

**THE UNIVERSITY OF ARIZONA**

**DEPARTMENT OF CHEMISTRY &  
BIOCHEMISTRY**

**GRADUATE HANDBOOK  
CHEMISTRY & BIOCHEMISTRY**

**FALL 2023**

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## A. GENERAL DESCRIPTION OF THE CHEMISTRY AND BIOCHEMISTRY GRADUATE PROGRAM

The Ph.D. program in Chemistry and Biochemistry focuses on original research leading to a doctoral dissertation. With guidance from the Research Director, Dissertation Committee, and the Graduate Program Committee (GPC), students gain expertise in modern chemical/biochemical research, emphasizing scholarship, knowledge creation, and defending their research. There's also an option for an M.S. degree with a shorter research experience. An M.A. degree is available for those interested in chemistry/biochemistry without a research career. An accelerated program combines B.S. and M.S. degrees, requiring a thesis. Successful completion is the student's responsibility. Use resources provided by the Graduate College and refer to the Chemistry and Biochemistry Graduate Handbook. Mentors assist in scientific training and guidance, but self-motivation is crucial for success.

### Ph.D. Program at a Glance

#### PRE-FIRST SEMESTER

Qualifying Examinations:	These exams, held before the semester begins, serve to outline the curriculum for the first term, pinpoint knowledge gaps, and suggest ways to address them. Passing three exams is required by the end of the second semester, with three attempts permitted.
CBC Research Symposium:	CBC Research Symposium includes a data blitz and poster session for new graduate students to familiarize themselves with research groups of interest.

#### FIRST SEMESTER

Course Work, Seminars:	Selection of first-semester coursework involves consultation with the GPC, considering the planned Program of Study and Qualifying Exam outcomes. All students should attend at least one divisional or program-related seminar, along with the Departmental Colloquia every week. Moreover, specialized training in areas such as radiation, chemical, biological safety, and other research-related requirements must be fulfilled.
Faculty Interviews:	All students are required to interview individually with at least 6 faculty members.
Laboratory Rotations:	All Students will undertake 3 – 4 laboratory rotations.
Research Director Selection:	Non-BCP Chemistry students should submit the Research Director Selection Report to the GPC after completing their third rotation. If a fourth rotation is chosen, the form can be submitted at the conclusion of that rotation, which is optional.
Research:	Begin research when Research Director selection is approved.
Teaching:	Students will perform TA duties as assigned.

#### SECOND SEMESTER

Course Work, Seminars:	Guided by your Research Director, you should deliver your Plan of Study to the GPC before April 30th. Weekly attendance at one divisional or program-specific seminar, along with the Departmental Colloquia, is
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mandatory for all students. For transfer credit inquiries, it's advisable to initiate the process early this semester.

Laboratory Rotations:	Biochemistry and Chemistry BCP students will complete 3 <sup>rd</sup> rotation.
Research Director Selection:	Biochemistry and Chemistry BCP students should submit the Research Director Selection Report to the GPC after completing their third rotation. If a fourth rotation is chosen, the form can be submitted at the conclusion of that rotation, which is optional.
Research:	Continue Research.
Teaching:	Students will perform TA duties as assigned.
TA Evaluation:	Your role as a Teaching Assistant is regarded as a vital aspect of your education and your obligation as a graduate student at the University of Arizona.

### FIRST SUMMER

Research:	Continue research.
Dissertation Committee:	In collaboration with your Research Director, you must choose your Dissertation Committee by the start of fall classes. Submit your Proposed Dissertation Committee to the Graduate Program Coordinator and document it in GradPath.

### THIRD SEMESTER

Course Work:	Follow the coursework outlined in the approved Plan of Study, ensuring attendance at relevant divisional or program-specific seminars, as well as the Departmental Colloquia every week. Comply with divisional or programmatic guidelines when delivering seminars.
Research:	Continue research and submit your Annual Research Summary in writing to both your Dissertation Committee and the GPC by September 1 <sup>st</sup> or the following first Monday.
Written Comprehensive Exam:	The Independent Research Proposal, outlined in Section "K" of this guide, should be submitted by November 1st or the subsequent first Monday. Faculty evaluations will be returned before the end of the Fall semester or within 5 weeks if submitted earlier. For students commencing in the spring semester, the deadline is March 15th.

### FOURTH SEMESTER

Course Work:	Follow the coursework outlined in the approved Plan of Study, ensuring attendance at relevant divisional or program-specific seminars, as well as the Departmental Colloquia every week. Comply with divisional or programmatic guidelines when delivering seminars.
Research:	Continue Research
Oral Comprehensive Exam:	Arrange the Oral Comprehensive Examination, aiming to schedule it as soon as possible, ideally within six weeks following the approval of the Independent Research Proposal. It's important to note that <b>all students must complete their oral examination by the conclusion of their fourth semester.</b>

### SECOND SUMMER

Research: Continue research and submit your Annual Research Summary in writing to both your Dissertation Committee and the GPC by September 1<sup>st</sup> or the following first Monday.

## REMAINING SEMESTERS

Course Work and Seminars: Follow the coursework outlined in the approved Plan of Study, ensuring attendance at relevant divisional or program-specific seminars, as well as the Departmental Colloquia every week. Comply with divisional or programmatic guidelines when delivering seminars.

## FINAL STEPS

Committee Meeting: Arrange a meeting with your Dissertation Committee about six months prior to your expected final defense date. During this meeting, prepare a presentation detailing your research progress and share a written dissertation outline with the committee members.

