STUDENT HANDBOOK
CELLULAR BIOLOGY AND ANATOMY
BIOMEDICAL SCIENCES Ph.D. PROGRAM

REV: 1/10/2015
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Chapter 1 -
Welcome to the Cellular Biology and Anatomy (CBA) Graduate Program

Departmental Mission
The Department of Cellular Biology and Anatomy has as its core mission the advancement of outstanding research and education. We work collaboratively to discover new knowledge through innovative biomedical research, to transmit that knowledge to students, and to train future researchers, educators and health care professionals.

This mission carries through in the Cellular Biology and Anatomy (CBA) Ph.D. Program, as described in this handbook. We begin with a message from Dr. Sylvia B. Smith, Chair of the Department of Cellular Biology and Anatomy.

Welcome to the Department of Cellular Biology and Anatomy!
Our graduate program offers excellent research training opportunities in the dynamic field of cell biology. Faculty members are eager to engage energetic pre- and post-doctoral fellows in research that covers a broad spectrum of cell biological research from development through normal processes, disease/degeneration and death. The developmental biologists within our department investigate polarity and patterning in organisms, while other faculty members study mechanisms of protection, repair and regeneration related to diseases of the kidney, bone, breast, visual and auditory systems and the central nervous system. A broad array of genetic, molecular, cell biological, and biochemical tools are used in in vivo and in vitro studies using multiple model systems including rodents, zebrafish, and Drosophila.

The department has strong collaborative ties with many of the research institutes and centers on campus, and offers a rich environment for scientific discovery and dissemination of new knowledge. There are numerous substantive interactions with clinicians offering myriad opportunities for translational research. As with all of the graduate programs in the Biomedical Sciences Ph.D. program, students are graduate research assistants and earn a stipend to support their studies. Our department also offers a robust seminar program, a dynamic and energized graduate journal club covering a broad range of cell biology topics (attended by faculty), as well as graduate courses tailored to the needs of our students.

There are a number of career opportunities that await an individual who has earned a Ph.D. in Biomedical Sciences with a concentration in Cellular Biology and Anatomy. Our graduates are poised to pursue post-doctoral research in universities and research institutes across the US and beyond. Armed with a solid underpinning in the fundamentals of cell biological approaches to organisms, students are attractive also to industry and biotechnology companies. For those interested in pursuing academic careers that combine research and teaching, students not only build upon their research experience, but are afforded opportunities also to participate in teaching within the medical school curriculum (serving as teaching assistants in histology, anatomy, neuroanatomy/ neuroscience). Students also have the opportunity to take advantage of educational experiences offered at the nearby GRU
undergraduate (Summerville) campus that can include non-science fields such as business or education.

We are delighted that you are exploring the opportunities within our program and look forward to working with you as colleagues!

About this CBA Program Handbook

The material in this handbook has been provided for the benefit of graduate students in the Cellular Biology and Anatomy (CBA) Ph.D. Program. This handbook is designed to simplify what can often be a confusing journey to graduation, and to compile in one place both general information and topics specific to this graduate program. The rules and procedures stated herein are consistent with those in the manual provided to all Biomedical Sciences Ph.D. students by the Graduate School. However, it is important that CBA students understand that this handbook is not designed to replace the Graduate School Ph.D. Guide that gives detailed information essential for meeting requirements of the Graduate School. Please also be aware that policies and forms generated by the Graduate School and the CBA Ph.D. Program may be updated after this handbook edition is published.

For the most current TGS policies and forms, please visit the following link: http://www.gru.edu/gradstudies/current_students/

Please also consult with program staff and the CBA Program Director for assistance with questions that undoubtedly will arise and are not covered in this handbook or where your specific situation requires a more detailed response.

We acknowledge the foundational documents provided by the Graduate School and the BCB Graduate Program on which portions of this CBA Program Handbook are based.

Cover Art: The colorful painting by Brian Phillips represents some of the research ongoing in the Department of Cellular Biology and Anatomy.
**ADMINISTRATION OF CBA GRADUATE PROGRAM**

<table>
<thead>
<tr>
<th><strong>Department Chair: Sylvia B. Smith, Ph.D.</strong></th>
<th>![Image of Sylvia Smith]</th>
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<tbody>
<tr>
<td>CB1101    706.721.3731   <a href="mailto:sbsmith@gru.edu">sbsmith@gru.edu</a></td>
<td>Thank you for your interest in the graduate program of the Department of Cellular Biology and Anatomy. Our program offers research training opportunities in the dynamic field of cell biology, which covers the continuum of development, normal processes, disease/degeneration and death. Our faculty work collaboratively and are dedicated to the success of our students. The department has strong collaborative ties with many of the research centers, institutes and clinical departments on campus offering a rich environment for scientific discovery and dissemination of new knowledge. We welcome your participation in our program!</td>
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<tr>
<th><strong>Program Director: Mark Hamrick, Ph.D.</strong></th>
<th>![Image of Mark Hamrick]</th>
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<tr>
<td>CB1116    706.721.1958   <a href="mailto:mhamrick@gru.edu">mhamrick@gru.edu</a></td>
<td>On behalf of my fellow faculty and graduate mentors, I welcome you to the Graduate Program in Cellular Biology and Anatomy. We are here to help you through the hurdles and exciting training toward earning your Ph.D. and beyond. I look forward to meeting each new student and seeing you mature as a colleague. Please call or e-mail with questions or to set up an appointment to see me, or feel free to drop by my lab.</td>
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<tr>
<th><strong>Administrative Manager: Sharon Lever</strong></th>
<th>![Image of Sharon Lever]</th>
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<tbody>
<tr>
<td>CB1101    706.721.3731   <a href="mailto:slever@gru.edu">slever@gru.edu</a></td>
<td>Welcome to the Department of Cellular Biology and Anatomy Graduate Program. I look forward to meeting and working with each of you. If you need assistance with your stipend, health insurance payments, grant submissions, and any other administrative issues, please feel free to contact me. I will be willing to assist you in any way I can.</td>
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<tr>
<th><strong>Office Manager: Nan Eaton</strong></th>
<th>![Image of Nan Eaton]</th>
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<tr>
<td>CB1101    706.721.3731   <a href="mailto:neaton@gru.edu">neaton@gru.edu</a></td>
<td>Welcome to the CBA graduate program. The success of our graduate students is important to me and I am always available to help with any questions or concerns. You will work with me on most of your administrative issues and I will be your contact (Academic Administrator) with deadlines or information from the Graduate School and the Registrar’s Office.</td>
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_CBA Graduate Program Council: Dr. Zheng Dong, Dr. Graydon Gonsalvez, Dr. Julia Brittain, Dr. Patricia Schoenlein and Dr. Mark Hamrick, Program Director._
**CBA FACULTY**

**CBA RESEARCH FACULTY**

**JULIA BRITTAINE, Ph.D.**  
Associate Professor  
My research program centers on understanding the role of the red blood cell in vascular pathology. Illnesses that directly perturb red blood cells usually have devastating consequences for the patient. One such illness is sickle cell disease. We seek to understand how red blood cells in this disorder promote a pro-coagulant, pro-inflammatory state in patients. We discover these mechanisms and translate them into therapies. We provide pre-clinical data that informs clinical trials and lead investigator initiated clinical trials as well.

**RUTH CALDWELL, Ph.D.**  
Professor  
Our lab focuses on vascular biology and the molecular mechanisms that control retinal vascular function and growth during health and disease. We seek to understand the role of the enzyme arginase in altering retinal blood flow and causing neuronal cell death in diseases like diabetic retinopathy and retinopathy of prematurity.

**JIAN-KANG CHEN, Ph.D.**  
Associate Professor  
Our lab is particularly interested in the mammalian or mechanistic target of Rapamycin (mTOR), a serine/threonine protein kinase sensing nutrients and growth factors and regulating autophagy, cell growth, and cell proliferation. mTOR activation is implicated in obesity, diabetes, cancer and kidney hypertrophy (a renal response increasingly implicated in progressive nephron damage leading to kidney failure).

**ZHENG DONG, Ph.D.**  
Regents’ Professor  
The overall goal of our research is to delineate the molecular mechanism of cell injury/death, its protection and subsequent regeneration. Our focus has continued to be the response of kidney and cancer cells/tissues to pathological conditions of hypoxia/ischemia, metabolic stress, and DNA damage. Our current work includes the investigation of cell death, cell cycle, DNA damage response, autophagy, and microRNA regulation.
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<th>Name</th>
<th>Title</th>
<th>Summary</th>
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<tr>
<td>GRAYDON GONSALVEZ, Ph.D.</td>
<td>Assistant Professor</td>
<td>The focus of our research is on understanding the mechanisms by which cells establish polarity. Establishment of cell polarity is essential for normal cell function. We also seek to understand how misregulation of this process results in disease.</td>
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<tr>
<td>MARK HAMRICK, Ph.D.</td>
<td>Professor</td>
<td>The primary objective of our research program is to understand how soft tissues, muscle and fat, influence bone metabolism and bone strength. We are particularly interested in defining the molecular mechanisms by which muscle and fat regulate bone formation and bone loss, so that these pathways can be targeted therapeutically in order to prevent and treat bone fractures.</td>
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<tr>
<td>WILLIAM D. HILL, Ph.D.</td>
<td>Associate Professor</td>
<td>The research in our lab focuses on bone marrow-derived mesenchymal stem cells and their secreted factors. They are used in multi-disciplinary studies for their capacity to repair damage and regenerate normal tissues, especially in stroke and bone repair models.</td>
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<tr>
<td>YUQING HUO, M.D., Ph.D.</td>
<td>Professor</td>
<td>The overall goal of our research is to understand mechanisms of inflammatory diseases, including metabolic and cardiovascular diseases at the molecular and cellular levels as well as in vivo animal models. We hope that eventually our studies can lead to the development of therapeutic approaches for above diseases for future clinical use in patients.</td>
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<tr>
<td>ELLEN K. LEMOSY, M.D., Ph.D.</td>
<td>Associate Professor</td>
<td>Our laboratory studies extracellular matrix proteins and carbohydrates that regulate growth factors having key roles in embryo patterning, craniofacial, nervous system, and renal development. We use cell culture, fruitfly, and zebrafish genetic model systems as needed. This work is relevant to human birth defects and diseases such as inflammation and cancer.</td>
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<tr>
<td>Name</td>
<td>Title</td>
<td>Research Focus</td>
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<td>YUTAO LIU, M.D., Ph.D.</td>
<td>Associate Professor</td>
<td>Dr. Liu's research interest is to identify genetic risk factors related to complex human diseases, such as corneal diseases, primary open-angle glaucoma (POAG) and amyotrophic lateral sclerosis (ALS, Lou Gehrig's disease). Dr. Liu is also interested in the role of genomic structural variation in human disease.</td>
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<td>MEGHAN McGEE-LAWRENCE, Ph.D.</td>
<td>Assistant Professor</td>
<td>The overall goal of my research is understanding the epi/genetic biology behind the development, maintenance, and regeneration of skeletal structure and biomechanical strength, focusing on biological, mechanical, and epigenetic control of bone remodeling, as well as integrative pathways involved in crosstalk between the skeleton and other organ systems to regulate development and disease progression.</td>
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<tr>
<td>PAUL McNEIL, Ph.D.</td>
<td>Professor &amp; Director of Cell Imaging Core Facility Component Director of Histology for Phase I Medicine</td>
<td>Disruption or tearing of the cell plasma membrane is a common form of cell injury under physiological conditions and in disease. We investigate, at the subcellular and molecular levels, the mechanism of repair of plasma membrane disruptions. We use as our primary tool quantitative light microscopy, applied to cultured cell and mouse models.</td>
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<td>PATRICIA SCHOENLEIN, Ph.D.</td>
<td>Associate Professor</td>
<td>Our overall goal is to improve the treatment of breast cancer by preventing resistance. Autophagy, a process of recycling organelles when cells are stressed, allows cancer cells to survive chemotherapy and radiation. Our laboratory seeks to identify key molecules that could be targeted to prevent pro-survival autophagy.</td>
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<td>SYLVIA B. SMITH, Ph.D.</td>
<td>Regents’ Professor and Chair</td>
<td>Our lab focuses on retinal cell biology, specifically understanding normal function of the retina and the consequences when those functions go awry. One major area of interest is folate and homocysteine as related to retinal health and another is retinal neuroprotection in diseases such as diabetic retinopathy and glaucoma.</td>
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MITCHELL WATSKY, Ph.D.
Professor & Dean of the Graduate School
My research interests have focused on corneal wound healing, ion channel function, cell signaling, and bioengineering of an artificial cornea. I also have a long term interest in bioactive lipids. Stemming from my corneal wound healing work, research projects in the lab have broadened to include translational projects aimed at understanding initiation of fibrotic diseases throughout the body, including scleroderma (SSc) and pulmonary fibrosis, as well as research involving osteoporosis and markers of bone metabolism. Most recently we have embarked on an exciting project examining vitamin D metabolism and function in the eye.

FULL TIME CBA FACULTY WITH PRIMARY DUTIES IN MEDICAL EDUCATION

ANNA EDMONDSON, Ph.D.
Associate Professor
Teaching responsibilities include:
- Director of Medical Development (Embryology)
- Course Director for Human Gross Anatomy (ANAT 7300)
- Primary Anatomy Teaching Faculty in Medicine, Allied Health and Graduate Studies

My research interests relate to medical education. I am interested in determining the effectiveness of innovative instructional designs, learning tools, and assessments in the curriculum. I am also interested in examining how factors such as learning styles and motivation influence academic performance and classroom attendance.

CHARYS MARTIN, Ph.D.
Assistant Professor
Teaching responsibilities include:
- Primary Anatomy Teaching Faculty in Medicine and Allied Health
- Course Director of Gross Anatomy and Neuroanatomy for Medical Illustrators
- Lab Director of Gross Anatomy for Nursing Anesthesiology and Respiratory Therapy

My research interest is in evaluating the influence of spatial visualization ability on different levels of anatomy examination questions, determined by Bloom’s Taxonomy in medical anatomical science education and allied health anatomical science education courses.
CAROL NICHOLS, Ph.D.
Associate Professor
Senior Director Phase I Curriculum MCG
Teaching responsibilities include:
- Curricular management of the foundational sciences modules and directing ECM.
- Gross Anatomy classroom and lab teaching for the Colleges of Medicine, Allied Health, and Graduate Studies
- Director of Medical Gross Anatomy
- Co-Director of the six integrated systems-based basic science courses in the Phase 1 medical curriculum.

My research interests relate to medical education. Specifically, I am interested in innovative curricular and instructional design and assessment and determining their effectiveness.

