UNT | HEALTH SCIENCE CENTER

GRADUATE SCHOOL OF BIOMEDICAL SCIENCES

Pharmacology and Neuroscience Student Handbook 2019-2020

The information provided in this document serves to supplement the requirements of the Graduate School of Biomedical Sciences detailed in the UNTHSC Catalog with requirements specific to the discipline of Pharmacology and Neuroscience.

Table of Contents

Pharmacology & Neuroscience Discipline

Robert C. Barber, Ph.D., Graduate Advisor
Center for BioHealth Building, Room 312
817-735-2506
Robert.Barber@unthsc.edu

Graduate Faculty: Barber, Cunningham R, Das, Dong, Forster, Gatch, Huang, Jin, Johnson, Jung, Luedtke, Nejtek, O'Bryant, Prokai K, Prokai L, Salvatore, Schreihofer D, Shetty, Sumien, Uht, Uteshev, Yang

Pharmacology is a discipline that bridges the basic and clinical sciences. Classically, pharmacologists sought to understand the pharmacological responses, mechanisms and clinical uses of drugs. In recent decades, the scope of pharmacology has expanded dramatically to include cutting edge research in signal transduction and cellular & molecular biology.

Neuroscience combines the fields of anatomy, physiology, molecular biology and cytology to study the function of the brain and nervous system. The goal of these studies is to gain a fundamental understanding of the biological basis of learning and memory, as well as the processes involved in neural development and neurodegeneration. The scope of neuroscience includes molecular and cellular studies of individual neurons to imaging the circuitry of sensory and motor tasks within the brain.

The Pharmacology & Neuroscience faculty maintain active research programs in the following areas: aging and Alzheimer's disease; drug discovery; glaucoma and ocular pharmacology; learning and memory; neurobiology of drug and alcohol abuse; neuronal degeneration and protection; neuropsychopharmacology; pharmacogenetics; and receptors and ion channels.

Students in the Pharmacology & Neuroscience Discipline may choose from a number of advanced elective courses that are related to their individual research interests. Students are also required to participate in seminars, works in progress presentations and group discussions of current research topics, and will be trained in a number of techniques required to address existing research problems in the field. Both MS and PhD students will conduct original, publishable research and will be expected to present their results at national scientific conferences. Completion of the master's degree typically requires two years while the PhD degree is generally completed in four to five years.

Students who successfully complete a graduate degree in the Pharmacology & Neuroscience discipline will be well prepared for careers in academic or government research laboratories, as well as in the pharmaceutical/biotechnology industry.

Pharmacology & Neuroscience Graduate Faculty and Their Research

Robert Barber, Ph.D.
Associate Professor, Pharmacology and Neuroscience
Category III

Research in my group is focused on identifying genetic and epigenetic risk factors for neurodegeneration. Ongoing projects include efforts to use patterns of DNA variation and differential methylation to predict the risk and progression rate of Alzheimer's disease. I am also interested in the biology of Alzheimer's among Mexican Americans and how disease etiology may differ between this underrepresented ethnic group and Caucasians. A second area of research interest is how an individual gut bacteria profiles may impact risk for neurodegeneration and the age at onset of cognitive decline. Collaborations are established with researchers at UNTHSC and other Texas institutions, as well as the University of North Carolina at Chapel Hill. Active projects are ongoing with Drs. O'Bryant, Allen, Planz, Cross, Hall, and Cunningham at UNTHSC; Chumley and Boehm at Texas Christian University, Sohrabji and Miranda at Texas A&M Health Science Center; Huebinger and Reisch at UT Southwestern; Royall and Palmer at UT Health Science Center at San Antonio and Wilhelmsen and Tilson at the University of North Carolina at Chapel Hill.

Rebecca Cunningham, Ph.D.
Associate Professor, Physiology and Anatomy
Category III

Through her lab work, Dr. Rebecca Cunningham studies the role of steroid hormones, specifically androgens, during aging. Most of the team's research has been focused on androgen signaling mechanisms and defining the effects of androgens on central nervous system function.
One of Dr. Cunningham's long-term research goals is to determine how development and aging alters steroid hormonal responses in the central nervous system. In pursuing this goal, Dr. Cunningham and team use in vitro, in vivo, and clinical approaches to understand the how androgens affect brain function. It is hoped that this research will expand the understanding of how steroid hormones in the brain participate in aging. At the same time, she is expecting new insights that can lead to a better understanding of the role of gender in central nervous system disorders.

