Graduate Program in
Biochemistry and
Molecular & Cellular Biology
THE UNIVERSITY OF ARIZONA.

BMCB Graduate Program Handbook

2015-2016

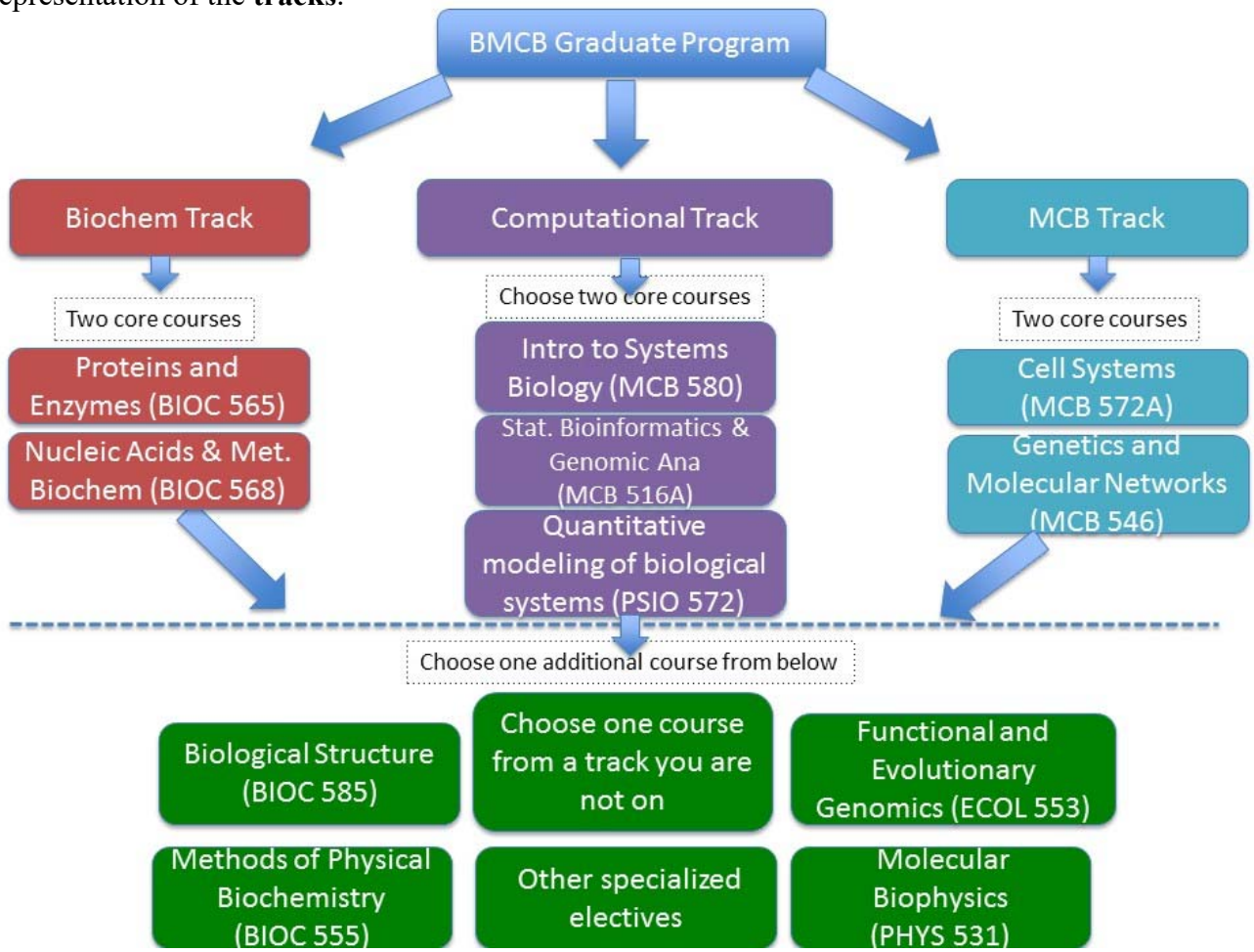
THE UNIVERSITY OF
ARIZONA®
TUCSON ARIZONA

A. Table of Contents

B. SUMMARY OF BMCB GRADUATE PROGRAM

1. BMCB tracks and degrees

Our program is multi-disciplinary and accommodating of many different academic paths toward the Ph.D. degree. There are three "**tracks**" with recommended course work: Molecular & Cellular Biology (MCB Ph.D.), Biochemistry (Biochemistry Ph.D.), and Computational Biology (MCB or Biochemistry Ph.D.) leading toward **degrees** in MCB or Biochemistry. Shown below is a graphical representation of the **tracks**.



The **degree** requirements for the **MCB Ph.D.** degree are:
Science, Society & Ethics (MCB 695E)
Cell Systems (MCB 572A)
Genetic and Molecular Networks (MCB 546)
AND
Additional course work totaling 36 units, of which 18 units must have lettered grades. Three core courses from the Computational or MCB tracks above are recommended.

The **degree** requirements for the **Biochemistry Ph.D.** degree are:
Science, Society & Ethics (MCB 695E)
Nucleic Acids and Metabolic Biochemistry (BIOC/MCB 568)
Proteins and Enzymes (BIOC 565)

AND
Additional coursework totaling 36 units, of which 18 units must have lettered grades.

Some important points to consider:

- Students take two core courses within their chosen BMCB track. Additional breadth is added to their coursework by choosing a third course from those outlined in green. Specialized electives are chosen via consultation with your mentor and tailored to your individual needs.
- The computational track is flexibly designed to support students whose interests range from systems biology, bioinformatics, biophysical analysis of macromolecules to mathematical theory.
- Additional coursework can be tailored to the individual needs of the student, as a decision among the student and his/her mentor and committee.
- All students are required to take an Ethics course and to refresh this training in the responsible conduct of research every four years
- Every track has some level of quantitative biology in it.
- Every student is recommended to acquire a basic understanding of Statistics.
- Students are expected to participate in departmental journal clubs and seminars throughout their course of graduate study. These choices are also tailored to the individual interests of the student.
- The coursework requirement for the PhD in biochemistry will not change. Students cannot go through the computational track and expect to receive a Biochemistry degree without also taking the core courses for the biochemistry degree. If a student takes two of the three purple-colored core courses in the computational track plus one of the green colored courses, they will earn the MCB degree.
- We expect students to strive toward publishing two first-author papers from their dissertation research.
- Students must earn a grade of A or B in their core courses and maintain a B average overall.

2. Minor degree requirements:

Per University policy, students must declare a minor. Nine units are needed to satisfy the minor degree requirement. Although a minor subject is usually taken outside the major department, a minor within the major department is permitted. In this case, a total of 45 units in that area is required. If you declare a minor outside of MCB or BIOC, please contact the minor department for their minor course requirements.

For the Biochemistry minor, three courses are required: BIOC 565, 568, one elective.
For the MCB minor, three courses are required: two MCB-listed electives and one course from the following list: MCB546, MCB572A or MCB580.

3. YEAR 1

FALL

1. Enroll in a minimum of two courses.

Physical chemistry is required for the BIOC degree (not for the MCB degree). If you have not satisfied this requirement, you should take it in the fall semester.

2. **Arrange and do laboratory rotations.**

   Rotation Schedule and Rotation Symposia
   Two rotations are standard in the fall semester. Students make a brief presentation of their work to the ABBS program at the conclusion of each rotation period. This brief 10-minute report should provide some background in an introduction and summarize findings and conclusions. An overhead projector and a computer are available.

   Students should arrange the first rotation (August to late October) during orientation. ABBS advisors can help with this choice. Students should arrange the second rotation (late October to early January) at least one month in advance so that the advisor has time to prepare for the student's experiments.

3. **Register for, attend, and participate in a weekly seminar and journal club.** Suggested: MCB 595A (section 001 = journal club; section 002 = seminar); BIOC 595B (journal club), BIOC 696D (seminar) or other seminar and journal club.

4. **Attend research retreat (one weekend in September or October).**

SPRING

1. **One additional rotation** (January to March)**.** Students should arrange the third rotation at least one month in advance so that the advisor has time to prepare for the student's experiments.

2. **Continue core coursework and/or minor electives**
   See diagram on page 1. Two graded 3+ unit courses are recommended in the spring semester.
   IMSD students will be registered for MCB 595E
   All students are required to complete MCB 695E (Science, Society & Ethics) by the second year.

3. **Choose a thesis laboratory by the end of February (begin in thesis lab early March).**

4. **Register for, attend, and participate in weekly seminar and journal club.**

4. YEAR 2

FALL

1. **Meet with director of the BMCB graduate program and your thesis advisor before the start of classes to confirm your coursework.**

   Continue coursework and/or minor electives. See diagram on page 1.
   36 units are required for the major (18 must be from courses with grade of A or B).
   9 units are required for minor (see section F).

2. **Choose a supervisory committee by November 1, in consultation with your thesis advisor.**

3. **Meet with committee to discuss preliminary exam topics by the end of the fall semester.**

   At this committee meeting:
   - Present your plan of study to the committee for approval
   - Briefly present an overview of your research project
   - Discuss potential topics for the preliminary examination.
   - Set a date for distribution of the preliminary examination questions

   The preliminary written examination must be completed by the end of Februrary.
   -Students will have three weeks to complete the questions.

4. **Submit the *First Committee Meeting* form to the BMCB graduate program coordinator**

5. **Complete the Responsible Conduct of Research Statement** – via GradPath in your UAccess student account.

6. **Complete the Plan of Study form** - via GradPath in your UAccess student account.