WILLIAM PEARSON, Ph.D.
Assistant Professor
Teaching responsibilities include:
- Teaching Faculty for Medical Gross Anatomy and Neuroanatomy
- Component Director for Phase 1 Medical Neuroscience
- Course Director for Phase 3 Clinical Anatomy and Teaching Skills and Clinical Anatomy Research Elective

My research interest is in translating the functional anatomy of swallowing. My research group collaborates with investigators at various institutions to develop methods using clinical imaging to model and phenotype morphologies associated with swallowing and swallowing impairment. Our aims are to use these methods to: more accurately describe the dynamic process of swallowing, determine the underlying structural deficits of swallowing impairment, and test interventions to improve or preserve swallowing function. Of special interest is evaluating the efficacy of treatment paradigms in preserving swallowing function in head and neck cancer patients.

Additional Research Faculty with Primary Appointments in the Department of Cellular Biology and Anatomy
QingQing Wei, Ph.D.
Ming Zhang, M.D., Ph.D.

Graduate Faculty with Secondary Appointments in the Department of Cellular Biology and Anatomy
Mohammed Al-Shabrawey, Ph.D. Carlos Isales, M.D
Manuela Bartoli, Ph.D. David J. Kozlowski, Ph.D.
Wendy Bollag, Ph.D. Gregory Liou, Ph.D.
Kathryn Bollinger, M.D., Ph.D. Mario Marrero, Ph.D.
Richard Cameron, Ph.D. Andrew Mellor, Ph.D.
Gretchen Caughman, Ph.D. David Munn, M.D.
Mohammed Elsalamy, M.D., Ph.D. Alexis Stranahan, Ph.D.
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<th>CURRENT GRADUATE STUDENTS</th>
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<tr>
<td><strong>KATHLEEN BUCKLEY</strong>, Ph.D. Candidate</td>
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<tr>
<td>Year of Entry: 2010</td>
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<tr>
<td>Mentor: William D. Hill, Ph.D.</td>
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<td>Lab: CB1119</td>
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<td>Ischemic stroke injury is the fourth leading cause of death in the United States and the cause of long-term disability. Rapamycin, an FDA approved pharmaceutical used in transplantation, improves survival and behavior outcome after experimental stroke injury. My project centers on the mechanism of rapamycin via autophagy in the neurovascular unit. I seek to understand the process of autophagy in the main three cells of the neurovascular unit after ischemia and reperfusion injuries.</td>
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<tr>
<td><strong>CHUNYUAN GUO</strong></td>
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<tr>
<td>Year of Entry: 2012</td>
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<td>Mentor: Zheng Dong, Ph.D.</td>
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<td>Lab: CB1124</td>
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<td>I study protein SUMOylation in experimental models of Acute Kidney Injury (AKI). I found that SUMOylation is induced in both cisplatin nephrotoxicity and ischemia reperfusion models. Furthermore, suppression of SUMOylation by Ginkgolic Acid enhances the apoptosis induced by cisplatin, suggesting SUMOylation plays a cytoprotective role in cisplatin nephrotoxicity.</td>
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<tr>
<td><strong>LAWRENCE HICKS</strong></td>
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<td>Year of Entry: 2012</td>
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<tr>
<td>Mentor: Graydon Gonsalvez, Ph.D.</td>
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<td>Lab: CB 2917</td>
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<tr>
<td>My research focuses on the role of Sorting Nexin 9 (Snx9) in endocytosis. The Drosophila egg chamber depends on endocytosis for proper development and thus provides an efficient in vivo model system to explore the involvement of Snx9.</td>
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### R. Nicole Howie

**Year of Entry:** 2011  
**Mentor:** Mohammed Elsalanty, M.D., Ph.D.  
**Lab:** CB2516  
Our lab is developing an animal model that presents BRONJ after bisphosphonate dosage comparable to that of a normal cancer patient. We also propose a novel method to prevent the onset of BRONJ by inducing the transient release of bisphosphonate from its attachment to the hydroxyapatite crystals in bone.

### Shanu Markand, Ph.D. Candidate

**Year of Entry:** 2010  
**Mentor:** Sylvia B. Smith, Ph.D.  
**Lab:** CB1114  
My project focuses on characterizing the retinal phenotype of mice deficient in the gene encoding for methylene tetra hydrofolate reductase (mthfr), a model of hyperhomocysteinemia (Hhcy). Hhcy is implicated in various visual disorders such as diabetic retinopathy, age related macular degeneration and central retinal vein occlusion. Mutations in mthfr gene are common in the American population and our study will investigate whether mthfr deficiency is associated with any ocular problems.

### Paulomi Sanghavi, Ph.D. Candidate

**Year of Entry:** 2010  
**Mentor:** Graydon Gonsalvez, Ph.D.  
**Lab:** CB 2917  
I am investigating the role of microtubule based motor proteins, Kinesin and Dynein in transport of a localized mRNA using Drosophila as a model system.
LOCATIONS AND MAPS

HEALTH SCIENCES CAMPUS:
Chapter 2: General Expectations and Your Advisory Committee

Overview and Timeline

The Cellular Biology and Anatomy Ph.D. Program aims to provide outstanding training for students seeking independent science leadership careers in academic, technology, and public service sectors. As such, the students do not advance in lock-step through a highly prescribed program. Instead, they will develop details of their training in conjunction with their major advisor, advisory committee, and program director. This handbook chapter outlines the major elements of the training experience and discusses the timeline for their integration. The timeline begins with the first year of graduate school.

Year 1. The student completes the core Biomedical Sciences Ph.D. curriculum, selects a research lab and major advisor via the rotation system, and begins to gain familiarity with research methods and the problems studied in their new laboratory and in the Department of Cellular Biology and Anatomy. The CBA program does not require completion of a specific Selective course in the Spring semester. Students may select a course of interest and are encouraged to seek advice of faculty with whom they are rotating or program directors.

Year 2. The student’s main objective during the second year should be to establish their research, and thus start on a strong path to success despite the many hurdles, distractions, and additional training goals that are part of graduate training. The student will delve deeply into the primary literature and gain direct expertise in the array of techniques used in their laboratory. With the major advisor, the student will assemble an advisory committee, which will oversee research progress and preside over major milestones of the student’s Ph.D. training, including Comprehensive Exam, Research Proposal, and Dissertation Defense. The advisory committee must meet by the end of the Spring semester of Year 2 (fifth semester of graduate school). CBA students are encouraged to present a departmental research seminar in their second year, and are required to present a journal club session. Though it may seem intimidating to begin presentations to the entire department so soon after beginning as a researcher, it is excellent preparation for the Comprehensive Exam as well as an opportunity for deep discussion with your research mentors. The Comprehensive Exam is taken between the fifth and seventh semesters of enrollment in graduate school, i.e., Spring of Year 2 through Fall of Year 3, and must be completed by Thanksgiving break of Year 3. The student should also complete the required Histology course (ANAT 8050) in the summer after Year 1 or after Year 2 as determined with major advisor as being least disruptive of research progress and preparation for the Comprehensive Exam. Students typically take 1-2 additional elective courses relevant to their research in Year 2, or in Year 3 if not offered in Year 2. Only one elective (with minimum 3 credit hours) is required by the CBA Program, but the student and their advisory committee may decide on additional coursework as a valuable addition to their training.
Timeline For Students In CBA Graduate Program

Enhanced Research
(fellowships encouraged)

Teaching Opportunities
(Contingent on performance, faculty approval, funds; recommend 1-2 seasons duration)

Elective Teaching-Related Coursework
(with approval of faculty; *preferred timing)

CBA Required/Elective Coursework
(approved by advisory committee)

Grad School and Research Milestones

Fellowships (usually no teaching in parallel)
Apply for predoc fellowships
Possible Undergrad, e.g., Biology Lab Sections
CBA Histology/Anat/NeuroAnat Teaching Fellowships
* Anat
Anat/Emb/Neuro?

Histo
Electives related to Research

Establish Research
Steady Research Progress and Productivity
Proposal
Target Defense

CORE
Comp Exam

F   S   Su       F   S   Su       F   S   Su       F   S   Su       F   S   Su       (Yr 6)
Year 3. If the Comprehensive Exam is not completed by the end of Year 2, the student must take it in Fall semester of their third year (7th semester of graduate school). Furthermore, the student must successfully submit to the Graduate School a formal Research Proposal approved by their advisory committee by the end of the 9th semester of enrollment (Summer at end of Year 3). CBA students typically complete the Research Proposal by the end of the 8th semester of enrollment (Spring of Year 3), or within 2 semesters of passing the Comprehensive Exam. If elective coursework is also completed to the satisfaction of the advisory committee, the student may be admitted to Ph.D. Candidacy during Year 3. The student continues a principal focus on their experimental research, is required to present and participate in departmental Seminar course (ANAT 9010) and Journal Club, and is expected to present a poster at Graduate Research Day.

CBA Program students who have completed the Comprehensive Exam, and are performing well in coursework and research progress, are competitive for medical school teaching opportunities in Histology, Gross Anatomy, and Neuro-anatomy offered by the Department of Cellular Biology and Anatomy. Exceptional students may be considered for these positions prior to completion of the Comprehensive Exam if slots are available and if they have completed the relevant coursework. Completion of the Comprehensive Exam is required for eligibility to apply for TA positions in undergraduate Biology course lab sections coordinated by the Graduate School. Application for predoctoral fellowships, e.g., NIH, NSF, AHA, is encouraged, typically in Years 2 and 3, but timing and content should be discussed with major advisor and program director so as to avoid conflict with the Graduate School’s criteria for student’s independence in the written portion of the Comprehensive Exam. Further criteria for these enrichment opportunities are outlined in Chapter 5 of this handbook.

Year 4. The student should be making good progress in carrying out research, publishing, and presenting work in GRU, regional, national, and/or international settings. The student should be on track to be able to meet the program’s Publication Requirement prior to dissertation defense (see Chapter 4). At this point in training, all didactic coursework and Graduate School milestones, other than the dissertation defense, have generally been completed and the student can concentrate fully on research and, as appropriate to their career goals, training in teaching. Achieving the best balance of research productivity and other training goals can be challenging; however, CBA students are encouraged to undertake 1-2 seasons of teaching fellowship(s) as this will increase career options and competitiveness for future employment. The student continues to present and participate in departmental Seminar and Journal Club, and is expected to present a poster at Graduate Research Day.

Year 5. Students in their fifth year of graduate training are generally completing their research and writing their dissertation, which, on average, is defended at the end of Year 5. Teaching activities should be secondary if there is any question of the excellence of progress on research. Planning for life after graduation, e.g., postdoctoral fellow position or other employment is a priority, as is completing publications and presenting work at scientific conferences. The student continues to present and participate in departmental Seminar and Journal Club, and is expected to present a poster at Graduate Research Day. Often the student may substitute the dissertation defense seminar for their departmental seminar in Year 5 if it is certain the defense will occur before the end of Spring semester.

Major Advisor
The major advisor chosen by the student must be a member of the Graduate Faculty and have either a primary or secondary appointment in the Department of Cellular Biology and Anatomy. The Department Chair must approve the selection of major advisor. The major advisor is responsible for guidance of the student’s research project, technical direction in the laboratory and financial support of the project. The major advisor also should be a role model and guide for learning scientific approaches to problems; for ethical, safe, and well-documented laboratory practices; and for the collaborative, political, and funding environment in which scientists work. The major advisor is responsible for editing and advising students with writing and presentations, including preparation of the dissertation defense, and should be instrumental in helping the student choose and interact with their advisory committee.

It is the student’s responsibility, not the major advisor’s, to maintain good standing in the Graduate School through satisfactory completion of all coursework, exam, and research requirements, arranging their required advisory committee meetings, and ensuring submission of appropriate paperwork in a timely manner. The student may consult with the CBA Program academic administrator and program director in completing these administrative requirements.

**PhD Thesis Advisory Committee**

After beginning research work in the laboratory, the student, in consultation with the major advisor, will assemble their advisory committee. Four additional faculty members are chosen, three of whom must hold appointments on the faculty of the Graduate School. At least three members of the advisory committee, including the major advisor, must hold appointments in the Department of Cellular Biology and Anatomy. If the major advisor holds a secondary appointment in CBA, at least one of the other advisory committee members must be a primary CBA faculty member. It is anticipated that the major advisor will play a key role in recommending faculty members to serve as advisory committee members because of their familiarity with the expertise of other faculty, but the student will also contribute to the process. Typically, the student will approach prospective advisory committee members about their willingness to serve, and should be prepared to discuss how the proposed committee composition will contribute to the student’s success in the CBA Program. Once all faculty have agreed to serve on the advisory committee, the student must complete the Advisory Committee Form, obtaining members’ and department chair’s signatures, and submit the completed form to the Graduate School.

The advisory committee is responsible for administering the Comprehensive Exam and Dissertation Defense, meeting at least annually or more frequently as required for appropriate progress of the student, and providing feedback and approval for research milestones such as the Research Proposal. The student should feel comfortable approaching advisory committee members for technical or professional guidance throughout their tenure in the graduate program. One or more of the advisory committee members may become research collaborators and/or trusted mentors, and the student may need to call on them in the future for writing letters of recommendation for fellowship or postdoctoral job applications. Thus, the student and major advisor should choose these key resource faculty carefully and interact with them professionally and productively throughout the student’s tenure in the program.
Committee Meetings

The Graduate School mandates that at least one advisory committee meeting must occur within each 12-month period. Typically, the CBA Program recommends that students have their first committee meeting in late Fall or in the Spring of their second year of graduate school (first year in the lab; fourth or fifth semesters of graduate school), and then annually thereafter. This timing facilitates organization of the Comprehensive Exam, which is generally taken between April and November after about a year of work in the laboratory (fifth to seventh semesters of graduate school). Students and advisory committees also often find it convenient to combine attendance at the student’s mandatory CBA seminar, presented annually from second year of graduate school, with a committee discussion afterwards. The student schedules the committee meetings, usually coordinating schedules by e-mail, and arranges reservation of a conference room with the CBA Program academic administrator.

It is important that the advisory committee be kept informed of major findings and setbacks associated with the student’s research, to ensure agreement on the direction and progress of the student’s project. Productive, focused annual committee meetings can ensure there are no surprises or disagreements toward the end of the student’s tenure regarding whether enough work, and the “right” work, has been accomplished to warrant awarding the Ph.D. Before each meeting, the student should discuss goals for, and structure of, the meeting with their major advisor. The student is also advised to prepare and practice presenting an oral presentation of their progress (~30 minutes, if not associated with annual seminar attended by the committee members). The major advisor chairs and mediates each meeting, but the student should take the lead role in presenting the agenda and project goals, and for fielding questions from the advisory committee. These meetings should be viewed as a positive opportunity to gain the focused attention and feedback of faculty who have committed to aid the student’s research and career development. In this relatively informal and non-public setting, the student can gain experience in “thinking on their feet” in response to the broad range of questions and thoughtful critiques presented by expert colleagues, and may want to practice “chalk talk” skills as well, presenting some of their plans without benefit of slides. If paperwork is to be signed at the committee meeting, the student is responsible for bringing forms (e.g., approval forms for coursework or research proposals). A summary of the meeting and advisory committee feedback is prepared and signed as described in the next section on Progress Reports, and submitted within 2 weeks of the committee meeting.

