Student Handbook for Pharmaceutical Sciences and Pharmacotherapy 2020-2021

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 Pharmaceutical Sciences and Pharmacotherapy.

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Pharmaceutical Sciences & Pharmacotherapy

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Graduate Faculty: Chaturvedula; Cheng; Cunningham; Dong; Ellis; Emmitte; Inman; Karamichos; Kastellorizios; Liu; Pang; Porkai, Rasu; Simecka; White; Wu; Yan

The Pharmaceutical Sciences and Pharmacotherapy Graduate Program is an interdisciplinary program that offers both Master of Science (MS) and Doctor of Philosophy (PhD) degrees. The goal of this program is to provide students with a rigorous education and training in biomedical sciences with a specialty in Pharmaceutical Sciences and Pharmacotherapy. Students receive training through original research, formal classroom education, problem-based learning, seminars, and journal clubs. The program includes faculty members engaged in various aspects of basic, clinical, and research in Pharmaceutical Sciences and Pharmacotherapy.

The specific research interests of faculty cover a wide range of subjects, including cancer stem cell biology, target identification, natural product discovery, design and synthesis of new drug molecules, mechanistic studies of drug action (pharmacology), drug analysis, drug formulation and drug delivery, drug metabolism, drug resistance, pharmacokinetics, pharmacodynamics, and pharmacogenomics, etc. The interdisciplinary research also includes investigation of the link between and among different categories of human diseases, such as cancer, aging and neurodegenerative diseases (e.g. Alzheimer's and Parkinson's diseases), HIV, psychiatric diseases, metabolic disorders, neurological disorders, and ocular diseases. The research projects employ state-of-the-art chemical, biochemical, molecular, cellular, immunological, *in vivo* and clinical, and health outcomes techniques that include computer-aided drug design, fermentation, chromatography, mass spectrometry, NMR, molecular cloning, gene targeting, FACS analysis, advanced fluorescence spectroscopy, optical imaging and advanced single cell technology, behavioral testing, cellular reprogramming, nanoparticle characterization, organoid modeling, and statistical methodology.

Students may enter the discipline after completing course work and laboratory rotations as required by the Graduate School of Biomedical Sciences. The discipline offers advance courses in all aspects of pharmaceutical sciences and pharmacotherapy. Students participate in seminars and discussion of current research and receive extensive laboratory training. Students perform original, publishable research, and present their research findings at regional and national scientific meetings. Approximately two years are required to complete the Master of Science degree, while the Doctor of Philosophy degree is completed in approximately five years.

Students who successfully complete a graduate degree in Pharmaceutical Sciences and Pharmacotherapy will be well prepared for careers in academic and government research laboratories, as well as in the pharmaceutical/ biotechnology industry.

Graduate Faculty and their Research

Ayyappa Chaturvedula, PhD
Associate Professor, Department of Pharmacotherapy
Graduate Faculty Full Member

I received a Bachelor's degree in Pharmacy from the University of Pharmaceutical Sciences, Kakatiya University, India, and a PhD in Pharmaceutical Sciences from Mercer University, Atlanta, GA. I received advanced training in Pharmacometrics as a visiting scientist in the Department of Bioengineering and Therapeutic Sciences, School of Pharmacy, University of California San Francisco, in association with the Center for Drug Development Science (CDDS). Prior to my current position, I have worked in pharmaceutical industry and academia in various positions. My research has been focused on drug delivery and pharmacokinetic-pharmacodynamic modeling since my graduate training. I have experience in developing transdermal, nasal, buccal and sublingual delivery systems using *in vitro* permeation models and utilizing pharmacokinetic models to simulate *in vivo* concentrations of drugs. I have significant experience in developing population pharmacokinetic models and applying mechanistic mathematical models to understand intracellular pharmacokinetics of metabolites.

