UNT | HEALTH SCIENCE CENTER

GRADUATE SCHOOL OF BIOMEDICAL SCIENCES

Cell Biology, Immunology & Microbiology Student Handbook 2018-19

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 Cell Biology, Immunology & Microbiology.

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Cell Biology, Immunology & Microbiology Discipline

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Graduate Faculty: Allen; Berg; Borejdo; Clark; Fudala; I. Gryczynski; Z. Gryczynski; He; Hodge; Jones; Krishnamoorthy; P. Mathew; S. Mathew; Millar; Park; Simecka; Su; Timani; Zode

Cell biology is the branch of biology that focuses on the study of cells, especially their formation, structure, components, and function. Immunology is the study of the defense mechanisms of the host against infectious diseases, cancers and other diseases. Microbiology is the study of microscopic forms of life, including bacteria, viruses, protozoans, and fungi. The disciplines of cell biology, immunology, and microbiology are uniquely intertwined and rely on cutting-edge techniques to answer questions related to multiple diseases. Gaining a thorough understanding of the molecular and cellular mechanisms used by the body to combat infectious diseases and other pathologies can result in the development of therapeutic approaches to prevent and cure these diseases.

Specific research interests of the cell biology, immunology, and microbiology faculty include neuroinflammation; HIV-1 biology; fluorescence spectroscopy and imaging; regulation of eukaryotic gene expression; T cell and NK cell biology; host response to infections; molecular immunology; tumor immunology; cytokine biology; vision research; function of skeletal and cardiac muscles; and molecular diagnostics for emerging vector borne pathogens. Faculty programs are funded by multiple sources including the federal government, state government, and private foundations.

The Cell Biology, Immunology & Microbiology graduate training program, culminating in either a MS or PhD degree, involves core courses that integrate key concepts of biochemistry, cell biology, molecular biology, genetics, physiology, pharmacology, immunology, and microbiology, as well as advanced courses in selected topics. Students participate in seminars and discussion of current research and receive extensive training in techniques of contemporary molecular biology, cell biology, immunology, and microbiology. Students perform original, publishable research and present their research findings at local, national, and international scientific meetings. In addition, students are required to present their research at the annual UNTHSC Research Appreciation Day (RAD) and during the weekly departmental Works in Progress (WIPs) presentations.

Approximately two years are required to complete the MS degree, while the PhD degree is normally completed in approximately five years.

Graduates with advanced degrees typically find employment in higher education, industry and government agencies.

Cell Biology, Immunology & Microbiology Graduate Faculty and Their Research

Michael Allen, PhD
Associate Professor, Microbiology, Immunology & Genetics
Category III

Our research focuses on understanding the ecological principles and factors that underlie microbial community dynamics in living and engineered systems, the mechanisms bacteria use for sensing changes in their environment, and the global genetic regulatory systems involved in adaptation. Specific areas of interest include: the microbiomes of ticks and other vectors and how these influence disease transmission, methods to manipulate microbial community composition, genetically engineered microbes as therapeutic treatments, lung microbiomes and disease resistance, and applications of microbial community analysis in forensics.

Rance Berg, PhD
Associate Professor, Microbiology, Immunology & Genetics
Category III

My laboratory has a long-standing interest in understanding the cellular and molecular aspects of immune responses against pathogenic microorganisms. Specifically, the gram-positive bacterium, *Listeria monocytogenes*, is utilized to dissect the roles of T cells, NK cells, NK-T cells, dendritic cells, monocytes, neutrophils, and macrophages during the innate and adaptive immune responses to this pathogen. Elucidating the proliferative capacity, cytokine/chemokine secreting potential, localization, and ultimate fate of these and other immune effector cells allows us to understand how the immune system coordinately responds to, and controls, pathogens. We are also actively studying how cytokine/chemokine networks, oxidative stress, and enzymes that regulate the production of reactive oxygen and nitrogen species modulate immune responses and clearance of pathogens.