Seminar: Schedule and present final seminar as required by your division.

Dissertation: Complete dissertation and deliver it to your Dissertation Committee.

Final Oral Defense: Plan the dissertation defense (final oral examination) and ensure you submit the Announcement of Oral Defense Examination at least two weeks before the scheduled defense date. At this time, provide your committee members with a final draft of your dissertation.

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 MUST BE COMPLETED WITHIN 5 YEARS OF PASSING THE ORAL COMPREHENSIVE EXAM.**

## B. EXPECTATIONS OF STUDENT & FACULTY

### WHAT THE FACULTY EXPECT FROM THE STUDENTS

The faculty anticipates that students in this program will adhere to the University of Arizona Academic Code of Conduct and the Academic Code of Integrity, as outlined in Section C of this Handbook. Non-compliance at any point may lead to dismissal from both the graduate program and the University of Arizona. Furthermore, the faculty's expectations of graduate students in this program include:

#### Research

- to discover and enthusiastically pursue a unique topic of research 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,
- 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,
- to keep appropriate records of your research design, results, and interpretation – this includes laboratory notebooks, regular digital backups, etc.,

- 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,
- to exercise the highest integrity in all aspects of your work, especially in the tasks of collecting, analyzing, and presenting research data.
- to work responsibly toward completion of the degree in a timely fashion,
- to mentor other students in the Department and individual research groups and foster the regular exchange of research ideas and teamwork between group members.

### **Teaching**

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

### **Professional Development/Program Progress**

- to develop, to the extent possible, a broad network of professional relations,
- to contribute, wherever possible, to the discourse of the scholarly discipline through conference presentations, publications, collaborative projects, and other means,
- to seek out a range of faculty and peer mentors that can help you prepare for a variety of professional and career goals and responsibilities,
- 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**

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

### **WHAT THE STUDENT SHOULD EXPECT OF THE RESEARCH DIRECTOR AND DISSERTATION COMMITTEE**

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

- Be willing to meet with you regularly,
- Be someone with whom you can talk freely and easily about research ideas and your professional development,
- Provide timely feedback on the quality of your work and the direction of your dissertation project,
- Be someone you can trust to look out for your professional interests,
- Be willing and enthusiastic in giving you credit for the work you do,
- Be willing to tell you when your work does or does not meet the standards they have set for their research program,
- Be willing to help you graduate in a reasonable time frame, with a dissertation that tells a complete story, and is representative of Ph.D. level research at peer institutions,
- 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.

### **WHAT THE STUDENT SHOULD EXPECT OF THE DEPARTMENT**

- Receive financial support, either as a Graduate Teaching Assistant (GTA) or Graduate Research Assistant (GRA), typically for a minimum of five years, subject to your satisfactory academic progress and favorable standing within the department (as elaborated in Section G of this handbook). The possibility of continued support beyond this period will be determined at the discretion of the research director and the department.
- Opportunities to develop skills beyond your specialty through seminars, short courses in departmental facilities, and interactions with renowned researchers,
- Opportunities to provide feedback to the department and to review policies to ensure the quality of the department,
- Classes being and end on time,
- Faculty are available for questions and office hours in a timely manner,
- Faculty will provide prompt feedback on exams, quizzes, coursework, etc.

### C. UARIZONA 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: (**ABOR Code of Conduct 5-301**) (**ABOR Student Code of Conduct 5-308**)

### D. GRADUATE PROGRAM COMMITTEE (GPC) – STRUCTURE AND FUNCTION

The Graduate Program Committee (GPC) plays a crucial role in overseeing the Graduate Program, with responsibilities that include guiding new students, monitoring their progress, and recommending fellowship recipients. This committee comprises faculty members and staff members. One of the committee's objectives is to assist you in tailoring an academic program that aligns with your needs before you select a Research Director and Dissertation Committee to guide your research endeavors.

Throughout your time in the program, the GPC will continually track your progress. If you encounter any issues that cannot be resolved by your advisor or if you are uncertain about fulfilling departmental or Graduate College requirements, you can seek guidance from one of the faculty or staff representatives on the GPC at any time.

In addition, the Graduate Program Coordinator is responsible for maintaining all records related to your academic advancement. However, it's advisable to keep duplicates of these records whenever possible. You can obtain various forms needed during your graduate student tenure from the Graduate Program Coordinator or the Graduate College.

### E. FINANCIAL ASSISTANCE WHILE PURSUING THE PH.D. DEGREES

Most full-time Ph.D. students in good standing, per Section F of this handbook, typically receive financial assistance, often in the form of an assistantship. These assistantships offer a stipend, student health care coverage, and both in-state and out-of-state tuition fees. Mandatory fees remain the students' responsibility.

During the first year, financial assistance usually comprises a teaching assistantship (TA) for the academic year (approximately August 15 to May 15) and a research assistantship (RA) for the summer (May 15 to August 15), often funded by the student's Research Director. In cases where the director doesn't provide funding, students may work as teaching assistants during the summer school program.



Competitively awarded University Fellowships are available in limited numbers. It's essential to maintain regular communication with your Research Director and the/or teaching supervisor to ensure satisfactory performance. Subpar performance could lead to dismissal from the program or loss of financial support eligibility. Meeting programmatic requirements, including coursework and research, is a full-time commitment, and students are expected to fulfill all assigned assistantship responsibilities.