Eric Y. Cheng, PhD
Professor, Department of Pharmaceutical Sciences
Graduate Faculty Full Member

The overall goal of my group research is to discover and develop bioactive natural products as drugs or drug leads for the treatment of cancer and infectious diseases. To this end, we have so far discovered a serial of potent histone deacetylase inhibitors, and a serial of potent pre-mRNA splicing inhibitors, among many other natural products from exotic bacterial species. We forged collaborations with cancer biologists to evaluate some of those small molecules in tumor xenograft models, including neuroendocrine cancer, breast cancer, colon cancer, prostate cancer, glaucoma, leukemia and neuroblastoma. Our research was supported by NIH grants (R03, R01, CTSA), a US Department of Defense BCRP Idea Award, a pilot grant from the Lynde and Harry Bradley Foundation, and supplemented with institutional funds. I have so far coauthored > 60 peer-reviewed publications and several book chapters. One of our publications was recognized as "The 2013 A. E. Schwarting Award for the *Journal of Natural Products* Best Paper of the Year". I am also an inventor in several issued US and international patents and pending patents. Students of my group will gain broad training in microbiology, molecular biology, biochemistry and natural product chemistry.

Rebecca L. Cunningham, Ph.D.
Associate Professor, Department of Pharmaceutical Sciences, Graduate School of Biomedical Sciences, Institute for Translational Research
Graduate Faculty Full Member

Our laboratory studies the role of steroid hormones, specifically androgens, from prenatal development to aging. Most of her 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 neuronal steroid hormonal responses in an oxidative stress environment, a key characteristic of aging, developmental disorders, and neurodegeneration. We have shown that androgens can either be neuroprotective or damaging, and these effects are dependent on the oxidative stress environment. Dr. Cunningham and team use in vitro, in vivo, and clinical approaches to understand the how androgens affect brain function and physiology. It is hoped that this research will expand the understanding of how steroid hormones impact the brain and body.

Xiaowei Dong, PhD
Associate Professor, Department of Pharmaceutical Sciences
Graduate Faculty Full Member

My research has focused on drug delivery and formulation development. Cancer definitely is one of my research areas. Finding novel delivery systems to efficiently deliver anti-cancer drugs to tumors is the goal for this research. The research on overcoming multidrug resistance in cancer, which was the area of my Ph.D. research, continues in my current lab. In addition, I obtained great experience on drug product development and manufacture. The projects I had worked on covered the development stages from pre-clinical to clinical Phase III. Thus, my research interests also include translating pharmaceutical research into commercial products. In this aspect, novel oral solid dosage forms are specially interested. In-vitro cell study and in-vivo animal study are essential, and the studies of the underlying mechanisms about why and how the novel delivery systems enhance therapeutic outcomes are emphasized in my lab. Moreover, I am actively looking for the collaboration opportunities with the groups working on drug discovery to provide the support on formulation development of novel compounds. The ultimate goal of my research is to provide more medication options for patient benefits and make best contribution on healthcare improvement.

Dorette Z. Ellis, PhD

Associate Professor, Department of Pharmaceutical Sciences, North Texas Eye Institute

Graduate Faculty Full Member

I am interested in understanding how aqueous humor is regulated in normal and the diseased state, glaucoma. Specifically, I study signal transduction and the regulation of ion transport (sodium and potassium) in physiological and pathological states. High intraocular pressure is a risk factor for glaucoma. Intraocular pressure is regulated by the rate of secretion of aqueous humor in the ciliary processes and the rate of exit of aqueous humor through the trabecular meshwork and Schlemm's canal. The role of the trabecular meshwork and Schlemm's canal in intraocular pressure regulation is unknown. Therefore, the goals of my laboratory are to determine how aqueous humor production and outflow via the trabecular meshwork and Schlemm's canal are regulated. Additionally, we will identify the molecular and cellular mechanisms by which certain ocular hypotensives lower intraocular pressure. Identification of these target sites will allow for potential therapeutic strategies for the treatment of glaucoma and ocular hypertension. Another area of interest is retinal ganglion cell survival in glaucoma; specifically, the involvement of the sigma 1 receptor in neuroprotection and its modulation of ion transport (calcium) and mitochondrial function. The elucidation of mechanism (s) involved in retinal ganglion cell survival is of great importance, as this may lead to potential targets for therapeutic strategies for the treatment of glaucoma.

