Total (minimum): 22

Other Courses Required

Journal Club	Group Meeting	Seminar	Other	Total units
BIOC 595B 1 credit/semester (Required attendance for students in BCP)	695b 1 credit/semester (After joining a research group)	696X 1 credit/semester	CHEM 595a/b Professional Development 2 credit MCB 695e (Science, Society, & Ethics) 1 credit	
Maximum counted toward degree: 10	Maximum counted toward degree: 10	Maximum counted toward degree 10		Ungraded total: 21

Graded (minimum 21) and ungraded courses listed in above tables must equal at least 45 credits. CHEM 920 Dissertation Research must be taken for a minimum of 18 credits. Total: 45+18=63

All students should register for at least 12 credits

CHEMICAL PHYSICS PROGRAM (CPP)

The Chemical Physics Program (CPP) is a multidisciplinary graduate training program that can be joined as a track through either the Chemistry or Physics departments. Students undertake courses and seminars involving both departments that are optimized for individual student interests with a maximum of flexibility. Admission requirements for CPP students correspond to the Home Department (Chemistry or Physics). The degree is granted in the Home Department with a focus in Chemical Physics.

Major	Minor	Total Graded*
Choose any courses from the following options: Quantum Mechanics CHEM 580 & 680 or PHYS 570A and 570B 3/3 Thermodynamics & Statistical Mechanics CHEM 582 or PHYS 528 3 Kinetics CHEM 583 3 Spectroscopy CHEM 584/587/687 3/3/3 Mathematical Methods CHEM 581 3 Electricity & Magnetism PHYS 515A/B 3/3 Condensed Matter PHYS 560A/B or CHEM 686 3 or course approved by committee	Choose courses from the indicated options to broaden general knowledge of chemistry and physics	* CPP students must take at least 2 major graduate courses from the home department.
Major Courses Total (minimum): 15	Minor Courses Total (minimum): 3	Graded Courses Total (minimum): 18

Other Courses Required

Journal Club	Group Meeting	Seminar	Other	Total units
CHEM 599 or PHYS 599 (CPP seminar) 1 credit per semester (Required attendance for students in CPP)	CHEM 695b 1 credit per semester (After joining a research group)	CHEM 696c (Physical Chemistry or Physics Seminar 1 credit/semester and/or	CHEM 595c (College Teaching, Fall I, 1 credit) CHEM 695a (Research Opportunities, Fall I, 1 credit) CHEM 696e graded seminar at discretion of GPC	
Maximum counted toward degree: 10	Maximum counted toward degree: 10	Maximum counted toward degree 10		Ungraded total: 27

Graded (minimum 18) and ungraded courses listed in above tables must equal at least 45 credits. CHEM 920 Dissertation Research must be taken for a minimum of 18 credits. Total: 45+18=63

All students should register for at least 12.

Certificate in Entrepreneurial Chemistry

This program is only offered to PhD graduate students who want to be successful as entrepreneurs or working in start-up companies.

PhD requirements	Business	Other	Total units
Students must fulfill all requirements for the Chemistry PhD program	BNAD 510 Business for Scientists 3 credits MIS578 Management 3 credits	CHEM 909 One chapter in the doctoral dissertation on the business aspects of the research	
63	6 credits	2 credits	71

Five Year B.S./M.S. Degree

The Chemistry and Biochemistry program offers the opportunity for students to participate in an accelerated curriculum that leads to both the Bachelor of Science and Master of Science degrees in either Chemistry or Biochemistry. This curriculum follows the normal B.S. degree for three years, but adds two graduate level courses during their fourth year that are applied to the subsequent M.S. program. These graduate courses cannot be included in the student's B.S. degree units. The fifth year includes three graduate courses, research credits, and the Master's Thesis. Students must apply to the Graduate College during their fourth year for official admission to the M.S. program immediately following completion of their B.S. requirements

Students must meet the following criteria in order to apply

- Be in their 3rd year at the time of application (that is, student who have completed at least 75 units by the end of their 5th semester but can apply before the required 35 units for a Chemistry or Biochemistry major have been met)
- Exceptions can be made in the case of a 4th year students provided they are enrolled in at least one graduate level course and have at least one more semester remaining in the B.S.
- Be a continuing U of A student working on a Bachelor's degree
- Have a minimum cumulative GPA of 3.5 (NO EXCEPTIONS)
- Have a minimum of one semester of research experience with demonstrated productivity
- Have a thesis advisor who is a primary CBC faculty member

Students are **strongly** encouraged to consult the respective chairs of the UPC and GPC before applying to this accelerated degree program.

The Master of Science degree requires 30 units (minimum) of graduate work in 500-level courses or above, up to 15 of which may be in thesis research. Up to 12 units of graduate credit earned as an undergraduate and not applied toward the baccalaureate degree can be applied for credit toward a master's degree.

Required Courses:

- Graded coursework constitutes 15 units of the Master of Science degree. A plan of study must be approved by the committee. Suggested core courses of study for the respective areas are:
 - Analytical: Choose 3 courses from Chem 522, Chem 523, Chem 525, Chem 526b, Chem 527, Chem 529
 - Biochemistry: Bioc 565, Bioc 568, and one other course by approval
 - Inorganic: Chem 510, Chem 514, and one other course by approval
 - Organic: Chem 550, Chem 541, Chem 545
 - Physical: Chem 580, Chem 581, Chem 582
- Up to 15 units of the Master of Science degree may be in thesis research, group meeting, seminar, etc.

Tuition and Fees:

- The student must pay graduate tuition and fees
- After 12 graduate level credits they will be considered a graduate student.