7. **Register for, attend and participate in a weekly seminar and journal club.**

8. **Attend research retreat and present a poster on your thesis project.**

SPRING

Please note: All portions of the Preliminary Exam must be completed by May 1 of the second year.

1. **Complete coursework and/or minor electives.**
   All students are required to complete MCB 695E (Science, Society & Ethics) or equivalent by the end of the second year.

2. **Take the preliminary written examination by the end of February.**
   Submit the *Qualifying Written Exam Report* form to the BMCB graduate program coordinator.

3. **Schedule your Oral Comprehensive Examination before May 1**
   - The ten-page proposal must be submitted to the supervisory committee two weeks before the examination.

3. **Complete the Comp Examination Committee Appointment AND Announcement of Doctoral Comprehensive Exam forms** - via GradPath in your UAccess student account. **Announcement form due two weeks before the scheduled examination.**

4. **Take the oral preliminary exam.**
   Submit the *Qualifying Oral Exam Report* form to the BMCB graduate program coordinator.

5. **Register for, attend, and participate in weekly seminar and journal club.**

5. YEAR 3 AND BEYOND

1. **Dissertation research talks.**
   Students are required to give a 30-minute talk on their dissertation research each year until they complete their Ph.D. degree. This dissertation research talk will be scheduled during the normal MCB/Biochemistry journal club slots during the fall or spring semester. It is advisable that the students schedule one of their committee meetings right after their dissertation research talk. A talk given at the annual Research Retreat can be used as a substitute for this 30-minute talk. It is a tradition that the 4th year students present their research at the annual research retreat.

2. **Arrange annual committee meetings.**
   Schedule a committee meeting every academic year. An *Annual Progress Report* form must be submitted to the BMCB graduate program coordinator after each meeting. Provide an *Annual Meeting Committee Update* form to each member of your committee at least one week in advance of your scheduled meetings.

3. **Register for, attend, and participate in a weekly seminar and journal club.**

4. **Attend research retreat each fall and present a poster or talk on your thesis research**.

6. FINAL YEAR

1. Within the year, hold a committee meeting to map out thesis content and remaining experiments.

2. **Secure approval of the dissertation prospectus.** Obtain approval of the dissertation prospectus no later than three months before the final defense. Submit a *Dissertation Prospectus Approval* form to BMCB graduate program coordinator for inclusion in your file.

3. **Complete Doctoral Dissertation Committee Appointment** form via GradPath in your UAccess student account.

4. **Submit a polished draft of the dissertation three to five weeks prior to final defense**. It is the responsibility of the student and their committee to be sure that the dissertation document conforms to Graduate College and BMCB Program requirements. See *Manual for Dissertations* at http://grad.arizona.edu/system/files/etd_Diss_Manual.pdf

5. **Complete the Announcement of Final Oral Defense** form via GradPath in your UAccess student account. Due at least seven working days before final defense; the student is responsible for scheduling the seminar room.

   If at all possible, students should schedule the dissertation defense presentation during normal journal club/seminar times (except during the summer).

C. General Description of the BMCB Graduate Program

1. Overview

The goal of the BMCB graduate program is to train students to develop as independent experimental scientists and foster a research environment conducive to the attack of critical questions at the forefront of modern biology.

The major emphasis in the program for Ph.D. candidates is laboratory research culminating in the writing of a dissertation. With the help of the Ph.D. advisor, the supervisory committee, and the BMCB Committee, successful students complete the BMCB graduate program with solid training in experimental research science and an emphasis on academic scholarship. **Depending on the track chosen, students will earn a Ph.D. in Biochemistry or Molecular & Cellular Biology.**

2. Mentoring

The BMCB program has several mechanisms to provide you with guidance during completion of your degree. During your first year and prior to choosing a dissertation advisor, you will be advised by the BMCB representative(s) on the ABBS Committee. However, you should feel free to discuss any questions about your graduate training with other members of the BMCB Committee or any other faculty members with whom you feel comfortable. The faculty is here to help train you to become their colleagues in the scientific endeavor. In addition to obtaining guidance from the faculty, you should utilize any resources the Graduate College makes available, including the online Graduate Catalog (http://grad.arizona.edu/Catalog/) and BMCB Graduate Program Handbook. This Handbook is designed to assist you in meeting the graduate school requirements, but it is not all inclusive. Also take advantage of the expertise of the graduate program coordinators, Denise Slay (MCB) and Lori Boyd (BIOC), who are knowledgeable about procedural issues both within the Graduate College and the University at large. While the faculty are well-intentioned, they most likely did not complete their degree here.

After you have chosen a dissertation advisor and a supervisory committee, these individuals will offer you scientific and professional guidance. Use them to your advantage! Feel free to consult with your committee members at any time about your project. Have timely committee meetings (at a minimum of once per year). Interaction with your advisor and your committee can give you important experimental insight and save you time, as you proceed toward your degree. These individuals will also be your major advocates in the future – writing letters of recommendation and promoting your talents to future employers. It is to your advantage for them to get to know you well. Do not feel, however, that your committee is your only faculty resource. Search out other faculty members for advice on special techniques or topics that interest you.

Although we aim to provide an optimal environment to foster your scientific and professional growth, it is important to realize that successful completion of the Ph.D. program is ultimately your responsibility. All of the necessary steps you need to take to finally receive the degree are important. Your dissertation advisor and supervisory committee guide you in becoming a professional scientist, but you are still the one doing the research at the bench which will earn you the degree. No advice or guidance will substitute for the self-motivation that will be required to reach your final goal.

D. BMCB Committee – Structure and Function

The BMCB Committee has several important roles with regard to overseeing the graduate program. These include recruiting new students, advising students, and monitoring student progress. The committee consists of eight faculty and two staff. Two graduate student representatives will report to the program co-directors outside of the committee. The student representatives are chosen by their peers on an annual basis at the research retreat. To complement the supervision of your training by your thesis advisor and your supervisory committee, the BMCB Committee tracks each student during their entire time in the program and meets periodically to discuss a variety of issues, which impact the program. If a student has a problem that cannot be solved by their advisor or if they are unsure about what they need to do to meet program or Graduate College requirements, they should talk to any of the representatives on the BMCB Committee.

The following people serve on the BMCB Committee:

Name	Responsibility	List of Functions
Tricia Serio	co-Chair	Co-PI of Training Grant
Ted Weinert	co-Chair	Co-PI of Training Grant
Andrew Capaldi	Faculty Representative	MCB Curriculum
Carol Dieckmann	Faculty Representative	Diversity Coordinator
Bill Montfort	Faculty Representative	Biochemistry Curriculum
Frans Tax	Faculty Representative	ABBS Liaison
Marty Pagel	Elected Faculty Representative	College of Medicine
Ross Buchan	Elected Faculty Representative	Junior Faculty
Tracey Beyer	Elected Student Representative	MCB Ph.D.
Jonathan Sanchez	Elected Student Representative	BIOC Ph.D.
Denise Slay	Student Affairs	Assists students; facilitates committee activities
Lori Boyd	Student Affairs	Assists students; facilitates committee activities

E. Participating Faculty

***Parker Antin,** Professor, Cellular & Molecular Medicine, and Molecular & Cellular Biology (Ph.D. 1982, University of Pennsylvania). Molecular regulation of vertebrate development.

***Tim Bolger**, Assistant Professor, Molecular & Cellular Biology (Ph.D. 2006, Duke University). Control of mRNP dynamics during post-transcriptional gene expression.

***Michael F. Brown**, Professor, Chemistry and Biochemistry & Molecular Biophysics (Ph.D. 1975, University of California, Santa Cruz). Nuclear magnetic resonance spectroscopy; membrane proteins; chemistry of membranes and liquid crystals; molecular basis of vision.

***John (Ross) Buchan**, Assistant Professor, Molecular & Cellular Biology (Ph.D. 2006, University of Aberdeen). Regulation of mRNA translation, localization and decay.

***Andrew Capaldi**, Associate Professor, Molecular & Cellular Biology (Ph.D. 1999, University Leeds, Leeds, UK). The signaling pathways and transcription factors in a cell are organized into circuits that allow cells to process information and make decisions. We are interested in understanding both how these circuits are built from their components and how they function and malfunction.

***Pascale Charest**, Assistant Professor, Chemistry & Biochemistry (Ph.D. 2005, Université de Montréal). Mechanisms of signal transduction that control the directed migration of cells.

***Matthew H. J. Cordes**, Associate Professor, Biochemistry & Molecular Biophysics (Ph.D. 1994, Yale University). Structural evolution and conformational change in proteins.

***Anne E. Cress**, Professor, Cellular & Molecular Medicine, Molecular & Cellular Biology, and Radiation Oncology (Ph.D. 1980, University of Arizona). Molecular mechanisms of cell adhesion and human tumor progression.

***Carol L. Dieckmann**, Professor, Molecular & Cellular Biology and Biochemistry & Molecular Biophysics (Ph.D. 1980, University of California, San Diego). Mitochondria1 RNA stability; Chlamydomonas eyespot positioning and assembly.

***Hanna (Johnny) Fares**, Professor, Molecular & Cellular Biology (Ph.D. 1995, University of North Carolina). Analysis of membrane trafficking; *Caenorhabditis elegans* as a model system.

***Felicia Goodrum**, Associate Professor, Immunobiology and Molecular & Cellular Biology (Ph.D., Wake Forest University School of Medicine). Human cytomegalovirus infection and latency in primary human hematopoietic cells, viral patogenesis.

Herman Gordon, Associate Professor, Cellular & Molecular Medicine and Molecular & Cellular Biology (Ph.D. 1983, Caltech). Molecular basis of synaptogenesis.