Kyle A. Emmitte, PhD

Professor & Chair, Departments of Pharmaceutical Sciences, Pharmacology & Neuroscience

Graduate Faculty Full Member

Dr. Emmitte's primary research interests include the design and optimization of biologically active small molecules to serve as *in vivo* probes and drug discovery leads. He has more than eighteen years of experience in the fields of medicinal chemistry and drug discovery, having previously held positions in the pharmaceutical industry and academia. Dr. Emmitte's current research primarily focuses on the optimization of novel small molecules for the treatment of childhood epilepsies. He is also engaged in additional projects related to obesity, glaucoma, pain, and intellectual disability. Dr. Emmitte's research is collaborative by nature and engages the areas of medicinal chemistry, molecular pharmacology, *in vivo* biology, and DMPK. His laboratory employs both classical and state-of-the-art synthetic chemistry techniques such as microwave assisted organic synthesis and flow chemistry in pursuit of new chemical targets. Students in the Emmitte laboratory gain experience in synthetic organic chemistry, including compound purification and characterization, as well as strategies for SAR development and drug design. To date, he has authored 60 peer-reviewed publications and is an inventor on 20 issued U.S. patents.

Denise Inman, PhD

Associate Professor, Department of Pharmaceutical Science, North Texas Eye Institute

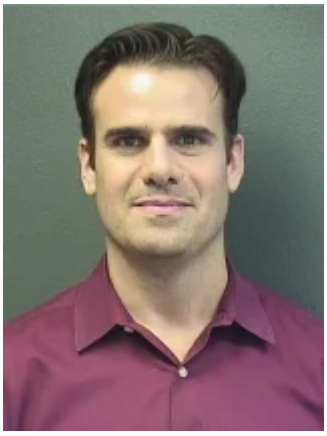
Graduate Faculty Full Member

The Inman laboratory investigates how energy generation and utilization in the central nervous system is impacted by chronic diseases such as glaucoma. Our work has shown that the visual system undergoes metabolic decline during glaucoma development. That decline occurs in mitochondria, but also in the various transporters that supply substrate to the mitochondria or glycolysis for energy production. We have been able to limit the metabolic decline and halt glaucomatous progression by increasing a transporter that moves pyruvate and lactate into the retinal ganglion cells and their axons, suggesting that improving cells' metabolic choices can prevent degeneration. We are also interested in the interaction of neurons and glia in the retina and optic nerve, two structures impacted by glaucoma, because of the metabolic coupling that exists between these cell types, and the implications those interactions have for disease. The lab uses in vitro and in vivo approaches to investigate these mechanisms. Ongoing studies include proteomics of retinal cells subjected to glaucoma, transgenic approaches to knockdown or knockout of various proteins to test their role in metabolic adaptation, and bioenergetic analysis of mitochondrial function and quality control.

Dimitrios Karamichos, PhD

Professor, Department of Pharmaceutical Sciences

Graduate Faculty Full Member



The Karamichos laboratory investigates novel therapies for the treatment of corneal trauma and diseases. More specifically, we are working on the following research topics: 1) Keratoconus: A corneal disorder affecting 1:400 people worldwide characterized by progressive thinning and steepening of the cornea. The pathobiology and treatment of this disorder remains elusive. The lab is working with clinicians, on pre-clinical studies, as well as in vitro models in order to delineate the mechanisms that drive Keratoconus. 2) Diabetic Keratopathy: Corneal complications due to diabetes include corneal erosions, corneal scarring, endothelium shape abnormalities, and decreased epithelial barrier function. The lab is utilizing both in vitro and in vivo models in order to develop novel, non-invasive treatments for the disease. 3) Corneal trauma: Physical, chemical, or any injury to the human cornea can be a serious threat to vision. The gold standard treatment, to-date, is corneal transplantation. While corneal transplantation is a safe procedure, it comes with numerous limitations and side effects including bleeding, infections, swelling, clouding of lens and/or cataracts, glaucoma, and lifetime of steroids treatment. The lab, using both in vivo and in vitro models, and novel molecules, seeks to develop novel drugs and/or therapeutic modalities for the treatment of corneal trauma. 4) 3D bioprinting: The lab, in collaboration with industry partners, are developing novel fabrication methods of a living cornea.

Michail Kastellorizios, PhD

Assistant Professor, Department of Pharmaceutical Sciences

Graduate Faculty Full Member

Dr. Kastellorizios' research focuses on drug delivery technologies including nanomedicine, medical devices, and regulatory science.

Our primary research focus is the translation of anticancer medicines from preclinical development to the clinic. We are developing novel nanoparticle characterization methods designed to be of clinical relevance by testing them against solid tumor biopsies. In particular, we are developing a method for personalized treatment of metastatic breast cancer, and we are studying breast cancer health disparities in African American women as they apply to nanotherapy outcomes.