Application Deadline: April 15

Decision: May 15 pending application review and interview

Requirements for the Graduate Minor in Chemistry

The graduate minor in chemistry for students with a major outside of chemistry will consist of an approved sequence of at least 9 units of chemistry courses, each to be passed with a grade of "B" or better. The written preliminary examination will be comprised of the final examinations on the courses.

Acceptable sequences of chemistry courses include:

- a. Analytical
Three from 522, 526b, 527, and 525
- b. Inorganic
510 and two from 511, 513, 514, 515, and 518
- c. Organic
550 and two from 541, 542a, 542b, 543, 544, 548 and 640
- d. Physical
580, 582, and one from 581, 583, 587, 680, 686, and 687

Other sequences may be accepted to fit special students needs, but it is the student's responsibility to obtain written approval from the minor members of his/her Dissertation Committee and from the GPC of the Department of Chemistry and Biochemistry prior to embarking on such a course of study.

Worksheet to plan schedule:

Courses for which all students should register are listed.

Choose any necessary courses and then use the Program of Study guidelines, by division, on the previous pages to choose additional courses.

Most students will take three, 3-credit courses in the first semester in addition to 595a, 696x, and 695a.

Fall I			Spring I		
Course #	Topic	Units	Course #	Topic	Units
			595b	Professional Development	1
595a	Professional Development	1	900	Research	1-5
696a - Analytical 696b - Inorganic 696c - Organic 696d - Physical	Seminar (Choose one)	1	696a - Analytical 696b - Inorganic 696c - Organic 696d - Physical	Seminar (Choose one)	1
695a	Research Opportunities	1	695b	Group Meeting	1
	Total	12		Total	12
Fall II			Spring II		
Course #	Topic	Units	Course #	Topic	Units
900	Research	1-5	900	Research	1-5
696a - Analytical 696b - Inorganic 696c - Organic 696d - Physical	Seminar (Choose one)	1	696a - Analytical 696b - Inorganic 696c - Organic 696d - Physical	Seminar (Choose one)	1
695b	Group Meeting	1	695b	Group Meeting	1
920	Dissertation Research	1-9	920	Dissertation Research	1-9
Total		12	Total		12

I. CHOOSING A RESEARCH PROJECT AND RESEARCH DIRECTOR

1. Selecting a Research Director – 1st semester in residence

- a) Prior to selection of a Research Director, you will become familiar with the research interests of the faculty through attendance at Department of Chemistry and Biochemistry Research Symposium, held the week before classes begin in the fall semester. Part of this Research Symposium will consist of poster presentations from graduate students and faculty in the department where you will have an opportunity to talk informally with presenters from multiple research groups about their research interests.
- b) Following this poster session you must make individual appointments to discuss research opportunities with at least 6 faculty, during which time you will narrow your choices for Research Director.
- c) Near the middle of the first semester, you will complete the process of selecting a Research Director. Your 1st, 2nd and 3rd choices for Research Director should be indicated on the Report of Selection of Research Director form and returned to the Graduate Program Coordinator by October 15 (fall entrance) or March 15 (spring entrance). Extensions will be granted at the discretion of the Director of Graduate Studies. Once your choices have been submitted, the Professor(s) selected will discuss this selection process with their division. The Division Chair will then forward their recommendations to the GPC and the GPC will make a final recommendation of Research Director selection to the Department Head.
- d) To complete the process, the student and Research Director will define a dissertation research problem. A one-page statement describing the areas to be explored and the techniques to be utilized must be presented to the GPC by April 1 of the second semester in residence.

Students may only join research groups that meet at least one of the following criteria (i)-(iv):

- i) A research group in CBC
- ii) A research group participating in a program of which CBC is part (e.g. BCP etc)
- iii) A project jointly supervised by a CBC faculty member and someone outside CBC, or
- iv) A research group of a faculty member that has a joint appointment in CBC.

NOTE: For students in interdisciplinary programs that require rotations, the Report of Selection of Research Director form should be returned to the Graduate Program Coordinator no later than April 15. You are encouraged to make your choices as early as possible.

Selection of the Research Director is an important step in your career and it deserves careful consideration. Several aspects of this decision should be kept in mind.

- It is important to meet with several potential faculty research directors prior to finalizing your decision.
- You should attend group meetings and interact with students from individual research groups prior to finalizing your decision.
- This decision is a mutual one between you and the chosen professor(s). The Research Director will be responsible for your training through a mentoring relationship.

- It is very important that you and the professor discuss the expectations each has for the dissertation research and that both agree on general policies that affect the "working environment". See section B for further expectations to consider when choosing a Research Director.

2. Selecting a Dissertation Committee

Graduate student Dissertation Committees for both the Comprehensive Examination and Final Oral Defense Examinations will consist of a minimum of four faculty members, consisting of the student's research advisor, two in the student's major area of study and one in a minor area of study. The latter may be from a department other than CBC. In consultation with Research Director, a Dissertation Committee must be selected by the first day of fall classes following your first year in residence. The form will be approved and signed by the Chair of the GPC. The Dissertation Committee advises you, helps plan the remaining graduate program and evaluates your progress during all phases of training.

Deviation from these guidelines requires written justification submitted to the GPC from both student and mentor. All four committee members must be present for the entirety of the preliminary and final oral examinations. Inclusion of additional committee members is allowed, but the minimum composition specified in the above paragraph must be maintained. Changes to the committee membership at any point must conform to this policy.

3. Changing Research Directors

In unusual circumstances, a student may consider changing Research Directors. This is a decision that has profound implications and should be undertaken only after thoughtful discussion with faculty members in the department who can guide the student and discuss the pros and cons of the situation.