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

### **TEACHING ASSISTANTSHIP (TA)**

The teaching assistantship serves not only as a means of financial support but also as an essential component of your graduate education. As a TA, you'll have the chance to solidify your grasp of fundamental chemical principles, cultivate a formal and professional approach to presenting technical information, and gain valuable experience in interacting with diverse personalities on a professional level.

While completing a TA is not a strict requirement for obtaining a Ph.D. degree, it is highly encouraged as a valuable avenue for professional development. For specific duties and responsibilities, please consult the "TA Training Manual."

### **RESEARCH ASSISTANTSHIP (RA)**

Students who have received financial assistance may qualify to be compensated as graduate research assistants under the supervision of their Research Director. (Approval from the Department Head is necessary for a research assistantship during the first year of graduate study.) The continuation of these research assistantships depends on the availability of research funds and the students' satisfactory progress toward their degree completion. Research assistantship students are required to complete the university's Responsible Conduct of Research training.

## **F. DEPARTMENTAL AND GRADUATE COLLEGE POLICIES**

### **Registration/Enrollment Policy**

Full-time graduate students must enroll in the appropriate number of units during Fall and Spring semesters to be eligible for research or teaching assistantships. Consult with the Graduate Program Coordinator. No summer registration is required currently.

To maintain degree progress, CBC graduate students are expected to complete all enrolled courses each semester. If considering course withdrawal, first discuss it with the instructor, then inform the GPC for guidance and potential tutoring or study group arrangements. University policies on schedule changes can be found in the university catalog (<http://catalog.arizona.edu/policy/graduate-change-schedule-drop-add>). Note that withdrawal results in a 'W' on your permanent transcript, impacting your graduate career, fellowships, and job prospects.

The Graduate College mandates Fall and Spring semester registration until all degree requirements, including the final thesis or dissertation, are met. Master's degree students must register for a minimum of 3 graduate units each Fall and Spring semester from initial enrollment. If summer completion is planned, register for 1 unit during that term.

Graduate degree students must register for a minimum of 12 graduate units each Fall and Spring semester from matriculation until all requirements, exams, and dissertation units are completed. Afterward, doctoral students not on financial assistance or needing visa status maintenance must register for at least 1 unit per semester until dissertation submission. Students with assistantships must register for a minimum of 12 units. Completion during summer or an intersession requires prior-semester registration.

By Graduate College rules, Doctor of Philosophy degree requirements **must be fulfilled within 5 YEARS of passing the Oral Comprehensive Exam**, with or without financial support. Exceeding this limit may

require retaking Comprehensive Exams with program approval, but the department isn't obligated to support beyond five years from program start."

### **Academic Probation Policy**

#### **Upon completion of the first semester:**

Full-time graduate students who, as per the regulations of the Graduate College or the Department of Chemistry and Biochemistry, find themselves on academic probation may be considered for a second semester of Departmental financial support. During this subsequent semester, they are expected to rectify their academic probation status. These appointments are contingent on funding availability and the department's requirements for teaching assistants.

As per the Graduate College rules, a GPA of 3.00 or higher is mandatory in ALL graduate courses. The Department of Chemistry and Biochemistry regulations necessitate a grade of B or higher in all graduate courses approved by the GPC for credit toward the Ph.D. degree, along with a minimum GPA of 3.00

Students whose GPA falls below 3.0, as determined by either the Graduate College OR the Department of Chemistry and Biochemistry, may face academic probation or potential dismissal from the program, depending on the severity of the GPA deficiency. Those on academic probation have one semester to elevate their GPA to 3.0. It's important to note that no student is permitted more than one semester on academic probation.

#### **Continuing Graduate Students:**

Continuing graduate students with no prior academic probation history but whose cumulative GPA, as determined by Graduate College and/or Departmental criteria, falls below 3.00, leading to academic probation, may be considered for Departmental support as a Teaching or Research Assistant in the subsequent semester. Eligibility hinges on the availability of support, approval from the Graduate College (details below), and the student's overall academic record.

Graduate students in probationary status lose their eligibility for Graduate Assistantships. To secure a graduate assistantship while on probation, the department must submit a justification waiver to the Graduate College. For the appropriate form, please consult the CBC Graduate Program Coordinator.

Academic probation must be resolved in the semester immediately following its imposition.

A student may undergo academic probation for a maximum of one semester throughout their entire graduate program. A second instance of academic probation will result in the loss of eligibility for ongoing Departmental financial support, and the student will be advised to withdraw from the program.

#### **Grade Replacement Option**

Graduate students are not eligible for grade replacement.

#### **Teaching Probation Policy**

Graduate students serving as Teaching Assistants (TAs) within the Department of Chemistry and Biochemistry are expected to diligently fulfill their responsibilities to meet the Department's and the University of Arizona's standards. The TA Evaluation Committee\*, responsible for assessing TA performance each term, will communicate its recommendations to the Department Head or designated authorities.

If a TA's performance is considered unsatisfactory in any term, they may be placed on teaching probation to indicate the need for improved teaching performance. The TA will receive written feedback outlining specific teaching deficiencies, and their progress will be evaluated during the next term of TA employment. Successful resolution of these deficiencies will end the probationary status. However, failure to address the deficiencies may result in the TA's ineligibility for further TA support within the Department of Chemistry and Biochemistry at The University of Arizona.

A TA can be placed on teaching probation once. If a TA's performance is deemed unsatisfactory in two terms, they will become ineligible for TA support within the Department and may receive counseling for program exit.

\*The TA Evaluation Committee will consist of faculty and staff members. Current procedures can be obtained from committee members or the Teaching Service Office (Koffler 201).