Julian Borejdo, PhD
Professor, Microbiology, Immunology & Genetics
Category III

My long-term goal is to understand how muscle works. Since mechanism of contraction of muscles (skeletal, smooth & cardiac) and of movement of non-muscle cells is based on the same principle this work is likely to have an impact on understanding the general principles of cell motility. I measure kinetics of rotations of few molecules of myosin in muscle. Muscle contraction results from interactions of myosin subfragment-1 (S1, cross-bridge) with actin. S1 consists of the N-terminal catalytic domain and the C-terminal regulatory domain. It is believed that the swing of the regulatory domain is caused by a specific event during the ATPase cycle of a cross-bridge. Thus, measuring orientation of cross-bridges in muscle is a key to understanding the molecular mechanism of muscle contraction. Ideally, orientation should be measured from a single molecule to avoid averaging signal from large assembly of myosins. The introduction of extremely small observational volumes defined by diffraction-limited laser beams and confocal detection made it possible to limit the number of observed molecules and eliminate much of the background. I have used confocal microscope to measure anisotropy of small number cross-bridges in muscle. Recently, my interest focused mainly on the question of the possible differences between cardiac muscle of the left and right ventricles, and the effect cardiac hypertrophy-causing mutations (such as R21C mutation in Troponin I) on the function of the ventricles.

Abe Clark, PhD
Regents Professor, Pharmacology & Neuroscience
Category III

Dr. Clark's research interests are focused on understanding the biochemical, cellular and molecular mechanisms involved in the pathobiology of glaucoma and other ocular diseases. His research focuses on the trabecular meshwork, optic nerve head, and retinal ganglion cells. His collaborates with laboratories throughout the US as well as internationally.

Rafal Fudala, PhD
Assistant Professor, Microbiology, Immunology & Genetics
Category II

Dr. Fudala in his current ongoing studies using fluorescence-based methods such as: laser confocal microscopy, fluorescence resonance energy transfer (FRET), fluorescence lifetime imaging microscopy (FLIM), and cellular imaging as well as polarization-based techniques. Recently, Dr. Fudala's interests have expanded to include fluorescence-based methods in biology and cellular imaging, as well as biological/biophysical applications of new nanophotonics processes and single molecule studies in the biomedical and diagnostic fields, especially for early malignant melanoma detection.

Ignacy Gryczynski, PhD
Professor, Microbiology, Immunology & Genetics
Category III

Fluorescence spectroscopy and microscopy progressed recently towards a nanotechnology. The technological advances in optics, computers, surface science and engineering made possible single molecule detection and overcome the diffraction limit. Dr. Gryczynski´s research focuses on fluorescence enhancements near metallic surfaces and particles. The enhanced fluorescence is being applied to sensing devices and bioassays. He also co-manages the time-resolved fluorescence laboratory. This laboratory carries basic spectroscopy research and is open to the needs of researchers

Zygmunt Gryczynski, PhD
Professor, Microbiology, Immunology & Genetics
Category III

The activities of the Center for Fluorescence Technologies and Nanomedicine (CFTN) are focused on applications of fluorescence spectroscopy and nanotechnology to study various biological systems using time-resolved fluorescence, anisotropy, and FRET. The main areas of CFTN are development of new technological approaches to fluorescence-based detection and imaging; development of novel fluorescent probes to study molecular interactions and dynamics on molecular and cellular levels; nanotechnology enabled plasmonic effects induced by light and excited fluorophore in metallic nanostructures; surface plasmons coupled emission (SPCE) phenomena for biomedical and diagnostics application (biophotonics).

Johnny He, PhD
Regents Professor and Interim Chair, Microbiology, Immunology & Genetics
Category III

Dr. He's research focuses on the molecular biology of host-virus interactions. His long-term goal is to understand how human cells interact with HIV/HCV viruses and to develop therapeutic strategies specifically targeted at these interactions. On basic studies, Dr. He is interested in determining what cells are infected by HIV/HCV, how these cells are infected by HIV/HCV, what host factors are needed to support virus replication, and how these infections alone or in combination ultimately lead to diseases. On translational studies, Dr. He is interested in development of therapeutics that is able to attack the viruses and/or prevent the diseases. Dr. He has been collaborating with investigators in countries such as China with limited resources but rapidly increased HIV infected population to determine how viral, host and socio-economic factors affect the nature and prevalence of HIV/HCV-associated diseases and their treatment. He has made several extremely novel observations including identification of the human mannose receptor as the HIV receptor for infection of CD4 negative astrocytes and elucidation of the mechanisms by which HIV-1 Tat protein leads to neurotoxicity. His development of the HIV Tat transgenic mouse model has allowed numerous research laboratories across the world to make advances in HIV neuropathogenesis research. In addition, Dr. He has been a leader in studying the interactions between HIV and Hepatitis C virus and has developed important collaborations in China to study the impact of these diseased on public health.