Hriday Das, Ph.D.
Professor, Pharmacology and Neuroscience
Category III

Currently there are no clinically-effective treatments or prophylactic-preventative agents for Alzheimer's disease (AD). My current research involves identification of molecular mechanisms of neuronal cell death in AD and develop cost-effective clinically-useful drug therapies for prevention of neuronal cell death and the treatment of AD. We are testing the effects of drugs that prevent neuronal cell death and improve memory in the genetically engineered mouse model of AD. The identification of novel pathways that these potential drugs regulate for neuroprotection in these genetically engineered mice, could provide new therapeutic avenues for AD. The anticipated outcomes of our mouse studies are likely to provide strong

justification for the continued development and future clinical trials of these drugs for the treatment of AD.

Xiaowei Dong, Ph.D.
Assistant Professor - Pharmaceutical Sciences
Category II

Dr. Xiaowei Dong received a BS in Industrial Analysis and a MS in Applied Chemistry from the universities in China, and a PhD in Pharmaceutical Sciences from the University of Kentucky. Dr. Dong was selected as one of six students nationwide to participate in the 2008 AAPS Graduate Student Symposium in Drug Delivery and Pharmaceutical Technology. She has worked as a lead formulator for drug development at Novartis Pharmaceutical Corporation for four years. In 2013, she joined UNT Health Science Center as an assistant professor in the Department of Pharmaceutical Sciences at the College of Pharmacy. Dr. Dong's research has focused on drug delivery and formulation development.

Michael Forster, Ph.D.
Interim Chair & Professor, Pharmacology & Neuroscience
Category III

The goal of research in our lab is to understand the biology that makes us slow down and become more vulnerable to disease and injury as we grow older. We know that it is possible to combat aging biology, because some people achieve advanced age in truly great condition. Studies of the habits and biology of such individuals during their lives are underway, but it may take several human lifetimes for them to be completed. Lower organisms grow old more rapidly and, like humans, show great differences among individuals in terms of how long they remain robust and resist disease and injury. By studying lower organisms, our laboratory is focused on the promise that we can rapidly discover ways to combat deleterious aging conditions, study how they work, and design trials in humans. Understanding the biology of aging will help us treat all aging-related diseases (i.e., Alzheimer's disease, diabetes, etc).

Michael Gatch, Ph.D.
Associate Professor, Pharmacology & Neuroscience
Category III

The focus of our research is on two broad's aims. One aim is to screen compounds that will attenuate the subjective and reinforcing effects of abused drugs as part of a NIDA-funded contract searching for effective treatment drugs for addiction to cocaine, methamphetamine, nicotine and marijuana. Another aim is to evaluate the potential abuse liability of novel designer drugs that are increasingly available as "legal" alternatives to controlled substances. We use drug discrimination procedures which assess the subjective effects of common drugs of abuse such as cocaine, methamphetamine, nicotine and marijuana, with designer drugs like MDMA (Ecstasy), with opioids like morphine, or with hallucinogens such as LSD. We also test the

reinforcing/rewarding effects of drugs using the conditioned place preference and self-administration assays.

Ren-Qi Huang, Ph.D.
Associate Professor, Pharmacology & Neuroscience
Category II

Our lab studies the details of inhibitory synaptic function mediated by GABA type A and glycine receptors, its modulation and plasticity, using a variety of modern electrophysiological and molecular biological techniques such as electrophysiological, molecular biological (e.g., site-directed mutagenesis, substituted cysteine accessibility method (SCAM)), immunofluorescence microscopy, pharmacological and biochemical techniques. Projects within the lab study these synapses at several different levels of organization from cellular to molecular level. We use different preparations including brain slice and recombinant preparations. Overall, our major objective is to provide a molecular description of the therapeutically important receptors/channels, and to gain a deeper understanding of their role in both healthy and diseased states, and eventually to develop of novel therapeutic drugs which target these receptors.