### Good Standing

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

- GPA at or above 3.0 and earn a grade of B or better in all required major coursework.
- Working under a CBC-approved research director.
- Satisfactory performance in all teaching duties.
- Due dates for independent proposal and oral exam are met unless prior approval from the GPC is obtained.
- No more than one incomplete grade or GPC-approved plan for remediation of incomplete grades.

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

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

\*In the case of unsatisfactory performance in teaching, see teaching probation policy. Specifically, Improvement can only be measured in the next term in which the student is employed as a TA. Therefore, unsatisfactory standing continues until such improvement is measured.

\*\*For GPA issues, remediation must be completed by the end of the Fall term.

***While in unsatisfactory 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.***

### Leave of Absence Policy

Please consult the University of Arizona Graduate College policies regarding program leave of absence. <https://grad.arizona.edu/policies/enrollment-policies/leave-absence>

## G. GRADUATE PROGRAMS OF STUDY

Each student, in collaboration with their Research Director, must create a Plan of Study (POS) within their first year of residence. This plan must be submitted to the GPC for approval by April 30th and filed with the Graduate College via Grad Path by the end of the second semester in residence. The POS serves to identify courses the student plans to transfer from other institutions, specify courses completed at the University of Arizona that will count toward the graduate degree, and outline additional coursework required to meet degree requirements.

Prior to submission to the Graduate College, the Plan of Study must receive approval from the student's Research Director and Director of Graduate Studies.

Below, we provide an overview of potential tracks within the Chemistry and Biochemistry graduate program. These tracks represent just a selection of possible course combinations, with room for customization based on individual student interests.

The following courses are strongly advised:

- Analytical Chemistry: CHEM 526b, CHEM 527 and CHEM 528

- Biochemistry: BIOC 565
- Inorganic Chemistry: CHEM 510, CHEM 514 and CHEM 515
- Organic Chemistry: CHEM 545, CHEM 550 and CHEM 541
- Physical Chemistry: CHEM 580, CHEM 582 and CHEM 680

In addition to these core courses, students have the flexibility to choose additional courses from their own specialization or other tracks to tailor their academic path to their individual interests and requirements.

### ANALYTICAL EMPHASIS

Major		Minor	Total Graded
<b>CHEM 526b</b>	3	3 credits minimum	
<b>CHEM 527</b>	3	choose courses to broaden general knowledge of chemistry or to focus on a secondary area that complements the major	
<b>CHEM 528</b>	3		
Choose either <b>CHEM 522</b> or <b>CHEM 525</b>	3		
Choose one: <b>CHEM 521a</b> , <b>CHEM 522</b> , <b>CHEM 523</b> , <b>CHEM 525</b> , or <b>CHEM 529</b>	3		
Major Courses Total (minimum):	<b>15</b>	Minor Courses Total (minimum) : <b>3</b>	Graded Courses Total (minimum): <b>18</b>

### Other Courses

Group Meeting	Seminar	Other	Total units
<b>695b</b> 1 credit/semester (after joining a research group)	<b>696a</b> 1 credit/semester	<b>595a/b Professional Development</b> (Fall and/or Spring), 1 or 2 credit  <b>792 Rotations</b> 1 credit/first semester  <b>900 Research</b> 1-5 credits per semester	
Maximum counted toward degree: <b>10</b>	Maximum counted toward degree <b>10</b>		

Graded (min. 18) and ungraded courses listed in the 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 per semester.

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

## BIOCHEMISTRY EMPHASIS

Major		Minor	Total Graded
<b>BIOC 565</b>	3	<b>BIOC 792</b> Introduction to Research	
<b>BIOC 568</b>	4		
Additional upper level Coursework	8		
Major Courses Total (minimum):	<b>15</b>	<b>6 units</b>	Graded Courses Total (minimum): 21

## Other Courses

Journal Club	Group Meeting	Other	Total units
<b>BIOC 595b</b> 1 credit/semester	<b>BIOC 695a</b> 1 credit/semester (After joining a research group)	<b>CHEM 595 a,b Professional Development</b> (Fall I and Spring I), 2 credits	
Maximum counted toward degree: <b>10</b>	Maximum counted toward degree: <b>10</b>	Maximum counted toward degree <b>2</b>	Ungraded total: <b>24</b>

Graded (min. 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 per semester.  
All students must earn a grade of B or better in all required major and minor coursework

## INORGANIC EMPHASIS

Major		Minor	Total Graded
<b>510</b> 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	
<b>514</b>	3		
<b>515</b>	3	Students interested in synthetic chemistry are strongly advised to take <b>CHEM 545</b> during the first Fall semester in the program	
6 credits chosen from 512, 513 6 (multiple times if different topics), 511A, 518 or course approved by committee			
Major Courses Total (minimum):		Minor Courses Total (minimum) :	Graded Courses Total (minimum):
<b>15</b>		<b>3</b>	<b>18</b>

## Other Courses

Group Meeting	Seminar	Other	Total units
<b>695b</b> 1 credit/semester  (after joining a research group)	<b>696b</b> 1 credit/semester	<b>595a/b Professional Development</b> (Fall and Spring I), 2 credit  <b>792 Rotations</b> (Fall I), 1 credit  <b>900 Research</b> 1-5 credits per semester	
Maximum counted toward degree: <b>10</b>	Maximum counted toward degree <b>10</b>		Ungraded Courses total: <b>27</b>