Graduate school is challenging and worthwhile research projects are not easy. Researchers often encounter rough spots or tedious sets of experiments on the way to the Ph.D. Research directors who push students to perform quality research and write quality manuscripts generally have the best interests of the students in mind. Students who have thoughtfully considered whether a change is necessary should meet with a faculty member who can provide guidance. A member of the student's dissertation committee, the GPC chairperson, or one of the division heads would be appropriate. The initial contact person will undoubtedly suggest others who may be able to provide valuable input. The processes of separating from one advisor, and selecting a new advisor should be sequential, not concerted processes.

- a) The Research Director and the GPC should be made aware of the situation at the earliest stage possible. Once it is clear to the student that this change is needed, a short memo should be delivered to the GPC explaining the need for a change in advisor. The GPC will consider the case on its merits, and then, if it is clear that a change is warranted, will act to facilitate the change of Research Directors.
- b) Once the GPC has ruled on the need for the student to select a new advisor the student should pick up a Research Director selection form from the Graduate Program Coordinator. Next, the student should meet with and obtain signatures from at least 3 faculty members and turn in the completed form with the selected advisor listed to the Graduate Program Coordinator. Finally, a letter must be

- submitted to the GPC explaining the reasons for the selection of the new advisor.
- c) Once the new Research Director has been selected, and a new Dissertation Committee constituted, it is an extremely good idea for the student to meet with this committee, to map out exactly what the new research effort will involve, and the expected time to completion of the degree.

4. Keeping the Dissertation Committee Updated on your Progress Toward the Ph.D. Degree

It is important that your Dissertation Committee remains updated of your progress during your time in the Department. This committee serves many roles in your journey toward graduation including:

- a secondary source of counsel, in addition to your primary advisor;
- a source of letters of recommendation for your future career;
- an evaluation committee for your Comprehensive Exam, Doctoral Dissertation and Final Oral Defense Exam.

There are three mandated mechanisms for maintaining contact with and drawing support from your Dissertation Committee:

(1) Second Year Dissertation Committee Meeting. All students must meet with each committee member *individually* between May 30 and September 30 to discuss in particular their ideas for the oral proposal and provide an informal status update on research integration into their research group and any other questions/points of information necessary.

Postponement of the Second Year Dissertation Committee Meeting is possible only with prior consent of the GPC.

(2) Annual Research Summaries. Department of Chemistry and Biochemistry rules state that, starting in the 2nd year of the program, all Chemistry Program Ph.D. students should prepare an Annual Research Summary, due at the end of July. One copy of the summary should be given to each committee member and to the Graduate Program Coordinator.

The format of the summary should be as follows: On page 1, list the student's name, the advisor's name and names of the committee members. This is followed by a listing of the student's progress on the formal requirements for the Ph.D. (courses taken with grades earned, cumulative exam record, date the preliminary oral is planned (or date(s) taken and result(s)), presentations given locally or at conferences, manuscripts submitted or published. On the following pages (2-3 suggested), summarize research progress made in the past year, describe future research objectives and discuss problems. The student or committee members may choose to hold a meeting to discuss the student's progress.

(3) Fourth Year Dissertation Committee Meeting. Chemistry Graduate Program students must have a short (1 hour) meeting with their Dissertation Committee in the spring semester of their fourth year. This meeting must be scheduled to take place between **January 15** and **May 15**. The purpose of this meeting is to discuss your progress to date in the program and your plans for the future in anticipation of graduation. Alteration of the timing of the Fourth Year Dissertation Committee Meeting is possible with prior approval of the GPC. This meeting will consist of:

- a 15-20 minute presentation on research progress and plans
- a discussion of a dissertation outline
- a discussion of future plans post-graduation
- a discussion with the committee in the absence of the primary advisor

J. DIAGNOSTIC EXAMINATIONS, COMPREHENSIVE EXAMINATION, AND ADVANCEMENT TO CANDIDACY

1. Qualifier/Diagnostic Examinations

The Department of Chemistry and Biochemistry Diagnostic Examinations are equivalent to the Qualifying (Diagnostic) Examinations required by the Graduate College.

- All students must qualify in three (3) areas of Chemistry and Biochemistry of their choosing. For Biochemistry students, Biochem part I and II are counted as separate areas owing to the breadth of the subject.
- In order to achieve qualification, students must pass any three qualifying exams, with passing scores set by the individual programs.
- Students have a total of three opportunities to take the exams. On arrival, all students will take three exams of their choosing. The week before start of second semester and at the end of second semester in residence, those who have not previously met the qualification requirements will have an opportunity to take up to three exams to meet this goal.
- Failure to pass three qualifying exams by the end of their second semester in the program will result in termination in the program.
- Clarification: Failure to qualify after three attempts will mean termination in the specific program, i.e. students in the PhD program will be relegated to the MS program (with an option of reapplying to the PhD program after successful defense of their MS), students in the MS program will be relegated to MA and students in the MA program will be asked to leave.

2. Description of the Comprehensive Examination

Students must pass a Doctoral Comprehensive Examination before they can be advanced to formal candidacy for the Ph.D. degree. This examination is intended to test the student's comprehensive knowledge of the major and minor subjects of study, both in breadth across the general field of study and in depth within the area of specialization. The Comprehensive Examination provides evidence that the candidate can independently analyze and solve complex chemical problems that may or may not be directly related to his or her own dissertation research problem. The Comprehensive Examination is considered a single examination, although it consists of a written portion and an oral portion.