Kunlin Jin, Ph.D.
Professor, Pharmacology & Neuroscience
Category III

Stroke remains a leading cause of disability in the world. Despite progress in understanding molecular mechanisms of neuronal cell death in these diseases, widely effective treatment remains elusive. For many stroke survivors, the best hope is a lengthy program of rehabilitation, followed by a life-long process of clinical support. However, even with rehabilitation therapy, 50% to 95% of stroke survivors remain impaired. We have documented that endogenous neural stem cells (NSCs) can proliferate, migrate and differentiate into functional neurons to replace or repair damaged neurons after acute ischemic stroke. Conditional depletion of neurogenesis inhibits functional recovery after ischemic stroke either in young adult or aged animals. Yet, patients who survive an acute stroke are typically left with fixed anatomical damage, which eventually transforms a brain cavity and results in permanent neurological deficits. Therefore, NSCs may not be able to reconstitute the lost neural tissue and restore the functional circuitry at chronic stage of stroke due to the brain cavity. To help elucidate the potential of cell replacement therapy in stroke, we found that transplantation of human ESC-derived NSCs with Matrigel scaffolding resulted in improved histologic and behavioral outcome in animal model of stroke. However, many issues remain to be addressed before clinical application of this strategy becomes feasible. Matrigel is a gelatinous protein mixture extracted from EHS mouse sarcoma cells. Therefore, there is almost no chance that this mouse sarcoma derived gelatin would be approved for use as a scaffold for grafting cells into the human stroke. To address this issue, we generated gel-like scaffold from serum with ideal properties, and treated patients with ischemic stroke using autogenous stem cells and serum-derived scaffold. We found that the motor deficits and tissue damage post-stroke were significantly improved after transplantation, suggesting that stem cells-based tissue engineering may be a clinically effective therapeutic strategy for repairing the damaged brain tissue in the chronic phase after stroke.

Leigh Johnson, Ph.D.
Assistant Professor, Pharmacology & Neuroscience
Category I

My area of expertise is in translational aging research. I am the Co-I of Health & Aging Brain among Latino Elders (HABLE) study (R01AG054073), and the Director of the Clinical and Outreach cores for this study. I have spent a great deal of time studying factors related to cognitive loss among Mexican Americans with specific emphasis on the link between depression and cognition. I have developed and cross-validated a depressive endophenotype (DepE) of cognitive aging across multiple national and international cohorts. This work has been translated into a proof of concept clinical trial (The DEMO trial).

Marianna Jung, Ph.D.
Assistant Professor, Pharmacology & Neuroscience
Category III

My laboratory focuses on the development of research/therapeutic strategies to slow premature brain aging resulting from a chronic use of drugs of dependence such as benzodiazepine (BZD, antianxiety medication) and alcohol, and withdrawal stress from the substances. Currently, we investigate whether BZD administration to mice elevates/alters the production of neurotoxic amyloid beta, amyloid beta-producing gamma-secretase, and peripheral BZD receptors. We also investigate whether these changes mediate aging like behavioral signs such as movement and cognition deficits. We are planning to test whether the aging-like effects of BZD will be attenuated by training mice with moderately low oxygen. Our study may help understand how to minimize accelerated brain aging associated with substance misuse.

Robert Luedtke, Ph.D.
Professor, Pharmacology & Neuroscience
Category III

Our laboratory is interested to developing and characterizing safe and effective drugs that can be used for the treatment of individuals afflicted with Parkinson's Disease, Alzheimer's Disease, schizophrenia, Tourette Syndrome and dystonia. We have also worked to develop drugs that can be used to assist in the rehabilitation of individuals who abuse cocaine. These studies have also provided insights on the role of dopamine and sigma receptors in the brain

Vicki Nejtek, Ph.D.
Associate Professor, Pharmacology & Neuroscience
Category II

The Nejtek lab currently examines biomarkers and cognitive functioning outcomes to predict risks for Parkinson's disease (PD) in veterans with and without mild traumatic brain injury (mTBI). We have successfully used BDNF, cortisol, and interleukin to identify treatment response, and have used cognitive functioning tests to predict mood state, and drug relapse. We have also used MRI with and without diffusion tensor imaging (DTI) to identify brain anomalies in patients with bipolar disorder with cocaine dependence in comparison to healthy controls. In a recent collaboration with Dr. Michael Salvatore, the Nejtek lab has received funding to conduct cross-species translational studies in parallel with our veterans with and without mTBI using a Parkinson's genetic PINK1 rat model compared to wild type.

