

THE UNIVERSITY OF ARIZONA

**DEPARTMENT OF CHEMISTRY &
BIOCHEMISTRY**

**GRADUATE HANDBOOK
BIOCHEMISTRY**

FALL 2016

CBC@UA!

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A. GENERAL DESCRIPTION OF THE GRADUATE PROGRAM

Biochemistry students accepted into the graduate program are admitted primarily to pursue a Ph.D. The Ph.D. program at the University of Arizona prepares high-achieving students for senior research positions in industry or government laboratories, or a career in college-level or university-level teaching and research. A number in interdisciplinary research and training programs are also available under the Biochemistry Ph.D. program including, Biological Chemistry Program, Biological Physics Program, and Biochemistry and Molecular and Cellular Biology.

An alternate track which students may be placed into, or choose to move into, is the Master of Science degree (M.S), which involves less time and less course work commitment.

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 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.

It is important to realize that successful completion of a graduate degree program in Biochemistry 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 Biochemistry 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.

PRE-FIRST SEMESTER

Qualifying 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 and 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 Journal Club as well as Departmental Colloquia.
Laboratory Rotations	Students will undertake 2 laboratory rotations: August 22 – October 14, 2016 October 17 – December 7, 2016

SECOND SEMESTER

Course Work and Seminars	Course Work for the second semester is based on the projected Program of Study. All students are expected to attend Journal Club as well as Departmental Colloquia. A second and third chance to pass three qualifying exams will occur at the start and end of this semester.
Laboratory Rotations	Continue with rotations: January 11 – March 3, 2017 March 6 – May 3, 2017
Research Director Selection	A matching process will take place at the end of the third rotation. If a successful match is made at this time, the student may spend a fourth rotation working in the lab of their newly chosen Research Director.
Research	Begin 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

Dissertation Committee

In consultation with Research Director, a Dissertation Committee must be selected by May 15. Submit Proposed Dissertation Committee to the Graduate Program Coordinator and also record it in GradPath.

FIRST SUMMER

Research

Continue Research

THIRD SEMESTER

Course Work

Advised by Research Director. Submit Plan of Study to GPC. Register for coursework according to Plan of Study. All students are expected to attend Journal Club as well as Departmental Colloquia.

Second Year Dissertation Committee Meeting

Schedule a meeting to occur prior to September 30 with your Dissertation Committee and prepare presentation on research progress

Research

Continue research.

Written Comprehensive Examination

Independent Research Proposal and Research Summary, as detailed in Section "J" of this handbook, are due on November 1 or the first Monday after November 1 of the third semester in residence. Faculty are to return reviews prior to the last day of the semester.

FOURTH SEMESTER

Course Work

Continue coursework as defined in accepted Plan of Study. Present seminars according to programmatic requirements. All students are expected to attend Journal Club as well as Departmental Colloquia.

Research

Continue research.

Written Comprehensive Examination

Independent Proposal must be approved by your Dissertation Committee, subsequent to any revisions required (see Section J).

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 fourth semester.**

SECOND SUMMER

Research

Continue research

REMAINING SEMESTERS

Course Work and Seminars

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

Research

Continue research

Annual Report and Annual Committee Meeting

Submit Annual Report to Dissertation Committee and Graduate Program Coordinator by July of each year in residence. Meet with Dissertation Committee once per year by July of that year.

FINAL STEPS

Approximately 6-9 months prior to expected date of graduation

Schedule a meeting with your Dissertation Committee to take place approximately 6-9 months prior to the expected date of graduation. Prepare presentation on research progress and distribute written dissertation outline.

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.** See the Graduate Program Office for guidelines.

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 biochemical 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,

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 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. Pascale Charest	BSW 345	626-2916	pcharest@email.arizona.edu
Dr. Indraneel Ghosh	CSB 410	621-6331	ghosh@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	OC 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
Aaron Pejlovas			pejlovas@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. DEGREE

Most full-time students in good standing (as defined in Section F in 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.

All TAs are assigned an average task load of 20 hours per week for a half-time position regardless of the assignment. Because of the nature of teaching, the task load will vary from week to week so that the 20 hours is an expected average over the term. Specific descriptions exist for every TA assignment and are available from the Teaching Support Office on request. Further information regarding the duties and responsibilities of TAs is provided in the department's "TA Training Manual".