(A) The Written Portion of the Comprehensive Exam

The process of the Written Comprehensive Exam will stimulate the student to take independent responsibility for personal growth in building their comprehensive knowledge of their field, outside and beyond the organized structure of the classroom, so that they can discuss their subject, answer questions, and solve problems at a professional level. The Written Comprehensive Exam consists of the Research Summary and Independent Proposal.

The student will submit a written document that consists of two parts: (a) a Research

Summary (5 -10 pages) and (b) an Independent Proposal (10-12 pages).

Written proposals are due November 1 or on the first Monday following of their 2nd year in the program (third semester). The proposal fulfills the written requirement of the comprehensive examination for PhD candidacy. Faculty are to return reviews prior to the last day of class in the Fall semester to provide students with enough time to improve the proposal or prepare for the oral examination. Students will have 4 weeks for revisions, and the committee members are expected to return comments on the reviewed proposal within 4 weeks of resubmission. Once the proposal receives a passing score, students have 6 weeks for scheduling of the oral examination. **Failure to receive a passing score in either the first or the second attempt results in termination in the PhD track**, with possible transfer to the MS track.

For students that start in the spring semester, the respective deadline for the research proposal is March 15.

Students are advised that the date of their oral exam may impact eligibility for certain awards and fellowships.

(a) Guidelines for the Research Summary

A suitable research summary will be written using the Template for Submission of Manuscripts to American Chemical Society Journals (see: http://pubs.acs.org/page/jacsat/submission/jacsat_templates.html) and should include an appropriate literature background section and sections describing the goals and significance of the research, experimental details, and results obtained or anticipated.

(b) Guidelines for the Independent Proposal

The Independent Proposal is a written proposal of an original, but hypothetical, research project in an area that **may or may not be directly related to the student's own research program**. This Independent Proposal may be a revised version of an independent proposal that the student has completed for one of his/her classes.

Students will prepare and submit the research proposal in NIH format. The proposal must be 10-12 pages in length with appropriate references. **Failure to heed the guidelines on page length will result in your proposal being returned without review**. The proposal should be formatted as follows:

Format:	1" margins in all directions
Font:	11 pt Arial or 12 pt Times New Roman
Spacing:	1 - 1.5*

[*Note: You may be requested to submit a copy that is double-spaced to facilitate handwritten comments.]

Abstract: A brief summary of the problem and the proposed approach to investigate this problem. *The abstract must be less than 250 words.*

Specific Aims: Provide a brief description of the overall problem and research question to be addressed. Then provide clear, concise descriptions

of the specific research sub-questions that must be addressed to achieve the overall goals of the project. *This section is limited to 1 page.*

Background and Significance: Clearly define the project and clearly state the significance of this research question. Describe what has been done in the area before and the advantages offered by the proposed approach. Briefly define the key innovations in the proposed approach. *This section is limited to 3 pages.*

Research Design and Methods: Describe the research plan that will be pursued to address the specific aims. Provide key details of experimental design and suggest alternate approaches to achieve the same goals. Details such as buffer compositions or descriptions of common experimental protocols (e.g. HPLC, gel electrophoresis, etc.) are not necessary to include. Where appropriate, provide reference to key works that describe the proposed methodological approach. For particularly innovative and novel aspects of the project, provide sufficient detail to evaluate feasibility. Be sure to describe key figures of merit, evaluative criteria, etc. If the proposed work involves animal or human models, justify why these are used. *This section is limited to 6-8 pages.*

References: Provide key references for all necessary points in the proposal using a suitable reference format. Provide full titles and complete author information for each reference. *There is no page limit for this section.*

Topic. The process of choosing a proposal topic should begin early. Most students find that this process consumes far more time than they had anticipated. Students may begin working on the Proposal at any time. ***A student should discuss the suitability of the proposal topic with the members of the Dissertation Committee before devoting a substantial amount of time to it.*** Thus, scheduling the Second Year Committee meeting earlier in the third semester is highly advantageous.

Suitable proposals may take a variety of forms. For example, an original interpretation or a reinterpretation of existing data; a proposed series of experiments to test a theory or hypothesis; a new theoretical approach to a problem; the design of new instrumentation. This proposal should be treated as if it were a potential dissertation project—students should not propose a study that would take 10 years to complete. The student is advised to develop a well-focused proposal that is not overly broad.

In order to facilitate an oral exam of appropriate scope, depth, and rigor, students are encouraged to propose research that is feasible (i.e., could conceivably be carried out in a research group in CBC, although not restricted to currently available instrumentation). Students who wish to pursue work relatively distant from their field of interest are advised to ensure that faculty members with relevant expertise and experience to evaluate the proposal are available to consult and/or serve as an additional examiner during their preliminary oral exam.

The student is free to consult with anyone, including the advisor, in developing

the proposal, but the advisor's role should be non-directive, and the work should represent the student's own creative thinking.

Evaluation. The student must submit the Research Summary and Independent Proposal electronically to the Graduate Program Coordinator who will distribute it to the faculty on the respective Dissertation Committee. The Research Summary will not be formally evaluated. By the beginning of the fourth semester in residence, the members of the Dissertation Committee will provide an evaluation of the Independent Proposal based on the follow criteria:

- Technical quality
- Significance of Proposed Research
- Feasibility of Approach

A score of 3 (passing), 2 (revisions required), 1 (major revisions required), or 0 (not passing) will be assigned by each committee member of the Dissertation Committee with the exception of the Research Director, (total of three). In the event that a student has two Research Directors on their Dissertation Committee, and the committee only has four members total, a member of the GPC that is not a member of the student's Dissertation Committee will serve as a third voting member for the purpose of Independent Proposal evaluation. The scores will be summed.