Sid O'Bryant, Ph.D.
Professor, Pharmacology & Neuroscience
Category II

The O'Bryant Laboratory is dedicated towards precision medicine in Alzheimer's disease and other neurodegenerative diseases, including Down syndrome, Lewy Body disease, Parkinson's disease and traumatic brain injury and others. The fully translational lab has a Biomarker Core (Dr. Hall, Director), Clinical Core (Dr. Johnson, Director), Administrative Core (Dr. O'Bryant, Director) and Data Core (Dr. Johnson, Director). The lab also has a Neuroimaging Core (USC, Dr. Toga, Director). Our multiple NIH grants focus on novel strategies for disease detection, screening into trials (therapeutic and prevention), patient stratification for optimal treatment response. As part of this work, our lab has a strong focus on the impact of ethnicity/diversity on cognitive loss during the aging process and runs the one-of-a-kind Health & Aging Brain among Latino Elders (HABLE) study, which is the most comprehensive study of aging among Mexican Americans to date.

Katalin Prokai, Ph.D.
Professor, Pharmacology & Neuroscience
Category II

The research in our laboratory is directed at medicinal chemistry-based drug design and delivery into the central nervous system with translational medicine in mind. We focus on agents (neuropeptides and estrogens) that are beneficial for brain and retinal health. Our projects involve pharmacokinetics, metabolism and drug distribution studies in early-phase drug discovery and the development of neuroactive/neuroprotective agents for the protection of the aging/diseased brain and retina. The current federally funded main project in our lab is entitled "A Novel Neuroprotective Approach for Glaucoma."

Laszlo Prokai, Ph.D.
Professor, Pharmacology & Neuroscience
Category III

Dr. Prokai is the first Chair in Biochemistry endowed by the Houston-based Welch Foundation, one of the United States' oldest and largest private funding sources for basic research, at the UNT Health Science Center. He is affiliated with the UNTHSC's Department of Pharmacology and Neuroscience, and with the Institute of Healthy Aging. Dr. Prokai also is Adjunct Professor at the Department of Chemistry and Biochemistry, University of Texas at Arlington, as well as Adjunct Professor and Associate Member of the Graduate Faculty at the Department of Chemistry and Biochemistry of the Texas Christian University. His interests focus on chemistry-driven multidisciplinary research and include the discovery, chemical biology, bioorganic and medicinal chemistry of central nervous system agents, as well as neuropeptides, proteomics and mass spectrometry. Dr. Prokai has maintained an actively funded research program from grant support by the National Institutes of Health (NIH) as well as through collaborations with pharmaceutical and chemical companies, and was the recipient of the 2017 Wilfred T. Doherty Award of the Dallas/Fort Worth Section of the American Chemical Society (ACS) and the 2017 Southwest ACS Regional Award.

Michael Salvatore, Ph.D.
Associate Professor, Pharmacology & Neuroscience
Category III

We aim to understand the molecular basis for locomotor impairment in aging and Parkinson's disease. Our immediate and long-term goals are to discover molecular, pharmacological, and non-invasive (exercise, calorie restriction) approaches that can target proteins associated with motor impairment, thereby reducing or eliminating locomotor impairment associated with aging and Parkinson's disease.

Derek Schreihofer, Ph.D.
Associate Professor, Pharmacology & Neuroscience
Category III

My laboratory is interested in understanding how steroid hormones like estrogen, testosterone, and natural estrogens from plants regulate brain function in injury and aging. We use both cell and animal models to examine the underlying mechanisms of steroid action under conditions in which they are beneficial and those in which they are not in order to understand what key factors result in beneficial effects on the brain. Our goal is to determine the conditions in which these compounds can be safely and effectively used to provide ongoing brain health and treat brain injury and disease. Additional collaborative projects are using novel compounds to protect and regenerate brain tissue after stroke and traumatic brain injury.