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

## Other Courses

Group Meeting	Seminar	Other	Total units
<b>695b</b>  1 credit/semester  (after joining a research group)	<b>696c</b>  1 credit/semester	<b>595a/b Professional Development</b> (Fall and Spring I), 2 credit  <b>792 Rotations</b> (Fall I) 1 credit  <b>900 Research</b> 1-5 credits per semester	
Maximum counted toward degree: <b>10</b>	Maximum counted toward degree <b>10</b>		Ungraded total: <b>27</b>

Graded (min. 18) and ungraded courses listed in the 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
<b>580</b> 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	
<b>582</b> Fall only	3		
<b>587</b> Spring only	3		
<b>680</b> Spring Only	3		
Elective course chosen from 581, 583, 682, 684, 686, 687, or course approved by committee	3		
Major Courses Total (minimum):	<b>15</b>	Minor Courses Total (minimum) : <b>3</b>	Graded Courses Total (minimum): <b>18</b>

## Other Courses

Group Meeting	Seminar	Other	Total units
<b>695b</b>  1 credit/semester (after joining a research group)	<b>696d</b>  1 credit/semester	<b>595a/b Professional Development</b> (Fall and Spring I), 2 credit  <b>792 Rotations</b> (Fall I) 1 credit  <b>900 Research</b> 1-5 credits per semester	
Maximum counted toward degree: <b>10</b>	Maximum counted toward degree <b>10</b>		Ungraded total: <b>27</b>

Graded (min. 18) and ungraded courses listed in the 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 focus on Chemical Education is intended for those aspiring to careers in chemical education research or teaching at various educational levels, including high school, college, or university settings. This program involves graduate-level coursework in chemistry alongside education and chemical education courses, providing graduates with the skills and knowledge needed to engage in research related to the teaching and learning of chemistry.

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

## Other Courses

Group Meeting	Seminar	Other	Total units
<b>695b</b>	<b>696x</b>	<b>595a/b Professional Development</b> (Fall I), 1 credit	
1 credit/semester  (after joining a research group)	1 credit/semester	<b>695a Research Opportunities</b> (Fall I), 1 credit	
795			
1 credit/first semester (rotations)			
Maximum counted toward degree: <b>10</b>	Maximum counted toward degree: <b>10</b>		Ungraded total: <b>min 21</b>

Graded (min. 18) and ungraded courses listed in the 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 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 BCP program. 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
One from the following		<b>BIOC 792</b>	
<b>BIOC 565</b>	3		
<b>BIOC 568</b>	3		
<b>PHSC 530</b> Proteins and Nucleic Acids as Drug Targets	4		
Plus one from the following		3 credits/semester Laboratory rotations during first and second semester in residence	
<b>CHEM 550</b> Synthetic & Mechanistic Organic Chemistry	3		
<b>510</b> Advanced Inorganic Chemistry			
<b>580</b> Introduction to Quantum Chemistry			
<b>527</b> Analytical Separations			
<b>525A</b> Mass Spectrometry			
Courses chosen from upper division chemistry or courses approved by committee.	6		
Major Courses Total (minimum):	<b>16</b>	Maximum counted toward degree: <b>6</b>	Graded Courses Total (minimum): <b>22</b>

## Other Courses

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

Graded (min. 18) and ungraded courses listed in the 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.

## BIOCHEMISTRY TRACK OF BMCB

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

## Other Courses

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

## Requirements for a Graduate Minor in Chemistry or Biochemistry

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

Acceptable sequences of chemistry courses include:

- a. **Analytical**  
Three from 522, 526b, 527, and 525
- b. **Biochemistry**  
565, 568 and one additional course
- c. **Inorganic**  
510 and two from 511, 513, 514, 515, and 518
- d. **Organic**  
550 and two from 541, 542a, 542b, 543, 544, 548 and 640
- e. **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 their Dissertation Committee and from the GPC of the Department of Chemistry and Biochemistry prior to embarking on such a course of study.

## H. Coursework for a Ph.D. Degree in CBC

### Total Credits

- A minimum of 63 units of graduate credit, 500-level or above, are required for a Ph.D.
- A total of 45 graded and ungraded units and 18 dissertation units comprise the 63 overall credits.
- 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: Some Biochemistry programs of study may require 21 graded units.
- 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 GPC and receive at least a 'B' in that replacement course. Note that this does not automatically remediate the GPA, which must be raised to a minimum of 3.0.
- The ungraded course work (approx. 24 units) is mostly comprised of seminar, group meetings, college teaching, or research opportunities.
- It is generally expected that CBC graduate students will complete all courses in which they are enrolled in any given semester in order to make timely progress toward the completion of their degree. (See F.1c.)

### Transfer Credits

The department has a policy that allows a maximum of 6 graduate credit units to be transferred from another institution. To initiate this process, students must first seek approval from the program faculty. This approval involves comparing the content of the course in question with equivalent courses offered within our program.

Following faculty approval, the process proceeds to the Graduate Program Coordinator (GPC) for further review. Ultimately, the Graduate College makes the final determination regarding the eligibility of courses for transfer.

Students wishing to transfer credit must complete a 'Transfer Credit' form through GradPath before the conclusion of their first year of study. This form initiates the evaluation of the courses for transfer eligibility.

## I. CHOOSING A RESEARCH DIRECTOR AND COMMITTEE

Students may only join research groups that meet at least one of the following criteria:

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

### Rotations – 1<sup>st</sup> semester in residence

Prior to the selection of a Research Director, you will become familiar with the research interests of the faculty through attendance at the CBC Research Symposium, held the week before classes begin in the fall semester. Part of this Research Symposium will consist of a data blitz and 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.