A score of 8-9 will be considered passing. The student may schedule their preliminary oral for within six semester weeks pending availability and recommendation of the faculty committee, but no later than the end of the fifth semester in residence.

A score of 3-7 will be considered a provisional pass. The student will have up to four weeks to provide a revised version of their proposal for re-evaluation. If a passing evaluation (score of 8-9) is not obtained after the first revision, the student is transferred to a terminal M.S. program at the discretion of the advisor.

A score of 0-2 will be considered failing. A student who fails the first round of evaluation will be required to write an entirely new proposal (i.e. new topic).

Failure to meet the due date for submission of the Independent Proposal and Research Summary will jeopardize your good standing in the Department (as defined in Section F of this handbook).

(B) The Oral Portion of the Comprehensive Examination

The oral portion of the Comprehensive Examination shall be scheduled for a date as soon as possible (ideally within six weeks) after a passing evaluation of the Independent Proposal. **All students must take their oral examination no later than the end of the fifth semester.** Students cannot schedule an Oral Comprehensive Examination while on academic probation as defined by the Department of Chemistry and Biochemistry or by the Graduate College.

The Oral Comprehensive Examination is administered by the student's Dissertation Committee.

The Oral Comprehensive Examination begins with a presentation and defense of the **Independent Proposal**. An explanation and defense of the Independent Proposal will be a significant part of the Oral Comprehensive Examination. It is expected that the student will be able to explain and justify the proposal and demonstrate a reasonable knowledge of the literature and special techniques of the field. In addition, a portion of the examination will consist of general questioning in the student's major and minor course areas which test the student's comprehensive knowledge both in breadth across the general field of study and in depth within the area of specialization.

The examination will not focus on the student's research progress but may use the student's **Research Summary** as a springboard for questions that examine the student's ability to understand the scientific process, to formulate a logical research plan, and to think creatively.

At the end of 1-1.5 hours of examination the Dissertation Committee typically takes a break to discuss the student's performance. For the second half of the exam the committee can continue to question the student on their research proposal, or (as is typically done) focus on the student's general understanding of the chemical sciences, most often drawing upon their coursework background for questions to be addressed.

The Oral Comprehensive Examination will last a minimum of one hour but not more than three hours. If a student does not pass the exam on their first try, their Dissertation Committee may recommend a second trial, and can dictate the scope and focus of questioning to be conducted in that second exam.

3. Preparing for the Oral Comprehensive Examination

The Oral Comprehensive Examination is scheduled by submitting the **Application for Comprehensive Oral Examination** form to the Graduate College via GradPath. **A student will not be allowed to officially schedule the oral examination until the written portion (Independent Proposal) of the examination has been passed, although a tentative date can be arranged at any time with the Dissertation Committee.** The student is responsible for scheduling the room for the oral examination.

The best way to study for this examination is to: (1) know the proposal thoroughly, including all related topics, (2) review class notes and lecture material from all the classes taken as a graduate student up to that point, (3) review the general principles of major and minor areas of interest; sometimes perusal of a textbook can help guide this studying, and (4) be familiar with the recent literature (particularly in the fields represented by the committee members). **It is important to plan one's studying to avoid "burn out" before the examination. Know what material you want to cover and then systematically go through it.** It is an excellent idea to have several "practice oral examinations" with other graduate students and postdocs before the scheduled examination. This can be very helpful for identifying weaknesses and providing practice for thinking on one's feet.

4. Re-taking the Oral Comprehensive Examination

In the event that a student fails the Oral Exam, s/he may be granted a second attempt by their Dissertation Committee. No student will be permitted a second attempt to pass the Oral Comprehensive Examination unless it is recommended by the Dissertation Committee, endorsed by the major department and approved by the Dean of the

Graduate College. The second attempt may require a re-draft and defense of the original proposal, or may consist only of general questions. A new Research Summary will also be required. The student should contact each committee member individually to find out what areas need to be improved and what expectations each may have for the second attempt. If a student passes the second attempt at the oral exam, s/he proceeds to the Ph.D. program. If the student fails the second attempt also, s/he is not granted advancement to the Ph.D. program and enters the terminal Master's Degree program.

K. DISSERTATION AND FINAL DEFENSE

1. General Description of the Dissertation and Final Oral Defense Exam

Your dissertation is the culmination of your degree program, and is the document required by the Graduate College for the awarding of your degree. The Graduate College expects you to present your work in the best form for your discipline and your intended audience, following the guidance of your committee. The recommended style of the Department follows a traditional style with an introduction, materials and methods, results and discussion sections (see Section K.5 below).

A formal defense of the dissertation research constitutes the Final Oral Defense Examination. This consists of a public seminar by the candidate followed by an oral examination by the candidate's dissertation committee and other interested faculty. Be sure to bring all the necessary paperwork that requires signatures from members of the Dissertation Committee to the examination.

2. Requirements for Ph.D.

There are a number of requirements that need to be met to satisfy both the Department of Chemistry and Biochemistry and the Graduate College. Ultimately, you will earn your degree by meeting all the requirements of the Graduate College which by design, incorporates Departmental requirements. **It is very important to familiarize yourself with the most current Graduate College guidelines, specifically with regard to preparation of the Dissertation.** You should also download the formatting guide for dissertations, which is available at <http://grad.arizona.edu/degrecert/formattingguide>.