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.

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

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
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 BIOCHEMISTRY

1. Total Credits

- a) A minimum of 63 units of graduate credit, 500-level or above, are required for a Ph.D. in Biochemistry.
- b) A total of 45 graded and ungraded units and 18 dissertation units comprise the 63 overall credits.
- c) At least 21 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: Some Biochemistry programs of study may require more than 21 graded units.
- 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. 24 units) is mostly comprised of seminar, journal club, group meetings, college teaching, or research opportunities.

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 the Biochemistry Program Faculty, 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 units of Professional Development (Chemistry 595a/b) with a grade of S or P is required of graduate students the first two semesters in residence. Note: for BMCB students, who typically join in their second year, this course may be taken in the second year. Also, the MCB ethics course may be substituted for the second semester of Chem 595b.

4. Research Opportunities

All entering Biochemistry students are required to take four units of Laboratory Rotation (BIOC 795a) and will undertake 3-4 rotations in the laboratories of participating faculty. At the end of each rotation period a brief presentation is required.

Rotations are graded, and count towards a total of 6 units of graded coursework (3 units per semester). Expectations of the graduate student in a rotation are at least 10 hours per week of work in the laboratory hosting the rotation, as well as attendance at group meetings (if it does not conflict with their teaching schedule). Students should also connect weekly with the rotation advisor, and present a poster near the end of the rotation (typically during the BCP journal club time slot) describing their work from the rotation. The rotation experience has several roles in the graduate student career including learning new techniques, experiencing what it would mean to join a particular lab, learning about the research projects of that lab, and making connections with Professors, other students, and other research professionals that can be valuable to the graduate student during their time at UA as well as long afterwards (writing letters of recommendation for example). Graduate students should take these rotations very seriously.

Rotation #	Rotation Period
1	August 22 – October 14, 2016
2	October 17 – December 7, 2016
3	January 11 – March 3, 2017
4	March 6 – May 3, 2017

5. Biochemistry Required Coursework in the Major and Minor areas

- a) The course requirements should be completed by the end of the second year in the Program. Section H lists course requirements for students in the various Biochemistry programs. The additional courses necessary to meet the graded coursework minimum requirements should be chosen 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.
- b) A minor in an area outside of department must be approved in advance by the GPC and must satisfy all the coursework, written and oral preliminary exam requirements of the minor department.
- c) 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.

7. Seminar

Regular attendance at seminar is expected of all students each semester. These units (BIOC 696d) may be used to meet graduation requirements (i.e. ungraded units).

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.

8. Group Meeting

At least one unit of Laboratory Meeting (BIOC 696a) should be taken each semester in residence after joining a research group. Up to ten (10) units may be used to meet graduation requirements (i.e. ungraded units). The format for this course is set by individual Research Directors.

9. Dissertation Research

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

H. PLAN OF STUDY (POS)

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 third 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.

BIOCHEMISTRY

BIOC 565	Proteins & Enzymes	3 units	Fall semester
BIOC 568	Nucleic Acids, Metabolism and Signaling	4 units	Spring semester

In addition, additional graded units must be completed to total 21 (rotations, BIOC 795a, generally 6 units, currently counts towards those 21). Coursework should be chosen in consultation with the student's advisor and dissertation committee. Suggested courses include:

BIOC 585A	Biological Structure 1 X-ray Crystallography	2 units	Fall semester
BIOC 585B	Biological Structure 2 NMR Spectroscopy	2 units	Spring semester
BIOC 548A	Plant Biochemistry & Metabolic Engineering	3 units	Fall semester
BIOC 553	Functional & Evolutionary Genomics	4 units	Fall semester
BIOC 553L	Functional & Evolutionary Genomics Laboratory	1 units	Fall semester
BIOC 573	Recombinant DNA Methods & Applications	4 units	Fall & Spring semesters
BIOC 588	Principles of Cellular & Molecular Neurobiology	4 units	Fall semester
MCB 577	Cell Biology	4 units	Fall semester
MCB 546	Genetic and Molecular Networks	4 units	Spring semester
MCB 572A	Cell systems	4 units	Fall semester
MCB 580	Systems biology	3 units	Fall semester
MCB 585	Multidisciplinary Approaches to Solving Biological Problems	4 units	Fall semester
PSIO 584	Cardiovascular Muscle Biology and Disease	3 units	Spring semester
PSIO 585	Cardiovascular Physiology	3 units	Fall & Spring semesters
CHEM 523a	Bioanalytical Chemistry	3 units	Fall semester
CHEM 510	Advanced Inorganic Chemistry	3 units	Fall semester
CHEM 550	Synthetic and Mechanistic Organic Chemistry	3 units	Fall semester
CHEM 580	Introduction to Quantum Chemistry	3 units	Fall semester
CHEM 527	Analytical Separations	3 units	Fall semester
PHSC 670	Principles in Drug Discovery, Design, and Development	3 units	Fall semester