The goal of the rotation is to build connections in the department (with both faculty and other students) and to help find a research lab to join. Students should have the chance to see ongoing work in each lab and think about projects they could work on. To broaden their horizons, students will meet with more faculty than they will rotate with, and they will rotate with more labs than they will join. Even for labs that students do not join, these additional meetings help build connections with future committee members and potential collaborators.

### Policies for Chemistry non-BCP:

First-year chemistry PhD students that are not in BCP will be required to participate in a 1 credit, graded rotation course. As part of the course:

- Students must attend the Data Blitz, Symposium, and Poster Session during orientation to generate a list of faculty they would like to meet with.
- Before the first day of fall classes students should schedule their first rotation by first contacting a faculty member and discussing doing a rotation. The faculty member needs to agree to take the student on for a rotation. Students should turn in their first rotation to the Graduate Coordinator
- Students must spend 4 weeks per lab rotating in the labs of at least 3 faculty. Students are expected to devote a minimum of 3 h/week to the rotation.
  - Each rotation will have a defined structure, but students and faculty are free to go beyond these minimum requirements.
  - Entire rotation: Students are expected to attend all group meetings or other relevant group activities as defined by the PI.
  - Week 1: Read a paper from the group.
  - Week 2: Shadow a graduate student (this can be done throughout).
  - Week 3: Discuss with the PI and lab members what a project would look like if the student were to join the group. This will likely also involve reading relevant literature.
  - Week 4: Prepare and present a presentation on what was learned during the rotation. This should be a 5 min, 3-slide powerpoint presentation:
    - Slide 1 should discuss an overview of what the lab works on and why it is important.
    - Slide 2 should discuss what the student directly observed and learned during shadowing, discussing an ongoing project.
    - Slide 3 should present a potential future project for that group.
- Before the end of the first rotation, students should meet with at least 6 faculty, for at least 30 min per faculty, to discuss their research. The purpose of these meetings is to explore potential rotations for the 2<sup>nd</sup>, 3<sup>rd</sup>, or (optional) 4<sup>th</sup> cycle. These faculty may also be considered as potential committee members. Students that fail to meet with 6 faculty will lose a letter grade in the grading. One of the 6 faculty can be the faculty member the student is rotating with in the first rotation. Students should refrain from scheduling their last two (or three) rotations until after meeting with the full 6 faculty.

- After meeting with 6 faculty, students should schedule their remaining rotations and turn in their scheduled rotations to the Graduate Coordinator.
- Students should turn in their advisor selection forms after the 3<sup>rd</sup> rotation. They can also do an optional 4<sup>th</sup> rotation and turn in advisor selection forms after that.

### **Policies for BCP Students:**

First-year chemistry or biochemistry PhD students that are in BCP will be required to participate in a 3 credit, graded rotation course. As part of the course:

- Students must attend the Data Blitz, Symposium, and Poster Session during orientation to generate a list of faculty they would like to meet with.
- Before the first day of fall classes, students should schedule their first rotation by first contacting a faculty member and discussing doing a rotation. The faculty member needs to agree to take the student on for a rotation. Students should turn in their first rotation to the Graduate Coordinator.
- Students must spend 7 weeks per lab rotating in the labs of at least 3 faculty. Students are expected to devote a minimum of 9 h/week to the rotation.
  - Students are expected to attend all group meetings or other relevant group activities as defined by the PI.
  - Students will participate in the research of the lab, often with mentoring from a grad student, postdoc, or faculty in the lab.
  - Week 7: Prepare and present a presentation on what was learned during the rotation, which will be presented at the BCP seminar.
- Before the end of the second rotation, students should meet with at least 6 faculty, for at least 30 min per faculty, to discuss their research. The purpose of these meetings is to explore potential rotations for the 2<sup>nd</sup>, 3<sup>rd</sup>, or (optional) 4<sup>th</sup> cycle. These faculty may also be considered as potential committee members. Students that fail to meet with 6 faculty will lose a letter grade in the grading. One of the 6 faculty can be the faculty member the student is rotating with in the first rotation.
- After meeting with 6 faculty, students should schedule their remaining rotations and turn in their scheduled rotations to the Graduate Coordinator.
- Students should turn in their advisor selection forms after the 3<sup>rd</sup> rotation. They can also do an optional 4<sup>th</sup> rotation and turn in advisor selection forms after that.

### **General Policies for Both:**

There is no cap on the number of students a faculty member can take in a single rotation or overall, as long as the faculty member can provide a meaningful rotation for all the students they take on.

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 recommendation to the GPC and the GPC will make a final recommendation of Research Director selection to the Department Head.

### **Selecting a Dissertation Committee**

The Dissertation Committees for graduate students must comprise a minimum of four faculty members. This includes the student's research advisor, two faculty members from the same major field, and one from a minor field, which can be outside the CBC department. Among these, at least two members must hold primary appointments in CBC, and at least three members should be impartial, without direct student supervision responsibilities. You may also include co-advisors and Research Professors in addition to the three independent committee members. You must select your Dissertation Committee in consultation with your Research Director by the start of the semester following your first year in residence. The committee composition will be approved and signed by the Chair of the GPC, and you'll submit the committee names to the Graduate College using the Grad Path committee reporting form. Throughout your training, the Dissertation Committee will provide guidance, assist in program planning, and assess your progress.

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 during a graduate student's tenure must be communicated to the GPC in writing as soon as possible and must conform to this policy.