Lisa Hodge, PhD
Associate Professor, Physiology & Anatomy
Category III

Our long- range research goal is to evaluate the effectiveness of osteopathic manipulative techniques (OMT) at modulating the immune response against a variety of infectious and inflammatory diseases. Clinical studies support the application of OMT for the treatment of infection, edema, neuromuscular dysfunction, and pain, but experimental support for their use is sparse and the mechanisms involved are not well understood. Currently, we are examining the mechanisms by which OMT influences lymphatics, inflammation, and lymphocyte migration during pneumonia, cancer and following tissue injury. In addition, we develop animal models to study the mechanisms by which alternative medicine therapies augment the lymphatic and immune systems in both healthy and diseased states.

Harlan Jones, PhD
Associate Professor, Microbiology, Immunology & Genetics
Category III

There is increasing evidence that psychological stress is an important risk factor in the initiation and progression of chronic disease (e.g. cancer, atherosclerosis and chronic infectious disease). My research interests include the investigation of how stress affects host immune mediation of chronic disease states with the intention of facilitating comprehensive therapeutic approaches against stress-induced disease pathogenesis.

Raghu Krishnamoorthy, PhD
Associate Professor, Pharmacology & Neuroscience
Category III

The major research emphasis is on understanding biochemical and molecular mechanisms underlying the etiology of glaucoma. Specific research interests are to understand the regulation of expression of the vasoactive active peptides, endothelins, and their receptors, which are thought to contribute to glaucomatous optic neuropathy. The long-term goals are to provide treatment modalities that block inappropriate expression of endothelin receptors in ocular tissues.

Porunelloor Mathew, PhD
Associate Professor, Microbiology, Immunology & Genetics
Category III

My laboratory focuses on the area of Cancer Immunology, specifically the molecular mechanisms by which Natural Killer (NK) cells recognize and eliminate cancer cells. NK cells are a subpopulation of lymphocytes that play an important role against cancer and various viral and bacterial infections. NK cell functions are controlled by a balance between positive and negative signals through various receptors. In order to understand the molecular basis of tumor cell recognition by NK cells, we identified, cloned and characterized three novel receptors expressed on NK cells. One of the receptors, 2B4 (CD244), is a member of the immunoglobulin superfamily and is involved in killing cancer cells and virus-infected cells by NK cells. By generating 2B4 gene knockout mice, our group explored the in vivo role of 2B4 in the immune system. Defective signaling via 2B4 contributes to X-linked lymphoproliferative disease (XLP) in humans. Dr. Mathew also identified two other novel receptors called LLT1 and CS1 (CD319) that play a role in killing of cancer cells by NK cells. Recently it has been reported that CS1 is overexpressed in multiple myeloma and a humanized

monoclonal antibody against CS1 (HuLuc63 or Elotuzumab) is in clinical trial for multiple myeloma. Dr. Mathew's research has opened new NK cell based targeted immunotherapy for cancer. We are also investigating the role of 2B4 and CS1 in autoimmune disease. Current research focuses on the role of LLT1 receptor in immune escape by breast cancer and prostate cancer.

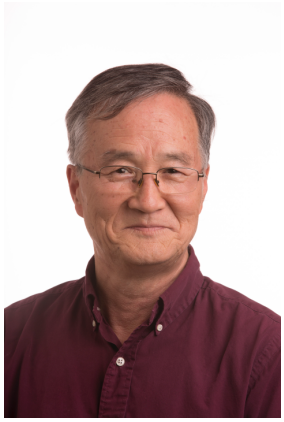
Stephen Mathew, PhD
Assistant Professor, Microbiology, Immunology & Genetics
Category II

Dr. Stephen Mathew's research focuses on understanding the role of natural killer (NK) cell receptors in different disease models like cancer and lupus. Natural killer (NK) cells are cells of the immune system that form the first line of defense against cancer and infectious diseases. The research in his laboratory is focused towards unraveling the molecular basis of tumor cell recognition by NK cell and its multiple receptor ligand interactions. Specifically, in collaboration with pediatric oncologists and basic science researchers, the research team is investigating the role of immune receptors in acute lymphoblastic leukemia (ALL) in children. This will provide important insights into the etiology of childhood leukemia as well as the development of new treatments that may improve the outcome of children with leukemia by modifying the function of immune cells in these patients. The other projects in the laboratory deal with deciphering the role of immune receptors 2B4, CS1 and LLT1 in prostate cancer, breast cancer, ewing sarcoma, and lupus.