3. List of Specific Steps Necessary for Graduation

The following list shows the major steps that need to be taken once your Research Director and Dissertation Committee agree that your dissertation research is defensible:

<u>WHEN</u>	<u>WHAT</u>
penultimate semester	File Committee Formation form with the Graduate College.
4 th year of residence	Submit a detailed Dissertation Outline to your Dissertation Committee and schedule a meeting with your committee.
5 weeks prior to oral defense	Submit a penultimate draft of the dissertation to the Dissertation Committee
No later than 2 week prior to oral defense	Submit Announcement of Oral Defense Examination form in Gradpath.

Final semester

Upon successful completion of the Final Oral Defense Examination, the candidate submits the dissertation through the submission site maintained by ProQuest/UMI: <http://dissertations.umi.com/arizona>. When you submit your thesis, \$90.00 will be billed to your Bursar's account for the thesis processing and archiving. (You pay an additional fee to ProQuest/UMI if you choose Open Access publishing.) If you choose to copyright (optional), an additional \$65.00 will be billed to your Bursar's account.

Provide a bound copy of the dissertation to the Research Director, at their discretion.

Before the last week of final semester all fees must be cleared with the Bursar's Office.

4. Guidelines for Preparation of the Dissertation

In the fourth year of residence the candidate should submit a 5-10 page detailed **Dissertation Outline** to the Dissertation Committee outlining the research progress to date. This document should clearly list those studies that the student intends to complete prior to writing the dissertation. The candidate then meets with the Dissertation Committee to discuss the outline during the spring semester of the fourth year in residence. It is common for the Committee to recommend a limited number of experiments and to make specific recommendations regarding a timeline for writing of the dissertation.

The candidate submits a completed, penultimate draft to each member of the Dissertation Committee at least **five weeks** prior to the final examination. It is anticipated that the Dissertation Committee will be able to read the dissertation and return it to the candidate within two weeks of receipt. This timing allows the candidate to make any suggested changes, provided they are minor, and to obtain final approval of the penultimate draft three weeks prior to the final examination. Then, no later than two weeks before the proposed date of the examination, the student must submit the on line form **Announcement of Oral Defense Examination** to the Graduate College.

5. Description of the Format Recommended by the Department

The Graduate College policy states that in addition to required elements of specifically formatted front matter (see Dissertation Formatting Guide at <http://grad.arizona.edu/degreecert/formattingguide>), each Department can establish their own guidelines for the Dissertation format. The Department of Chemistry and Biochemistry has the following list of guidelines for preparation of a traditional dissertation:

- A. The suggested Dissertation format should include the following components, either as a single document, or subdivided into chapters that each have these components:
- **ABSTRACT** - describing the problem, the results and the interpretation
 - **INTRODUCTION** - general introduction to the field
 - **MATERIAL AND METHODS** - a complete description all in one section
 - **RESULTS** - should be logically divided into separate chapters with an introductory paragraph at the beginning of each chapter and a summary paragraph at the end

- **DISCUSSION** - a thorough analysis of the data and its implications, this section should tie the Dissertation together into a cohesive theme/thesis
 - **SUMMARY** - a short synopsis, including future directions that should be taken
 - **LITERATURE CITED** - should follow the format of the Journal of the American Chemical Society
- B. Figures and tables should be included in the chapters rather than as an appendix. Permission to use copyrighted material is the responsibility of the student.
- C. If appropriate, the dissertation may include portions of manuscripts being prepared for submission, but the text should reflect the student's own writing. The Dissertation Committee has the responsibility of checking the Dissertation for adherence to Graduate College specifications and for approving the overall appearance and format.

6. Committee Composition and Attendance at Final Defense.

The Department of Chemistry and Biochemistry requires students to compose a committee of four members: three within the major and one in the minor.

The student should make all attempts to have the four members attend the final defense. If, however, a scheduling conflict exists, there must be at least a minimum of three members in attendance, two of which must be in the major. If a committee member is unable to attend the defense because of unforeseen circumstances a substitution is allowed, provided that the originally scheduled committee member has read and approved the dissertation.

7. Policy on Inclusion of Published Papers as Appendices to Dissertations and Theses.

Note: The following rules have no impact on the body of the dissertation or thesis. The dissertation or thesis must stand on its own even without the appendices described here.

1. Subject to the approval of the Dissertation Committee, material published, or accepted for publication, in a refereed journal may be included as an appendix in the dissertation/thesis.
2. The dissertation/thesis author need not be the primary author of the publication(s).
3. The dissertation/thesis author need not be the principal contributor to the publication(s) as long as the Dissertation Committee agrees that the author's contribution is sufficient to warrant inclusion in the dissertation/thesis.
4. Since the appendices contain supplementary material, there is no conflict of interest when the Research Director is coauthor of the publication(s).
5. The Research Director's signature on the dissertation/thesis approval form will certify that the Dissertation Committee has approved the published material in the appendix.

L. REQUIREMENTS FOR A MASTER'S DEGREE

1. Master of Science and Master of Science with Emphasis in Chemical Education

This information is a supplement to the general regulations for graduate study as set forth in the catalog of the Graduate College. In addition to the classical M.S. degree in Chemistry, the Department of Chemistry and Biochemistry also offers an M.S. degree program with emphasis in Chemical Education. This program is designed as a component of an M.S./Ph.D. program that affords students additional training in Chemical Education. Terminal M.S. students may also elect to follow this program.

By Department of Chemistry & Biochemistry rules, all requirements for the degree of Master of Science must be completed within **3 YEARS** of joining the program, whether the student is supported financially, or not. Should a student not finish within that time period, he/she may appeal to the GPC for a one year extension. The student must provide a research update including a time line of completion that has been approved by his/her committee. This in no way implies that the Department of Chemistry & Biochemistry is bound to financially support the student for more than three years from the start of their program.