***Henk Granzier**, Professor, Cellular & Molecular Medicine, Physiology, and Molecular & Cellular Biology; Allan and Alfie Norville Endowed Chair, Molecular Cardiovascular Research Program (Ph.D. 1988, University of Washington). Role of the filamentous proteins titin and nebulin in function of normal and diseased muscle.

***Carol C. Gregorio**, Professor and Head, Cellular & Molecular Medicine and Professor, Molecular & Cellular Biology (Ph.D. 1992, Roswell Park Cancer Institute). Cytoskeletal protein interactions in heart muscle development.

***Ryan Gutenkunst**, Assistant Professor, Molecular & Cellular Biology and Ecology & Evolutionary Biology (Ph.D. 2007, Cornell University). Computational biology, with focus on

inferring history and natural selection from population genomic data and on understanding the function and evolution of complex biomolecular networks.

Andrew Hausrath, Assistant Professor, Biochemistry & Molecular Biophysics (Ph.D. 2000, University of Oregon, Eugene). My research goal is to understand the organizing principles governing the action and form of macromolecular complexes.

Erik J. Henriksen, Professor, Physiology and Biochemistry & Molecular Biophysics (Ph.D. 1987, University of Arizona). Regulation of glucose transport system in normal and insulin resistant skeletal and cardiac muscle.

***Nancy C. Horton**, Associate Professor, Biochemistry & Molecular Biophysics (Ph.D. 1994, Pennsylvania). Protein-nucleic acid recognition, enzymology, x-ray crystallography, kinetics, protein dynamics, DNA repair.

***Bonnie Hurwitz**, Assistant Professor, Agriculture and Biosystems Engineering (Ph.D. 2012, University of Arizona). Computational biology for understanding the functional role of microbial communities in human and environmental health.

***John Kececiouglu,** Professor, Computer Science (Ph.D. 1991, University of Arizona). Applied algorithms, especially for areas of bioinformatics and computational biology

***John Konhilas,** Associate Professor, Physiology and Molecular & Cellular Biology (Ph.D. 2001, University of Chicago). We are very interested in how the molecular and cellular biology of the heart cell impacts the contractile properties of the intact heart.

***Paul A. Krieg**, Professor, Cellular & Molecular Medicine and Molecular & Cellular Biology (Ph.D., 1981, Adelaide University). Organogenesis; development of the vertebrate heart and blood vessels.

***Michael Kuhns**, Assistant Professor, Immunobiology (Ph.D. 1999, University of California at Berkeley). We are specifically working to understand how the information that is critical for T cells to decide if and how they should respond to antigen is conveyed from an APC to a T cell.

***Jeffrey Laney**, Associate Professor, Molecular & Cellular Biology (Ph.D. 1995, Yale University). The goal of our research program is to understand how cells exploit the dynamic process of ubiquitin-mediated proteolysis to change patterns of gene transcription and switch between alternative phenotypic states.

***Lalitha Madhavan**, Assistant Professor, Neurology and Molecular & Cellular Biology (Ph.D. 2006, Iowa State University). Stem cells and their potential to help understand and treat neurological diseases.

***Joanna Masel,** Associate Professor, Ecology and Evolutionary Biology (D. Phil. 2000, Oxford University). Robustness and evolvability of biological systems

***Justina McEvoy**, Assistant Professor, Molecular & Cellular Biology (Ph.D. 2007, Brown University). Epigenetic regulation of differentiation programs during normal development and

tumorigenesis in pediatric cancers.

***Megan M. McEvoy**, Associate Professor, Biochemistry & Molecular Biophysics (Ph.D. 1997, Oregon). Structure/function of protein complexes; NMR; structure and function of proteins involved in asymmetric cell division in Drosophila neuroblasts.

Emmanuelle Meuillet, Associate Professor, Nutritional Sciences and Molecular & Cellular Biology (Ph.D. 1995, University Louis Pasteur, France). Regulation of the tumor suppressor, PTEN, and the survival pathway (PtdIns-3-Kinase/Akt/PTEN) and its importance in cancer and diabetes.

***Roger L. Miesfeld**, Professor, Biochemistry & Molecular Biophysics and Molecular & Cellular Biology (Ph.D. 1983, SUNY, Stony Brook). Steroid-regulated gene expression.

***William R. Montfort**, Professor, Biochemistry & Molecular Biophysics (Ph.D. 1985, University of Texas, Austin). Protein structure, function, and inhibition.

***Rebecca Mosher**, Assistant Professor, The School of Plant Sciences (Ph.D. 2005, Duke University). RNA-directed DNA methylation and transcriptional gene silencing

***Ghassan Mouneimne**, Assistant Professor, Cellular & Molecular Medicine (Ph.D. 2006, Albert Einstein College of Medicine). Regulation of cellular behavior by structural changes to the actin cytoskeletal architecture

***Lisa M. Nagy**, Professor, Molecular & Cellular Biology, Cellular & Molecular Medicine, and Ecology & Evolutionary Biology (Ph.D. 198 1, University of Washington, Seattle). Analysis of the genetic basis of morphological diversification.

***Janko Nikolich-Zugich**, Professor, Immunobiology (Ph.D. 1993, Belgrade University). My laboratory is interested in the biology of cytotoxic T lymphocytes (CTL) in health, infection and aging.

***Marty Pagel,** Associate Professor, Biomedical Engineering, Chemistry and Biochemsitry, and Medical Imaging (Ph.D. 1993, University of California, Berkeley). Molecular Imaging of cancer biomarkers

***Ravishankar Palanivelu**, Associate Professor, Plant Sciences and Molecular & Cellular Biology (Ph.D. 1998, University of Georgia at Athens). Long-term goal of my lab is to understand the molecular basis of how cells communicate with each other. In the immediate future we are focused on identifying and characterizing the guidance signals generated by the A.thaliana pistils to guide pollen tubes to their final target.

***Leilei Peng**, Associate Professor, Optical Sciences (Ph.D. 2005, Purdue University). Invent and develop new fluorescence imaging tools for biomedical research

***Gregory Rogers**, Associate Professor, Cellular & Molecular Medicine and Molecular & Cellular Biology (Ph.D. 1999, University of California at Davis). My laboratory is interested in the molecular mechanisms cells use to maintain stability of their genomes.

***Joyce A. Schroeder**, Professor, Molecular & Cellular Biology and Program in Molecular Genetics (Ph.D. 1998, University of North Carolina, Chapel Hill). Transgenic mice as models for breast cancer.

Karen S. Schumaker, Professor, Plant Sciences and Molecular & Cellular Biology (Ph.D. 1987, University of Maryland). Molecular mechanisms underlying cellular polarity establishment and morphogenesis.

***Jacob Schwartz**, Assistant Professor, Chemistry & Biochemistry (Ph.D. 2010, UT Southwestern Medical Center). The role of RNA-binding proteins in neurodegenerative disease and cancer

***Tim Secomb,** Professor, Physiology and Mathematics (Ph.D. 1979, University of Cambridge). Theoretical studies of the microcirculation.

***Tricia Serio**, Professor and Head, Molecular & Cellular Biology (Ph.D. 1997, Yale University). Protein-only (prion) inheritance, protein misfolding, and protein quality control.

***Magdalene So,** Professor, Immunobiology and Molecular & Cellular Biology (Ph.D. 1976, University of Washington). Microbes have evolved numerous mechanisms to adapt to, and co-exist with, their human host. Our goal is to define these mechanisms in molecular terms and to understand how they influence the genesis of disease.

***Frans Tax**, Professor, Molecular & Cellular Biology, and Plant Sciences (Ph.D. 1994, University of Washington). Functions of plant receptor kinases and their signaling pathways.

***Donata Vercelli**, Professor, Cellular & Molecular Medicine (M.D. 1978, University of Florence, Italy). The central theme of the Functional Genomics Laboratory I direct at the Arizona Respiratory Center is the characterization of the mechanisms through which natural variation in immune genes contributes to the pathogenesis of complex diseases, with special emphasis on respiratory disorders such as allergic inflammation and asthma.

***Ted A. Weinert**, Professor, Molecular & Cellular Biology (Ph.D. 1984, Yale). Cell cycle checkpoints that arrest cell division after DNA damage.

***Charles Wolgemuth**, Associate Professor, Physics and Molecular & Cellular Biology (Ph.D. 2000, University of Arizona). My research uses theoretical, computational, and experimental methods to determine the mechanisms by which cells produce the force necessary to create and maintain their shape, grow, and move.

***Stephen Wright**, Professor, Physiology and Biochemistry & Molecular Biophysics (Ph.D. 1978, University of California, Irvine). Membrane transport; energetics and kinetics of transport; molecular basis of transporter-substrate interaction.

***Ramin Yadegari**, Associate Professor, Plant Sciences and Molecular & Cellular Biology (Ph.D., University of California, Los Angeles). Molecular mechanisms of early development in plants; epigenetic regulation of gene expression and imprinting.

***Guang Yao**, Assistant Professor, Molecular & Cellular Biology (Ph.D. 2002, University of Wisconsin). Systems biology study of gene networks that control cell-fate decisions and cancer development.

***Daniela C. Zarnescu**, Associate Professor, Molecular & Cellular Biology (Ph.D., Pennsylvania State University). Molecular mechanisms for neural development and polarity; fragile X syndrome.

***Konrad E. Zinsmaier**, Professor, Neurobiology and Molecular & Cellular Biology (Ph.D. 1990, University of Wuerzburg, German). Synaptic transmission, neurotransmitter exocytosis, presynaptic calcium signaling, membrane fusion, synaptic vesicle recycling, synaptic vesicle genesis.