Progress Reports

Progress is documented in each semester of enrollment via submission of reports that are part of the Investigation of a Problem and Research courses (ANAT9210 and ANAT9300). Essential elements of these reports include: (a) outline or narrative description of major experimental accomplishments in the current semester, and plans for the next semester, relating them to context of the overall project goals, and (b) if significant variance from normal progress occurs, e.g., due to illness or heavy non-research commitments, this should be noted and a plan briefly outlined to establish how such delays will be compensated for. Attach additional sheets if necessary to convey an accurate report. The student writes the Progress Report, and their
major advisor approves the content and writing. In semesters where no advisory committee meeting is held, the second page (of three) of the Report of Research Progress and Advisory Committee Meetings Form should be used, and signed by student and major advisor. In semesters where an advisory committee meeting is held, pages two and three of the Report of Research Progress and Advisory Committee Meetings Form should be used, and the completed form is to be signed by student, major advisor, and advisory committee members. In semesters where a committee meeting is held, the student also provides to the CBA office a print-out of slides used in their oral presentation to the committee (e.g., department seminar if the meeting was combined), and reviews with CBA Program Director their Degree Works (JagTrax) report of coursework and research milestones.

The Progress Report provides an opportunity for the student to assess overall progress and short-term goals and accomplishments. It affords review with the major advisor and advisory committee at regular intervals about how the project is proceeding, what is working and what is not working. Thoughtful completion of these reports will facilitate communication within the student-major advisor-committee unit, actual progress toward timely and highly accomplished completion of training, and preparation for seminars, conference presentations, and manuscripts.

**Mentoring**

The interaction of the student with their major advisor is the single most important relationship contributing to the student’s success in the Ph.D. program. Clear communication of expectations and respectful dialogue about critiques are key components of successful student-mentor collaboration. Many guides and resources are available that discuss how to select a laboratory and major advisor, and how to navigate through graduate school with this key mentor. Here, we offer some suggested topics that the student may wish to address early with their major advisor, and review as appropriate over the course of the project.

- Time expectations: how many hours per week are expected, and do these need to be specific times of day or can they be flexible? How long does a PhD project in this laboratory generally take, what outcomes are achieved, and what is required from the student in order to achieve the agreed-upon expectations?

- Meetings: How often will you meet one-on-one to discuss the project, e.g., daily, weekly, monthly? What level of communication is expected by each party, and what issues require direct meetings instead of e-mails? How much project planning will be done in conjunction with senior lab personnel such as a Research Associate or Postdoc, instead of the major advisor? How often will there be lab group meetings? Discuss expectations of each party. For example, most faculty expect the student to prepare an agenda for the meeting, present their data, its analysis and questions that need to be discussed, and have all data and notebooks available. The mentor monitors and gives feedback on the quality of the experimental design and data.

- Project: How does this project fit into the overall research of the laboratory? If it is collaborative, how will the dissertation research be delineated as independent? What are general funding streams for this project, and what are expectations for the student in generating data for new funding? How
risky versus sure-thing is the project, and does it offer appropriate opportunities for the student to develop approaches to thinking and doing research that are suitable for an advanced degree?

- Editing/Critique of Manuscripts or Proposals: How rough a draft is acceptable? Does the mentor want to see a complete draft rather than sections? Should the student expect to see many corrections, or few, so not surprised? Should the student continue to work on the document while it is being reviewed? What is a typical timeline and effective scheme for collaboratively writing a manuscript or for critiquing a fellowship proposal? How to distinguish between “secretarial”-level acceptance of corrections and Ph.D.-level dialogue over ideas?

- Other Training Opportunities and Student Life: What amount of teaching is expected, or allowed, by this mentor? When will a teaching opportunity fit into my training, and how important is it to funding the student’s stipend? What opportunities make the most sense with regard to student’s future career goals? How much involvement in activities outside the laboratory is acceptable? Will the student be encouraged to write proposals for independent fellowship funding? If so, when?

Many other questions will arise over the course of Ph.D. training, such as credit by authorship for work and ideas; ethical and safety questions in the laboratory; and opportunities to present work. The student should seek advice of their major advisor, as well as that of advisory committee members. One mentor is not likely to be sufficient for all of the student’s professional and personal guidance.

Here are a few thoughtful resources on how students can get the mentoring they want, and need:

http://www.sph.umich.edu/students/current/HowtogetthementoringYouWant.pdf

http://www.grad.washington.edu/mentoring/students/index.shtml
Chapter 3: Coursework

Course Requirements

The first year Biomedical Sciences Ph.D. Program core curriculum provides a fundamental knowledge base relevant to cell and tissue function, and to underlying molecular mechanisms and methods, e.g., in biochemistry and physiology. The CBA Program coursework then promotes a comprehensive understanding of discipline-specific knowledge and research skills. The required Graduate Histology course (ANAT 8050) provides a solid grounding in tissue structure and the analysis of cells and tissues by histochemical and electron microscopy techniques. Additional elective courses led by expert Cellular Biology & Anatomy faculty combine didactic and discussion-based primary literature approaches to understanding state-of-the-art research in vision science and developmental biology, as well as in special topics such as cell imaging techniques. Our students may further select elective course(s) from offerings of other departments, e.g., BCMB 8201 (Current topics and techniques in molecular biology), VBI 8140 (Cell signaling in vascular biology), and COGS 8130 (Scientific grant writing), as appropriate for their chosen research area and interests, and as approved by their advisory committee. At least 3 hours of elective coursework must be taken in addition to the required Histology course to fulfill CBA Program requirements. Research effort in the laboratory is assessed via the required Investigation of a Problem course (ANAT 9210) taken each semester prior to admission to Ph.D. candidacy, and via the required Research course (ANAT 9300) taken each semester following admission to Ph.D. candidacy.

Opportunities to present work to peers and faculty are provided in the required Seminar in Cell Biology course (ANAT 9010), taken in Fall and Spring semesters each year. In addition to seminars presented by the CBA graduate students, this course includes presentations by department faculty, postdoctoral fellows, and guest faculty speakers from within other GRU departments and from other universities and industry. The CBA graduate students have been able to invite and host outside speakers in this series. Additionally, Ph.D. students and faculty in CBA are expected to fully participate in a monthly Journal Club designed for the benefit of all department researchers. Each Ph.D. student will be assigned a topic chosen by a faculty member as a “key area” for understanding in Cellular Biology, will work with that faculty member one-on-one to become familiar with the literature, and the student will present background and a key paper at one departmental Journal Club each year. In addition to providing an opportunity to present, all participants will benefit from greater understanding of discipline-specific knowledge, which is helpful to the Ph.D. students in preparing for their Comprehensive Exam and dissertation defense.

Completion of the summer Graduate Histology course qualifies CBA Ph.D. students to apply for a teaching opportunity in the Medical Histology course offered to first-year medical students across the Fall and Spring semesters. Similarly, CBA students who wish to be considered for teaching opportunities in Medical Gross Anatomy or in Medical Neuroscience must first complete with high performance the Human Gross Anatomy (ANAT 7300) Summer course or the Neuroscience (ANAT 7030) Spring course, respectively, or alternatives acceptable to the faculty director of the course in which they would like to teach. These teaching opportunities
are normally only available to CBA Ph.D. Program students, and can significantly enhance our students’ competitiveness for postdoctoral and faculty positions in medical schools or in other undergraduate or health sciences departments where expertise in these content areas is sought.

Students are referred to the Graduate School’s Ph.D. Guide and website for detailed discussion of scholastic regulations and procedures. A cumulative GPA of at least 2.8 must be maintained for all courses attempted, and a minimum grade of C (or satisfactory in courses graded S or U) must be earned in each course. Failure to complete Comprehensive Exam and/or Research Proposal requirements by deadlines will result in a U grade being assigned for the Investigation of a Problem course; major advisors may also assign a U grade in Investigation of a Problem or Research courses if progress in the laboratory is not satisfactory. A U grade in these courses or failure to maintain an overall GPA of 2.8 will result in placement on academic probation with terms for remediation specified by the Dean of the Graduate School. Failure to meet academic expectations can result in recommendation for academic dismissal and/or termination from GRA appointment.

Coursework Proposal

A plan for the student’s coursework should be discussed with the advisory committee in Year 2, and be approved at latest by the end of Year 3. This coursework proposal should include the courses the student must satisfactorily complete for Graduate School and CBA Program requirements, and include required electives and any additional coursework that the student and advisory committee determine is appropriate for facilitating the student’s research project and any training in teaching. The advisory committee should be fully apprised of the student’s plans at the time of approving the Coursework Proposal form, which must be further signed by department chair and Dean of the Graduate School. Historically, the student must demonstrate through their coursework a proficiency in two appropriate tools of research, where graduate courses demonstrating research communications and statistics literacy are recommended. The Graduate Histology and Seminar courses typically contribute to the Research Tools requirement, as would courses directly in imaging or molecular techniques, or those involving extensive analysis and presentation of primary literature. The student will not be admitted to Ph.D. candidacy without satisfactory completion of research tools requirements and the coursework approval form, as well as comprehensive exam and research proposal requirements.
COURSE DESCRIPTIONS

Mandatory CBA Program Courses

ANAT 8050  GRADUATE HISTOLOGY
This course provides the student a detailed study of the microscopic anatomy and development of all human organ systems plus the cellular biology of various tissues and organs. In addition, early human development and systemic development will be considered in detail. Cellular Biology, as it relates to anatomic structure, will be presented.
This course is offered in the Summer Semester for 5 credit hours.

ANAT 9010  SEMINAR IN CELL BIOLOGY
This course provides our students a forum for MCG faculty, visiting faculty, and graduate students to present their research. Students in the third year and beyond present a full research seminar at least once a year where confidential summary feedback will be provided to the student, faculty advisor and program director. Students are expected to attend every CBA department seminar as part of this course.
This course is offered in Fall and Spring Semesters for 1 credit hour.

ANAT 9210  INVESTIGATION OF A PROBLEM
This course provides students an introduction to analytical techniques and the scientific method in action. The students work with individual faculty members on a specific investigative research problem.
This course is offered every semester for variable credit hours.

ANAT 9300  RESEARCH
This course is to provide the student an opportunity to work closely with his/her faculty advisor on an in-depth study of a research problem that culminates in the preparation of a PhD dissertation.
This course is offered every semester for variable credit hours.

Elective Courses Offered by Cellular Biology and Anatomy

ANAT 7030  NEUROSCIENCE
This course will provide the student with an in-depth study of the central and peripheral nervous system as related to functional and clinical neurology. Lectures are based on 18 units of the nervous system as covered in the course textbook. Laboratories consist of the study of the surface anatomy of the brain, spinal cord and peripheral nervous system. Internal structures of the brain and spinal cord are studied in coronal, sagittal and axial sections, as well as x-rays, CT-scans and MRI series. The second half of the laboratory is devoted to special dissections of nuclei, tracts and other internal structures of the brain and spinal cord.
This course is offered in the Spring semester in combination with Medical Illustration and medical school students.
Prerequisite: Satisfactory completion of the first year biomedical sciences core curriculum, or permission of the course director.
ANAT 7300  HUMAN GROSS ANATOMY
This course will provide the student with an introduction to specialized areas of the macroscopic structures of the human body through the use of lectures, laboratory dissection, and demonstrations.

This course is offered in the Summer semester.
Prerequisite: This course is mandatory in the curriculum of some Allied Health programs (PT, OT, PA); graduate students, e.g., Biomedical Sciences Ph.D., are admitted only with permission of instructor.

ANAT 8010  SPECIAL TOPICS IN ANATOMY
This course will provide the student with an opportunity for discussion and analysis of current research areas applicable for their field of study. This course was most recently taught by Dr. Paul McNeil, the Director of the Cell Imaging Core Facility, on imaging techniques used in cell biology, but other topics are possible.
Prerequisite: Satisfactory completion of the first year biomedical sciences core curriculum, or permission of the course director.

ANAT 8030  FUNDAMENTALS OF VISION SCIENCE
This introductory course will provide the student the fundamentals of the visual system including anatomy and development of the eye, biochemistry, cell biology and physiology of vision, general and ocular pharmacology, immunology and overview of pathology of the eye.

This course is team-taught by Culver Vision Discovery Institute (VDI) faculty.
Prerequisites: Satisfactory completion of the first year biomedical sciences core curriculum, or permission of the course director.

ANAT 8040  CURRENT TOPICS IN VISION SCIENCE
This course will provide the students an opportunity to familiarize themselves with recent discoveries in vision research and ophthalmic disease. The forums for interaction and learning include: formal journal clubs, ophthalmologic grand rounds, the Culver Vision Discovery Institute (VDI) seminar series, and Culver VDI monthly group meetings. The course will include interactive discussions of recently published vision science papers and current research being pursued by the enrolled students. Students will develop their skills in reading the vision research literature critically and in effective presentations of scientific and clinical information.

This course is team-taught by Culver Vision Discovery Institute faculty.
Prerequisites: Satisfactory completion of the first year biomedical sciences core curriculum, or permission of the course director.

ANAT 8060  VISUAL NEUROSCIENCE
This course covers current topics of advanced research in visual information processing. It focuses on a thematic area of research, including, but not limited to neurological deficits in vision, visual prosthesis, 3-D vision, color vision, developmental disorders of vision, commercial aspects of vision, etc. Students read relevant literature critically and present to fellow students under faculty guidance.

Prerequisite: Satisfactory completion of the first year biomedical sciences core curriculum, or permission of the course director.
**ANAT 8070**  **PROGRESS IN VISION RESEARCH**  
This course covers current progress in all aspects of advanced vision research, including, but not limited to, various aspects of eye development, ocular function in healthy vision, ocular disorders, dysfunction and therapies, neurological aspects of vision and visual dysfunction, rehabilitative treatments for low vision, visual prostheses, commercial and societal aspects of vision, etc.

Prerequisites: Satisfactory completion of the first year biomedical sciences core curriculum, or permission of the course director.

**ANAT 8080**  **CELLULAR MECHANISMS IN DEVELOPMENT AND DISEASE**  
This introductory course provides students a foundation in the cellular and molecular mechanisms underlying the development of multi-cellular organisms. Experimental examples will come from genetic model organisms. Correlations between developmental cell biology and processes relevant to diseases and injury responses will be discussed. Students also read relevant literature critically and present to fellow students under faculty guidance. It is planned that this course will be offered in alternating Fall semesters.

Prerequisite: Completion of Biomedical Sciences Ph.D. Program core curriculum, or permission of the course director.

*Registration for Classes*

A week before registration opens, students will receive emails from the Registrar’s Office and from the CBA Program Academic Administrator (Nan Eaton) alerting them of the date registration will be open in POUNCE. Nan will list the CBA course numbers for classes offered in that semester and any important information necessary for students to be able to register on time. It will be the student’s responsibility to resolve issues with the cashier’s office or the registrar’s office concerning holds on their personal accounts. If, for some reason, a student does not register during the appointed time they will have to get with Nan to generate and route a drop/add form. Timely registration is greatly appreciated.