Our work on regulatory science includes the development of novel quality assurance testing methods for nanoparticle drug products. We apply the principles of Physical Pharmacy and Physical Chemistry to characterize nanoparticle formulations based on their unique interfacial properties. In addition, we provide formulation development and characterization expertise to other researchers that work on new drug candidates, generic drug formulations, and medical devices. These smaller projects are utilized to train Dr. Kastellorizios' lab members in the science of and application of Pharmaceutical Technology.

Jin Liu, PhD

Associate Professor, Department of Pharmaceutical Sciences

Graduate Faculty Full Member

Dr. Liu is broadly interested in the development and application of computational methods to solve problems in pharmaceutical sciences. Her lab integrates pharmaceutical sciences with computer sciences, chemistry, biology, and physics to develop new biotechnologies, understand molecular mechanisms underlying diseases, and design new drugs. Specifically, Dr. Liu's lab is interested in protein allostery study, computer-aided drug design, CRISPR-Cas9 technology improvement, artificial intelligence (AI) for drug discovery, and big data analysis of health disparity diseases. Her lab extensively engages in dynamic collaborations with various experimental labs with a goal to bridge the interface of computational, experimental, and clinical research.

Iok-Hou Pang, Ph.D.

Professor, Department of Pharmaceutical Sciences, North Texas Eye Institute

Graduate Faculty Full Member

Dr. Pang has considerable experience in glaucoma research and ocular pharmacology. He has been involved in glaucoma drug discovery since 1990 and dedicated in the evaluation and discovery of new potential therapeutic targets and agents for the disease. His current research interests mainly focus on the understanding of glaucoma etiology, pathology, and pharmacology, especially on glaucoma neuroprotection. He is working to delineate essential molecular and cellular mechanisms, as well as characterize receptors and signal transduction pathways related to the abnormal changes in glaucoma. His laboratory is using rodents and primary cultures of retinal cells, neurons as well as glias, as study models to clarify biological events leading to glaucomatous optic neuropathy and retinopathy as well as its prevention and protection. He has edited one book, coauthored more than 90 peer-reviewed publications and book chapters. He is a member of numerous professional organizations, including the American Association of Pharmaceutical Scientists, Association for Research in Vision and Ophthalmology, International Society for Eye Research, and Society for Neuroscience. He has served on editorial boards and as reviewer for many journals. He is an inventor in 18 issued US & international patents and numerous pending patents.

Katalin Prokai-Tatrai, PhD

Professor, Pharmacology & Neuroscience

Member, Institute for Healthy Aging

The research in my laboratory is focused on 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.

Rafia S. Rasu, PhD

Professor, Departments of Pharmacotherapy and Health Behavior & Health Systems, Senior Fellow of *SaferCare* Texas Institute of Patient Safety

Graduate Faculty Full Member

Dr Rafia Rasu is a health services outcomes researcher. She analyzed numerous population health level national level datasets, EMR, and hospital quality/safety dataset to evaluate effectiveness and safety of care. Her academic and research objectives are focused on pharmacoepidemiology and economic evaluation of health care interventions. Her wide-range of background in pharmacy, epidemiology, economics, finance, and public health allowed her to collaborate with many multidisciplinary professionals. She applied risk adjustment techniques with real-world evidence to make informed health care decisions. She published close to 50 peer reviewed articles and 2 book chapters. Currently serving as an NIH grant reviewer and editorial board member of Journal of Managed Care and Specialty Pharmacy.

Annesha White, PharmD, PhD

Associate Professor and Assistant Dean for Assessment, Department of Pharmacotherapy

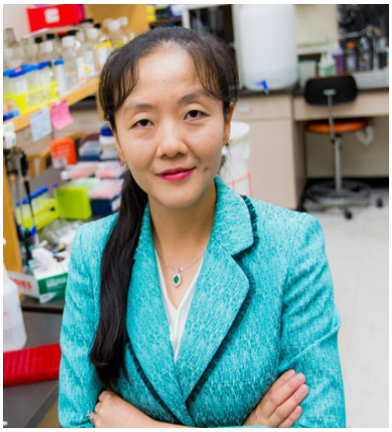
Graduate Faculty Associate Member

Dr. White's primary research interests include the design of studies to address issues in the health services research arena. Areas of focus include Medicare, Managed Care, Pharmacoeconomics, Comparative Effectiveness and Outcomes Research. Her research over the years has included a focus on a variety of disease states, such as heart disease, asthma, hypertension, and diabetes with the goal of providing care that is balanced in quality and cost. Dr. White's recent research has focused on accountable care organizations and health system mergers to improve patient care coordination. She also works on projects to improve care for chronic kidney disease patients, specifically targeting novel therapies to treat hyperphosphatemia. Dr. White's research involves a team approach to care examining the various aspects of the health care system and how entities can join together to enhance efforts. She has published several peer-reviewed articles, a textbook entitled Introduction to the Pharmacy Profession and serves as a referee for journals such as Medical Care and the Journal of Managed Care Pharmacy.