*faculty trainer for NIH-funded training grant (T32GM008659)

F. Financial Assistance

1. Basic stipend

The basic graduate stipend is $25,000/year. As a graduate student supported on a teaching or research assistantship, tuition is waived, and single-only health insurance is paid by the University. Depending on the source of funding, you may receive this stipend in the form of bi-weekly paychecks or in larger lump-sum amounts, three-to-four times per year. Students should save a little each pay period in the fall to pay the miscellaneous fees due for the spring (due by first day of class), and in the spring save the extra amount for the subsequent fall. Check www.registrar.arizona.edu for the exact due date for payment of fees, to avoid late payment penalties and registration restrictions. Most graduate students do not register for classes during the summer sessions. See Denise Slay (MCB) or Lori Boyd (CBC) for clarification or with questions regarding registration.

Direct deposit for paychecks is an available benefit for those compensated through the payroll system. This can be done electronically via UAccess Employee (Employee/Manager Self Service). Students on stipends can sign up for direct deposit through UAccess Student. Paychecks may be picked up on payday (every other Friday) in BSW 310.

2. Health insurance

All BMCB graduate students are required to maintain student-only health insurance. Health insurance premiums are covered as a benefit of the BMCB program. Note that health insurance premiums paid during the spring semester provide coverage through summer. For additional information please visit http://www.health.arizona.edu/insurance.htm.

3. Sources and duration of funding

All first-year students are funded from multiple university sources. By the middle of the second semester, students should have identified a dissertation advisor. From that point forward, financial responsibility for the student resides with the dissertation advisor. Students may not be denied financial support for any period of time, including the summers, with the exception of a University-documented leave of absence.

During dissertation research, students are typically paid as graduate research assistants for a period of up to five years, contingent on the availability of funds and continued satisfactory progress. Only under exceptional circumstances will students exceeding a six-year program of study receive financial support.

In the event that an advisor suffers a funding hiatus, the BMCB graduate program will make every effort (but cannot legally guarantee) to identify alternative funding sources for students in good standing. Alternative sources could include special training grants, fellowships, as well as teaching assistantship positions.

4. Competitive fellowships

All eligible students are encouraged to submit applications for pre-doctoral fellowship support from external sources, such as the National Science Foundation and the National Institutes of Health, Department of Defense and Department of Energy. Pre-doctoral fellowship support is available from these agencies; however, in some instances eligibility is limited to students in their first year of graduate school. Information about these applications and their deadlines will be made available early in the fall semester. Deadlines are typically early November (NSF) and early December, April, and August (NIH). Be alert for availability of application information. A formal course in grant writing is open to all second-year BMCB graduate students in the fall semester (MCB575), and independent studies with faculty members can be arranged for students interested in submitting a fellowship application.

5. Funding to attend scientific meetings

It is important for graduate students to attend professional meetings to present their research and to develop networking skills. Students that are funded by the BMCB training grant receive an allowance from these grants to support attendance at one meeting per year. Students can also apply for funds for meeting travel from the Graduate Students Association (http://gpsc.arizona.edu/travel-grants) or other sources.

G. Required course work for the Ph.D. in Biochemistry or Molecular & Cellular Biology

1. General description of course work

Students will take most of their coursework during the first two years. ABBS advisors will help each student plan their first-year courses. Once a student has joined a BMCB lab, the Ph.D. advisor, the Program Director, and the student's committee members will help the student plan the second and subsequent years. All BMCB students are required to enroll in, attend, and participate in a journal club and seminar course every semester until graduation. All students must take a 1-unit course in Ethics, MCB 695E or equivalent, by the end of the second year and refresh this training in the responsible conduct of research every four years. For the Ph.D., the Graduate College requires a minimum of 36 units in the major, of which 18 must be in courses with letter grades (A, B). The Graduate College also requires a 9-unit minor. Students must earn a grade of A or B in all core courses and maintain a B average overall.

2. Course listings

All course descriptions and a listing of courses being offered each semester (Schedule of Classes) can be found online at http://www.arizona.edu/students/registering-classes.

H. Requirements for the Minor Specialty Area

1. Minor in Biochemistry or Molecular & Cellular Biology

A minor in Biochemistry or Molecular & Cellular Biology consists of three advanced (500-level or above) courses or a minimum of nine units. For the Biochemistry minor, three courses are required: BIOC 565, 568, one elective. For the MCB minor, three courses are required: two MCB-listed electives and one course from the following list: MCB546, MCB572A or MCB580.
Note: your major and minor can be the same (ie: MCB major and MCB minor or BIOC major and BIOC minor).

2. Minor in a specialty area other than Biochemistry or Molecular & Cellular Biology

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

I. Teaching Assistantships

1. Teaching as an important component of graduate training

Teaching is a valuable component of the graduate program. First, it gives you the opportunity to develop the skills needed to be an effective communicator, and, second, it provides stipend support for students who are not on a fellowship. In general, all students will teach two semesters as part of their overall training, once in the second year and once in the third year, unless restricted by the funding source.

2. Teaching assignments

Teaching assignments are made in May or June for the following year. Every effort will be made to accommodate your interests when course assignments are made.

3. Responsibilities and duties of a teaching assistant (TA)

General guidelines for teaching assistant responsibilities can be found in the Graduate Assistant/Associate manual: http://grad.arizona.edu/financial-resources/ua-resources/employment/ga-manual

The amount of time spent on this activity varies depending on the course and the type of assistantship (lecture TA or laboratory TA), with an average of about 10 hours per week. You are expected to abide by all University rules with regard to conduct and to perform your duties in a professional manner. The course coordinator is the TA supervisor and provides direction. Students

awarded a teaching assistantship in their second or third year should attend the TA training offered by the College of Science in August, and in some cases, a specialized training program may be required for a course, depending on the course coordinator. Students must also complete the Teaching Assistant Training Online (TATO) and achieve a minimum score of 95% on the required online modules. All International Teaching Assistants (ITAs) whose citizenship is that of a non-English speaking country must demonstrate proficiency in spoken English. Attendance at an English-speaking institution does not satisfy this requirement.

Once a student is assigned to a TA position, failure to complete TA duties without approval of a University-documented leave of absence will result in a written warning. If TA duties continue to be unfulfilled following this warning, financial support will be suspended.

J. Laboratory Rotations

During each rotation, you have full status as a member of the laboratory and participate in all activities normally expected of laboratory personnel. Laboratory rotations are an important opportunity not only to explore the "fit" between the student and advisor but also to experience a variety of scientific approaches and philosophies. For these reasons, our faculty suggest students immerse themselves in the research experience during rotations and maximize their time in the laboratory. Laboratories are available to students at all hours, and it is expected that students will take advantage of this availability on evenings and weekends.

Upon completion of each rotation, students are evaluated by the faculty mentor in written format. The report is then forwarded to the ABBS graduate program coordinator's office where it is placed on file to become part of the student's record. The student and faculty member must meet together to discuss the evaluation, the possibility of further discussions on thesis projects, and the state of funding for the laboratory.

K. Choosing Laboratories for Rotations (see also section K: Choosing an Advisor)

Students are encouraged to choose rotation mentors based on information they obtain from faculty and other students in the program. It is the student's responsibility to arrange the various rotation experiences based on information provided by the ABBS program with regard to availability of space and funding in each laboratory. While it might be necessary to arrange one or two of the rotations in advance, you are not expected to arrange all three at one time. Additional perspective for future rotations will be gained as the year progresses.

L. Rotation System

The rotation schedule for all ABBS students will consist of three mandatory rotations during the first year. Each student will present their rotation research in a group setting at the conclusion of each rotation period. A matching process will take place at the end of the third rotation.

M. Choosing a Dissertation Advisor

Many points should be considered when choosing a laboratory and an advisor.

Choosing a dissertation advisor is one of the most important decisions that you will make in your graduate career. Since the laboratory rotations are the mechanism through which you will narrow down your choice of advisors, it is very important that you consider the following issues at the very beginning of your graduate career.

Science, Mentoring Style and Laboratory Environment:
Does your potential advisor work in a field that truly fascinates you? Does s/he have a project in which you are passionately interested? Having a passion for your research subject will motivate you to expend the effort that is necessary for completing your studies. Does your potential advisor have a personality that you believe to be compatible with yours? Does his/her mentoring style and availability match with your needs and expectations? Is the degree of independence expected consistent with your needs and expectations? Be aware that you will be reliant upon your advisor to guide your professional development during this phase of your career and probably in developing your career well beyond the completion of your degree but that your independence in these endeavors will build as you progress through the program and your career.

Ask what your potential advisor expects and requires of you in order for you to complete your dissertation. What is the nature of the feedback you will receive on your work? Are there regular laboratory group meetings? What is the intellectual climate in the laboratory? Does the advisor send students to conferences? Are these attributes of the laboratory culture consistent with your needs and expectations?

Talk to other students, postdocs, and faculty about a potential advisor. Their familiarity and knowledge of a potential advisor's capabilities and personality can be enormously important in helping you to reach a decision about an advisor. However, different individuals interact in different ways. Be aware of your own strengths and needs and make your own final decision.

Financial Support:
You should discuss with your potential advisor how you will be financially supported during your stay in his/her laboratory. Sources of support may come from research grants to the advisor, student fellowships or other awards, institutional training grants, and teaching assistantships. Note that few laboratories can guarantee a consistent period of funding from the same source. Thus, it is likely that your support may be derived from different sources during your graduate years. You should also be aware that teaching assistantships frequently are quite demanding of one's time. Consequently, you may not be able to devote as much time to your research project, and the length of time required to complete your degree may be extended if much of your support is based on a teaching assistantship. However, teaching assistantships do provide relevant experience that contributes toward your professional development.