## Changing Research Directors

In some circumstances, a student may consider changing Research Directors. This is a decision that has important 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. Students who have thoughtfully considered whether a change is necessary should meet with a staff or 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 likely 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.

- The student should inform the Research Director and the GPC as early as possible. Once the need for a change becomes clear, a brief memo should be submitted to the GPC, explaining the rationale for the change. The GPC will assess the case and, if warranted, facilitate the change in Research Director.
- After GPC approval, the student should obtain a Research Director selection form from the Graduate Program Coordinator. The student must meet with and secure signatures from at least three faculty members. The completed form, listing the selected advisor, should be submitted to the Graduate Program Coordinator, accompanied by a letter explaining the reasons for choosing the new advisor.
- Once the new Research Director is selected, and a new Dissertation Committee is formed, it is advisable for the student to meet with the committee to outline the specifics of a new research effort and the expected timeline for degree completion.
- A change in Research Director also requires approval from the Graduate College, which can be processed through Gradpath using a new committee appointment form.

## Keeping the Dissertation Committee Updated

It is important that your Dissertation Committee remains updated on 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.

The following are mechanisms for maintaining contact with and drawing support from your Dissertation Committee:

**Annual Research Summaries.** CBC rules state that all Chemistry Program Ph.D. students should prepare an Annual Research Summary. This summary is due September 1 (or first Monday following) for students that have just completed their first summer in residence, and at the end of July in all following years. 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.

**Annual Meetings.** CBC 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 dissertation
- 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

**Final Dissertation Committee Meeting.** All Graduate students must have a short (<1 hour) meeting with their Dissertation Committee 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. Alteration of the timing of the Final Dissertation Committee Meeting is possible with prior approval of the GPC. This meeting will likely 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 EXAMINATION, COMPREHENSIVE EXAMINATION, AND ADVANCEMENT TO CANDIDACY

**Qualifier/Diagnostic Examination:** 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.

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. Biochem part I and II exams are counted as separate areas.
- 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 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.

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

### Description of the Comprehensive Examination:

**Written Portion:** 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 primarily of the Independent Proposal.

The student will submit a written document that consists of the Independent Proposal (10-12 pages).

Written proposals are **due no later than** November 1 or on the first Monday following of November in their 2<sup>nd</sup> 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 the oral examination. The student must file the date of the oral comprehensive exam in Grad Path *before* taking the exam. Results will be posted by the committee chair in Grad Path. **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 who 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.

**GUIDELINES:** 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 their classes.

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*

**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 may want to 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 a Second Year Committee meeting earlier in the third semester can be 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.

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 Independent Proposal electronically to the Graduate Program Coordinator who will distribute it to the faculty on the respective Dissertation Committee. Research Director, co-advisors and other committee members directly supervising the student will not vote on the proposal. 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.

*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 **will jeopardize your good standing** in the Department (as defined in Section G of this handbook). Moreover, the proposal may be **marked down** as a penalty.

**Oral Portion:** 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. Co-advisors and other members supervising the student will leave the room and not vote on the exam outcome.

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.

**Re-taking the Oral Comprehensive Examination:** In the event that a student fails the Oral Exam, they 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. An updated Research Summary may be requested. 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, they proceed to the Ph.D. program. If the student fails the second attempt also, they are not granted advancement to the Ph.D. program and may be invited to change programs to the Master's degree.

Students who pass the combined written and oral comprehensive exams are advanced to candidacy status for the Ph.D. The results are posted in Grad Path and the student will be billed candidacy fees at that time.

## K. DISSERTATION AND FINAL DEFENSE

General Description: 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 L.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. At least 10 days before the date of the exam, file the announcement of the final defense date using GradPath. You may submit this announcement as soon as you establish the date, time, and room for the defense. The Graduate College will announce your defense on the University of Arizona calendar.

Requirements: There are a number of requirements that need to be met to satisfy both CBC 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/gsas/dissertations-theses>.

Specific Steps Necessary for Graduation:

### WHEN

penultimate semester

### WHAT

File Committee Formation form in Gradpath.

4 <sup>th</sup> year of residence	Submit a detailed Dissertation Outline to your Dissertation Committee and schedule a meeting with your committee.
Approx. 6 months prior to expected date of graduation	Schedule a meeting with your Dissertation Committee to take place approximately 6 months prior to the expected date of graduation. Prepare presentation on research progress and distribute written dissertation outline.
2 weeks prior to defense	Submit a penultimate draft of the dissertation to the Dissertation Committee
2 weeks prior to defense	Submit Announcement of Final Defense Examination form in Gradpath.

**Dissertation Format Guidelines:** The Graduate College policy states that in addition to required elements of specifically formatted front matter (see Dissertation Formatting Guide at <https://grad.arizona.edu/gsas/dissertations-theses/dissertation-and-thesis-formatting-guides>), 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:

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

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.

If appropriate, the dissertations may include portions of manuscripts being prepared for submission, but the text should reflect the student's own writing.

**Committee Attendance at Final Defense:** According to graduate college requirements, all four committee members must be present for the final defense, although remote attendance is allowed. 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. The substitute committee member must be approved by the Graduate College.

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

- 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.
- The dissertation/thesis author need not be the primary author of the publication(s).
- 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.