Hongli Wu, PhD

Associate Professor, Department of Pharmaceutical Sciences, Pharmacology & Neuroscience

Graduate Faculty Full Member

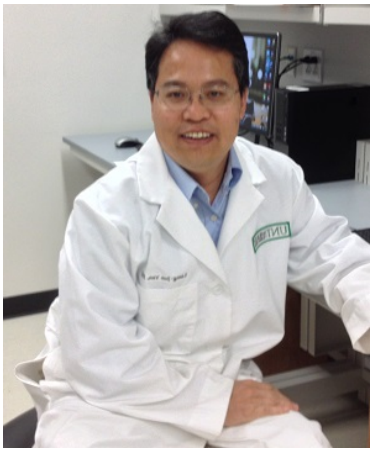


The central theme of my research is to understand the role of protein repair enzymes and evaluate their therapeutic potentials for the treatment of eye diseases and cancer. Of primary interest is the age-related macular degeneration (AMD), the most common retinal disorder that affects 25 million people worldwide, yet its pathogenesis remains poorly understood. My lab uses gene knockout and transgenic animals, and primary retinal cells as models to elucidate how altered redox signaling and disrupted redox homeostasis contribute to the pathogenesis of AMD. My research emphasizes the effects of oxidative damage and its repair on retinal proteins, in particular the thiol (SH)-containing proteins/enzymes. We also identify new therapeutic agents from natural products for AMD treatment and cancer prevention.

Liang-Jun Yan, PhD

Professor, Department of Pharmaceutical Sciences, Pharmacology & Neuroscience

Graduate Faculty Full Member



We investigate the roles of mitochondrial protein oxidation and posttranslational modifications in aging and aging-related diseases. We are particularly interested in mitochondrial protein oxidation and modifications that play beneficial roles in age-associated chronic diseases. Our current projects, utilizing mouse or rat as animal models, focus on two mitochondrial enzymes: dihydrolipoamide dehydrogenase (DLDH) in stroke protection and NADH-ubiquinone oxidoreductase (complex I) in diabetic pathogenesis. Both enzymes use NAD^+ as their cofactor which serves as an essential molecule in cellular redox sensing, stress response, energy metabolism, and mitochondrial function.

Jerry Simecka, Ph.D.
Associate Dean of Research, Executive Director of Preclinical Services
Department of Pharmaceutical Sciences
Graduate Faculty Full Member

Dr. Simecka's lab founded the Pre-Clinical Services group at the University of North Texas Health Science Center in 2008. We conduct studies utilizing established models of both acute and chronic bacterial and fungal infections in several different animal species to help researchers evaluate and develop need antimicrobial therapies. Animal models established include septicemia, lung, intestinal, urinary tract, gastric, biofilm, abscess, and skin infections from a broad range of pathogens. We also work with sponsors to develop and establish new animal models to meet their needs. In addition, pharmacokinetic studies with accompanied bioanalytical LCMS or HPLC analysis are performed in-house for submitted compounds. Overall, we support and guide the drug discovery process of the sponsor, through protocol design, implementation and analysis for compound lead selection. Importantly, there are 7 drugs/therapies that we tested and are currently used clinically, and others will be added to this list soon.

Requirements

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

A student who receives a single "C" in BMSC 6201, BMSC 6202, BMSC 6203, or BMSC 6204, but maintains an overall GPA of 3.0 or better after the first semester will be allowed to enter the Pharmaceutical Sciences & Pharmacotherapy Discipline and enroll in PSPT 6100 and PSPT 6400.

I. PhD REQUIRED COURSES

Principles of Drug Discovery and Development (PSPT 6400) – 4 SCH

A PhD student who receives a "C" or "F" in the required course will be allowed to self-remediate the course, and the PhD student will still be allowed to take the oral qualifying exam in the summer of year 1 or the fall of year 2.