Registration for 12 total hours of coursework, and for a minimum of 5 research course hours, is required to maintain GRA eligibility. A ‘typical’ registration has been for 12 total hours, with Investigation of a Problem or Research courses being assigned the difference between Seminar plus any elective course hours and the 12 total. However, the Graduate School has standardized the ratio of actual lab hours/week to credit hours/semester to be 3:1, thus each credit hour of a research course is considered to correspond to a *minimum* of 3 hours in the lab each week. So, a student signing up for 1 hour of Seminar and 11 hours of Investigation of a Problem or Research is ‘getting credit for’ 33 hours/week of time in the lab. Note that this time for which academic credit is given is in addition to the ~13 hours/week expected for maintaining GRA eligibility. (Discuss specific expectations with your major advisor and advisory committee, and also with program director if there is confusion or concern.) You are welcome to sign up for more than 12 total hours of coursework without additional fees, up to a maximum of 20 hours of coursework.
Chapter 4: Major Milestones Along the Path to Your Ph.D.

Comprehensive Examination

The Comprehensive Exam is the first major milestone the student must achieve following completion of the core Biomedical Sciences curriculum. It assesses the student’s aptitude as an independent investigator, and knowledge base spanning the Biomedical Sciences and CBA Program curricula, the general discipline of Cell Biology, and research and technical areas necessary for undertaking research within their chosen laboratory. Detailed instructions for the CBA Program Comprehensive Exam and comparison to other programs’ and the Graduate School’s requirements for Biomedical Sciences Ph.D. students are provided in Appendix 2.

There are two components of the Comprehensive Exam:

Written Component: The student will prepare a realistic research proposal relevant to their interests and within the realm of their chosen laboratory. The proposal should illustrate a solid knowledge of experimental approaches, and thoughtful attention should be given to expected outcomes and the impact of the project on the field as a whole. This proposal must conform to the established guidelines for either American Heart Association Predoctoral Fellowship or NIH F31 Predoctoral Fellowship proposals. Following completion of the comprehensive exam, it is expected that the advisory committee members will provide verbal and written feedback to facilitate adaptation of this exam component to fellowship applications and/or the Research Proposal requirement of the Graduate School described later in this Chapter.

This written research proposal must be the student’s independent work, not derived from an existing grant, proposal or manuscript from this or another laboratory. The major advisor may have minor input in the form of suggestions on content and organization before the student begins writing, but should not directly edit or revise the document. Each advisory committee member will independently evaluate the written component using a rubric assessing grantsmanship, scientific quality, and significance, and will assign an overall score using the “-1, 0, +1” scale, representing unacceptable, basic understanding, and outstanding respectively. The current passing score for the written component is +1 (on a -5 to +5 scale). **Passing the written exam is required before the oral comprehensive exam can be attempted.**

Oral Component: Between three and five weeks following submission of the written component, the Comprehensive Exam Committee (includes advisory committee plus an independent Comprehensive Exam Chair) must administer the oral component. This will consist of a 30 minute uninterrupted oral presentation by the student and, after a short break, 1.5 to 2 hours of questioning by the committee. Questioning will not be limited to the research proposal and oral presentation; it will include aspects related to the broader disciplines within Cellular Biology and Anatomy and general areas of expertise as defined by the CBA graduate program and the advisory committee at a pre-exam planning meeting, and approved by the Dean of the Graduate School.

Each advisory committee member will independently evaluate the oral component using a
rubric assessing quality of the oral presentation, scientific knowledge, and ability to answer questions, and will assign an overall score using the “−1, 0, +1” scale. Performance on the oral component must receive a minimum passing grade of +1 (out of +5 possible), and the combined written plus oral examination score must be at least +2 (out of +10 possible). The CBA Program Director encourages students to shoot for an exemplary performance rather than a merely passing performance, as preparation and mastery resulting in exemplary performance are reasonable predictors of research success during the Ph.D.

Research Proposal

The research proposal is an important milestone in the path towards graduation because it encourages the student to focus their studies on specific questions. It also forces one to look at the experimental results from a larger perspective that is central to creating the dissertation later in the program. Finally, the research proposal should be considered as a structural framework that, if carried out successfully, will result in a dissertation of sufficient breadth and significance to warrant successful graduation. The research proposal should not be considered to be a binding contract, or a promise to successfully complete the proposed experiments, but it does bind the student to a specific study area. Failure to complete experiments outlined in the research proposal should be explained to the committee in subsequent advisory committee meeting(s). The research proposal must be approved and submitted to the Graduate School by the end of the 9th semester at GRU (2nd year in the research laboratory).

Unlike the research proposal that serves as the written component of the comprehensive exam, this formal Research Proposal generally involves extensive discussions with the major advisor prior to submission to the advisory committee. The Research Proposal is sent to advisory committee members for review, and then approved at an advisory committee meeting in which the student presents its main elements with a slide presentation. Each committee member must complete the Research Proposal Evaluation Rubric and submit to Marvis Baynham in the Graduate School, in addition to the student’s submission of the final approved Research Proposal to CBA Program Director and Graduate School.

Instructions for Writing a Research Proposal

Following the outline below, provide the details of the proposal.
(1) Hypothesis and Specific Aims. State the hypothesis to be tested and the specific aims of the research proposal.
(2) Background and Significance. Describe briefly the background to the proposal, including relevant studies by other investigators. State concisely the importance of the research described in this proposal by relating the specific aims to broad, long-term research objectives in the field.
(3) Research Design and Methods. Provide a description of:
   · Research design and the specific procedures to be used to accomplish the specific aims;
   · Tentative sequence for the investigation;
   · Statistical procedures by which the data will be analyzed; and
   · Any procedures, situations, or materials that may be hazardous to personnel and the precautions to be exercised.

Potential experimental difficulties should be discussed together with alternative approaches that
could achieve the desired aims.

(4) **Previous Work Done in this or Related Fields.** Describe briefly any work you have done that is pertinent to this project or demonstrates your ability to carry out the study plan.

(5) **Personal Publications.** Cite your most important published and pending scientific publications in this or related work. Include all authors in the same order as they appear in the journals, as well as titles of articles and complete literature references.

(6) Provide **Literature Citations** at the end of the research proposal for any published work referenced in the proposal. Each citation must include names of all authors, titles, book or journal, volume number, inclusive page numbers, and year of publication.

(7) **Human Subjects/Vertebrate Animals.** Provide the rationale for the choice of any experimental animals or procedures involving human subjects. Also, summarize the gender and racial/ethnic composition of any human subject population.

**SUBMIT RESEARCH PROPOSAL ON PLAIN 8 1/2” X 11” PAPER.**

Alternative formats with similar length and detail, e.g., conforming to standard predoctoral fellowship application formats, may be substituted with prior permission of the advisory committee, department chair, and Dean. If appropriate, the Research Proposal for the Dissertation may be adapted, and usually expanded, from the research proposal written as part of the Comprehensive Exam. It will typically include more background and preliminary data, and should take into account feedback from the advisory committee.

**Admission to Candidacy for the Doctor of Philosophy Degree**

A student will be admitted to candidacy for this degree by the Dean of the Graduate School following successful completion of the research tools requirement, acceptance of the coursework and research proposals, and passing of the comprehensive exam. A completed **Admission to Candidacy Form** must be submitted to the Dean. The Dean notifies the student in writing of his/her admission to candidacy. Until this occurs, graduate courses taken are not credited toward the degree. **A student must be eligible for candidacy for the Ph.D. degree at least two semesters before the proposed graduation date.** In the CBA program, this milestone is typically met by the end of the third year of graduate school; however, note that Defense of the Dissertation must be completed within three years of Admission to Candidacy unless an exception is approved by the Dean of the Graduate School.

**Publication Requirement for CBA Ph.D. Students**

All CBA Program students are required to be the primary (first) author on a full-length peer-reviewed journal article published or accepted for publication in a national or International journal prior to defending their Ph.D. research. This must be a work of original research, and the student's research advisory committee must approve the selected journal. A co-first-authored journal article may be considered acceptable if the advisory committee confirms the substantive contribution of the student to this work. In general, the expectation is that the first-authored publication will be one part of a sustained pattern of scholarship during the Ph.D. training, e.g., as represented by conference presentations and co-authorships on review of research articles. Exceptions to the publication requirement are anticipated to be rare and
must be requested by a majority of the advisory committee, preferably 1-2 semesters prior to anticipated defense date. The CBA Program Council and CBA Department Chair will review and render decisions on individual cases.

Residence and Time Limits

The minimum requirement for the Doctor of Philosophy degree is three full academic years beyond the bachelor’s degree, which cannot be satisfied through summer work alone. At least two full consecutive semesters must be spent in residence on the campus. If the student has part-time duties (employment or an assistantship), the residence requirements will be increased accordingly to provide the equivalent of two semesters of full-time study in residence. All coursework and other requirements for the Doctor of Philosophy degree, including the Final Oral Examination, must be completed within seven (7) consecutive calendar years from the date of enrollment in the Graduate School. Leaves of absence do not extend the seven-year limit. It is the student’s responsibility to meet all the requirements for the degree in the proper sequence and in the time limits specified in this document. For students in combined MD/PhD or DMD/PhD degree programs, the seven-year limit does not include semesters of enrollment in the professional degree program. Where circumstances warrant, a student may petition the Dean for exceptions to this residence and time limit policy.

Dissertation

The dissertation is the culmination of the student’s research, representing an original investigation leading to new information that provides evidence of independent thinking, scholarly ability and critical judgment. It should also demonstrate mastery of research methods and analytic techniques. The dissertation should make a compelling case for the importance of the findings as they apply to the field of study, and put them in context with this field. Publication of the dissertation research as one or more journal articles is urged, and the Graduate School has in 2013 recommended a program expectation for the student to have (at least) one first-author peer-reviewed publication accepted or in press prior to graduation. Having only a submitted first-author manuscript at time of graduation is risky for students in that substantial changes or additions may be required before the manuscript is acceptable for publication. Defense (Final Oral Examination) of the dissertation is required and must be completed within three years of admission to candidacy. If it is not, the Advisory Committee and graduate program may require that the student be re-examined.

As the student approaches the semester in which they plan to defend their dissertation, we recommend reviewing this chapter and Graduate School documents, as well as meeting with the CBA Program Director and with Marvis Baynham in the Graduate School office to discuss timing, deadlines, and requirements. Writing and defending the dissertation is not something that can be done on short notice, and students are urged to schedule the defense by the beginning of the semester in which they plan to graduate. Once the final oral defense is scheduled, the student must complete the online Application for Graduation that can be found at: http://www.gru.edu/registrar/healthsciences.php
Directions for the preparation of the written aspects of the dissertation are available from the Graduate School office and website: [http://www.gru.edu/gradstudies/documents/thesis-dissertation-preparation.pdf](http://www.gru.edu/gradstudies/documents/thesis-dissertation-preparation.pdf). This Thesis/Defense Preparation Booklet provides formatting requirements, as well as a description of the defense (final oral examination) format. In no instance should another thesis/dissertation be used as a guide for the style and format of the dissertation manuscript. It is the responsibility of the major advisor to see that the student adheres to the policies outlined in the Thesis/Defense Preparation Booklet. The Graduate School will not approve dissertations that do not follow the prescribed format.

The dissertation should be the work of the student with only organizational and editorial input from the mentor. Generally there are two acceptable formats, the first being a traditional manuscript, with Aims, Introduction, Methods, Results, Discussion, and References sections. The student should pay particular attention to the Methods section, which should be much more detailed than in a typical published paper so as to enable future investigators to easily reproduce or continue the work in their laboratory. In addition, highly compact/crowded figures generally encouraged in manuscripts with limited publication space should be avoided in a dissertation, which in contrast should focus on presenting the information in the most clear and understandable format possible. The alternative format for a dissertation that is acceptable is the compilation of papers if the dissertation work has been published. However, a common Introduction and Discussion is required and the Methods should be expanded as described for the recommended traditional format. This alternative format is rarer, and often is preferred in cases where several loosely related projects are carried out rather than a larger project with several inter-related sub-topics. **Extra attention is required by students opting to use the alternative format for their dissertation because published papers generally have several contributing authors.** Since a dissertation is to reflect the student’s work, it is imperative that notarized acknowledgment of the role of each co-author is included. Moreover, if GRU students are co-authors on any of the manuscripts, it is very important to provide a notarized letter from the student acknowledging that they resign their claims on any data included in the dissertation. The same data cannot be included in two different dissertations.

**Approval of the Dissertation**

The student and advisory committee should follow these procedures for approval of the dissertation:

1) **At least five (5) weeks** before the date of the student’s final oral examination, a good draft of the dissertation, proof-read and corrected by the student and approved by the major advisor, is distributed by the student to members of the advisory committee.

2) **At least three (3) weeks** before the oral examination, the dissertation should be approved by the advisory committee. This approval is documented by completion of the Dissertation Approval Form submitted to the Dean. The signed form indicates that the members of the committee have read the draft copy of the dissertation and find it acceptable for the purpose of examining the student. The student will be responsible for making all changes recommended by the committee.

3) **At least two (2) weeks** before the oral examination, a corrected printed draft copy of the dissertation (in required format) must be submitted to the major advisor, advisory
Typically, advisory scheduling defenses when a dissertation is completed involves the Graduate School. Also at this time, the signed Dissertation Approval Form, signed Faculty Agreement Form (verifying planned attendance of all participants at the final oral examination), and an electronic copy of the dissertation seminar announcement must be provided to the Graduate School.

**Final Oral Examination**

The Dissertation must be defended in a Final Oral Examination involving the advisory committee, dissertation readers, faculty, students and the public. This examination is based primarily on the dissertation and the field of knowledge that constitutes the student’s major subject. The student must be enrolled in the semester that the examination is administered. The student is not enrolled in the semester(s) after they defend unless they fail or pass with major revisions.

Typically, a 3-hour exam will include a 40-minute un-interrupted seminar by the student, followed by questions from any audience member. After a short break, a closed session takes place, at which senior students and CBA Program Director may be present as observers, and involves up to 90 minutes of questioning. Format of the exam is determined by the Graduate School and is subject to change; students will be informed of any changes in advance of the examination.

The Final Oral Examination for the Doctor of Philosophy degree is chaired by the major advisor, unless another member of the advisory committee has been designated and approved as Chair. In addition, external examiners (readers) must be present, who participate in the exam and vote along with the student’s advisory committee on the student’s performance. A majority vote of the examining committee is required for satisfactory performance to be established.

It is the responsibility of the student and their major advisor to select two or three readers for approval by the Dean. After approval is granted, the student contacts the readers to determine that they will be available to serve in this capacity. The Graduate School office must be notified when the readers agree. The Dean and readers must receive a corrected copy of the dissertation approved by the advisory committee at least two (2) weeks before the Final Oral Examination is administered.