Cameron Millar, PhD
Research Assistant Professor, Pharmacology & Neuroscience
Category I

My major research interests focus around primary open-angle glaucoma (POAG), a heterogeneous group of potentially blinding optic neuropathies that share characteristic pathognomic changes to the optic disk and visual field of the eye. In recent years, I have focused on the mouse as a model for the study of this disease. My current interests include (in the mouse): Measurement of intraocular pressure (IOP). The study of aqueous humor dynamics, and age and strain effects on the same. Creation of induced models of POAG via over-expression of POAG-associated transgenes (for example; $sFRP_1$, SAA, MYOC.Y437H, Gremlin, $hTGF\beta_2^{226/228}$) using viral vectors based on adenovirus (Ad), adeno-associated virus (AAV), and lentivirus (FIV and HIV). Expression of viral-vector transfected fluorescent reporter genes to assess locus of expression (e.g. GFP, eGFP, copGFP) via fluorescence detection both in vivo and in fixed sections of ocular tissue. Creation of induced models of POAG via daily topical treatment with dexamethasone. Creation of transgenic (Tg) models of POAG (for example, TgMYOC.Y437H). Models of retinal ganglion cell (RGC) degeneration achieved via retinal ischemia/reperfusion (I/R) and optic nerve crush (ONC). Imaging of retinal tissues via Spectral Domain-Ocular Coherence Tomography (SD-OCT). Assessment of visual acuity via assessment of the optomotor response. Assessment of the electroretinogram (ERG). Ocular examination (slit lamp examination, direct ophthalmoscopy, gonioscopy).

In-Woo Park, PhD
Associate Professor, Microbiology, Immunology & Genetics
Category III



Dr. Park's research focuses on two main topics. The first is HIV-1-mediated aggravation of liver disease in HCV virus coinfectees. While this basic phenomenon is well documented, the laboratory now wishes to unravel the specific mechanisms by which HIV-1 augments HCV replication in accelerating hepatic malady. The second topic, which is critical to AIDS pathobiology, is the HIV-1-triggered virus/cell protein degradation that occurs at all phases, from virus entry to progeny virion release. The laboratory is currently applying a range of molecular studies to identify and evaluate the coordinate viral/host determinants that orchestrate protein fates.

Jerry Simecka, PhD
Regents Professor, Pharmaceutical Sciences
Category III

The major goal of our laboratory is to understand the immune mechanisms involved in respiratory diseases. Immune responses along the respiratory tract have both beneficial and detrimental effects. Immune responses can protect against infectious disease by preventing infection or by eliminating disease causing bacteria or viruses. However, in some cases, the immune response can contribute to the problem. This is the case for infectious diseases and asthma. We are taking advantage of a murine model of respiratory pneumonia caused by mycoplasma to study the generation of immunity that leads to either protection or more severe disease. Mycoplasmas are major causes of pneumonia in man and animals. The immune response against a mycoplasma infection has both beneficial and detrimental effects. We have shown that immune responses, through the activity of T cells, clearly promote the development of inflammatory reactions leading to severe mycoplasma lung disease. However, immune responses can also prevent disease and ensures that the infection remains localized to the lung. Our work is focusing on the role of T cell populations, antigen presenting cell populations and cytokine networks in determining the impact of immunity in mycoplasma disease.