- a) **Diagnostic Examinations:** All entering students for a M.S. degree in Chemistry will take Diagnostic Examinations in the five core study areas: Analytical, Biological, Inorganic, Organic or Physical Chemistry. The Diagnostic Exams will be ACS standardized examinations to allow comparison to national norms.
- b) **Advisement:** The GPC is the academic advisor to all new students. The student and the Committee plan a program of course work based on the results of the Diagnostic Examinations and the student's interests. The GPC continues to serve as the student's advisor until the student selects a Research Director.
- c) **Selecting a Research Director – 1st semester in residence**
 - a) Prior to selection of a Research Director, you will become familiar with the research interests of the faculty through attendance at Department of Chemistry and Biochemistry Research Symposium, held the week before classes begin in the fall semester. Part of this Research Symposium will consist of poster presentations from graduate students and faculty in the department where you will have an opportunity to talk informally with presenters from multiple research groups about their research interests.
 - b) Following this poster session you must make individual appointments to discuss research opportunities with at least 6 faculty, during which time you will narrow your choices for Research Director.
 - c) Near the middle of the first semester, you will complete the process of selecting a Research Director. Your 1st, 2nd and 3rd choices for Research Director should be indicated on the Report of Selection of Research Director form and returned to the Graduate Program Coordinator by October 15 (fall entrance) or March 15 (spring entrance). Once your choices have been submitted, the Professor(s) selected will discuss this selection process with their division. The Division Chair will then forward their recommendations to the GPC and the GPC will make a final recommendation of Research Director selection to the Department Head.

- d) **Thesis Committee:** A Thesis Committee consists of three members, no more than two of whom can be from the student's major division. The Research Director will serve as chair of this Committee. The proposed thesis committee members and their signatures should be presented to GPC by the first day of fall classes of the third semester in residence. The GPC reviews the proposed Thesis Committee in the context of the proposed research and makes suggestions where appropriate.
- e) **Plan of Study:** The student will consult with the Thesis Committee shortly after it is formed to prepare a Plan of Study which should be submitted to the GPC. A total of 30 units of credit is required and at least 15 units must be in courses for which a letter grade (A,B,C) is awarded. Attendance at seminar (Chem 696) is also required of all students, but no more than 4 units of Chem 696 can be applied toward the 30 unit requirement. A maximum of 8 units of Thesis (Chem 910), 4 units of Exchange of Chemical Information (Chem 695b) and 2 units of Professional Development (Chem 595a/b) can be counted in the 30 unit total.

In addition a minimum of two graduate courses in education, approved by the Thesis Committee, is required for students (M.S./Ph.D. or M.S. in chemistry) who elect an emphasis in Chemical Education.

- f) **Thesis:** Original research and reporting the results of the research in a Thesis are the most important parts of the M.S. degree. Additional information about preparing theses may be obtained from the Graduate Program Coordinator or the Graduate College or at <http://grad.admin.arizona.edu/degrecert/formattingguide>.

Approximately one semester before the student expects to complete the thesis research, the student meets with the Thesis Committee. At this meeting the student summarizes the completed research and outlines the goals and proposed approaches for the remainder to the project. The Committee reviews this information and advises the student on the completion of the thesis research.

Thesis research and the thesis for the M.S. with emphasis in Chemical Education degree must represent original work in Chemical Education and must conform to the same high standards as for the traditional M.S. degree in Chemistry. The Chemical Education research must be separated and apart from any work the student is assigned as a Departmental Teaching Assistant.

- g) **Final Oral Examination:** After a candidate's thesis has been reviewed and accepted by the Thesis Committee, a final public oral examination covering the research and field of major interest will be administered.
- h) **Guideline for conversion from MS to PhD program:** Students admitted into the MS program in CBC may petition to transfer into the PhD program. The student must submit to the GPC a petition detailing the reasons for the request and the change of their original graduate study plans, a letter of support by the Research Director and one other research-active faculty member, an evaluation of the teaching performance by the Teaching Support Office and a list of ranking in each of the graduate classes taken. A CV containing other pertinent information may be submitted as well. Only outstanding students with very strong performance in all course work, research and teaching will be considered. The GPC will discuss the

request and make the final recommendation. In some circumstances, the GPC will recommend completion of an MS thesis before reviewing the request. If admission to the CBC graduate program is recommended, the student must apply to the CBC and University of Arizona graduate programs following the official application procedures.

i) Graduate Student Support: Graduate students in the M.S. program who remain in good standing (as defined in Section F in this handbook) and are making adequate progress in their degree program may be eligible for support as Graduate Teaching Assistants (TA) and/or as Graduate Research Assistants (RA). TA support is generally not available beyond a student's third year. Extensions of this time limit must be requested in a letter of appeal to the GPC. In addition to the requirement of being in good standing, the TA's teaching performance is evaluated each year. RA positions are provided at the discretion of the Research Director and are renewed subject to demonstrated productivity as measured by the Research Director.

2. Master of Arts

The Master of Arts Degree is a non-thesis degree that is awarded for advanced study in chemistry beyond the bachelor's degree. This degree is typically awarded after two years of graduate study if the following have been satisfied.

