Cell Biology, Immunology & Microbiology Discipline Handbook 2023-2024

Regardless of the discipline, each SBS student (MS or PhD) will receive the degree of Biomedical Sciences. The discipline is listed on the transcript as the Major.

The information provided in this document serves to supplement the requirements of the 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

Michael Allen, PhD, Graduate Advisor
office: CBH 361
Phone: 817-735-2121
Email: Michael.Allen@unthsc.edu
Discipline website: https://www.unthsc.edu/school-of-biomedical-sciences/cell-biology-immunology-and-microbiology/

Graduate Faculty: Allen, Berg, Bunnell, Hodge, Jones, Krishnamoorthy, Malaer, P. Mathew, S. Mathew, Mathis, Ortega, Park, Sankpal, Simecka, Su, Vishwanatha, Woerner, Zhang, Zascavage

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 and SARS-CoV-2 biology, stem cell biology, regulation of eukaryotic gene expression, T cell and NK cell biology, host response to infections, molecular immunology, tumor immunology, cytokine biology, 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 M.S. or Ph.D. 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 HSC Research Appreciation Day (RAD) and in the Departmental Seminars in Microbiology, Immunology and Genetics series each year. 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

Graduate Faculty Membership Categories: Associate members of the Graduate Faculty are able to serve as members of thesis or dissertation advisory committees, as major professors or co-major professor on thesis advisory committees, and as co-major professor on dissertation advisory committees with a full member as the other co-major professor. Full members of the Graduate Faculty are able to serve as members of thesis or dissertation advisory committees, and as major professors or co-major professor on thesis or dissertation advisory committees.

Michael Allen, Ph.D.
Professor, Microbiology, Immunology & Genetics
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/michael-allen
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 this influences disease transmission, methods to manipulate microbial community composition, pathogenicity and virulence of *Borrelia burgdorferi*, genetically engineered microbes as therapeutic treatments, and applications of microbial community analysis in tracking pathogens and antibiotic resistance genes in the environment.

Rance Berg, Ph.D.
Associate Professor, Microbiology, Immunology & Genetics
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/rance-berg
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.

Bruce Bunnell, Ph.D.
Professor and Chair, Microbiology, Immunology & Genetics
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/bruce-bunnell
Dr. Bunnell's research program is focused on stem cells and tissue engineering. His group focuses on both the basic science and translational applications of adult stem cells. Dr. Bunnell investigates use of mesenchymal stem cells (MSCs) isolated from the bone marrow or adipose tissue. He is particularly interested in the interactions of MSCs with the immune system and how the cells effectively inhibit robust inflammation in vivo. He is also working on the impact of biologic aging and obesity on the quality of the stem cell populations. His research group has determined that communication between ASCs from obese donors and breast cancer cells induces alterations in the cancer cells to make them more tumorigenic and metastatic. With regard to tissue engineering, Dr. Bunnell's group is collaborating on the development, testing and application of a microphysiologic model of the

osteoarthritic human knee, which is composed of bone, cartilage, adipose tissue, immune cells and synovium. This in vitro physiologic model has applications in understanding disease processes and drug screening.

Kejin Hu, Ph.D.
Associate Professor, Microbiology, Immunology, and Genetics
Graduate Faculty full member
https://experts.unthsc.edu/en/persons/kejin-hu
Dr. Kejin Hu's lab studies molecular mechanisms of human pluripotency and pluripotency reprogramming. Pluripotency is the unique differentiation potentials of human pluripotent stem cells (PSCs) including embryonic stem cells (ESCs) and induced pluripotent stem cells (iPSCs). PSCs have unlimited proliferation and the potentials to become any type of cells in our body. Thus, PSCs are unlimited resources for cell therapy, disease modeling, drug screening and biotechnology. Pluripotency reprogramming is the technology to convert various human somatic cells back to PSCs. The second line of research in Hu lab is roles of bromodomain extra terminal (BET) proteins in inflammation, which is a contributing factor to many human diseases. BET proteins are epigenetic readers due to their ability to bind to the acetylated lysine in histones. His lab uses conditional KO mouse models to study BET roles in neural and heart inflammation. Hu lab also uses human iPSC-derived cell models to study BET roles in human neural inflammation.

Harlan Jones, Ph.D.
Associate Professor, Microbiology, Immunology & Genetics
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/harlan-jones
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, Ph.D.
Associate Professor, Pharmacology & Neuroscience
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/raghu-krishnamoorthy
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.