Ritu Shetty, PhD., R. Ph.
Clinical Assistant Professor & Research Scientist, Pharmacology and Neuroscience
Category I

Long-lasting drug related memories can play an important role in addiction cycle and relapse. I am interested in understanding the mechanisms behind formation and consolidation of memories; predominantly drug-related memories. The main focus of my research is to understand the acquisition and development of drug-seeking behavior using various rodent models, and also identify molecular targets in different brain regions involved in expression of such behaviors.

Nathalie Sumien, Ph.D.
Associate Professor, Pharmacology & Neuroscience
Category III

My scientific interests are focused on identifying interventions improving motor and cognitive function during aging and disease state. Our focus has been on the interaction between antioxidant supplementation and exercise and whether combining the two anti-aging interventions would further their benefit on brain function declines associated with aging and Alzheimer's disease. My laboratory also works on other interventions for other conditions: sigma 1 compounds and chemobrain (brain dysfunction associated with chemotherapy), hyperbaric oxygen therapy to alleviate the symptoms of Alzheimer's disease, and new antiaging therapy manipulating internal acidity. Identifying successful interventions and their interaction with factors such as genes and gender will lead to specialized recommendations to patients. Furthermore, it will allow us to determine specific mechanisms involved in positive outcomes leading to the development of therapeutic to ultimately improve healthspan of individuals. Another project of the laboratory is to study the interaction of stroke

and/or aging with drugs of abuse and determine whether drug use makes individual more susceptible to stroke and develop accelerated aging.

Rosalie Uht, M.D., Ph.D.
Associate Professor, Pharmacology & Neuroscience
Category III

A properly functioning stress response is required for maintaining homeostasis. The endocrine arm of the stress response is sub-served by the hypothalamic pituitary adrenal (HPA) axis. Dysregulation of this axis is tightly correlated with the mood disorders of depression and post-traumatic stress disorder. The Uht lab is interested in the molecular mechanisms of stress response downregulation. Specifically, how the stress steroids, glucocorticoids, downregulate the peptide that triggers the stress response itself: corticotropin releasing hormone (CRH). We have provided evidence that a specific epigenetic repressive complex is necessary to effect downregulation. Further studies may pinpoint interaction of this complex with unique conformations of chromatin, and thus uncover novel drug targets, in particular for depression.

Victor Uteshev, Ph.D.
Associate Professor, Pharmacology & Neuroscience
Category III

Many neurological disorders remain untreatable and continue to cause incalculable losses to productivity, independence and overall quality of life among patients globally. Currently available approaches to the treatment of ischemic stroke and traumatic brain injury do not adequately meet clinical and social demands. Discovery and development of drugs with clinical efficacy presents tremendous intellectual and commercial challenges. Dr. Uteshev was trained as neuro-pharmacologist and his lab focuses on developing novel therapeutic strategies and pharmacological tools to treat ischemic stroke, traumatic brain injury and other challenging neurological disorders linked to brain injury and inflammation. The prime focus is the cholinergic system and α7 nicotinic acetylcholine receptors (nAChRs). These receptors are commonly expressed throughout the body including neuronal, glial and immune tissues. A balanced activation of α7 nAChRs inhibits inflammation and elevates brain resistance to ischemic and traumatic injury. Accordingly, whenever a brain injury occurs, two simultaneous processes are automatically initiated as the injury stimulates α7 nAChRs: first, the brain tissue near the site of injury becomes protected from spreading injury; and second, the injury-induced inflammation is mitigated to prevent additional injury by the immune system. Positive allosteric modulators (PAMs) of α7 nAChRs hold considerable promise as stroke and TBI treatment. PAMs augment α7 activation by endogenous agonists, choline and ACh, allowing for a gentle modulation of immune response and recovery from injury.