Well in advance, the student must contact the Graduate School office, CBA Program Director, advisory committee and readers to arrange a time that all individuals will be able to attend the oral examination. Once the time is established, notification in writing is sent to the Dean on a completed Oral Examination Faculty Agreement Form. The oral defense must take place no later than three (3) weeks before the end of the term and during a term (related to the requirement that the student must be enrolled at time of the Final Oral Examination). No oral defenses will be scheduled to take place between semesters. The student is responsible for scheduling the room location and coordinating distance technology for committee members who cannot be present face-to-face at the final oral defense. The CBA Program Academic Administrator will help in making these arrangements. The student must send electronic copies of the PowerPoint presentation in advance to any committee member or reader participating.
via distance technology, and confirm successful access to the documents and distance technology prior to the exam.

The examination is open to the public, and the CBA Department is responsible for transmitting a formatted Exam Announcement to all Biomedical Sciences faculty and students. A sample of the Final Oral Examination announcement is included in the “Thesis/Dissertation Preparation” document and available at the Graduate School office and its website. The Final Oral Examination Form, provided by the Graduate School, and Rubrics for Evaluating Ph.D. Dissertation and Defense (Final Oral Exam) forms must be completed at the end of the examination by the advisory committee, readers, and other indicated signators.

The possible outcomes of the final oral examination include:

1) **Pass/Minor Revisions**: If a student passes with minor revisions, they will not be enrolled (nor will be allowed to enroll) for the following or any subsequent semester in the degree program in which they have just defended the dissertation. The student will be expected to graduate at the end of the semester in which they defend. All final documents, including the required number of copies of the final, approved, revised dissertation on Crane’s Thesis paper, must be submitted to the Graduate School at least one (1) week before the end of the term.

2) **Pass/Major Revisions or Fail**: If a student passes with major revisions or fails, a subcommittee will be appointed and the student must enroll for the following semester. The subcommittee will establish a list of necessary revisions and a timeline for completion that are required to be fulfilled to the satisfaction of the subcommittee in order for the dissertation to be approved and subsequently accepted by the Graduate School in partial fulfillment of the Ph.D. degree requirements. The student’s final approved revised dissertation and all final paperwork is required to be submitted to the Graduate School at least one (1) week prior to the end of the semester/graduation.

**Finishing Up for All Students**

The Application for Graduation mentioned in the Dissertation section above must be completed online, preferably early in the semester in which the student plans to defend. Marvis Baynham, the Office Manager in the Graduate School office, will typically send out a query asking if the student plans to graduate for May commencement; students graduating in other semesters will not receive this reminder to apply for graduation. This application informs the Graduate School and the Registrar’s Office of your intent to graduate, and provides information about what information should appear on your diploma and in the Commencement Ceremony program. If an Application for Graduation has not been completed, the student will not be listed in the program. The completed application will also inform them if you will be attending May graduation and/or the Graduate Studies Hooding Ceremony, and enable the Bookstore to order the appropriate regalia in time for graduation. If a student believes they will complete the requirements during the Spring semester and completes the form, but the degree requirements are not met by that time, the student will NOT be charged for ordering regalia. However, if the
requirements are completed on time for May commencement and this form has not been completed, regalia may not be available for participation in hooding and graduation exercises.

Satisfactory fulfillment of any additional requirements of the CBA department or the institution is required. A recommendation for graduation signed by the CBA Department Chair and the Dean of the Graduate School is submitted to the Registrar verifying that the student has completed all requirements.

**Finishing Up for International Students**

It is the student’s responsibility to meet with Ms. Beverly Tarver in Student Diversity International Services to discuss graduation plans to determine if/how their visa and student compliance status will be affected. If a student is planning to apply for OPT (Optional Practical Training), they must allow sufficient time for the application process. It is the student’s responsibility to ensure they remain in compliance with all official paperwork for student status and that they have completed any paperwork that may be required for post-graduation plans in the United States. Students who have not made such arrangements may be caught by surprise as the GRU affiliation is terminated soon after completion of dissertation defense and submission of related documents. It is NOT the responsibility of the major advisor or CBA Program personnel to handle timing or completion of paperwork for student status, or to remind students of their responsibilities in this area.
Chapter 5: ENRICHING YOUR Ph.D. TRAINING

Teaching Opportunities Available to CBA Program Students

CBA Teaching Fellows

The Department of Cellular Biology and Anatomy offers a limited number of competitive fellowships for training in Medical Histology, Medical Gross Anatomy, and Neuro-Anatomy teaching. Only CBA Ph.D. Program students are eligible to receive these fellowships, except in instances when there are too few qualified CBA Program applicants. First year medical students are the primary population taught, though medical illustration, allied health, and biomedical sciences Ph.D. program students may be represented as well. These students are highly motivated and engaged, providing a strong training ground for CBA Teaching Fellows. Faculty instructors include graduate faculty within the CBA department as well as professional teaching faculty. As a group and as individuals, these CBA faculty members have won many teaching awards and several are involved in the Education Innovation Institute performing educational research and pedagogical training.

Teaching Fellowships in Medical Histology are those most commonly undertaken by our CBA students, because they have taken the prerequisite Histology (ANAT 8050) course. Medical Histology Teaching Fellows are expected to actively engage students in lab sessions, prepare sufficiently to be able to respond to student questions from those labs and corresponding lectures, and proctor and grade lab quizzes and course examinations. Advanced Fellows may be chosen to give reviews at the end of lab sessions, and may have an opportunity to give a lecture. Overall, it is anticipated that Medical Histology Teaching Fellows will not spend more than 8-10 hours in any week on this activity; as our students remain GRAs (graduate research assistants), they are expected by the graduate school, the program, and their mentors to fulfill research progress along with their non-teaching peers.

Teaching Fellowships in Medical Gross Anatomy or Neuro-Anatomy are undertaken by students who want to strengthen their teaching credentials to become faculty in medical, allied health, and other programs where anatomical sciences expertise is highly valued. To become eligible for either of these fellowships, students must have taken and excelled in the relevant prerequisite course(s) as described in Chapter 3, and are advised to discuss plans to apply for these fellowships with the relevant Medical Course Director, CBA Program Director, and their major advisor early in their Ph.D. training. The medical student Neuro-Anatomy course is concentrated in an ~7 week block in the Spring term, while Gross Anatomy, like Medical Histology, is spread across Fall and Spring semesters. In Gross Anatomy, Teaching Fellows are expected to attend lectures and actively facilitate in all labs (with about 70% of the total time commitment in the Fall semester), prepare sufficiently to be able to respond to student questions during the lab sessions, and assist in setting up and grading lab exams. Advanced Fellows will be mentored in preparing course materials and delivering lectures. Overall, it is anticipated that Medical Gross Anatomy Teaching Fellows will spend 8-12 hours on this activity in each week. The dense course content and increased lab hours compared to the Medical Histology teaching make this a more intensive teaching experience. Students remain GRAs and
are expected by the graduate school, the program, and their mentors to fulfill research progress alongside teaching.

The assignment of Teaching Fellowships is a competitive process. Students who have performed well in the prerequisite course, who are maintaining strong research progress and have support of their major advisor and advisory committee, and who have strong support of the medical course directors will improve their chances of selection. Students who have 0-1 years prior experience as a CBA Teaching Fellow and who have passed their Comprehensive Examination are given priority. In the Spring semester, the Program Director will solicit student applications and course preferences, and communicate with major advisors and the medical course directors. The Program Director and CBA Graduate Program Council will assemble a ranked list of recommendations, and Department Chair will make final decisions. Typically, a student may be a Teaching Fellow for up to 2 years, but will need to re-apply for the second and subsequent year. A third year is occasionally granted, but in no case should student and major advisor rely on teaching fellowships as a primary mechanism of funding the student’s stipend.

For further information, please contact the course directors directly:

Medical Histology – Paul McNeil, Ph.D. – pmcneil@gru.edu
Medical Gross Anatomy – Carol Nichols, Ph.D. – canichols@gru.edu
Medical Neuro-Anatomy – William (Bill) Pearson, Ph.D. – wpearson@gru.edu

Additionally, Dr. Anna Edmondson directs the summer anatomy course that our interested students take as a prerequisite, and directs the embryology/development component of the medical school curriculum (aedmondson@gru.edu). Dr. Charys Martin directs a medical illustration anatomy course (cmartin1@gru.edu). Each of these faculty members can provide insight into the medical teaching experience and the CBA Teaching Fellows program.

**Undergraduate Lab Teaching Opportunity for Biomedical Sciences Ph.D. Students**

The Graduate School collaborates with the Department of Biological Sciences on the GRU-Summerville Campus to provide a mentored opportunity to teach a section of BIOL 1107 Principles of Biology I. An estimated 8 hours/week commitment is required, including meetings with a Lab Section Coordinator and an assigned faculty mentor from the Biology Department, preparation and teaching a 2 hour laboratory, lab report grading, and e-mail availability to student queries. In addition to these teaching expectations, biomedical sciences Ph.D. students must fulfill their research commitment as required by their program, research course credit hour enrollment and conditions of their GRA; a portion of the GRA stipend will be covered by the Graduate School for participants.

Eligibility is restricted to full-time enrolled students who have successfully completed the first year curriculum and their Comprehensive Exam, who are in good academic standing, and who have the permission and support of their major advisor as articulated in a formal letter of support. An application and formal support letter must be submitted to the Vice Dean of the Graduate School in response to deadlines to be announced. This is a one-semester
opportunity, and additional semesters require submission of a new application. Selected applicants will be asked to interview with the Chair of the Department of Biological Sciences and the faculty mentors. As an example of timetable, for Fall 2013, the application deadline was in mid-July, training activities began in early August, and classes began on August 19. Please contact the Graduate School directly for details of this program.

**Teaching Practicum in Physiology**

Dr. Ruth Harris offers a 2-credit hour course, PSIO 8315, open to Biomedical Sciences Ph.D. students in good academic standing, and who received an A or B grade in Integrated Systems Biology. Students who enroll in Teaching Practicum are assigned to one of the ~1-month modules of the core Integrated Systems Biology course. They are expected to attend class (6 hrs/week), hold weekly group review/tutoring sessions (~2 hrs/week), assist in proctoring exams, and to distribute and collect papers during an exam review session. Modules include 1 (cell structure/homeostasis, nervous system); 2 (cardiovascular and GI physiology); 3 (renal and respiratory physiology); and 4 (endocrinology). Interested students should discuss with their major advisor, and contact Dr. Ruth Harris directly prior to registering for this course.

**Other Teaching Opportunities**

Senior Ph.D. students in the CBA Program have independently found additional teaching opportunities suitable for their field of research and future career plans. It is important for the student to gain their major advisor’s support and to ensure they remain in compliance with conditions of their GRA. Here are some suggestions based on prior students’ successes and new opportunities at GRU:

- volunteer to teach a graduate school lecture for your major advisor; if the course director agrees and major advisor provides appropriate oversight, being a ‘guest lecturer’ can be a valuable addition to your curriculum vitae
- volunteer to teach a guest lecture in an undergraduate course such as developmental biology or cell biology
- experienced CBA Teaching Fellows may find opportunities to volunteer in various courses taught by the department’s teaching faculty
- teach an evening lecture or lab class at one of the nearby colleges or universities; these can often be paid and recurring positions, however, only try this level of commitment if you are close to the end of your Ph.D. training and have your dissertation research and publications well in hand. Please check with the Graduate School regarding possible implications for your GRA status.

**Applying for Predoctoral Research Fellowships**

CBA Program students are strongly encouraged to apply for extramural, independent fellowship funding for their research. Writing a fellowship application gives practice in grant-writing, with the opportunity to build experimental strategies and have ideas critically assessed by outside reviewers. If successful, the fellowship will provide financial support, often including funds
designated for the student to use for travel or other resources. Fellowships also may provide access to a peer network of fellow awardees across the country, opportunities to present at meetings sponsored by the awarding agency or foundation, and are a notable and prestigious item to add to the curriculum vitae. As a further incentive and reward, the Graduate School requires that major advisors supplement the stipends of students who have been awarded independent research fellowships, by up to $3000 over the standard stipend.

It is beyond the scope of this handbook to outline all the possible sources of fellowship funding, but a few of the common ones will be mentioned. National Science Foundation (NSF), National Institutes of Health (NIH), and other federal agencies generally restrict fellowship eligibility to US citizens, US nationals, and permanent residents. The NSF Graduate Research Fellowship Program (http://www.nsfgrfp.org/) differs from most in that students are generally only eligible to apply in the first or second year of graduate training. While a research proposal is required as part of the NSF fellowship application, it does not require preliminary data nor in fact a hard commitment to work on the project described; selection is made on the strengths of the applicant student, their ideas, and the environment they describe for their research. The NIH Ruth L. Kirschstein National Research Service Award series for individual predoctoral fellows (F31; http://grants.nih.gov/training/F_files_nrsa.htm) is a mainstay of federal predoctoral fellowship applications, and gives a valuable introduction to the procedures and mechanisms employed by NIH in review and awarding of funding. Both NSF and NIH particularly encourage applications from historically under-represented ethnic and racial minority students, and disabled students. The American Heart Association welcomes predoctoral fellowship applications without regard to citizenship status, so is open to international students (http://my.americanheart.org/professional/Research/FundingOpportunities/ForScientists/For-Scientists_UCM_316962_SubHomePage.jsp). Although students are expected to make a sincere effort to link their research field to cardiovascular disease and/or stroke, the relevance criterion is employed more loosely to predoctoral fellowship applicants than to any other category of AHA applicants.

The student’s major advisor and advisory committee will be able to recommend fellowship opportunities relevant to their research area, e.g., from private foundations related to a disease. The Sponsored Programs Administration (Grants) Office may also have information for the student determined to get independent funding, as may web resources such as this NSF list (http://www.nsfgrfp.org/applicants/other_opportunities).

**Opportunities to Present Your Work**

As outlined in previous chapters, CBA students are required to present in the departmental seminar series from their third year onward, and encouraged to present in the second year if student and major advisor agree that they are ready. They are further expected to present in the departmental journal club series and to have posters at Graduate Research Day each Spring. These basic opportunities to present locally are a solid introduction to communicating your research to the scientific community.
Students and their mentors are also encouraged to present research at regional, national and international meetings when ready, and preferably on more than one occasion while in graduate school. CBA students have typically attended 1 or 2 such meetings each year from the third or fourth year of training. These presentations outside of the home institution facilitate networking, establishment of collaborations, and more exposure to critical and differing views than is possible when ideas are developed only within an insulated environment.

Funding for meeting travel typically comes from the major advisor’s resources, but students are strongly encouraged to seek out their own travel funding. Many scientific societies offer competitive travel awards that students can apply for at the time they submit their meeting abstract and registration; as with predoctoral fellowships, travel awards are a notable achievement and may provide access to a professional peer network. The Graduate School also has a travel award program that may provide partial support for presenting a first-author abstract at one meeting per year, as funding permits. Students in their final two years of Ph.D. training are given priority, and those with fellowship or traineeship support are required to request support from those sources before applying for Graduate School travel funds. Official guidelines and an application for these funds are included in Appendix 1, Forms.