Home Department:
If your potential advisor has a primary appointment in a department other than Chemistry & Biochemistry or Molecular & Cellular Biology, make sure that s/he is aware of the requirements of the BMCB program. Choosing an advisor who is based in another department can provide a unique opportunity for obtaining a broad and interdisciplinary research experience. But keep in mind that if

your advisor's department and laboratory are located elsewhere on the campus, it may require a bit of extra effort on your part to maintain regular contact with other students and faculty within your degree-granting program.

N. Changing Laboratories

If at any time you come to an impasse in communication with your advisor, we strongly encourage you to take prompt action. Be assured that your success is our goal. You should first discuss the issues with other members of your committee. A committee meeting should be scheduled, including both the student and thesis advisor, to discuss the situation. At this meeting, another member of the committee should be selected as acting chairperson. Time should be allotted to allow both the student and the advisor to speak separately with the committee. The committee will facilitate a discussion to address the issues raised and draft a memorandum of understanding on responsibilities for both the student and advisor moving forward. This memorandum of understanding should be signed by all participants and forwarded to the Director of the Graduate Program. The chair of the committee should follow-up with the student and with the advisor within two months of the meeting, and a letter detailing progress, or lack thereof, should be written and forwarded to the student, to the advisor and to the Director of the Graduate Program.

Should the student or the advisor come to feel that the relationship remains unproductive after these significant efforts to address the underlying reasons have been exhausted, either can terminate it. In such circumstances (and when such a course of action is being considered), the student should consult with his or her committee and with the Director of the Graduate Program formally or individually to determine the best course of action (continuation in the program or termination with or without a Master's degree). Should the student continue, a meeting with the committee (modified, to include the new advisor and any other necessary substitutions) should take place as soon as possible to map out a plan of study. Changing advisors does not entail an extension of the funding guarantee.

O. Selecting a Supervisory Committee and Committee Meetings

1. Selecting a committee

Selection of a supervisory committee is a matter worthy of both careful thought and investigation. The committee's role goes beyond that of simply evaluating you and includes challenging you to excellence, providing fresh insights for your project, and integrating you as a colleague in the intellectual life of the program. The committee can also serve as a valuable source of external evaluation of differences of opinion between you and your advisor. For these reasons, it is essential that you not only choose a committee that commands your respect but also one with which you can interact fruitfully. It is recommended that you interview prospective committee members to determine their views on what constitutes Ph.D.-level research, expectations on the content of the oral examination and dissertation, etc. You should also aim to choose committee members that complement each other in their range of experience and expertise.

Your committee should consist of five members: your thesis advisor plus four faculty members. One member of your committee, usually your thesis advisor, serves as the chair of your committee. At least one of your committee members, outside of your advisor, must be a BMCB trainer. If you

select a minor outside of MCB or BIOC, one of your committee members must represent your minor department. After completing the preliminary examination and advancing to candidacy, your committee can be reduced to four members (your Advisor plus three).

2. Arranging meetings

Committee meetings are scheduled by the student every year (beyond the first year). SCHEDULE A TWO-HOUR BLOCK OF TIME. However, make every effort to end the meeting in an hour. It is better to focus on the most significant results rather than to show everything that you have done since the last meeting.

Arranging a time for committee meetings can be one of the most difficult tasks for a graduate student. Faculty often have well over 20 hours of their week committed to classroom teaching, meetings, and seminars. In addition, faculty may make frequent out-of-town trips for seminar engagements and attendance at scientific meetings or national service committees. While it can be challenging to schedule a meeting of all five members of your committee, it is well worth the effort to have five people focusing all of their attention on you and your research question. The most successful approach is to plan ahead (2 months before the meeting) before their schedules become too restricted.

Two approaches seem to work well for finding a mutually satisfactory time: (1) Use a Doodle poll (doodle.com). Provide possible days and times for a meeting over the course of a four-week period that you already know are compatible with your schedule and that of your advisor. (2) Email possible days and times for a meeting that you already know are compatible with your schedule and that of your advisor to your committee members. They can check off when they are (or are not) available, and you can match up everybody's schedules. Use email to confirm the final date, time, and place. Send out an email reminder the week of the meeting.

If over the course of two months you cannot find a time during which all members of your committee can meet, it is acceptable to have a meeting with as few as three members present, rather than to have no meeting at all. However, you should then make an appointment to meet with each of those members that could not attend the meeting to discuss the status of your research and other issues, such as attending scientific meetings, submission of manuscripts, and future career decisions.

3. Meeting agendas

The following guidelines should be used by the student in arranging the agenda for the annual meetings with their supervisory committee. **The student should provide a written summary (Annual Meeting Committee Update form) of progress to the committee at least one week in advance of the meeting and bring an Annual Progress Report form, which will be filled out by the appointed chairperson and signed by the attending committee members.** The original form should be submitted to the BMCB program coordinator (Denise Slay) for inclusion in the student's file. Both forms are available on the BMCB website. Note: students should use the First Committee Meeting form (available on BMCB website) for their first meeting.

The student sets the agenda and runs the meeting. After the scientific and programmatic/career discussions of the meeting are completed, all committee meetings should include a time in which the student can meet briefly with the committee in the absence of the advisor. This time offers the

opportunity for the student to discuss any issues between the student and the advisor with the committee. The committee meeting should also include a brief time at the end during which the committee can meet in the absence of the student.

The following suggestions should make your committee meetings productive:

(1) Meetings should include time during which the advisor leaves the room and the student is able to discuss concerns in the absence of the advisor.

(2) Meetings should include time during which the student leaves and the advisor can speak to the committee in the absence of the student.

(3) Committee meetings should block out a two-hour slot on the committee's schedule. This meeting is intended to discuss the entire results of one year of research, generate ideas and suggestions, and also to leave time for reasonable discussion of other issues, as might arise in (1) and (2) above.

First Meeting (by the end of the fall semester of the second year)

- Provide a general discussion of the proposed research for the dissertation.
- Discuss coursework taken and planned.
- Discuss possible preliminary exam topics for the written exams (see below).
- Sets a date for the preliminary examination
- Plans the timing for the comprehensive examination

Subsequent Meetings

- Provide an outline of your research progress to the committee members at least one week before the meeting.
- Briefly present (30 minutes) your present and future research.
- Describe future research objectives and discuss any problems.
- Career Planning

Final Meeting before the dissertation defense (within the year of the defense)

- Map out the content of the thesis and discuss any remaining experiments.
- Come to a consensus on what research needs to be completed to satisfy the committee.
- A detailed summary of the meeting must be sent to the BMCB graduate program coordinator for inclusion in the student's file (complete a *Dissertation Prospectus Approval* form).

Note: A dissertation prospectus (see page 24) must be given to the committee members at least three months before the defense.

P. Preliminary Examinations

1. Description of the Preliminary Written Examination and Oral Comprehensive Examination

Before advancing to formal candidacy for the Ph.D. degree, you must pass an examination, which is prepared concurrently with course requirements. The examination consists of a written and oral portion. To satisfy the requirement of a qualifying examination (a Graduate College prerequisite to

the preliminary examinations), the BMCB program stipulates that you must have passed the required core courses in the program with a grade of B (3.0) or better in each course, and maintain an overall average of B in all coursework. The written preliminary examination consists of two parts and is described in more detail below. The written preliminary exam must be completed at least three weeks prior to taking the oral comprehensive examination. The written and oral examinations will be completed before May 1 of the second year. Planning for the examinations must be done well in advance. If a committee member is unavailable or is on sabbatical leave, a substitute member must be found.

2. General guidelines for preparing the written preliminary exam

a. **General examination on areas outside of the dissertation research topic.**
The first part of the written portion of the examination consists of three questions outside of the area of the student's research topic. The general areas of questioning are determined by consultation of the student with the members of the supervisory committee at the first committee meeting. The student is encouraged to suggest areas of interest from which questions might be generated. Each member of the committee generates one question. After consultation with the committee members, the student then selects three of the five questions to answer.

The goal of this part of the written exam is to teach the student to: (1) rapidly assimilate a body of information from the primary literature; (2) summarize the key concepts, critically evaluate the data available in this area, and define unsolved problems; (3) formulate models or hypotheses; (4) devise experimental approaches to test the predictions of the models or hypotheses; and (5) communicate the approaches and results in a concise and informative manner.

Thus, the format of each question should require the student to learn a concept or principle from a field within the primary literature and then to use the concept or principle to solve a problem or test a hypothesis. The scope of each question should be limited so that it can be concisely answered within no more than ten double-spaced typed pages. The student is allowed three weeks to answer the chosen questions. At the end of the three-week period, the answers to the three questions are submitted to the supervisory committee members. Students are encouraged to use not only library resources but also to discuss the question with colleagues or researchers on campus or elsewhere who study related problems or topics although the synthesis of material and final answers must be the student's own work.