Shaohua Yang, Ph.D.
Professor, Pharmacology & Neuroscience
Category III

Dr. Yang's laboratory is interested in understanding the mechanism of neuronal loss during cerebral ischemia (stroke) and the discovery of novel therapy for ischemic stroke and vascular dementia. His research has been focusing on the neuroprotective effects and mechanisms of estradiol and non-feminizing estrogen-like compounds. He is particularly interested in the interaction between estrogens and anti-clotting factor in stroke therapy and in the progressive effects on cognition of cerebral ischemia. He uses animal and in vitro models of cerebral ischemia and a spectrum of techniques ranging from animal models to molecular biology to address these issues.

Requirements

The requirements below are in addition to the GSBS requirements listed in the GSBS Degree Programs chapter of the UNTHSC Catalog.

I. REQUIRED COURSES for Doctoral Degree*

Functional Neuroscience (PHRM 6400) - 4 SCH
Basic and Clinical Pharmacology (PHRM 6410) - 4 SCH

**Master's Degree students are encouraged, but not required to take Functional Neuroscience or Basic and Clinical Pharmacology*

II. SEMINAR AND JOURNAL CLUB COURSES

Seminar in Current Topics (PHRM 5140) - 1 SCH
Current Topics in Pharmacology (PHRM 6140) - 1 SCH

Seminars

All MS and PhD students in Pharmacology and Neuroscience are required to attend all departmental seminars in their entirety (whether they are taking the associated course for credit or not) and to meet with invited seminar speakers when assigned. Students are required to register for Seminar in Current Topics (PHRM 5140) for credit once.

Journal Clubs

MS students in Pharmacology and Neuroscience are required to attend all journal clubs until they graduate; PhD students are required to attend journal clubs for 3 long semesters (Spring year 1, and Fall/Spring year 2). Students are required to take Current Topics in Pharmacology & Neuroscience (PHRM 6140) for course credit once.

III. WORKS IN PROGRESS (WIPs)

All Pharmacology and Neuroscience students are required to attend all Works in Progress (WIPs) sessions. Beginning in year 2, all students are required to present their work in WIPs sessions.

IV. ELECTIVE COURSES (Must include at least 2 SCH in PHRM courses, excluding Special Problems courses)

Elective courses offered by other departments can also be taken, provided that the required electives in Pharmacology and Neuroscience are completed. The student is referred to the Graduate Catalog for course offerings in other departments.

Offered every semester:
Techniques in Biomedical Sciences: Multifactor Experiments (BMSC 5170.400) - 1 SCH

Offered every year:
Mitochondria and Complex Diseases (PHRM 6200) - 2 SCH

Offered in "even" fall semesters:
Drug Discovery and Design (PHRM 6270) - 2 SCH

Psychiatric Disorders: From Bench to Bedside (PHRM 6340) - 3 SCH
Receptors and Drug Action (PHRM 6480) - 4 SCH

Offered in "even" spring semesters:
Neurobiology of Aging (PHRM 5300) - 3 SCH

Offered in "odd" fall semesters:
Neuropharmacology (PHRM 5470) - 4 SCH
Receptors and Second Messenger Signaling (MIMG 6435) - 2 SCH
Kinases and Phosphatases (MIMG 6436) – 2 SCH

Offered in "odd" spring semesters:
Biomedical Mass Spectrometry (PHRM 6361) - 1-2 SCH
The Nuclear Receptor Superfamily (PHRM 6360) - 3 SCH

SAMPLE DEGREE PLANS

I. **Master of Science Degree Plan** – The sample below does not imply that all requirements for graduation will be met with 30 SCH of course work. While it is possible to complete the requirements in this time frame, most research projects require additional semesters to complete. The typical time-to-degree for MS students is two years.