Biological Chemistry Program (BCP)

BIOC 565	Proteins & Enzymes	3 units	Fall semester
BIOC 568	Nucleic Acids, Metabolism and Signaling	4 units	Spring semester
Plus one from the following:			
CHEM 510	Advanced Inorganic Chemistry	3 units	Fall semester
CHEM 550	Synthetic and Mechanistic Organic Chemistry	3 units	Fall semester
CHEM 580	Introduction to Quantum Chemistry	3 units	Fall semester
PHSC 670	Principles in Drug Discovery, Design, and Development	3 units	Fall semester
CHEM 523A	Bioanalytical Chemistry	3 units	Fall semester
CHEM 527	Analytical Separations	3 units	Fall semester

In addition, additional graded units must be completed to total 21 (rotations, BIOC 795a, generally 6 units, currently counts towards those 21). Coursework should be chosen in consultation with the student's advisor and dissertation committee. See previous page for suggested courses.

Biological Physics Program (BPP)

BIOC 565	Proteins & Enzymes	3 units	Fall semester
BIOC 585A	Biological Structure 1 X-ray Crystallography	2 units	Fall semester (alternate years)
BIOC 585B	Biological Structure 2 NMR Spectroscopy	2 units	Spring semester (alternate years)
PHYS 530	Intro to Biophysics	3 units	Fall semester
PHYS 531	Molecular Biophysics	3 units	Spring semester
CHEM 580	Introduction to Quantum Chemistry	3 units	Fall semester
CHEM 582	Statistical Thermodynamics	3 units	Fall semester

In addition, additional graded units must be completed to total 21 (rotations, BIOC 795a, generally 6 units, currently counts towards those 21). Coursework should be chosen in consultation with the student's advisor and dissertation committee. See previous page for suggested courses.

Biochemistry track of the BMCB program

BIOC 565	Proteins & Enzymes	3 units	Fall semester
BIOC 568	Nucleic Acids, Metabolism and Signaling	4 units	Spring semester
Recommended:			
MCB 585	Multidisciplinary Approaches to Solving Biol. Problems	4 units	Fall semester

In addition, additional graded units must be completed to total 21 (rotations, BIOC 795a, currently counts towards those 21). Coursework should be chosen in consultation with the student's advisor and dissertation committee. See page 22 for suggested courses.

All tracks: All students must earn a grade of "B" or better in all required major coursework

Additional Course Requirements:

BIOC 795A	Laboratory Rotation	Variable units (1-6)	Fall and Spring semesters
CHEM 595c	College Teaching	2 units	Fall and Spring semesters

In addition, students must register for BIOC 696a (laboratory meeting), BIOC 696d (seminar, meaning attendance at the departmental colloquium), and BIOC 900 *each* semester after their first year. Once the student has advanced to candidacy for the Ph.D. by passing the written preliminary and oral comprehensive examinations, the student should enroll in BIOC 920 (dissertation) each semester rather than BIOC 900. These courses have variable credits; students must register for as many credits as are required for 12 units/semester.

BIOC 696a	Laboratory Meeting	1-3 unit
BIOC 696d	Seminar	1 unit
BIOC 900	Research	Variable credits
BIOC 920	Dissertation	Variable credits (18 required)

Students in the BCP must be registered and attend BCP Journal Club (graded by attendance) each semester while in the BCP program. In addition to attendance each week, BCP students will present a poster after each rotation in the first year, present a research seminar in their third year, present a literature seminar in their fourth year, and a research seminar in their fifth year.