**Coordinating and Timing Elements of Your Training**

Looking ahead from the time a student commits to a major advisor’s laboratory and the CBA Graduate Program, the contents of this handbook and the accompanying Timeline (p. 17) can seem daunting. There seem to be many activities to juggle and obstacles to be hurdled. Rest assured that many students have succeeded before you, and that the faculty and staff in CBA are knowledgeable and here to assist the motivated student in their program and longer-term goals. Here are just a few recommendations:

1) Remember that the Ph.D. is a research degree. Establishing the dissertation research project and mastering the techniques, experimental design, and analysis should be the top priority early, and maintaining progress with productivity documented by abstracts, publications, and presentations should remain the central activity of your training throughout the program.

2) We encourage students to get 1-2 years of teaching experience and to apply for research fellowship funding, yet the terms of research fellowships often preclude time spent on non-research activities. Also, these activities both typically occur in the 2-4 years after completion of the Comprehensive Exam, again raising possibility of time conflicts. Since it may take two or more application rounds to be successful at gaining a research fellowship, its timing cannot be readily predicted. Find out the terms of the fellowships and if some teaching could be continued on a volunteer basis, but don’t let a potential conflict be a barrier to trying for both activities if appropriate for your career goals and approved by your major advisor and advisory committee.

3) It is important to have open discussions early with your major advisor and/or other mentors about long-term career goals, and how training for these goals can be accommodated within the constraints of funding and your chosen research project. Not
everything can be planned at once; adaptation and flexibility in taking advantage of new opportunities as they arise are skills that will serve you well in your future career.

4) Take advantage of CBA’s peer mentorship program to get advice from senior students and alumni. They have been through what you are facing much more recently than faculty mentors, and will have current and practical perspectives. The CBA Program Director will match you up with a senior mentor early in your training, but we recognize your needs may change over time and you may want new or additional views.
APPENDIX #1 - REQUIRED FORMS

http://www.gru.edu/gradstudies/current_students/
Absent from Campus Permission
Admission to Candidacy for PhD
Advisor-Department-Degree Change Form
Advisory Committee/ PhD
Checklist for PhD Requirements
Coursework Proposal/ PhD
Dissertation/Thesis/Capstone Project Approval Form
Final Oral Exam Faculty Agreement Form
Progress Report of Research and/or Advisory Committee Meeting Form
Travel Funds; Guidelines and Request for Graduate Student Support

http://www.gru.edu/gradstudies/current_students/documents/phdguidejuly20132.pdf
Comprehensive Exam Score/Signatures Form (see page 46)
Research Proposal; Instructions for writing

http://www.gru.edu/gradstudies/faculty_info/index.php
Comprehensive Exam Evaluation Policy and Rubric
Comprehensive Exam Pre-Approval Form
Ph.D. Dissertation and Defense Rubric
Research Proposal Rubric
APPENDIX #2 - DETAILED COMPREHENSIVE EXAM GUIDELINES

Cellular Biology & Anatomy PhD Comprehensive Exam Format  
(Revised 01/06/2015)

The comprehensive exam in Cellular Biology & Anatomy conforms to the standard policy developed and approved by PhD program directors in conjunction with TGS administration, which represents the minimum standards and basic process for all CGS PhD programs. [Note: see the TGS policy document for comp exams]

Individual programs may set more stringent or additional requirements. Faculty and students are advised to check with their program’s program director for the most current and officially approved program-specific format and for additional information and details. The revision here applies to students entering the Biomedical Sciences Ph.D. Program in Fall 2012 or later.

1. The CBA Comprehensive Exam process must be completed at least 3 weeks (so prior to Thanksgiving week) before the end of the seventh semester of full-time (year-round) study, to allow sufficient time for scoring and submission of documents to TGS before semester grades are due.

2. The Comprehensive Exam Committee consists of the student’s advisory committee and a non-voting Exam Chair. The Graduate Program Director is responsible for oversight of the program’s Comprehensive Examinations, and will usually serve as the non-voting Comprehensive Exam Chair except in cases of conflict, e.g., when Program Director serves on the Advisory Committee, or when unable to attend. In these cases, a substitute Comprehensive Exam Chair is nominated by the Graduate Program Director and approved by The Graduate School prior to setting dates for written and oral components of the exam. The Comprehensive Exam Chair ensures integrity of the exam, compliance with College of Graduate Studies and CBA Program policies, and fairness to the student. In some cases, e.g., if the Graduate Program Director is a member of the advisory committee, TGS may recommend a Co-Chair arrangement in which the GPD provides knowledge of policies while the neutral Co-Chair has authority over the oral exam and scoring of both components.

At a pre-oral examination planning meeting, the student and major advisor will briefly present suggested oral exam topics based on the research proposal and program guidelines, then the student will leave the room while additional topics are recommended by the Advisory Committee, a list of topics is generated, and logistics and grading scheme are discussed. The student will then be informed orally and subsequently in writing of the format, timing, and grading scheme of the oral exam. The Exam Chair is responsible for communicating all exam information to TGS for approval, via the Ph.D. Comprehensive Exam Pre-Approval Form. Currently this is submitted at two times: 1) two weeks prior to student’s agreed deadline for submission of the written proposal, providing timetable and administrative information for the entire exam process including dates by which TGS and student will be informed of written and, later, oral exam outcomes, and 2) after the pre-oral exam planning meeting, a revised form is submitted that now contains the oral exam topics list. This revised form generally will not include any other new or changed information; if it does, this should be noted and explained in the accompanying e-mail to the TGS Associate Dean.
It is generally expected that all members of the Comprehensive Exam Committee will be present throughout the process, including review of the written proposal, attendance at the pre-oral exam planning meeting, and participation in the oral exam and grading. Advisory Committee members should be cognizant that they have this responsibility. Under adverse circumstances or conflicts, the pre-oral exam planning meeting may be allowed to proceed without one committee member as long as measures are undertaken to get the input of the unavoidably absent faculty member prior to submission of the Comprehensive Exam Pre-Approval Form to the College of Graduate Studies. However, the oral exam cannot proceed without all members of the Comprehensive Exam Committee present, except in case of a documentable emergency such as a serious accident affecting one committee member and with agreement of the remaining Exam Committee members; otherwise, it would need to be re-scheduled. Students and faculty should keep this in mind when scheduling the oral examination.

3. The Written Component of the CBA Comprehensive Exam consists of an independently written research proposal.

What the written exam component is testing: The student will apply his/her fundamental knowledge of the research literature to the creation and defense of experimental design to test their original hypotheses. Use of a fellowship proposal format allows assessment of grantsmanship and experimental design skills, and student’s aptitude for developing significant research within the field of cell biology.

Content and authorship: The proposal should be a complete and realistic research proposal relevant to student’s project and/or research areas of their laboratory. It must be the student’s independent work, not derived from an existing grant, proposal or manuscript. The major advisor may have minor input in the form of suggestions on content and organization before the student begins writing, but should not directly edit or revise the document.

It is intended that, in most cases, this proposal will form the basis of the formal research proposal required for admission to candidacy, however it should not be viewed as a ‘draft’ version; it should be a complete, polished document. The advisory committee members will provide feedback as part of assessing the written exam to facilitate revision and approval of a mature formal research proposal by the end of the 9th semester of full-time (year-round) study, and usually within 1-2 semesters of taking the Comprehensive Exam. It is strongly recommended that students submit their revised proposals to funding agencies.

Format of the proposal: Two predoctoral fellowship formats (AHA, NIH) are acceptable. The student should receive prior approval from his/her advisory committee for the format they choose. The choice should generally be made on the basis of relevance of the project to the funding agency’s mission, and student’s eligibility to apply for funding from that agency. CBA strongly encourages its students to submit applications for individual predoctoral fellowship funding. Scientific sections specified by the approved format should be included in the submitted exam written proposal, and will contribute to scoring of the exam by Exam Committee members. Students are encouraged to submit biographical sketch/IDP for feedback from their advisory committee, but these sections are not part of the comprehensive exam.

AHA Format: Include Title, ½ page Project Summary (Abstract), up-to-8-page Research
Plan, and Literature Cited. The Research Plan contains the following sections: Specific Aims, Background and Significance, Preliminary Studies, Research Design and Methods, and Ethical Aspects of the Proposed Research. Section lengths within the Research Plan may be adjusted as appropriate for the exam proposal, e.g., more Background, less Preliminary Studies, as long as the entire length is within 8 single-spaced pages following the specific font and margin guidelines of AHA.

It is a good idea to check the AHA Grants webpage for most current guidelines, especially if proposal will be submitted to the funding agency, but because there are blackouts between funding cycles where no information is available online, their general review criteria and instructions for preparing the research plan are appended to this document.

**NIH Format:** Include Title, Project Summary/Abstract, Specific Aims (limited to 1 page), up-to-6-page Research Strategy, and Literature Cited. The Research Strategy includes Significance and Approach, and may include Innovation, sections. Font and margin guidelines of NIH must be followed.

As with AHA format, it is a good idea to check the NIH F31 fellowship webpage or parent F31 announcement (http://grants.nih.gov/grants/guide/pa-files/PA-14-147.html) for most current guidelines, but the most relevant pages of the SF424 Fellowship Application Guide are appended to this document.

**Timing Related to the Written Proposal:** Plan on 6-10 weeks of part-time writing after making decisions about content of the written exam proposal. This is the flexible portion of the comprehensive exam, and the student should be careful to work efficiently and conscientiously to complete the writing within timeframe agreed upon in advance with their faculty mentor and advisory (exam) committee. The student should set dates with the Exam Committee for deadline to submit the proposal (which cannot be revised after submission), an oral exam planning meeting to occur ~2 days after proposal submission, and the oral examination at least 3 weeks and not more than 5 weeks after proposal submission. The timing of these 3 events is not flexible, to allow for compliance with TGS policies, so the student should take care to schedule realistically and to allow completion of the entire exam process before Thanksgiving week of their 7th semester of enrollment. The exam committee members individually have up to two weeks to read and score the written proposal using a rubric, and a **passing overall score on the written exam component is required before permission is granted to take the oral exam component.**

4. The Oral Component of the CBA Comprehensive Exam consists of a 30-minute uninterrupted oral presentation of the research proposal by the student, followed by 1.5 – 2 hours of questioning by the exam committee.

**What the oral exam component is testing:** The student will demonstrate fundamental and current knowledge within the major discipline of cellular biology, and in sub-fields and methods related to his/her research area (e.g., vision science, developmental biology, bone biology, neuroscience). The student will synthesize and apply this knowledge to problems posed in an oral examination, and will critically analyze problems they may not have encountered before. Quality of presentation, breadth of knowledge, and ability to respond to questions and to think on their feet are assessed via a rubric.

**Format of the oral exam:** The oral examination is administered between 3 and 5 weeks
after the submission of the written proposal. The oral exam will consist of a 30 minute uninterrupted oral presentation by the student and, after a short break, 1.5 - 2 hours of questioning by the committee. Questioning will not be limited to the research proposal; it will include aspects related to the broader disciplines within Cellular Biology & Anatomy and general areas of expertise as defined in a topics list by the graduate program and the advisory committee at a pre-exam planning meeting.

5. Scoring of the written and oral components is performed individually by Exam Committee members, using a rubric (current version appended). The top portion containing written exam rubric sub-topics, and the overall written exam score field near the bottom, are completed after careful review of the written proposal, and submitted to a CBA administrative staff member for tallying, as arranged by Exam Chair prior to the exam; similarly, oral exam-specific sections are completed and submitted in the days following the oral examination. Documentation of the written critiques of the research proposal, the questions asked in the oral exam, and the research proposal and slides from the student’s oral presentation will be kept by the CBA Graduate Program. Rubric summaries and final scores on written and oral components are submitted to the student, major advisor, and TGS on timetable agreed upon in the exam pre-approval forms.

To encourage faculty to identify areas of particular weakness for a given student, we have included a “Needs Attention” option on the comprehensive exam rubric sub-topics. Selection of this option is not equivalent to choosing a -1, and a single “Needs Attention” need not prejudice overall scoring on written or oral examination if other aspects of the student’s performance are solid or exemplary.

The overall scores of the written and oral exam components are separately graded as follows, and the scores from the committee members are added to give a single score for each component of the exam:

+1 = Excellent, very good, exceeding expectations
0 = Acceptable, average, meeting expectations
-1 = Unacceptable, inadequate, below expectations

The additive score on each component must be at least +1 (out of +5 possible) to pass. The sum of written and oral exams must be at least +2 (out of +10 possible) to pass.

6. If a student fails the written component of the CBA Comprehensive Exam, he/she cannot proceed to the oral examination on this first attempt. Instead, he/she will be afforded one opportunity to retake the written and oral examinations after additional preparation, typically within 3 months. A written plan of action for remediation and retaking the examination must be submitted to TGS and student within two weeks of the original unsuccessful attempt at the exam, and is typically prepared by collaboration of the Exam Chair, major advisor, and TGS Dean. Second attempts scheduled beyond 3 months must be pre-approved by the Program Director and Dean. Similarly, if a student passes the written component, yet fails the oral component of the Comprehensive Exam, he/she will be afforded one opportunity to retake the oral examination. A second failure of either component of the Comprehensive Exam will be grounds for dismissal from The Graduate School.

All attempts and results (scores) must be reported to the College of Graduate Studies. Students’ original, completed and graded exams must be kept on file by their Graduate Program.
# CBA COMP EXAM RUBRIC

## Evaluation / Guidance

<table>
<thead>
<tr>
<th></th>
<th>Needs Attention</th>
<th>Acceptable</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written Research Proposal</td>
<td>Provide explanation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grantsmanship</td>
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<td></td>
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<tr>
<td>Proper format / grammar / figures/ writing</td>
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<td></td>
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</tr>
<tr>
<td>Scientific</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Appropriate design / reasonable expectations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Significance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact on the field, and medicine / compelling rationale</td>
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<tr>
<td>Oral Presentation</td>
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<tr>
<td>Quality of Presentation</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Slide quality / communication skill / length</td>
<td></td>
<td></td>
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<tr>
<td>Knowledge Base</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Understands technical details and wider implications; + discipline-level knowledge</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response to Questions</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Answers all questions / ability to “think on their feet”</td>
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</table>

### Overall Assessment

The assessment of the overall performance of the student based on the evidence provided in items 1-6 above.

## Criteria

<table>
<thead>
<tr>
<th></th>
<th>Unacceptable/ Major Deficits/ Inadequate/ Below expectations -1</th>
<th>Acceptable/Average/ Meeting Expectations/ Minor Deficits 0</th>
<th>Excellent/ Very Good/Exceeding Expectations +1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written Proposal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oral Presentation</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

For Overall Assessment of each part, scores from the 5 committee members are added (giving possible score range of -5 to +5). To pass, the student must receive an additive score of +1 in each part of the exam, for a minimum total score of +2. If you assign a -1 score, you must provide explanation. Comments, feedback or suggestions for remediation are welcome regardless of score given.
American Heart Association Predoctoral Fellowship – peer review criteria, and formatting instructions (as of 1/6/2015)

Peer Review Criteria

To judge the merit of the application, reviewers will comment on the following criteria. Please be sure to address these in your proposal. Each criterion will account for one-third of the overall score.