Dong-Ming Su, PhD
Professor, Microbiology, Immunology & Genetics
Category III

The goal of Dr. Su's research is to provide mechanistic insights into rejuvenating aged poor and harmful T-cell immunity, focusing on establishment and maintenance of thymic microenvironment, using cellular and molecular approaches. The lab particular strengths include using and generating genetically engineered mouse models in understanding genetic and epigenetic regulation of T cells, thymic epithelial cells, and immune system microenvironment development-associated immunodeficiency and aging-associated chronic inflammation. The lab has several well-designed research projects with unique animal models, reagents, and knowledge necessary. In addition, with on-campus and interuniversity collaboration, Dr. Su's research is also involved in studies on utility of bone marrow mesenchymal stem cells in rejuvenation of neurodegeneration, as well as tumor dormancy in the thymus as a tumor cell reservoir.

Khalid Timani, PhD
Research Assistant Professor, Microbiology, Immunology & Genetics
Category I

Dr. Timani's research focuses on elucidation of the role of Tip110/SART3 in regulation of cancer progression. Function of Tip110 is multifarious, ranging from modulation of tumor antigenicity, regulation of gene transcription, splicing of pre-mRNA, to development of embryo. We demonstrated that Tip110/SART3 protein interacts with and/or regulates several transcription factors such as p53, c-Myc and YB-1, which are important for regulation of cancer progression. We also reported that USP15, an oncogenic protein, regulates UPS-mediated Tip110 protein degradation. Based on these findings, we employ multifaceted experimental approaches, using animal models, to investigate molecular mechanisms and biological significance of Tip110-mediated regulation of oncogenic proteins with respect to cancer development.

Gulab Zode, PhD
Assistant Professor, Pharmacology & Neuroscience
Category III

My research focus is to understand the pathological molecular mechanisms of glaucoma, a leading cause of irreversible blindness worldwide and to develop therapeutic targets based on the understanding of these mechanisms. Recently, we have demonstrated the pathological role of protein misfolding and endoplasmic reticulum (ER) stress in glaucomatous trabecular meshwork and elevation of intraocular pressure (Zode et al., 2011 and 2014). Main current projects in my laboratory are: 1) Gene therapy: Using shRNA or CRISPR mediated knock down of mutant myocilin or ER stress pathway genes to rescue glaucoma in our mouse models. 2) Protein misfolding and ER stress in glaucoma: Further studying how mutant myocilin causes ER stress and manipulation of these pathways for treatment. 3) Studying the pathological role of ER-stress induced pro-apoptotic transcriptional factor Chop in TM cell death and IOP elevation and 4) Studying the role of autophagy and phagocytosis of trabecular meshwork cells.

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 Cell Biology, Immunology & Microbiology Discipline and enroll in MIMG 6203, MIMG 6204, and MIMG 6206.

I. REQUIRED COURSES

Advanced Cell Biology (MIMG 6203) – 2 SCH
Advanced Immunology (MIMG 6204) – 2 SCH
Fundamentals of Microbiology (MIMG 6206) – 2 SCH

An MS or PhD student who receives a "C" or "F" in one of these required courses (MIMG 6203, MIMG 6204, or MIMG 6206) 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. An MS or PhD student who receives two or more "C's" or "F's" in the discipline-specific required courses must retake those courses in their entirety the following year. If the PhD student receives "A's" and/or "B's" upon retaking the courses, they will be allowed to take the oral qualifying exam.

II. SEMINAR COURSES, JOURNAL CLUB COURSES, AND WIPs

Current Topics in Immunology (MIMG 5122) – 1 SCH
Current Topics in Cell Biology (MIMG 6141) – 1 SCH
Seminar in Current Topics (MIMG 5140) – 1 SCH

All CBIM students are required to register for a journal club course (MIMG 5122, MIMG 6141, or comparable course) during every long semester beginning in the spring of year 1. 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. All MS and PhD students are required to present their research in Seminar in Current Topics (MIMG 5140), also known as "Works in Progress or WIPs," once per year beginning in their second year.