The faculty members who wrote the questions that the student chooses to answer will serve as the primary reviewers. Prior to starting the exam, the student is encouraged to discuss with each primary reviewer what is expected in terms of answering the question and to discuss any portions of the question that may be unclear. The other faculty will serve as secondary reviewers. After consultation, the supervisory committee will grade each question as a pass or fail within one week of receiving the student's written answers. All three questions must be answered satisfactorily in order to pass this portion of the written examination. If the student fails one or more of the questions, the student will be asked to answer one or more of the remaining questions generated by the committee. The student will have one week per question to prepare an answer starting immediately upon

notification of an unsatisfactory response to any question answered in the first set. If the student cannot satisfactorily complete three of five questions, the student's continued participation in the program must be discussed with the supervisory committee and with the Director of the Graduate Program (see Probation).

b. General examination on areas within the dissertation research topic.
This portion of the written examination consists of a research proposal related to the student's dissertation topic. The proposal must originate with the student and should be an independent synthesis of ideas and experimental design from within the student's field of interest. However, the proposal is not expected to serve as a "contract" for research to be accomplished and may substantially differ from the final dissertation project. The topic and scope of the research proposal must be approved by the supervisory committee prior to writing the proposal.

The student is advised to develop a well-focused proposal which is not overly ambitious and that can be completed in a timely manner. The responsibility for the quality of the proposal, which includes originality, practicality, significance, and methodology, rests entirely with the student. The student may seek general advice from members of the supervisory committee and the dissertation advisor but should not expect them to be active participants in the generation and completion of the proposal. The topic for the original research proposal must be approved by the supervisory committee prior to the student devoting a substantial commitment of time and effort to writing the proposal (typically at the first committee meeting). Try to focus the proposal on no more than three specific aims. In addition, the specific aims need to be independent of one another. For example, if A precedes B, which precedes C, and the experiments in A do not work, then B and C cannot be done. These types of proposal are a trap and should be avoided.

Once the topic of the research proposal has been approved by the supervisory committee, the student then proceeds to write the complete document. Be prepared to spend at least two to four weeks writing this draft. Like any other good grant proposal, quality will come from spending a lot of time thinking about the potential flaws in the proposal and then finding solutions. It is advisable to ask fellow students and colleagues to critique the document before it is distributed to the supervisory committee. When the proposal has been written as well as possible, a copy should then be given to each member of the committee (this includes your dissertation advisor). The committee will need two weeks to critique the proposal and to give feedback. At this point, major revisions may be requested. The committee will not approve this part of the preliminary examination until the document is acceptable.

The proposal should have a title that accurately describes the major hypothesis. This should be followed by an abstract (<200 words) that concisely summarizes the problem being addressed and the proposed experimental approaches (specific aims). The body of the proposal should include background information, enumerated specific aims, methods of approach, and an appraisal of the significance of the proposition. An excessive bibliography should be avoided. However, it must include all pertinent references in which the methods are described and or observations supporting the proposed studies are reported. Use primary references where possible, avoiding excessive reliance on reviews. The total written proposal, including figures and tables but excluding references, should

be limited to 10 single-spaced typewritten pages. Detailed descriptions of established methods can be left to the oral defense. The submitted document should be proofed carefully for grammar and spelling. A general format is given below:

I. Title Page
II. Abstract
III. Research Plan (10 pages total)
    A. Hypothesis/Specific Aim (1/2 page)
    B. Background and Significance (2 – 3 pages)
    C. Experimental Design (6 – 8 pages)
IV. References (include full article titles)
V. Appendix (figures, tables, flow diagrams)

You may also find that the proposal is easier to read if the figures and tables are included in the text of the research plan rather than as a separate appendix. The above format should be taken as a suggestion with the exception of the total length of the text. A well-written, defensible proposal is the major requirement for passing the written preliminary exam.

Upon completion of the written exam, submit a ***Qualifying Written Exam Report*** form (available on the BMCB website) to the BMCB graduate program coordinator.

3. Information and guidelines for the oral comprehensive exam

The student's supervisory committee is responsible for administering the oral examination. All members of the committee must be in attendance at the examination, and other faculty members are not permitted to attend. To schedule the oral exam, the student is required to complete the **Announcement of Doctoral Comprehensive Exam** form at least two weeks before the examination is scheduled. This form is completed online via GradPath in your UAccess Student account. No student will be allowed to officially schedule the oral exam unless the written exam has been passed although a tentative date can be arranged at any time with the supervisory committee. The student is responsible for scheduling the room for the oral exam. The oral portion of the preliminary exam generally will consist of two components: (1) a defense of the original research proposal; and (2) questions concerning general knowledge within the field of biochemistry and/or molecular and cellular biology. The defense of the research proposal will test the student's ability to generate original ideas and to defend the adequacy of the proposal for solving the problems addressed. It is expected that the student will demonstrate a reasonable knowledge of the literature and special techniques in the field.

The general questioning portion may account for up to 50% of the oral examination. The general questions will primarily be derived from both the core and elective courses that the student has taken. Additional questions pertaining to the questions from the written portion of the examination may also be asked.

It is common for the student to give a five- to ten-minute overview of the research proposal followed by questions from the committee centered about a defense of the research proposal (1-1½ hours). The best way to study for the examination is to: (1) know the proposal thoroughly, including all related topics; (2) review all class notes and lecture material from all the classes taken as a graduate student up to that point, especially the core course material; (3) review the general principles of

biochemistry and molecular and cellular biology; and (4) be familiar with the recent literature (particularly in the fields represented by the committee members). **It is important to plan your studying to ensure that you have sufficient time to review all of the necessary material. Early on, identify the material that you want to cover and then systematically go through it.** It is an excellent idea to have at least one "practice oral exam" with other graduate students and postdocs about two weeks before the scheduled exam. This can be very helpful in identifying your weaknesses and give you practice thinking on your feet.

Print the ***Qualifying Oral Exam Report*** form (available on the BMCB website) prior to your exam. Submit the signed form to the BMCB graduate program coordinator upon completion of the exam.

4. Recommended time frame for the preliminary exam:

When	What
1st Year/Fall	(1) Core courses, and (2) Rotations.
1st Year/Spring	(1) Core courses, (2) Rotations (3) Select dissertation advisor and supervisory committee.
Summer	Research.
2nd Year/Fall	(1) Research, (2) Elective class, (3) arrange committee by November 1, (4) hold first committee meeting by end of the fall semester; discuss timetable for second-year examinations and classes.[1]
2nd Year/Spring	(1) Research, (2) Elective class, (3) Written preliminary exam[2] to be completed by February 28. (4) Oral comprehensive exam.[3]

[1]Requires that a minimum of three supervisory committee members be present.
[2]It is recommended that the questions be received no later than February 1 (You will have three weeks to complete the questions).

Remember that the Graduate College requires seven working days between applying for and taking the oral examination.

5. BMCB program and University policies regarding the oral comprehensive exam

- If the oral comprehensive exam is passed with no deficiencies:
  1. You will be advanced to Doctoral Candidacy by the Graduate College.

- If the oral comprehensive exam is failed on the first attempt:
  1. You may be given a chance to retake all, or part, of the exam after four months.
  2. You may be asked to leave the program with no chance for a second attempt.

- If the oral comprehensive exam is failed on the second attempt the supervisory committee will decide on one of the following options:
  1. Recommend dismissal from the Ph.D. graduate program and Graduate College.
  2. Recommend dismissal with a Master's degree.
  3. Recommend dismissal following the writing of a Master's thesis.

If option 2 or 3 is decided upon, the student must file a Change of Degree request with the Graduate College. To obtain a Master's degree, students must have completed 30 units of course work. No minor is required.

If the committee recommends dismissal from the program, the chair of the committee must draft a letter detailing the reasons for the recommendation to the Director of the Graduate Program, with a copy to the student and to the advisor. The Director of the Graduate Program, in consultation with the BMCB executive committee, must submit a decision on the recommendation to the student within one week.

Q. Dissertation and Final Defense

Note: We expect students to strive toward publishing two first-author papers from their dissertation research.

1. General description of the dissertation and final oral defense

There are two formats possible for the dissertation. Option 1 follows the more traditional style with an introduction, materials and methods, results, and discussion sections. Option 2 is available to students who have published papers in which they are the primary author. The format for Option 2 is based on inclusion of the published article(s) as the actual dissertation. Both of these options are described on pages 26-27. A formal defense of the dissertation research constitutes the final examination. This consists of a public seminar by the candidate followed by an oral examination by the candidate's committee and other interested faculty. Be sure to bring all the necessary paperwork to the examination that requires signatures from members of the supervisory committee. This includes the multiple cover pages to the dissertation if all of the final revisions have already been made.

There are a number of requirements that must be met to satisfy both the department and the Graduate College. Ultimately, you will earn your degree by meeting all the requirements of the Graduate College, which by design incorporates program requirements. **It is very important to familiarize yourself with the most current Graduate College guidelines, specifically with regard to preparation of the dissertation.** See the *Manual for Dissertations* on the Graduate College website at http://grad.arizona.edu/current-students. Samples and templates are available in the manual.

2. List of specific steps necessary for graduation

The following list shows the major steps that need to be taken once your dissertation advisor and supervisory committee agree that your dissertation research is defensible:

When	What
Within one year of the defense	Schedule a committee meeting to discuss the content of the thesis and the remaining experiments to be completed.

Three months prior to oral defense	1) Submit a detailed dissertation prospectus to your supervisory committee. Complete a ***Dissertation Prospectus Approval*** form (available on BMCB website) and submit to BMCB graduate program coordinator for inclusion in your file. 2) Complete *Doctoral Dissertation Committee Appointment* form via GradPath in your UAccess Student account. Note: the approved Prospectus form must be submitted before this step can be completed.
Three to five weeks prior to oral defense	Submit a polished draft of the dissertation to the supervisory committee.
Seven days prior to oral defense	Complete the *Announcement of Final Oral Defense* form via GradPath in your UAccess Student account.
Final Semester	Submit the final dissertation to the Graduate Degree certification office via the electronic submission site at www.etdadmin.com/arizona.

Before the last week of the final semester, clear all fees with the Bursar's office.