Criterion 1 - Evaluation of the Investigator
Does the trainee have potential for a research career?

  Are the trainee's career plans specified in the application?
  Is this supported by the trainee's academic record and the assessment provided by the three letters of reference?
  Does the trainee have prior research experience and/or publications?
  Is there a clear rationale supporting the need for the proposed training?
  What is the sponsor's assessment of the applicant?

Criterion 2 - Sponsor/Training Plan and Environment (not applicable for CBA comp exam)

  Sponsor/Training Plan
  Is the mentor an independent investigator?

  Does the mentor have the experience to direct the proposed research training, as evidenced by a track record regarding productivity, funding and prior trainees?
  Does the mentor have adequate current funding to support the fellow's project?
  Does the mentor provide a comprehensive training plan which incorporates career and developmental goals detailed in the applicant’s Individual Development Plan (IDP)?
  Will the mentor’s training plan facilitate the applicant's progress towards his/her research career goals?

  Environment
  Does the scientific environment in which the work will be done contribute to the probability of success for the training experience?
  Is there evidence of institutional commitment?
Criterion 3 - Evaluation of the Proposal

**Significance**: Does this study address an important problem? What will be the effect of these studies on the concepts, methods and technologies that drive this field?

**Approach**: A new fellow may not have had adequate time to generate preliminary data. Applicants can present preliminary data generated by the sponsor. The assessment of preliminary data, whether generated by the sponsor or the applicant, should be put into perspective so that bold new ideas and risk taking by beginning investigators are encouraged rather than stymied.

Are the conceptual framework, design, methods and analyses adequately developed, well integrated, well-reasoned, feasible (as determined by preliminary data or the expertise available in the mentor's and/or collaborator's laboratories) and appropriate to the aims of the project? Does the applicant acknowledge potential problem areas and consider alternative tactics?

**Innovation**: Is the project original?

Impact: How does this project address the mission of the AHA, and how likely will this support enhance PI career development in the area of cardiovascular diseases and stroke? Apply same concepts to whatever research field you are working in.

Creating the Research Plan – 8 Pages for Predoctoral Fellowships

**FORMAT/TYPE REQUIREMENTS**

The Research Plan must be created as a Word-processed document, converted to a Portable Document Format (PDF) file, and uploaded to Grants@Heart. Only PDF files will be accepted. When creating the Research Plan, you must comply exactly with the association's format/type requirements and page limits. Failure to comply will result in the administrative withdrawal (disqualification) of the application.

Only Portable Document Format (PDF) files will be accepted. File must be single-spaced.

No more than 15 characters per inch (cpi) or an average of no more than 15 cpi (cpi includes symbols, punctuation and spaces).

No less than ¾” margins allowed.

Sixty lines per page are the maximum allowed (The average number of lines per page using the font and point size below will be approximately 50-55 lines).

Arial Font style, 12 point font size for Windows users; Helvetica Font style, 12 point font size for Macintosh users.
Figures, charts, tables, graphics and legends may be smaller in size but must be clear and legible.

Eight-page limit

Users of other Word-processing programs must adjust settings appropriately and should measure text after saving and printing as a PDF. Type requirements should be checked using a standard measuring device (such as a ruler), rather than relying on the font selected for a particular word processing/printer combination. Type size specifications must be observed in the text of your research plan or the application will not be reviewed and will be withdrawn. Adherence to font and margin requirements is necessary. No applicant should have an advantage over other applicants by providing more content in his/her application by using smaller, denser type. The AHA has the responsibility to make the final determination of conformance to format requirements and the authority to withdraw applications. This decision is final and not subject to appeal. Internet Web site addresses (URLs) may not be used to provide information necessary to the review because reviewers are under no obligation to view the Internet sites. Moreover, the reviewers are cautioned not to directly access an Internet site as it could compromise their anonymity. If this application is a "resubmission" of a previous proposal, mark changes within the Research Plan by using brackets, italics or bold (do not shade or underline changes). A separate document addressing modifications is also required.

Type the research plan specifically following the outline given below, in the same sequence. All items should be addressed. Indicate N/A or None if not applicable to this application. The suggested lengths (in parenthesis) are guidelines only; the entire proposed research plan must not exceed the 8-page limit.

**Specific Aims** (1/2 page) Provide a clear, concise summary of the aims of the work proposed and its relationship to your long-term goals. State the hypothesis to be tested.

**Background and Significance** (1 page) Sketch the background leading to this application. Summarize important results outlined by others in the same field, critically evaluating existing knowledge. Identify gaps that this project is intended to fill. State concisely the importance and relevance of the research to cardiovascular function or disease, stroke, or to related fundamental problems. Also, it is incumbent upon the applicant to make a clear link between the project and the mission of the AHA. The significance section will be assessed in terms of potential impact on the AHA mission; this will be factored into the overall priority score as noted in the peer review criteria.

**Preliminary Studies** (1 page) Describe concisely previous work related to the proposed research by the applicant (or others in the lab!) that will help to establish the experience and competence of the investigator to pursue the proposed project. Include pilot studies showing the work is feasible. (If none, so state.)
**Research Design and Methods** (approx. 5 pages) Description of proposed tests, methods or procedures should be explicit, sufficiently detailed, and well defined to allow adequate evaluation of the approach to the problem. Describe any new methodology and its advantage over existing methodologies. Clearly describe overall design of the study, with careful consideration to statistical aspects of the approach, the adequacy of controls, and number of observations, as well as how results will be analyzed. Include details of any collaborative arrangements that have been made.

Discuss the potential difficulties and limitations of the proposed procedures and alternative approaches to achieve the aims. Note: If a proposed research project involves human subjects, the population sampled shall be inclusive of the general population, of relevance to the scientific question posed, without restriction in regard to gender, race, age, and socioeconomic status. Proposals that intentionally restrict the population sampled must include a compelling scientific rationale for such research design. Be sure to address this topic.

**Ethical aspects of the proposed research** (up to 1/2 page; *can be minimized in this comp exam proposal*) Describe any special consideration you have given to all ethical issues involved in your proposed investigations (biohazards or human subjects, etc.), identifying risks and management. Be sure to address this topic. If using animals, go here for instructions.

Discuss the nature of the informed consent that will be obtained if the research involves human subjects. If the proposed project involves no ethical questions, indicate "5: NONE".

End of text for the Research Plan (not to exceed 8 pages)

**PHS SF424 (R&R) Individual Fellowship Application Guide**

See full guide to access sections referenced in the extracted text below:

NIH and AHRQ require all text attachments to the Adobe application forms be submitted as PDFs and that all text attachments conform to the agency-specific formatting requirements noted below. Failure to follow these requirements may lead to rejection of the application during agency validation or delay in the review process. (See Section 2.3.2 for more information on creating PDFs.)

Text attachments should be generated using word processing software and then converted to PDF using PDF generating software. Avoid scanning text attachments to convert to PDF since that causes problems for the agency handling the application. Additional tips for creating PDF files can be found at [http://grants.nih.gov/grants/ElectronicReceipt/pdf_guidelines.htm](http://grants.nih.gov/grants/ElectronicReceipt/pdf_guidelines.htm).

When attaching a PDF document to the actual forms, please note you are attaching an actual document, not just pointing to the location of an externally stored document. Therefore, if you revise the document after it has been attached, you must delete the previous attachment and then reattach the revised document to the application form. Use the **View Attachment** button to determine if the correct version has been attached.

**File Name**

Save all files with descriptive file names of 50 characters or less and be sure to only use standard
characters in file names: A through Z, a through z, 0 through 9, underscore (_), hyphen (-), and period (.). Do not use any special characters (example: “&”, “*”, “%”, “/”, and “#”) or spacing in the file name. For word separation use underscore (example: “My_Attached_File.pdf”) in naming the attachments.

Font

Use an Arial, Helvetica, Palatino Linotype, or Georgia typeface, a black font color, and a font size of 11 points or larger. (A Symbol font may be used to insert Greek letters or special characters; the font size requirement still applies.)

Type density, including characters and spaces, must be no more than 15 characters per inch.

Type may be no more than six lines per inch.

Paper Size and Page Margins

Use standard paper size (8 ½" x 11).

Use at least one-half inch margins (top, bottom, left, and right) for all pages. No information should appear in the margins, including the PI’s name and page numbers.

Page Formatting

Since a number of reviewers will be reviewing applications as an electronic document and not a paper version, applicants are strongly encouraged to use only a standard, single-column format for the text. Avoid using a two-column format since it can cause difficulties when reviewing the document electronically.

Do not include any information in a header or footer of the attachments. A header will be system-generated that references the name of the PD/PI. Page numbers for the footer will be system-generated in the complete application, with all pages sequentially numbered.

Figures, Graphs, Diagrams, Charts, Tables, Figure Legends, and Footnotes

You may use a smaller type size but it must be in a black font color, readily legible, and follow the font typeface requirement. Color can be used in figures; however, all text must be in a black font color, clear and legible.

Grantsmanship

Use English and avoid jargon.

PHS SF424 (R&R) Individual Fellowship Application Guide

6.a. If yes, identify countries

Enter the countries with which international cooperative activities are involved.

6.b. Optional Explanation

Enter an explanation for involvement with outside entities (optional).

If you have checked “Yes” to 6, applicants to the NIH and AHRQ must describe special resources or characteristics of the research training project (e.g., human subjects, animals, disease, equipment, and techniques), including the reasons why the facilities, the mentor, or other aspects of the proposed experience are more appropriate than in a domestic setting. The justification is evaluated in terms of the scientific advantages of the foreign training experience as compared to
the training available domestically. Provide this information in a separate file, attaching it as Item 12, Other Attachments. In the body of the text, begin the section with a heading indicating “Foreign Justification.” When saving this file, please name it “Foreign Justification” as well.

7. **Project Summary/Abstract**

The Project Summary must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained description of the project and should contain a statement of objectives and methods to be employed. It should be informative to other persons working in the same or related fields and insofar as possible understandable to a scientifically or technically literate lay reader. This Summary must not include any proprietary/confidential information. Please click the Add Attachment button to the right of this field to complete this entry.

The **Project Summary** is meant to serve as a succinct and accurate description of the proposed work when separated from the application. State the application’s broad, long-term objectives and specific aims, making reference to the health relatedness of the project (i.e., relevance to the mission of the agency). Describe concisely the research training program design and methods for achieving the stated goals. This section should be informative to other persons working in the same or related fields and insofar as possible understandable to a scientifically or technically literate reader. Avoid describing past accomplishments and the use of the first person. Finally, please make every effort to be succinct. This section must be no longer than 30 lines of text, and follow the required font and margin specifications. An abstract which exceeds this allowable length may be flagged as an error by the agency upon submission. This would require a corrective action before the application will be accepted.

As noted above, do not include proprietary, confidential information or trade secrets in the description section. If the application is funded, the Project Description will be entered into an NIH database and made available on the NIH Research Portfolio Online Reporting Tool (RePORT, available at [http://report.nih.gov](http://report.nih.gov)) and will become public information.

The attachment must be in PDF format. (See Section 2.6 for additional information on preparing attachments.)

8. **Project Narrative**

Provide Project Narrative in accordance with the announcement and/or agency-specific instructions. Please click the Add Attachment button to the right of this field to complete this entry.

For NIH and AHRQ applications, using no more than two or three sentences, describe the relevance of this research to public health. In this section, be succinct and use plain language that can be understood by a general, lay audience.

**PHS SF424 (R&R) Individual Fellowship Application Guide**

<table>
<thead>
<tr>
<th>Field Name</th>
<th>Instructions</th>
</tr>
</thead>
</table>

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citations, because reviewers are under no obligation to view the Internet sites. Moreover, reviewers are cautioned that they should not directly access an internet site as it could compromise their anonymity.

**Note:** Begin each text section of the Research Training Plan with a section header (e.g., Introduction, Specific Aims, Research Strategy, etc.).

**Research Training Plan of Resubmission Applications**

A resubmission application must include substantial changes. If the summary statement cites weaknesses specifically to the Research Training Plan, identify these changes in the resubmitted Research Training Plan clearly by bracketing, indenting, or changing typography, unless the changes are so extensive as to include most of the text. This exception should be explained in the Introduction. Do not underline or shade changes. Application processing may be delayed or the application may be returned if it does not comply with all of these requirements.

Include sufficient information to permit an effective review without reviewers having to refer to any previous application.

<table>
<thead>
<tr>
<th>1. Introduction to Application (Resubmission Applications Only)</th>
<th>The Introduction (resubmissions only).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attach for all resubmission applications an Introduction of no more than one page that summarizes the substantial additions, deletions, and changes. The Introduction must also include responses to criticisms and issues raised in the summary statement for the previous application. See specific instructions in Part I Section 2.7, Resubmission Applications, on the content of the Introduction.</td>
<td></td>
</tr>
<tr>
<td>First time (new) applications should not include an Introduction unless specified in the FOA.</td>
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<tr>
<td>Save this information in a single file in a location you remember. Click Add</td>
<td></td>
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</table>

<table>
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<tr>
<th>2. Specific Aims</th>
<th>Specific Aims are limited to one page.</th>
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<tbody>
<tr>
<td>State concisely the goals of the proposed research and summarize the expected outcome(s), including the impact that the results of the proposed research will exert on the research field(s) involved.</td>
<td></td>
</tr>
<tr>
<td>List succinctly the specific objectives of the research proposed, e.g., to test a stated hypothesis, create a novel design, solve a specific problem, challenge an existing paradigm or clinical practice, address a critical barrier to progress in the field, or develop new technology.</td>
<td></td>
</tr>
<tr>
<td>Save this information in a single file in a location you remember. Click Add Attachment, browse to where you saved the file, select the file, and then click Open.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Research Strategy</th>
<th>Research Strategy is limited to six pages.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organize the Research Strategy in the specified order using the instructions provided below. Start each section with the appropriate section heading — Significance,</td>
<td></td>
</tr>
</tbody>
</table>

**PHS SF424 (R&R) Individual Fellowship Application Guide**
Innovation, Approach. Cite published experimental details in the Research Strategy section and provide the full reference in the Bibliography and References Cited section (Part I Section 4.4.9).

Follow the page limits for the Research Strategy in the table of page limits (Table 2.6-1), unless specified otherwise in the FOA. Note that the page limit for this attachment will be validated as a single file.

(a) **Significance**

- Explain the importance of the problem or critical barrier to progress in the field that the proposed project addresses.
- Explain how the proposed project will improve scientific knowledge, technical capability, and/or clinical practice in one or more broad fields.
- Describe how the concepts, methods, technologies, treatments, services, or preventative interventions that drive this field will be changed if the proposed aims are achieved.