III. ELECTIVE (ADVANCED AND TECHNIQUE) COURSES (Must include 4-6 SCH for MS Students and 8-10 for PhD students from the following (other courses can be substituted according to the research project of the student):

Offered every fall and spring:
Bioimaging (MIMG 5201) – 2 SCH
Introduction to Confocal Microscopy (MIMG 5202) – 2 SCH

Offered every fall:
Principles of Super Resolution Microscopy (MIMG 6101) - 2 SCH
Histology (PHAN 5400) - 2 SCH
Practical Fluorescence for Biomedical Science (MIMG 6210) - 2 SCH
Cellular and Molecular Fluorescence (MIMG 6220) - 2 SCH
Practical Laser Capture Microdissection (MIMG 6230) - 1 SCH

Offered every spring:
Animal Models of Immunological Diseases (MIMG 6207) - 2 SCH
Molecular and Cell Biology of Cancer (MIMG 6250) - 2 SCH
Clinical Immunology (MIMG 6355) - 3 SCH

Offered every summer:
Introduction to Flow Cytometry (MIMG 5150) - 1 SCH
Introduction to Bioinformatics (PHRM 5200) - 2 SCH
Methods in Molecular Biology (PHRM 6440) - 4 SCH

Offered in "even" fall semesters:
Immune Responses Against Pathogenic Microorganisms (MIMG 6201) - 2 SCH

Offered in "even" spring semesters:
Emerging Role of the Microbiome in Health and Disease (MIMG 5500) - 2 SCH

Offered in "odd" fall semesters:
Advanced Molecular Biology: Techniques and Principles (MIMG 6202) - 2 SCH
Fundamentals of Virology (MIMG 6205) - 2 SCH
Receptors and Second Messenger Signaling (MIMG 6435) - 2 SCH
Kinases and Phosphatases (MIMG 6436) - 2 SCH

Offered in "odd" spring semesters:
Advanced Biophysical and Biochemical Methods (MIMG 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	1	Spring year 1
MIMG	5140	Seminar in Current Topics	1	Spring year 1
MIMG	6203	Advanced Cell Biology	2	Spring year 1
MIMG	6204	Advanced Immunology	2	Spring year 1
MIMG	6206	Fundamentals of Microbiology	2	Spring year 1
		Journal Club Course	1	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	3-6	Summer year 1
		Advanced Courses	0-3	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 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	Biomedical Ethics	1	Spring year 1
BMSC	5315	Principles of Scientific Communication	2	Spring year 1
BMSC	5998	Individual Research	1	Spring year 1
MIMG	5140	Seminar in Current Topics	1	Spring year 1
MIMG	6203	Advanced Cell Biology	2	Spring year 1
MIMG	6204	Advanced Immunology	2	Spring year 1
MIMG	6206	Fundamentals of Microbiology	2	Spring year 1
		Journal Club Course	1	Spring year 1
		Subtotal	***12***	
Milestones to be completed: Designation of Advisory Committee, Degree Plan				
BMSC	6998	Individual Research	2-6	Summer year 1
		Advanced Courses	0-4	Summer year 1
		Subtotal	***6***	
Milestone to be completed: Oral Qualifying Examination				
BMSC	6998	Individual Research	4-8	Fall year 2
MIMG	5140	Seminar in Current Topics	1	Fall year 2
		Journal Club Course	1	Fall year 2
		Advanced Courses	2-6	Fall year 2
		Subtotal	***12***	
BMSC	6998	Individual Research	1-5	Spring year 2
MIMG	5140	Seminar in Current Topics	1	Spring year 2
		Journal Club Course	1	Spring year 2
		Advanced Courses	2-6	Spring year 2
		Subtotal	***12***	

BMSC	6998	Individual Research	2-5	Summer year 2
		Advanced Courses	1-4	Summer year 2
		Subtotal	***6***	
Milestone to be completed: A Research Proposal must be on file prior to enrollment in Doctoral Dissertation (BMSC 6395)				
BMSC	6998	Individual Research	4-5	Fall year 3
		Journal Club Course	1	Fall year 3
		Advanced Courses	2-3	Fall year 3
		Subtotal	***9***	
BMSC	6998	Individual Research	5-6	Spring year 3
		Journal Club Course	1	Spring year 3
		Advanced Courses	2-3	Spring year 3
		Subtotal	***9***	
BMSC	6998	Individual Research	2-5	Summer year 3
		Advanced Courses	1-4	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.

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 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 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.

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 Cell Biology, Immunology & Microbiology 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 Cell Biology, Immunology, and Microbiology. 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 Cell Biology, Immunology & Microbiology graduate faculty and the student's university member. The committee is established by the Cell Biology, Immunology & Microbiology 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 student's major professor may attend the qualifying examination but may not ask questions, be present during the voting, or cast a vote. 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.