Dept	***Course Number***	***Title***	***SCH***	***Semester to be Completed***
BMSC	5150	Lab Rotations	2	Fall Year 1
BMSC	6200	Intro to Experimental Design & Biostatistical Methods	2	Fall Year 1
BMSC	6201	Fundamentals of Biomedical Science I	2	Fall Year 1
BMSC	6202	Fundamentals of Biomedical Science II	2	Fall Year 1
BMSC	6203	Fundamentals of Biomedical Science III	2	Fall Year 1
BMSC	6203	Fundamentals of Biomedical Science IV	2	Fall Year 1
		Subtotal	***12***	
Milestones to be completed: Selection of Major Professor, Change of Discipline				
BMSC	5160	Biomedical Ethics	1	Spring Year 1
BMSC	5315	Principles of Scientific Communication	2	Spring Year 1
BMSC	5998	Individual Research	0-7	Spring Year 1
PHRM	5140	Seminar in Current Topics	1	Spring Year 1
PHRM	6140	Current Topics in Pharmacology	1	Spring Year 1
		Advanced Courses	0-7	Spring Year 1
		Subtotal	***12***	
Milestones to be completed: Designation of Advisory Committee, Degree Plan. The Research Proposal must be filed prior to enrollment in Thesis (BMSC 5395).				
BMSC	5395	Thesis	0-6	Summer Year 1
		Advanced Courses	0-6	Summer Year 1
		Subtotal	***6***	
		Total for Degree	***30***	

II. **Doctor of Philosophy Degree Plan** - The sample below does not imply that all requirements for graduation will be met with 93 SCH of course work. While it is possible to complete the requirements in this time frame, most research projects require additional semesters to complete. The typical time-to-degree for PhD students is four-to-five years.

Dept	***Course Number***	***Title***	***SCH***	***Semester to be Completed***
BMSC	5150	Lab Rotations	2	Fall Year 1
BMSC	6200	Intro to Experimental Design & Biostatistical Methods	2	Fall Year 1
BMSC	6201	Fundamentals of Biomedical Science I	2	Fall Year 1
BMSC	6202	Fundamentals of Biomedical Science II	2	Fall Year 1
BMSC	6203	Fundamentals of Biomedical Science III	2	Fall Year 1
BMSC	6203	Fundamentals of Biomedical Science IV	2	Fall Year 1
		Subtotal	***12***	
Milestones to be completed: Selection of Major Professor, Change of Discipline				
BMSC	5160	Biomedical Ethics	1	Spring Year 1
BMSC	5315	Principles of Scientific Communication	2	Spring Year 1
PHRM	5140	Current Topics in Pharmacology	1	Spring Year 1
PHRM	6400	Functional Neuroscience	4	Spring Year 1
PHRM	6410	Basic and Clinical Pharmacology	4	Spring Year 1
		Subtotal	***12***	
Milestones to be completed: Designation of Advisory Committee, Degree Plan				
BMSC	6998	Individual Research	0-6	Summer Year 1
		Advanced Courses	0-6	Summer Year 1
		Subtotal	***6***	
BMSC	6998	Individual Research	0-11	Fall Year 2
PHRM	5140	Seminar in Current Topics	1	Fall Year 2
		Advanced Courses	0-11	Fall Year 2
		Subtotal	***12***	
Milestone to be completed: Oral Qualifying Examination				
BMSC	6998	Individual Research	0-12	Spring Year 2
		Advanced Courses	0-12	Spring Year 2
		Subtotal	***12***	
BMSC	6998	Individual Research	0-6	Summer Year 2
		Advanced Courses	0-6	Summer Year 2
		Subtotal	***6***	
Milestone to be completed: A Research Proposal must be on file prior to enrollment in Doctoral Dissertation (BMSC 6395)				

Dept	*Course Number*	*Title*	*SCH*	*Semester to be Completed*
BMSC	6998	Individual Research	0-9	Fall Year 3
		Advanced Courses	0-9	Fall Year 3
		Subtotal	***9***	
BMSC	6998	Individual Research	0-9	Spring Year 3
		Advanced Courses	0-9	Spring Year 3
		Subtotal	***9***	
BMSC	6998	Individual Research	0-6	Summer Year 3
		Advanced Courses	0-6	Summer Year 3
		Subtotal	***6***	
BMSC	6395	Doctoral Dissertation	9	Fall Year 4
		Subtotal	***9***	
		Total for Degree	***93***	

Advancement to Candidacy

I. Master of Science

Advancement to master's Candidacy is achieved after successful completion of a research proposal.