Pedagogy in Pharmaceutical Sciences and Pharmacotherapy (BMSC 6391) – 1 SCH

PhD candidate students are expected to participate in BMSC 6391 a minimum of once per academic year. Prerequisites are successful completion of PSPT 6400 or approval from course director.

II. SEMINAR COURSES, JOURNAL CLUB COURSES, AND WIPs

Independent Topics in Pharmaceutical Sciences (Journal Club)
PSPT 6100 – 1 SCH

- Offered in the Spring of Year 1
- Minimum of 2 SCH required
  - Once MS students register for Thesis (BMSC 5395) or PhD students register for Doctoral Dissertation (BMSC 6395), they are no longer required to register for a journal club course.

Works in Progress

- All students are required to present their research in Works in Progress or WIPs once per year beginning in their second year
- Comparable courses may be substituted
  - Works in Progress (PHAN 6385) -1 SCH

III. PhD ELECTIVE (ADVANCED AND TECHNIQUE) COURSES

PhD students are required to take <u>at least two advanced courses in addition to PSPT 6400</u>. Students are free to take advanced courses from other disciplines to complete their

advanced course requirements. Advance courses should be selected in consultation with the student's major professor.

Advanced Course Options:

Pharmaceutical Sciences & Pharmacotherapy:
PHAR 7375: Special Topics in Pharmacy Research (1-3 SCH)
PHAR 7313: Pharmaceutics I
PHAR 7323: Pharmaceutics II
PHAR 7232: Principles of Medicinal Chemistry & Pharmacology
PHAR 7322: Pharmacogenetics, Genomics, & Personalized Medicine
PHAR 7321: Pharmacology of Infectious Disease

Integrative Physiology:
PHAN 5300: Cardiovascular Physiology
PHAN 6380: Neurohumoral Control of Autonomic Function

Pharmacology & Neuroscience:
PHRM 5300: Neurobiology of Aging
PHRM 5470: Neuropharmacology
PHRM 6400: Functional Neuroscience
PHRM 6401: Visual Sciences I
PHRM 6402: Visual Sciences II
PHRM 6410: Basic & Clinical Pharmacology
PHRM 5200: Introduction to Bioinformatics
PHRM 6440: Methods in Molecular Biology

Biochemistry and Cancer Biology:
MIMG 6250: Molecular and Cell Biology of Cancer
MIMG 6435: Receptors and Second Messenger Signaling
MIMG 6436: Kinases and Phosphates
MIMG 5202: Introduction to Confocal Microscopy
MIMG 6220: Cellular & Molecular Fluorescence
MIMG 5150: Introduction to Flow Cytometry

Cell Biology, Immunology, Microbiology:
MIMG 6203: Advanced Cell Biology
MIMG 6204: Advanced Immunology
MIMG 6206: Fundamentals of Microbiology