(b) **Innovation**

- Fellowship applications should not include an Innovation section unless specified in the FOA.

(c) **Approach**

- Describe the overall strategy, methodology, and analyses to be used to accomplish the specific aims of the project. Unless addressed separately in Item 14 (Resource Sharing Plan), include how the data will be collected, analyzed, and interpreted as well as any resource sharing plans as appropriate.

If an applicant has multiple Specific Aims, then the applicant may address Significance, Innovation and Approach for each Specific Aim individually, or may address Significance, Innovation and Approach for all of the Specific Aims collectively.

As applicable, also include the following information as part of the Research Strategy, keeping within the three sections listed above: Significance, Innovation, Approach.

**PHS SF424 (R&R) Individual Fellowship Application Guide**

**Scoring**

Each FOA specifies all of the review criteria and considerations that will be used in the evaluation of applications submitted for that FOA; RFAs and other types of funding opportunities (e.g., for construction or fellowship applications) may include different and/or additional review criteria and considerations.

SRG members are instructed to evaluate individual fellowship applications by addressing the scored review criteria (see below) and additional review criteria as applicable for the application.

For each application that is discussed, a final overall impact/priority score will be given by each eligible committee member (without conflicts of interest) following the panel discussion. Each member’s impact/priority score will reflect his/her evaluation of the potential overall impact of the project in its entirety, rather than an arithmetic formula applied to the reviewer’s scores given to each criterion. The final impact/priority score for each discussed application will be determined by
calculating the arithmetic average of all the eligible members’ impact/priority scores, and multiplying the average by 10.

As part of the initial merit review, and regardless of whether an application is discussed or not discussed, all applicants will receive a written critique, called a Summary Statement, unless stated otherwise in the FOA. The Summary Statement represents a combination of the reviewers' written comments and scores for individual criteria. The Summary Statement for discussed applications includes the SRO's summary of the members' discussion during the SRG meeting; the final impact/priority score; the recommendations of the SRG, including budget recommendations; and administrative notes of special considerations. For applications that are not discussed by the full committee, the scores of the assigned reviewers and discussants for the scored review criteria will be reported individually on the Summary Statement. Numerical impact/priority scores are not given for applications that are not discussed.

6.1 Individual Fellowship Application Review Criteria

**Overall Impact/Merit.** Reviewers will provide an overall impact/priority score to reflect their assessment of the likelihood that the fellowship will enhance the applicant’s potential for, and commitment to, a productive independent scientific research career in a health-related field, in consideration of the scored and additional review criteria (as applicable for the project proposed).

**Scored Review Criteria.** Reviewers will consider each of the five review criteria below in the determination of scientific and technical merit, and give a separate score for each.

The following review criteria are applicable to F31 and F32 applications. For review criteria pertaining to other individual fellowship applications (e.g., F05, F30, F33), please refer to the specific FOA.

- **Fellowship Applicant:** Are the applicant’s academic record and research experience of high quality? Does the applicant have the potential to develop as an independent and productive researcher in biomedical, behavioral or clinical science?

- **Sponsor(s), Collaborator(s), and Consultant(s):** Are the sponsor(s) research qualifications (including successful competition for research support) and track record of mentoring appropriate for the proposed fellowship? Are there (1) evidence of a match between the research interests of the applicant and the sponsor (including an understanding of the applicant’s research training needs) and (2) a demonstrated ability and commitment of the sponsor to assist in meeting these needs? Are the qualifications of any collaborator(s) and/or consultant(s), including their complementary expertise and previous experience in fostering the training of fellows, appropriate for the proposed research project?

- **Research Training Plan:** Is the proposed research plan of high scientific quality, and does it relate to the applicant’s training plan? Is the training plan consistent with the candidate’s stage of research development? Will the research training plan provide the applicant with individualized and supervised experiences that will develop research skills needed for his/her independent and productive research career?

- **Training Potential:** Does the proposed research training plan have the potential to provide the fellow with the requisite individualized and supervised experiences that will develop his/her research skills? Does the proposed research training have the potential to serve as a sound foundation that will lead the fellow to an independent and productive career?

- **Institutional Environment and Commitment to Training:** Are the research facilities, resources (e.g. equipment, laboratory space, computer time, subject populations), and training opportunities adequate and appropriate? Is the institutional environment for the scientific development of the applicant of high quality, and is there appropriate institutional commitment?
to fostering the fellows’ training as an independent and productive researcher?

As applicable for the project proposed, reviewers will consider the following additional terms in the determination of scientific and technical merit, but will not give separate scores for these items.

**Protections for Human Subjects.** For research that involves human subjects but does not involve one of the six categories of research that are exempt under 45 CFR part 46, the committee will evaluate the justification for involvement of human subjects and the proposed protections from research risk relating to their participation according to the following five review criteria: 1) risk to subjects, 2) adequacy of protection against risks, 3) potential benefits to the subjects and others, 4) importance of the knowledge to be gained, and 5) data and safety monitoring for clinical trials.

For research that involves human subjects and meets the criteria for one or more of the six categories of research that are exempt under 45 CFR part 46, the committee will evaluate: 1) the justification for the exemption, 2) human subjects involvement and characteristics, and 3) sources of materials.

For additional information, see the [Human Subjects Protections Guidelines](#).

**Inclusion of Women, Minorities, and Children.** When the proposed project involves human subjects and/or NIH-defined research, the committee will evaluate the proposed plans for inclusion (or exclusion) of individuals on the basis of sex/gender, race, and ethnicity, as well as the inclusion (or exclusion) of children to determine if it is justified in terms of the scientific goals and research strategy proposed.

For additional information, see the [Human Subjects Inclusion Guidelines](#).

**Vertebrate Animals.** The committee will evaluate the involvement of live vertebrate animals as part of the scientific assessment according to the following five points: 1) proposed use of the animals, and species, strains, ages, sex, and numbers to be used; 2) justifications for the use of animals and for the appropriateness of the species and numbers proposed; 3) adequacy of veterinary care; 4) procedures for limiting discomfort, distress, pain and injury to that which is unavoidable in the conduct of scientifically sound research including the use of analgesic, anesthetic, and tranquilizing drugs and/or comfortable restraining devices; and 5) methods of euthanasia and reason for selection if not consistent with the AVMA Guidelines on Euthanasia.

For additional information, see the [Vertebrate Animals Checklist](#).

**Biohazards.** Reviewers will assess whether materials or procedures proposed are potentially hazardous to research personnel and/or the environment, and if needed, determine whether adequate protection is proposed.

**Resubmission Applications.** When reviewing a resubmission application, the committee will evaluate the application as now presented, taking into consideration the responses to comments from the previous scientific review group and changes made to the project.

**Renewal Applications.** When reviewing a renewal application, the committee will consider the progress made in the last funding period.
# Doctor of Philosophy with a major in Cellular Biology & Anatomy

## Curriculum Schema

**Level of Program** Doctoral, PhD

**CIP code for Program** 26040701

<table>
<thead>
<tr>
<th>FALL (SEMMETER 1)</th>
<th>SPRING (SEMESTER 2)</th>
<th>Summer (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>YEAR 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COGS 8011(1): Responsible conduct of Research</td>
<td>COGS 8033: Integrative Systems Biology (6)</td>
<td>STAT 7070 (3): Biomedical Statistics</td>
</tr>
<tr>
<td>COGS 8012(1): Scientific Communication</td>
<td>COGS 8060: Introduction to Research II (4)</td>
<td>ANAT 9210 (9) Investigation of A Problem</td>
</tr>
<tr>
<td>COGS 8021 (5): Biochemistry</td>
<td>SELECTIVE COURSES: (Choose 4 credit hours):</td>
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<tr>
<td>COGS 8022 (5): Molecular Cell Biology</td>
<td>• COGS 8080 (4): Neuroscience I</td>
<td></td>
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<tr>
<td>COGS 8040(2): Introduction to Faculty Research</td>
<td>• COGS 8090 (2): Fundamentals of Genomic Medicine</td>
<td></td>
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<tr>
<td>COGS 8050 (2): Introduction to Research I</td>
<td>• COGS 8030(2): Experimental Therapeutics</td>
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<tr>
<td><strong>42 credit hours</strong></td>
<td>• COGS 8215 (2) Fundamentals of Oncology</td>
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<td>• COGS 8230 (2) Biology of Proteins in Disease</td>
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<td></td>
<td>• COGS 8240 (2) Introduction to Immunology and Infectious Disease</td>
<td></td>
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<td>16 credit hours</td>
<td>14 credit hours/30</td>
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<tr>
<td><strong>FALL (SEMESTER 4)</strong></td>
<td><strong>SPRING (SEMESTER 5)</strong></td>
<td><strong>SUMMER (6)</strong></td>
</tr>
<tr>
<td><strong>YEAR 2</strong></td>
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<td></td>
</tr>
<tr>
<td>ANAT 9010 (1) Seminar in Cell Biology</td>
<td>ANAT 9020 (1) Seminar in Cell Biology</td>
<td>ANAT 8050 (5) Graduate Student Histology *mandatory for CBA, elective for COGS.</td>
</tr>
<tr>
<td><strong>ELECTIVE COURSES:</strong></td>
<td><strong>ELECTIVE COURSES:</strong></td>
<td><strong>ELECTIVE COURSES:</strong></td>
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<tr>
<td>• ANAT 8040 (3) Topics in Vision Science</td>
<td>• ANAT 7030 (3) Neuroscience</td>
<td>• ANAT 7300 (6) Human Gross Anatomy</td>
</tr>
<tr>
<td>• ANAT 8070 (1) Progress in Vision Research</td>
<td>• ANAT 8010 (1) Special Topics in Anatomy</td>
<td>• ANAT 8050 (5) Graduate Student Histology</td>
</tr>
<tr>
<td>• ANAT 8080 (2) Cellular Mechanism in Development &amp; Disease</td>
<td>• ANAT 8030 (3) Vision Science</td>
<td>• ANAT 8070 (1) Progress in Vision Research</td>
</tr>
<tr>
<td><strong>36 credit hours</strong></td>
<td><strong>12 credit hours/54</strong></td>
<td><strong>12 credit hours/66</strong></td>
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<tr>
<td>12 credit hours/54</td>
<td>12 credit hours/66</td>
<td>12 credit hours/78</td>
</tr>
</tbody>
</table>
### FALL (SEMESTER 7)

**ANAT 9210 (5-11):** Investigation of A Problem (or ANAT 9300 if admitted to candidacy)

**ANAT 9010 (1) Seminar in Cell Biology**

**ELECTIVE COURSES:**
- ANAT 8040 (3) Topics in Vision Science
- ANAT 8070 (1) Progress in Vision Research
- ANAT 8080 (2) Cellular Mechanism in Development & Disease

**ELECTIVE COURSES:**
- ANAT 7030 (3) Neuroscience
- ANAT 8010 (1) Special Topics in Anatomy
- ANAT 8030 (3) Vision Science
- ANAT 8060 (1) Visual Neuroscience
- ANAT 8070 (2) Progress in Vision Research

12 credit hours/90 + PhD COMPREHENSIVE EXAM

### SPRING (SEMESTER 8)

**ANAT 9210 (5-11):** Investigation of A Problem (or ANAT 9300 if admitted to candidacy)

**ANAT 9020 (1) Seminar in Cell Biology**

**ELECTIVE COURSES:**
- ANAT 7030 (3) Neuroscience
- ANAT 8010 (1) Special Topics in Anatomy
- ANAT 8030 (3) Vision Science
- ANAT 8060 (1) Visual Neuroscience
- ANAT 8070 (2) Progress in Vision Research

12 credit hours/102

### SUMMER (9)

**ANAT 9210 (5-12):** Investigation of A Problem (or ANAT 9300 if admitted to candidacy)

**ANAT 8050 (5) Graduate Student Histology *if not completed previously**

**ELECTIVE COURSES:**
- ANAT 7300 (6) Human Gross Anatomy
- ANAT 8050 (5) Graduate Student Histology
- ANAT 8070 (1) Progress in Vision Research

12 credit hours/114 + PhD RESEARCH PROPOSAL

### FALL (SEMESTER 7)

**ANAT 9300 (5-11):** Dissertation Research (or ANAT 9210 if NOT admitted to candidacy)

**ANAT 9010 (1) Seminar in Cell Biology**

**ELECTIVE COURSES:**
- ANAT 8040 (3) Topics in Vision Science
- ANAT 8070 (1) Progress in Vision Research
- ANAT 8080 (2) Cellular Mechanism in Development & Disease

**ELECTIVE COURSES:**
- ANAT 7030 (3) Neuroscience
- ANAT 8010 (1) Special Topics in Anatomy
- ANAT 8030 (3) Vision Science
- ANAT 8060 (1) Visual Neuroscience
- ANAT 8070 (2) Progress in Vision Research

12 credit hours/126-4th

### SPRING

**ANAT 9300 (1-11):** Dissertation Research

**ANAT 9020 (1) Seminar in Cell Biology**

**ELECTIVE COURSES:**
- ANAT 7030 (3) Neuroscience
- ANAT 8010 (1) Special Topics in Anatomy
- ANAT 8030 (3) Vision Science
- ANAT 8060 (1) Visual Neuroscience
- ANAT 8070 (2) Progress in Vision Research

12 credit hours/138-4th

### SUMMER

**ANAT 9300 (1-12):** Dissertation Research

**ELECTIVE COURSES:**
- ANAT 7300 (6) Human Gross Anatomy
- ANAT 8050 (5) Graduate Student Histology
- ANAT 8070 (1) Progress in Vision Research

12 credit hours/150 4th

- ANAT 9210- Investigation of a Problem must be taken every semester until admissions to candidacy requirements are complete.
- ANAT 9300 - Research must be taken every semester after admission to candidacy until dissertation requirements are met.
• The number and type of advanced (2nd year and beyond) elective courses vary, and may include courses within the student’s biomedical program as well as courses in other disciplines.
• Please note: some elective courses are only offered every other year. Check with CBA Academic Administrator for clarification of which courses will be offered over the coming 12-24 months when planning your elective course schedule.

Additional Requirements:
In addition to specific course requirements, students must complete additional PhD degree requirements, including satisfactory performance on the Comprehensive Examination, development of an approved research proposal, writing and obtaining approval of the doctoral dissertation, and satisfactory performance on the Final Oral Examination (dissertation defense). Publication of at least one first-authored original research article in an approved peer-reviewed journal is required for students entering CBA Graduate Program in 2014 and beyond. A CBA Program Handbook is available online and updated at least once yearly in the fall to reflect any changes that have occurred during the academic year.
The Doctor of Philosophy curriculum is not lock-step; students do NOT graduate as a class at the end of a specific semester. The average time to degree is approximately 5 years of full-time, year-round study; acceptable duration of the program may be between 3 and 7 years. The PhD curriculum is individualized for each student based on the Advisory Committee’s recommendations. The number and type of advanced (2nd year and beyond) elective courses vary, and may include courses within the Cellular Biology and Anatomy program as well as courses in other disciplines.