3. Guidelines for preparation of the dissertation

No later than three months before the final oral defense, the candidate must submit a detailed **dissertation prospectus** to the supervisory committee, outlining the research progress to date. Importantly, this document should clearly list those studies that the student feels need to be completed prior to writing the dissertation. **Students will not be allowed to schedule the final oral examination less than three months after submission of the prospectus. However, if extenuating circumstances exist which make it impossible to meet this timetable, the student's advisor and supervisory committee may request a waiver of the three-month period in writing to the BMCB Committee, but only after the prospectus has been submitted.** The candidate then meets with the supervisory committee to discuss the prospectus. The committee reviews this information and helps the candidate to formulate any new plans, if appropriate. It is common for the committee to recommend a limited number of experiments and to make specific recommendations regarding a timetable for writing of the dissertation. It is appropriate at this time to discuss with the committee the two optional dissertation formats and to decide which one will be more appropriate. It is the responsibility of the supervisory committee to decide which of the two program dissertation formats (Option 1 or 2) will be the used by the student.

At a minimum, the student must be a first author on a submitted publication, or make the equivalent contribution to other submitted publications or scholarly work, for the prospectus to be approved.

Once the dissertation is written, the candidate submits a completed, polished draft to each member of the supervisory committee **at least three to five weeks** prior to the final examination. It is your responsibility to be sure that sufficient time is allowed for this polished draft of the dissertation to be read by your supervisory committee. It is anticipated that the supervisory committee will be able to read the dissertation and return it to the candidate within two weeks of receipt. This timing allows you to make any suggested changes, provided they are minor, and to obtain final approval of the

penultimate draft prior to the final examination. Then, no later than seven days before the proposed date of the examination, you must complete the ***Announcement of Final Oral Defense*** form via GradPath in your UAccess Student account. Faculty members cannot approve this form unless they have approved the penultimate draft of the dissertation.

Graduate College policy on the use of copyrighted material is below. You will also find the two different options for the dissertation format that have been approved by the Departments of Biochemistry and Molecular & Cellular Biology.

USE OF COPYRIGHTED MATERIAL IN THESES AND DISSERTATIONS

Use of copyrighted material in your thesis, including illustrations, usually requires written permission from the copyright holder. Start this time-consuming process as early as possible. Play it safe and assume that you must obtain permission if the material is copyrighted. Consult your advisor about this process.

Exceptions, sometimes pertaining to small fractions of a musical score or other document, are governed by the concept of "fair use." Factors weighed in determining "fair use" include: the purpose of the use, whether commercial or non-profit and educational; the nature of the copyrighted work; the amount and substance of the material used in relation to the entire work; and the effect of the use upon the potential market for or value of the copyrighted work. The "fair use" concept is explained in detail in the *Chicago Manual of Style*. According to the Association of American University Presses, permission is required for quotations that are complete units; for example, an entire poem, letter, book chapter, or an entire map, chart, drawing, or other illustration. Permission to use copyrighted material should be in writing and retained by the author. The release letters should indicate that permission extends to microfilming and publication by University Microfilms, Incorporated (UMI) and that the copyright owners are aware that UMI may sell, on demand, single copies of the thesis, dissertation, or document, including the copyrighted materials, for scholarly purposes. UMI requires copies of permission letters to be attached to the publication agreement and assumes no liability for copyright violations. If permission letters are not supplied, copyrighted materials may not be filmed.

It is polite and good practice to obtain permission to use non-copyrighted material, which may or may not be acknowledged in the text.

For additional information, telephone the Copyright Public Information Office in Washington, DC, (202) 479-0700, weekdays between 8:30 a.m. and 5:00 p.m. EST or write to the Copyright Office, Library of Congress, Washington, DC 20559.

4. Description of two different formats allowed by the program – Options 1 and 2

Dissertation Format Option 1 – Traditional Style of Dissertation

The Graduate College policy states that each department can establish their own guidelines for the dissertation format. However, the final document must adhere to all the Graduate College requirements. A *Manual for Dissertations* can be found at http://grad.arizona.edu/current-students. The Departments of Biochemistry and Molecular & Cellular Biology have the following list of

guidelines for preparation of a traditional dissertation (please refer to the dissertation manual for order of sections and specifications):

1. The suggested dissertation format should include the following components:

    - Abstract – describing the problem, the results, and the interpretation.
    - Introduction – general introduction to the field and the biological system.
    - Material and Methods – a complete description all in one section.
    - Results and Discussion – should be logically divided into separate chapters with an introductory paragraph at the beginning of each chapter. Each chapter should include a thorough analysis of the data and its implications.
    - Summary – a short synopsis, including future directions that should be taken.
    - Literature Cited – should follow that of the journal *Cell*, with in-text citings, using the author's name(s) and year published; the full references with titles should be listed alphabetically at the end of the dissertation.

2. Figures and tables should be included in the chapters rather than as an appendix. Permission to use copyrighted material is your responsibility.

3. If appropriate, the dissertation may include portions of manuscripts being prepared for submission, but the text should be your own writing.

4. The supervisory committee has the responsibility for checking the dissertation for adherence to Graduate College specifications and for approving the overall appearance and format ascribed to Option 1.

Dissertation Format Option 2 – Inclusion of Previously Published Papers

1. General description as defined by the Graduate College

At the option of the student and the supervisory committee, an alternate format permitting inclusion of papers published or accepted for publication in scholarly journals may be used. The decision to allow the inclusion of previously published or submitted work in a dissertation is left to the candidate's degree-granting unit (in this case, the supervisory committee).

The alternate format for the dissertation is based on the philosophy developed by the Council of Graduate Schools: "The published work must be logically connected and integrated into the dissertation in a coherent manner. Simply binding reprints or collections of publications together is not acceptable as a dissertation in either format or concept," *The Role and Nature of the Doctoral Dissertation*, Council of Graduate Schools, 1991.

2. BMCB policy for dissertation format Option 2

    a. The student must be a primary author on at least one of the papers.

    b. The following types of publications are acceptable:

        - Any peer-reviewed refereed journal in the biological or physical sciences that is published in English.
        - Non-refereed journals are unacceptable.
        - Conference proceedings are unacceptable.
        - Manuscripts that have been submitted for publication may be included as a separate chapter as long as they have been approved by the supervisory committee and it is clearly stated on the first page of that chapter to which journal (i.e., acceptable journals only, see above) the manuscript has been submitted

The program policy is that a minimum of 20% of the effort on each paper must be attributed to the student. The paper must include data which result solely from the experimental work of the student; gratuitous authorship is unacceptable. This definition of effort includes measurable input toward the writing and intellectual content of the paper. In cases where it is difficult to assign percent effort, it is up to the student's supervisory committee to decide.

At the time of the oral defense of the dissertation, the student must be able to defend all of the work in the dissertation, even in cases of multiple authors. With this stipulation, the program does not perceive a conflict of interest when other committee members are co-authors on the paper.

Required Format

Published papers should be appended. However, in order to provide coherency, the body of the dissertation must include a summary of the student's contribution and a summary of the research. Note that all margin, pagination, and paper restrictions described in the *Manual for Dissertations* apply.

The order of sections described in the manual applies except that the body of the paper must include two chapters as follows:

1. An introduction that describes the unique contribution of the student's work to the field of study. That uniqueness should be described via the following subsections to the extent they are appropriate.

    a. Explanation of the problem and its context.

    b. A review of the literature.

    c. Explanation of dissertation format. This subsection explains the relationship of the papers that were included and the contribution of the candidate to each of the papers;

where doctoral research efforts are part of a larger collaborative project, students must be able to identify one aspect of that project as their own and be able to demonstrate their original contribution. The role that the dissertation author had in the research and production of the published paper(s) should be clearly specified in this section.

2. A chapter labeled "Present Study" that summarizes the methods, results, and conclusions of the research. The chapter should begin with a statement such as: "The methods, results, and conclusions of this study are presented in the papers appended to this dissertation. The following is a summary of the most important findings in these papers."

   References for the two chapters described above should follow the "Present Study" chapter.

   Appendices:
   Two types of appendices are appropriate.

   a. Each paper in the form of a reprint

      - The statement of permission for use of copyrighted material must be placed immediately before the reprint on correct paper.

      - The title page of the journal in which the article appeared should precede the statement of permission.

      - University Microfilms, Inc., will not accept a dissertation with double-sided pages (the typical format of a reprint). Therefore, reprints must be copied onto correct bond paper, single-sided, and numbered in sequence.

   b. Supplemental materials that are resources to the methods and results.

      These most often include data tables, graphs, maps, and computer printouts that may be reproduced in microfiche form. Restrictions on the uses of certain kinds of computer printout (e.g., no use of striped computer paper) apply.

Multiple Authorship

Multiple authorship of papers that have been published or are to be submitted for publication is allowed. It is the responsibility of the student's doctoral committee to ensure that a dissertation represents the original, individual efforts of the candidate. It is recommended that the majority of the student's committee not be co-authors on papers included in the dissertation.

Requirements for Contemporaneous Enrollment and Research

The research that is described in the published paper(s) that are part of the dissertation must have been conducted during the time the candidate was enrolled in his or her current degree program and cannot have been submitted toward any other degree at the University of Arizona or elsewhere.

R. Advanced Student Evaluation

At the end of the fifth year, the director of the graduate program and the graduate program coordinator will meet with individual students and their advisors together to assess the status for remaining publications and plans for completion of the degree. A timeline will be drawn for both and must take into account the trajectory of the student up until this point. Failure to achieve these goals will result in a warning status for the student. If the student has not yet collected sufficient data to plan a publication, the development plan must include additional committee meetings over the course of the coming year (one meeting every 6 months). In addition, the BMCB executive committee may choose one of its members to serve as an ad hoc member of the thesis committee during a warning period to provide additional oversight on forward progress toward the degree.