Genetics:
MIMG 6301: Molecular Genetics
MIMG 6302: Medical Genetics

Special Problems Course Options:
Max 2 courses

4. 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	Responsible Conduct of Research	1	Spring year 1
BMSC	5315	Principles of Scientific Communication	2	Spring year 1
BMSC	5998	Individual Research	0-4	Spring year 1
PSPT	6100	Independent Topics in Pharmaceutical Sciences (Journal Club)	1	Spring year 1
		Advanced Course/Electives	0-6	Spring year 1
		Subtotal	***12***	
Milestones to be completed: Designation of Advisory Committee, Degree Plan.				
BMSC	5395	Thesis	0-6	Summer year 1
BMSC	5998	Individual Research	0-6	Summer year 1
		Advanced Courses	0-3	Summer year 1
		Subtotal	***6***	
		Total for Degree	***30***	
Milestones to be completed: Research Summary (annual committee meeting), Research proposal (advancement to candidacy). The Research Proposal must be filed prior to enrollment in BMSC 5395. 30 SCH are accumulated at this point. If degree requirements are not met, student continues to register for BMSC 5998.				
BMSC	5998	Individual Research	1-12	Fall year 2
BMSC	5395	Thesis	1-12	Fall year 2
		Advanced Courses/ WiPs	0-3	Fall year 2
		Subtotal	***12***	
Once a student completes the research proposal, SCH can be reduced to 9 SCH.				
BMSC	5395	Thesis	1-9	Spring year 2
PSPT	6100	Independent Topics in PSPT		Spring year 2
		Subtotal	***9***	
		Minimum 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 90 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 approximately 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	Responsible Conduct of Research	1	Spring year 1
BMSC	5315	Principles of Scientific Communication	2	Spring year 1
BMSC	5998	Individual Research	1-4	Spring year 1
PSPT	6100	Independent Topics in Pharmaceutical Sciences (Journal Club)	1	Spring year 1
PSPT	6400	Principles of Drug Discovery and Development	4	Spring year 1
		Subtotal	***12***	
Milestones to be completed: Designation of Advisory Committee, Degree Plan				
BMSC	6998	Individual Research (**max 40 SCH**)	1-6	Summer year 1
		Advanced Courses	0-4	Summer year 1
		Subtotal	***6***	
Milestone to be completed: Oral Qualifying Examination, Research Summary (annual committee meeting)				
BMSC	6998	Individual Research	1-10	Fall year 2
		Advanced Courses/ Electives	1-4	Fall year 2
		Works in Progress	0-1	Fall year 2
		Subtotal	***12***	
BMSC	6998	Individual Research	1-11	Spring year 2
PSPT	6100	Independent Topics in PSPT	1	Spring year 2
		Advanced Courses/ Electives	0-11	Spring year 2
		Subtotal	***12***	
BMSC	6998	Individual Research	1-6	Summer year 2
		Advanced Courses/Electives	0-4	Summer year 2
		Subtotal	***6***	

Milestone to be completed: A Research Progress Summary (annual committee meeting) and approved Research Proposal (subsequently advancement to candidacy) must be on file prior to enrollment in Doctoral Dissertation (BMSC 6395). Once a student completes qualifying exam and research proposal, SCH can be reduced to 9 SCH.				
BMSC	6998	Individual Research	0-11	Fall year 3
		Works in Progress	0-1	Fall year 3
BMSC	6391	Pedagogy in PSPT	1	Fall year 3
		Advanced Courses	0-8	Fall year 3
		Subtotal	***9-12***	
BMSC	6998	Individual Research	0-11	Spring year 3
BMSC	6395	Doctoral Dissertation (**max 12 SCH**)	0-9	Spring year 3
PSPT	6100	Independent Topics in PSPT	1	Spring year 3
		Advanced Courses/Electives	0-8	Spring year 3
		Subtotal	***9-12***	
BMSC	6998	Individual Research	0-6	Summer year 3
BMSC	6395	Doctoral Dissertation	0-6	Summer year 3
		Advanced Courses	0-5	Summer year 3
		Subtotal	***6***	
BMSC	6998	Individual Research	0-9	Fall year 4
BMSC	6395	Doctoral Dissertation	0-9	Fall year 4
BMSC	6391	Pedagogy in PSPT	1	Fall year 4
		Subtotal	***9-12***	
		Total for Degree	***90***	
130 SCH is the maximum hours for in-state tuition. In some cases, a different degree plan may be applicable. In all cases, the degree plan must be approved by the student's advisory committee and the Dean of the GSBS.				

For students entering the Ph.D. program with the M.S. or other advanced degree, some of the BMSC core courses may be waived. Waiving of a core course will usually require that the student has made a grade of B or above in an equivalent course or has made a grade of 80 or above in a waiver examination. Course waiver must have Dean and advisory committee approval. The waiving of a course does not mean the student will receive credit for those specific course hours toward the Ph.D. degree. Once it is determined which core courses are to be waived, the remaining course hours required for the Ph.D. are determined by the student's Advisory Committee.

1. D.O./M.S. Degrees At least 18 SCH, not including courses in the D.O. program will be required to obtain the M.S. degree. These SCH will normally include:

BMSC 6200	Intro to Exp Design & Biostatistical Methods	2 SCH
BMSC 5160	Responsible Conduct of Research	1 SCH
BMSC 5315	Principles of Scientific Communications	1 SCH
BMSC 5998	Individual Research for MS students	3 or more SCH
BMSC 5395	Thesis	3 or more SCH
PSPT 6100	Independent Topics in PSPT (minimum 2 SCH)	2 SCH
	Electives	Variable

2. D.O./Ph.D. Degrees At least 45 SCH, not including courses in the D.O. program, are required to obtain the Ph.D. degree as a second terminal degree. These SCH will normally include:

BMSC 6200	Intro to Exp Design & Biostatistical Methods	2 SCH
BMSC 5160	Responsible Conduct of Research	1 SCH
BMSC 5315	Principles of Scientific Communications	1 SCH
BMSC 6998	Individual Research	3 or more SCH
BMSC 6395	Doctoral Dissertation	12 SCH
PSPT 6100	Independent Topics in PSPT (minimum 2 SCH)	2 SCH
PSPT 6400	Principles of Drug Discovery & Development	4 SCH
	Advance Course/Electives	Variable

3. PharmD/Ph.D. Degrees At least 70 SCH, not including courses in the PharmD program, are required to obtain the Ph.D. degree as a second terminal degree.