- a) Diagnostic Examinations:** All entering students for a M.A. degree in Chemistry will take Diagnostic Examinations in the five core study areas: Analytical, Biological, Inorganic, Organic or Physical Chemistry. The Diagnostic Exams will be ACS standardized examinations to allow comparison to national norms.
- b) Advisement:** The GPC is the academic advisor to all new students. The student and the Committee plan a program of course work based on the results of the Diagnostic Examinations and the student's interests. The GPC continues to serve as the student's advisor until the student selects a Faculty Mentor
- c) Faculty Mentor:** The student's choice of mentor should be indicated on the Report of Faculty Mentor form and returned to the Graduate Program Coordinator by the October 15 (fall entrance) or March 15 (spring entrance). Once the choice has been submitted, approval by the Professor, the GPC and Department Head are needed.
- d) Plan of Study:** The student will consult with the faculty mentor to prepare a Plan of Study, which should be submitted to the GPC for approval. A total of 30 units of credit is required and at least 15 units must be in courses for which a letter grade (A,B,C) is awarded. Attendance at seminar (Chem 696) is required, but not more than 4 units of Chem 696 can be applied to the 30-unit requirement. Up to 4 units of Chem 695b (Exchange of Chemical Information) and 2 units of Chem 595a/b (Professional Development) can be counted in the 30 unit total.

An overall 3.0 (B) GPA must be maintained for all courses in Chemistry, cross listed in Chemistry, or those approved by the GPC.

Graduate students admitted to Ph.D. candidacy are encouraged to apply for an M.A. degree. Students should be aware that they cannot use the same course work to obtain both an M.A. and an M.S. degree.

M. PART-TIME GRADUATE PROGRAMS

1. Policy on Part-Time M.A./M.S. Graduate Students

The Part-Time M.A./M.S. program is designed for students who are working full-time in “permanent” jobs in or near Tucson and wish to pursue the M.A. or M.S. degree part-time. Employment constraints may make it impossible for these students to take more than one course per semester and it is not expected that they would be able to take more than two courses per semester.

- a) **Diagnostic Examinations:** All entering students for a M.A. degree in Chemistry will take Diagnostic Examinations in the five core study areas: Analytical, Biological, Inorganic, Organic or Physical Chemistry. The Diagnostic Exams will be ACS standardized examinations to allow comparison to national norms.
- b) **Advisement:** The GPC is the academic advisor to all new students. The student and the Committee plan a program of course work based on the results of the Diagnostic Examinations and the student's interests. The GPC continues to serve as the student's advisor until the student selects a Faculty Mentor (M.A.) or Research Director (M.S.).
- c) **Research Director and/or Faculty Mentor Selection:** Selection and approval of Faculty Mentors/Research Directors is discussed in Section L of this Handbook.
- d) **Plan of Study:** Plan of Study requirements will follow that discussed in Section L of this Handbook. A total of 30 units of credit are required for the M.A. and M.S. degrees, of which at least 15 units must be in graded courses A, B, C, etc. Part-Time M.A./M.S. students are expected to enroll in Chemistry 696 (seminar) and/or Chemistry 695b (Exchange of Chemical Information) each semester and may include up to 6 units of each in the required 30 units.
- e) **Time Limits:** The M.A. degree must be completed within three years from the first date of enrollment. M.S. students must complete the course work requirements within three years.

2. Policy on Part-Time Ph.D. Program

The Part-Time Ph.D. Program in Chemistry is designed for students who are working full time in “permanent” jobs in or near Tucson and wish to pursue the Ph.D. degree part-time. Employment constraints may make it impossible for these students to take more than one course per semester and it is not expected that they would be able to take more than two courses per semester.

[Students must apply specifically to the Part-Time Ph.D. Program. Students who have been admitted to, and have begun, the regular, full-time, Ph.D. Program may not transfer into the Part-Time Ph.D. Program. Students in the Part-Time Ph.D. Program are not eligible for TA support. Students must take at least one major or minor course each semester until coursework is complete].

- a) **Diagnostic Examinations:** Students must take Diagnostic Examinations on entrance into the Part-Time Ph.D. Program. (Students are encouraged to make up

as many known or expected deficiencies as possible before application. This can be accomplished by registering as non-degree seeking students).

- b) **Coursework:** The minimum level of coursework can be completed in four and one-half years [two and one-half years at the rate of two courses per semester].
- c) **Seminars:** Students will be expected to participate (attend and give) the seminars in their area(s). They will take the same number of units of seminar (10 units) as full-time students.
- d) **Research Director Selection:** Students will select a Research Director by following the guidelines in Section J.
- e) **Committees:** The student and the Research Director will recommend a Dissertation Committee by **first day of classes** of the third semester in residence.
- f) **Plan of Study:** Students must file a Plan of Study before the end of their first year.
- g) **Written Comprehensive Examination:** The Independent Proposal and Research Summary will be prepared according to the guidelines for full-time students. Standards will be the same as for full-time students.
- h) **Oral Comprehensive Examination:** The oral comprehensive exam shall be scheduled for a date as soon as possible (ideally within twelve weeks) after a passing evaluation for the Independent Proposal. The standards will be the same as for full-time students.
- i) **Research:** Research may begin very early in the program. Standards for acceptable dissertation research (quantity and quality) will be the same as for full-time students.

Control and direction of the research must reside with the Research Director. Issues, such as publication, patents, etc., must be agreed upon, in writing, beforehand by the Research Director, the University, and the student's employer.
- j) **Group Meetings:** Students will be expected to take the same number of 695b units as full-time students. Attendance at group meetings will be agreed upon by the student and the Research Director.
- k) **Dissertation:** Same standards as full-time students.
- l) **Time Limitation:** All requirements for the PhD Program must be completed within 5 years of passing the Comprehensive Exam. Should a student not finish within that time period, s/he may be allowed to re-take the Comprehensive Exam (both written and oral) with permission of the GRC. It is possible to petition for an extension, but approval of the extension is not guaranteed.
- m) **Final oral:** Same standards as full-time students.