S. Warning Status

The purpose of the warning status is to address problems identified by the student's advisor, committee or graduate program that have remained unresolved through the normal mentoring procedures in the program and to find a solution.

Students experiencing significant delays or more significant issues in progressing toward their degrees may be placed on warning status for a period of not more than one year. Examples include, but are not limited to, issues with:
• Completion of coursework in accordance with program guidelines
• Completion of preliminary examination in accordance with program guidelines
• Completion of oral examination in accordance with program guidelines
• Satisfactory progress in meeting research goals as judged by supervisory committee
• Scheduling annual committee meetings in accordance with program guidelines

For students, who have not yet been admitted to candidacy, the directors(s) of the BMCB graduate program, in consultation with the BMCB executive committee, can place students on warning status for failure to maintain the grade point average required for good standing in the program or for failure to successfully complete the preliminary and oral examinations according to the timeline detailed in the program handbook.

For students who are not making satisfactory progress in their research (either pre- or post-candidacy), the chair of the thesis committee must call a meeting of the committee, including both the student and the advisor, to discuss the situation. If the committee concurs with the request for warning status, the deficiencies and a plan for rectifying them by a specific deadline determined by the committee (typically within one semester) must be detailed in a written letter to the student, which is also copied to the director of the graduate program. The director of the graduate program, in consultation with the BMCB executive committee, will write a separate letter to the student, the advisor, the committee, and the Graduate College to detail the consequences of not meeting the requirements of the plan by the specified deadline. The consequences can include the immediate removal of funding and enrollment in the program in rare circumstances dictated by the severity of the problem and in accordance with university policy.

By the specified deadline, the student must convene another committee meeting to discuss progress toward the goals outlined in the original notification letter. The committee must evaluate the

student's progress and notify both the student and the director of the graduate program in writing of their recommendation. If the student has made satisfactory progress, the committee may recommend that the student return to good standing. If the progress is promising but not complete, the committee may recommend extension of the warning for one additional semester. If the progress is unsatisfactory, the committee should recommend removal from the program. At any point in this process, the student may explore opportunities in other laboratories or programs. The director of the graduate program, in consultation with the BMCB executive committee, will notify the student, the advisor, the committee and the Graduate College of his/her decision on the continuing status of the student.

In all cases, attention should be given to the particular difficulties being faced by the student. If necessary, the student should be advised to explore a leave of absence (see Section T).

T. Student Appeal of Warning Status

Within one week of notification of warning status, the student may appeal this decision in writing to the department head of the degree granting program: Chemistry and Biochemistry for the Biochemistry Ph.D., and Molecular and Cellular Biology for the MCB Ph.D. The appeal should specifically address all of the points raised in the warning status notification letter.

U. Annual Retreat

The annual BMCB retreat is a time set aside to mingle with colleagues socially and to share your progress and ideas with other students, postdocs, and faculty. It is expected that you will avail yourself of this opportunity and, barring exceptional circumstances, formally present your ongoing research in the form of a poster or talk. It is typical for 2nd year students to present a poster and 4th year students to present a research talk. In either format, the goal should be one of sharing the excitement as well as the rationale of your goals and approach. The retreat is held annually in the fall.

V. Personal and/or Medical Leave

The program realizes that there are personal and/or medical reasons for a student to require a limited break in their studies. Although the University has no formal policy for such contingencies, the program recognizes the general policies of the Federal Family and Medical Leave Act of 1993 and will allow students to take a break in their studies without applying for a formal University leave of absence. Under the federal policy, a personal or medical absence of 12 work weeks can be arranged for: (1) the birth of a child and to care for such child*, (2) to care for another individual in the student's household or immediate family, or (3) the student's own health conditions. Arrangements for such an absence should be discussed with your advisor and the Chair of the BMCB committee in advance of the proposed absence. Stipend during such an absence is not guaranteed and is dependent on availability of funds on a case-by-case basis. However, we want to assure you that efforts will be made to find solutions that will not jeopardize the continuation of your graduate studies.

*The Graduate College offers paid parental leave (up to six weeks) for Graduate Research Assistants (this policy does not extend to Graduate Teaching Assistants). Please see http://grad.arizona.edu/parentalleave for eligibility and application information.

W. The Next Step – Finding Postdoctoral Opportunities

Your choices may be directed or modulated by your goals for what you want to do after your postdoctoral training.

1. Are you aiming for a position where you will be conducting and directing research, such as at a university, research institute, or biotech firm? Will your project lead to an independent research program, or will you learn the approaches and skills you need at the next level? Will you have opportunities to help direct students or staff?

2. Do you want to work in the biotech industry? Many companies hire at the postdoctoral level. Others prefer Ph.D. hires to have a variety of experiences that come with the broadening of a postdoctoral experience in an area different from your Ph.D. work. You may have more opportunities to enter the biotech industry at the postdoctoral level, but may limit your ability to "move around" or eventually to be a laboratory director.

3. Are you considering becoming a small college professor? You may want to find out if there will be opportunities to teach or help in courses. You may also want to think carefully about what type of project or area of research you choose as a postdoctoral researcher such that you can later develop research projects to be done by undergraduates perhaps in an environment that does not include all of the equipment and expensive disposable supplies available at a large research university. Some small colleges are well equipped and provide some money for supplies, but very labor intensive projects can be limited by the time that faculty and students can spend on the projects and are usually limited to the summer break.

You may not have formulated **exactly** what your career goals will be and may become stymied in trying to decide **before** you do postdoctoral work. In that case, it is suggested that you choose a postdoctoral experience that leaves the door open to many different opportunities in research and teaching.

The first thing you need to do is decide what you want to work on and why. Choosing something that you are passionately interested in is a good place to start. Thinking about this for several years, perhaps from the time you first start graduate school, is a good idea. If you start thinking about this early, you will have time to change your mind several times and investigate and refine your ideas over time. This choice may not only occupy you for a few postdoctoral years but perhaps may be carried over into whatever position you take after that time. Reading in the topic area is recommended to become familiar with the science and who is doing it. No one knows exactly when they will finish their Ph.D., but getting very serious about planning your postdoctoral experience at least a year and a half before the projected finish date is recommended. At that time, you need to talk with anyone available who knows the area. This includes faculty and postdocs, both in the department and in other departments on campus. Faculty are often willing to help by contacting the people they know to get more information on who might be good postdoctoral advisors in a certain area. Read the papers and talk to as many people as you can about the prospective advisors. Narrow

down your list and write to the advisors. Provide them with the names, addresses, phone numbers, and email addresses of at least three references. Follow up your letter with email if you do not hear from them in a reasonable amount of time. If you do not start early, you may limit your choices because some advisors may need more time to fit you into **their** future plans. In addition, you will probably have more choices if you indicate that you are willing and have time to write a fellowship application. Obtaining a fellowship is good because it may give you more freedom of choice in projects during your postdoctoral training, and it will look good on your CV. If a move becomes imperative during the term of the fellowship for personal or other reasons, often fellowships can move with you to a new location and advisor because they have been awarded to **you** and not your advisor.

Other things to consider are your preferences for working conditions, supervision styles, and environment. Big lab or small lab? Famous advisor or young advisor starting out? University, research institute, or company? Will you have the chance to develop an independent project? What is the environment outside of the advisor's lab like? Seminars? Journal clubs? Informal discussions on science? Geographical location? Coordination with a significant other? If you need to coordinate your move with your significant other, plan as far in advance as possible and make some contingency plans for "waiting" time.

Maybe you've decided that you want to skip doing a postdoctoral experience and move directly into the biotech industry or find a teaching job. How do you find out about biotech jobs? Networking seems to be the most fruitful method. Talk to as many faculty here at the University and elsewhere that you know for contacts at companies. Use the web. Subscribe to, go to the library for, or visit some of the local coffee shop/bookstores for the classified ads in the Sunday newspaper of your city or cities of choice. The industry is concentrated in a few locations: Boston area, around D.C., San Francisco Bay area, San Diego, Seattle.

What if you want to go right into teaching? Currently, most small colleges are hiring people that have some postdoctoral experience. But some community, state, and other small colleges may be eager to hire new Ph.D.s. Contact schools that you are interested in directly, especially if you are going to be restricted by location, e.g., staying in Tucson. Subscribe to or visit the library for *The Chronicle of Higher Education*. The job listings in the *Chronicle* are accessible on the web. Most college teaching jobs are advertised in this weekly periodical.

A last bit of advice is to talk with all of the students that are presently going through this process or have gone through it. You can talk to postdocs that have come from other places, but probably more helpful would be to call and interview students from Arizona that have gone on to postdoctoral positions or jobs elsewhere. Contact Denise Slay at 621-1519 or Lori Boyd at 621-4348 for names, phone numbers, and email addresses. You may have to contact the former Ph.D. advisor for the most recent phone number or email address.

X. Required Forms

For the BMCB Program (available online: http://bmcb.biology.arizona.edu/current/)
First Committee Meeting Report
Annual Progress Report
Annual Meeting Committee Update

Qualifying Written Exam Report
Qualifying Oral Exam Report
Dissertation Prospectus Approval

For the Graduate College: (completed online via your UAccess Student account)
Responsible Conduct of Research Statement
Plan of Study
Comp Exam Committee Appointment
Announcement of Doctoral Comprehensive Exam
Doctoral Dissertation Committee Appointment
Announcement of Final Oral Defense