BIOC 595b	BCP Journal Club	1 unit	Fall and Spring semesters
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Students in other Biochemistry PhD programs must take an appropriate journal club each semester.

MCB 695a	BMCB Journal Club	1 unit	Fall and Spring semesters
BIOC 595b	BPP Journal Club	1 unit	Fall and Spring

BIOLOGICAL CHEMISTRY PROGRAM (BCP)

Major and Distributed Minor (Graded courses)*	Introduction to Research (Rotations)	Total Graded
Core courses in Biochemistry: BIOC 565 Proteins and Enzymes 3 units BIOC 568 Nucleic Acids, Metabolism, and Signaling 4 units	BIOC 795a Introduction to Research	
Core courses in Chemistry or Medicinal Chemistry: Choose one from: CHEM 510/523A/527/550/580 or PHSC 670 3-4 units		
Additional upper level coursework: at least 4-5 units		
Major and Distributed Minor Courses Total (minimum): 15 units	6 units	Graded Courses Total (minimum): 21 units

*Note that it is possible to do a Minor from another department. In such case, that department's requirements for the minor must be followed. Typically, this involves a minimum of 9 units (graded) from that department.

Other Courses Required

Journal Club	Group Meeting	Seminar	Other	Total units
BIOC 595b BCP journal club 1 credit/semester	BIOC 696a 1 credit/semester (After joining a research group)	BIOC 696d 1 credit/semester	595c College Teaching (Fall I and Spring I), 2 credits	
Maximum counted toward degree: 10	Maximum counted toward degree: 10	Maximum counted toward degree: 10	Maximum counted toward degree: 2	Ungraded total: 24

BIOCHEMISTRY TRACK OF BMCB

Major and Distributed Minor (Graded courses)*	Introduction to Research (Rotations)	Total Graded
Core courses in Biochemistry BIOC 565 Proteins and Enzymes 3 units BIOC 568 Nucleic Acids, Metabolism, and Signaling 4 units	BIOC 795a Introduction to Research	
Additional upper level coursework: at least 8 units		
Major and Distributed Minor Courses Total (minimum): 15 units	6 units	Graded Courses Total (minimum): 21 units

*Note that it is possible to do a Minor from another department. In such case, that department's requirements for the minor must be followed. Typically, this involves a minimum of 9 units (graded) from that department.

Other Courses Required

Journal Club	Group Meeting	Seminar	Other	Total units
MCB 695a 1 credit/semester	BIOC 695a 1 credit/semester (After joining a research group)	BIOC 696d 1 credit/semester	595c College Teaching (Fall I and Spring I), 2 credits Note: the second semester can be substituted with the MCB ethics course	
Maximum counted toward degree: 10	Maximum counted toward degree: 10	Maximum counted toward degree 10	Maximum counted toward degree 2	Ungraded total: 24

Minor Subjects

A student must choose a minor subject. Students may meet the minor requirement by one of the two options listed below.

Option 1 - Minor in Biochemistry

A minor in BIOC consists of three advanced (500 level or above) courses or a minimum of 9 units. The 9 units required for the BIOC minor can be from any department that the graduate advisor (first year students) or Dissertation committee (second year students) approves. (Non-majors who wish to minor in BIOC must take 9 units of classes listed in BIOC.

Option 2 - Minor in a Specialty Area Other than Biochemistry

Students should check with the respective departments to verify minor degree and course prerequisite requirements.

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

I. CHOOSING A RESEARCH PROJECT AND RESEARCH DIRECTOR

1. Selecting a Research Director

During the first year of the graduate program, students will undertake 3-4 laboratory rotations. The laboratory rotations are designed to familiarize students with the work that is carried out in each laboratory. A matching process will take place at the end of the third rotation. If a successful match is made at this time, the student may spend a fourth rotation period working in the lab of their newly chosen Research Director, or alternatively may arrange an "internship" in a different lab, if the PI of that lab is agreeable. If no match is made, the fourth rotation period will be a "real" rotation in which the student is seeking a potential Research Director.