- Since the appendices contain supplementary material, there is no conflict of interest when the Research Director is a coauthor of the publication(s).
- 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

According to CBC rules, students pursuing a Master of Science degree must complete all program requirements within three years of enrollment, regardless of their financial support status. Should a student be unable to meet this timeframe, they may submit an appeal to the GPC for a one-year extension. To do so they must submit a research progress report that includes an approved timeline for completion approved by their committee. It is important to note that this extension request does not imply a commitment of financial support. 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, provided certain conditions are met.

**a) Diagnostic Examinations:** All Master's students must qualify in two areas of Chemistry and Biochemistry. 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 coursework 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 Faculty Mentor/Research Director – 1<sup>st</sup> semester in residence

Prior to selection of a Research Director, you will become familiar with the research interests of the faculty through attendance at the CBC Research Symposium, held the week before classes begin in the fall semester. Part of this Research Symposium will consist of a data blitz and 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.

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.

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.

**MS 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 should be presented to the GPC by the first day of fall classes of the third semester in residence. Once established, the student should report the names of the committee to the Graduate College via GradPath.

**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.

**Thesis:** A thesis is optional for all MA degrees and Biochemistry MS degrees. Additional information can be obtained through the Graduate College. After a candidate's thesis has been reviewed and accepted by the thesis committee, a final public oral defense covering the research and field of major interest will be administered.

**Graduate Student Support:** Graduate students in the Master's program who remain in good standing (as defined in Section G in this handbook) and are making adequate progress in their degree program may be eligible for support as Graduate Teaching Assistant (TA).

An overall 3.0 (B) GPA must be maintained for all graduate-level courses. Graduate students admitted to Ph.D. candidacy are encouraged to apply for an MA degree if they do not already have a master's degree. Students should be aware that they cannot use the same course work to obtain both an MA and an MS degree.

### **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 typically two (but up to four) graduate level courses during the fourth year that are also applied to the subsequent M.S. program. The fifth year then includes the remaining graduate courses to bring the total to five, research credits and the Master's Thesis. Students will generally apply to the Graduate College during the third year for official admission to the M.S. program immediately following completion of B.S. requirements. Admission to this program must precede enrollment in graduate courses.

Students must meet the following criteria in order to apply

- Completion of a minimum of 75 undergraduate credit hours at the time of application; a minimum of 90 undergraduate credit hours will be required at the time of entry into the program. If the student's GPA falls below 3.3 at the time they have completed 90 units, the student will not be admitted into the program. Typically, this unit requirement means that students will be in their third year at the time of application. Exceptions can be made for fourth year students, depending on progress to the degree.
- Completion of at least 12 earned undergraduate credits in their major at the University of Arizona.
- Units still graded incomplete, units graded Pass/Fail or units taken as audit will not count toward the requirement of the 12 undergraduate units in the major.
- Completion or near completion of general education requirements.
- Submission of a graduate AMP application and payment of a graduate application fee.
- Demonstration of the maturity necessary for success in an accelerated, highly competitive program.
- Expectation to complete the undergraduate degree within four years. The undergraduate degree requirements must be completed before the student is eligible to have the Master's degree awarded.
- Students must have a minimum of one semester or research experience and have demonstrated research productivity.

### *Degree and Tuition Policies*

1. Students will be considered undergraduates until they complete their undergraduate requirements, which should be no later than the end of the fourth year.
2. Students entering with Advanced Placement Credit and/or who attend summer school may complete their Bachelor's degree in the Junior year.
3. During years 1-3 (or approximately 0-90 credits) students will be taking undergraduate coursework and charged at the undergraduate rate.
4. Once admitted to AMP, during the senior (or transition year), students may take up to 12 units of graduate coursework that may apply toward both the Bachelor's and the Master's degrees. Students will be charged at the undergraduate rate and retain eligibility for undergraduate scholarships.
5. Students classified as seniors who have not yet completed a bachelor's degree may enroll in 500-level courses following the University's policies on [undergraduate enrollment in graduate courses](#). Courses numbered at the 600, 700 and 900 levels are not open to undergraduates.

6. When the student nears completion of all Bachelors' requirements, the student will submit an application for admission to the graduate Master's program. There is no application fee for admitted AMP students.<sup>1</sup> The student should apply by the program application date. Once the student has graduate status, the student will be charged at the graduate rate and be eligible for graduate assistantships. The student won't be eligible to graduate nor will they be eligible for assistantships until all Bachelors' requirements are completed. While an undergraduate, students are required to keep their graduate coursework cumulative GPA at 3.0, or higher if required by the graduate degree offering unit, to be admitted to the Master's program.

7. Should a student have completed 12 graduate credits, but not yet completed the undergraduate degree, they will be considered graduate for financial aid and tuition purposes and coded as 'graduate' in UAccess. They will no longer be eligible for undergraduate scholarships, nor will they be eligible for graduate assistantships.

8. At least 12 graduate credits must be taken while in graduate status, after completing all degree requirements for the Bachelor's.

9. Students should be encouraged to complete their undergraduate requirements as soon as possible, but not later than one semester before receiving their Master's degree. Students finishing their undergraduate requirements later than one semester before receiving their Master's degree will no longer be eligible for undergraduate scholarships, nor will they be eligible for graduate assistantships. Neither degree will be awarded until the undergraduate requirements are completed along with the Master's requirements.

### **M. POLICIES ON APPEALS**

Students may appeal any departmental ruling in writing to the Graduate Program Committee. As with all Graduate Students, CBC students have the right to present grievances not satisfactorily addressed within the Department or College for review by the Graduate College. Policies and procedures regarding grievances can be found at <https://grad.arizona.edu/policies/academic-policies/grievance-policy>.