BMSC 6200	Intro to Exp Design & Biostatistical Methods	2 SCH
BMSC 6202	Fundamentals of Biomedical Science II	2 SCH
BMSC 6203	Fundamentals of Biomedical Science III	2 SCH
BMSC 5160	Responsible Conduct of Research	1 SCH
BMSC 5315	Principles of Scientific Communications	1 SCH
BMSC 6998	Individual Research	3 or more SCH
BMSC 6395	Doctoral Dissertation	12 SCH
PSPT 6100	Independent Topics in PSPT (minimum 2 SCH)	2 SCH
PSPT 6400	Principles of Drug Discovery & Development	4 SCH
	Advance Course/Electives	Variable

- PhD students are required to take at least two advance courses in addition to PSPT 6400.

ADVANCEMENT TO CANDIDACY

I. Master of Science

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

The research proposal is a detailed outline of the thesis project. It must include a summary of the proposed project, the hypothesis and aims to be investigated, significance and innovation of the project, research design and methodology to be used, a review of the salient literature that supports or opposes the hypothesis, and potential limitations. To take advantage of the advisory committee's expertise and advice, and to clearly define the project and the committee's expectations, it is imperative that the student meets with his/her advisory committee before preparing the research proposal. **The research proposal should be provided to the advisory committee no later than 14 days prior to the defense.** The formal public presentation will be followed by a private defense of the research proposal to the members of the student's advisory committee. The research proposal must be approved by the advisory committee and the Dean prior to registering for Thesis (BMSC 5395). It is expected that M.S. students will complete their Research Proposal in the Fall of year 2. Research Proposal Guidelines and the Research Proposal approval forms are available on the GSBS Forms and Guidelines website.

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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 Pharmaceutical Sciences & Pharmacotherapy Discipline for advancing to candidacy.

A. Oral Qualifying Examination

The qualifying examination ensures that the doctoral student has mastered information needed to succeed as a PhD in the fields of Pharmaceutical Sciences & Pharmacotherapy. The graduate advisor will distribute a list of key topics to the student prior to the qualifying examination. The student is expected to become knowledgeable in each of these topics through their previous course work, reading of textbooks and scientific literature, and discussion with faculty members.

The qualifying examination is administered by a committee comprised of members of the Pharmaceutical Sciences & Pharmacotherapy graduate faculty and the student's university member. The committee is established by the Pharmaceutical Sciences & Pharmacotherapy Graduate Advisor. The Graduate Advisor will chair the committee, unless he/she is the major professor for the student taking the oral qualifying exam. In such a case, an alternate chair will be appointed by the graduate advisor. The qualifying examination will be administered in the summer of the first year. The student will be given a list of questions covering topics from core and required advanced courses. The student will be given 1 hour 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 the oral qualifying exam will be determined by the 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 student 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, university member, graduate advisor, and department chairman upon completion of the exam. The appropriate form may be obtained from the GSBS Forms and Guidelines website.

B. Research Proposal

The research proposal is a detailed outline of the dissertation project. It must include a summary of the proposed project, the hypothesis and aims to be investigated, significance and innovation of the project, research design and methodology to be used, a review of the salient literature that supports or opposes the hypothesis, and potential limitations. To take advantage of the advisory committee's expertise and advice, and to clearly define the project and the committee's expectations, it is imperative that the student meets with his/her advisory committee before preparing the research proposal. **The research proposal should be provided to the advisory committee no later than 14 days prior to the defense.** The formal presentation and defense of the research proposal will only be to the members of the student's advisory committee. The research proposal must be approved by the advisory committee and the Dean prior to registering for Dissertation (BMSC 6395). It is expected that PhD students will complete their Research Proposal no later than the summer of year 2. 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.