During a student's rotation in a lab, s/he is encouraged to discuss prospects for future work in the Research Director's lab regarding projects, funding and space availability. However, to give all students an equal opportunity to join the lab of their choice, no commitments should be made by either student or faculty before the end of the third rotation (the middle of the second semester), except under special prior arrangements of direct first-year sponsorship of students by an affiliated professor. Near the end of the third rotation, 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 April 15th. 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 the division. The Program 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.

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: 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.

- First, be adventurous – students should think broadly about where their passion lies in science.
- 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. The Proposed Dissertation Committee form must be submitted by May 15. (For students who start in the spring semester,

the deadline for meeting with the committee is Feb 15.) 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 the Biochemistry Program Faculty head 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. Biochemistry Graduate Program students must have a short (1 hour) meeting with their Dissertation Committee in the Fall of the second year. This meeting must be scheduled to take place by **September 30**.

The purpose of this meeting is to discuss your progress to date in the program and your plans for the future. This meeting will consist of:

- a 15-20 minute presentation on research progress and plans
- a discussion of classes taken, the plan of study, and any future classes
- a discussion of proposal ideas for the Comprehensive Exam
- a discussion with the committee in the absence of the student
- a discussion with the committee in the absence of the primary advisor

Postponement of the First 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 their third year of the program (i.e. after 2 Spring and 2 Fall semesters), all **Biochemistry Program Ph.D. students should prepare an Annual Research Summary, due by July of that year.** One copy of the summary should be given to each committee member and 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. Attach CV to the report.

(3) Annual Meetings. Department of Chemistry and Biochemistry rules state that, all **Biochemistry Program Ph.D. students are required to meet with their Dissertation Committee annually, by July each year, starting their fourth year (i.e. after 3 Spring and 3 Fall semesters).** The purpose of these meetings is to discuss progress to date in the program and your plans for the future. The meeting will consist of:

- a summary of the research progress (submit to committee members one week prior to the meeting) including progress towards publication and completion of thesis
- a discussion of classes taken, the plan of study, and any future classes
- a brief presentation (30 min) of present and future research
- a discussion with the committee in the absence of the student
- a discussion with the committee in the absence of the primary advisor

After the meeting, a report must be made to the Graduate Program Coordinator and the Biochemistry Program Faculty Liaison.

(3) Final Dissertation Committee Meeting. Biochemistry Graduate Program students must have a short (1 hour) meeting with their Dissertation Committee at least six months prior to their final defense. 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.

This meeting will consist of:

- a dissertation prospectus (given to the committee members at least two weeks prior to the scheduled meeting)
- a discussion of the prospectus and consensus on what research needs to be completed to satisfy the committee
- a discussion of future plans post-graduation

The prospectus and a detailed summary of the meeting needs to be sent to the Graduate Program Coordinator for inclusion in the student's file.

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

1. Diagnostic Qualifying Exams

All students must qualify in three (3) areas of Chemistry and Biochemistry of their choosing. Biochem part I and II exams are counted as separate areas.

In order to achieve qualification, students must pass any three qualifying exams. Passing scores are set by the individual programs.

Students have a total of three opportunities to take the exams. On arrival, all students take three exams of their choosing. The week before the start of second semester and at the end of second semester in residence, those who have not previously met the qualification requirements have an opportunity to take up to three exams to qualify.

Failure to pass three qualifying exams by the end of the second semester in residence will relegate students in the PhD program to the MS program and students in the MS program to the MA program.

Note: since BMCB students enter the Biochemistry PhD program through the ABBS program their second year, they are exempt from taking the qualifying exams.

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 on Nov 1 or the Monday following Nov 1 of the 2nd year in the program (third semester) as assigned by the GPC. The proposal fulfills the written requirement of the comprehensive examination for PhD candidacy. Return of reviews of the proposal by the committee (excluding research director) will take place prior to the last day of class of the semester to provide students with enough time to improve the proposal or prepare for the oral exam. 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 start in the spring semester, the respective deadline for the research proposal is Mar 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 or NIH-like 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 fourth 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.
Approximately 9 months prior to expected date of graduation	Schedule a meeting with your Dissertation Committee to take place approximately 9 months prior to the expected date of graduation. Prepare presentation on research progress and distribute written dissertation outline.
5 weeks prior to oral defense	Submit a penultimate draft of the dissertation to the Dissertation Committee
No later than 2 weeks 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 six months prior to the final defense. 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 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/degrecert/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.