Each student will be required to submit a research proposal to his/her advisory committee. The student and his/her mentor will decide upon the format of the research proposal: 1) traditional proposal with no page limits, or 2) NIH style grant including all its limitations (F31, R21)). Traditional proposal format is as follows: Abstract (1pg), Specific Aims (1pg), Background and Pilot Studies (3-5pgs), Experimental Design and Methods including an anticipated results section (4-5pgs), References (unlimited). For NIH-style grant format, refer to the National Institutes of Health website for current information.

After conferring with the major professor, the student will set a meeting with his/her advisory committee to present and defend the proposal. **The research proposal should be provided to the advisory committee no later than 10 days prior to the defense.** The advisory committee will determine if the proposal is satisfactory. The proposal must be approved by the advisory committee and submitted to the GSBS during the semester prior to the student's final semester, at the latest. Submission of an approved research proposal is prerequisite for registration in Thesis (BMSC 5395)

Research Proposal Guidelines and the Research Proposal approval forms are available on the GSBS Forms and Guidelines website.

Once a master's student has successfully advanced to candidacy, he/she may use "MS Candidate" as a title on any general business correspondence such as business cards, e-mail messages, etc.

II. Doctor of Philosophy

Advancement to Doctoral Candidacy is a two-step process. The first step of this process is successful completion of the Oral Qualifying Examination, a common rite of passage in most doctoral programs regardless of the field of study. The second step of this process is the preparation and defense of a research proposal. Below are details of the Pharmacology and Neuroscience specifications for advancing to candidacy.

A. Oral Qualifying Examination

The doctoral student will successfully defend his/her general knowledge of pharmacology and neuroscience in an Oral Qualifying Examination (OQE) before an examination committee comprised of 3-5 members of the Pharmacology & Neuroscience graduate faculty and the student's university member. The graduate advisor will chair these examinations. The committee will be appointed by the department chair and graduate advisor. The student's major professor may not serve on the examination committee, but may, at the request of the student, be present for the examination as a silent observer. This examination will be held at the beginning of the Fall semester of the second year.

The student will be given a list of questions covering topics from core and required advanced courses. The student will be given 30 minutes of preparation time to review the questions and select a specified number of questions upon which he/she will be examined. The student will address the selected topics as well as any questions from the committee that may arise from the question and answer session.

Successful completion of this requirement will be determined by the OQE committee. If unsuccessful on the first attempt, a student may be allowed to retake the examination. The second examination should be completed within twelve weeks of the original examination, unless otherwise specified by the examination committee. If unsuccessful on the second attempt, the students will be required to transfer to the MS degree program to complete the requirements for the MS degree.

It is the responsibility of the student to obtain signatures from the examination committee members, university member, graduate advisor, and department chair upon completion of the exam. The appropriate form may be obtained from the GSBS Forms and Guidelines website.

B. Research Proposal

Each student will be required to submit a research proposal to his/her advisory committee. The student and his/her mentor will decide upon the format of the research proposal: 1) traditional proposal with no page limits, or 2) NIH style grant including all its limitations (F31, R21)). Traditional proposal format is as follows: Abstract (1pg), Specific Aims (1pg), Background and Pilot Studies (3-5pgs), Experimental Design and Methods including an anticipated results section (4-5pgs), References (unlimited). For NIH-style grant format, refer to the National Institutes of Health website for current information.

After conferring with the major professor, the student will set a meeting with his/her advisory committee to present and defend the proposal. **The research proposal should be provided to all committee members at least 10 days prior to the presentation to the advisory committee.** The advisory committee will determine if the proposal is satisfactory.

For PhD students, the proposal should be completed within a year of having passed the OQE. The proposal must be approved by the advisory committee and submitted to the GSBS during the semester prior to the student's final semester, at the latest. Submission of an approved research proposal is prerequisite for registration in Doctoral Dissertation (BMSC 6395)

Research Proposal Guidelines and the Research Proposal approval forms are available on the GSBS Forms and Guidelines website.

Once a doctoral student has successfully advanced to candidacy, he/she may use "PhD Candidate" or "Doctoral Candidate" as a title on any general business correspondence such as business cards, e-mail messages, etc. In addition, the minimum number of credit hours required for full-time enrollment drops from 12 SCH to 9 SCH in long semesters.