Joseph D. Malaer, Ph.D.
Assistant Professor, Microbiology, Immunology & Genetics
Graduate Faculty Associate Member
https://experts.unthsc.edu/en/persons/joseph-malaer
Dr. Joseph Malaer's research interest is in cancer immunology, focusing on enhancing natural killer (NK) cell targeting of cancer cells. Dr. Malaer is expanding his research to include best practices in online education. In addition to graduate education, Dr. Malaer is heavily involved in teaching for the undergraduate Biomedical Sciences program and serves as course director for the undergraduate Immunology, Applied Molecular and Cellular Biology, Human Physiology, Introduction to Health Disparities, and Epidemiology courses.

Porunelloor Mathew, Ph.D.
Professor, Microbiology, Immunology & Genetics
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/porunelloor-mathew
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. CS1 is overexpressed in multiple myeloma and a humanized monoclonal antibody against CS1 (Elotuzumab or Empliciti) has been approved as a breakthrough drug for the treatment of 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 Cancer Stem Cells and the role of LLT1and PCNA in immune escape by breast cancer, prostate cancer, and pancreatic cancer.

Stephen Mathew, Ph.D.
Associate Professor, Microbiology, Immunology & Genetics
Graduate Faculty Full Member https://experts.unthsc.edu/en/persons/stephen-mathew
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.

Michael Mathis, Ph.D.
Professor, Pharmacology & Neuroscience Dean, School of Biomedical Sciences
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/j-michael-mathis
Cancer remains one of the major causes of mortality and morbidity in the world. Unfortunately, current therapies are limited by ineffective early detection and treatment; thus, new tools are needed. In my laboratory, we are working in translational research to develop oncolytic virotherapy vectors as gene delivery vehicles for cancer detection and therapy. Oncolytic virotherapy uses engineered replication-competent viruses to infect and kill malignant cells while sparing their normal counterparts. We are modifying capsid proteins on virus vectors for cancer retargeting, as well as developing novel combination approaches to induce anti-cancer immunity. In addition, we are working to develop novel nanoparticle platforms for cancer imaging and detection as well as delivery of anti-cancer cytotoxic agents.

Sterling Ortega, Ph.D.
Assistant Professor, Microbiology, Immunology & Genetics
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/sterling-ortega
The overarching theme of my research program is to discover novel therapeutics that can reverse immune-mediated neurological dysfunction. In line with this focus, my lab studies two debilitating neurological diseases. Stroke, which is caused by the loss of blood flow to the brain, results in neurological injury and inflammation. There is a dynamic interaction between the adaptive immune system and the injured ischemic brain. Our investigations characterize how CD8 T-cells modulate neuropathology and neurorecovery. Self-reactive, neuronal GluN2A-reactive CD8 T-cells produce both interferon-gamma and tumor necrosis factor-beta, which are highly inflammatory cytokines. The immuno-biology of CD8 T-cells makes them perfect harbingers of neuropathology. In parallel, we study the role of neuroprotective myelin-specific CD8 T-cells in a mouse model of Multiple Sclerosis (MS). We have demonstrated that myelin-reactive CD8 T-cells can robustly reverse disease through interferon-gamma production. Investigating CD8 T-cell associated neuroimmune mechanisms that potentiate pathological & direct reparative processes in the brain is a novel, translational approach to treat neurological disease.

In-Woo Park, Ph.D.
Associate Professor, Microbiology, Immunology & Genetics
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/inwoo-park
Dr. Park's research focuses on two main topics. The first is HIV-1-mediated aggravation of liver disease in HCV virus co-infectees. 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.

Umesh Sankpal, Ph.D.
Assistant Professor, Pediatrics & Women's Health / Microbiology, Immunology & Genetics
Graduate Faculty Associate Member
https://experts.unthsc.edu/en/persons/umesh-sankpal
Dr. Sankpal's research is focused on translational cancer research with two specific areas of interest, (i) developing innovative approaches for cancer treatment and (ii) identifying diagnostic/prognostic markers for cancer. The strategy for the first project involves identifying novel anti-cancer compounds that target cancer specific genes and work synergistically with the standard treatments of chemotherapy and radiation. Various cell-based assays, gene expression analysis, and animal models are used to evaluate the underlying molecular mechanism of action and design combination therapies. The second project uses immunohistochemical analysis of breast tumor tissue and analysis of tumor derived exosomes to evaluate potential factors associated with breast cancer that corelate with various clinical-pathological characteristics. The goal is to address disparity in mortality rates between racial groups by using differentially expressed markers for diagnosis/prognosis or as therapeutic targets.

Jerry Simecka, Ph.D.
Regents Professor, Pharmaceutical Sciences
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/jerry-simecka

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, Ph.D.
Professor, Microbiology, Immunology & Genetics
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/dong-ming-su
Dr. Su's research focuses on immunology by providing mechanistic insights into rejuvenating aged poor and harmful T-cell immunity, 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-associated immunodeficiency, immunosenescence, autoimmune predisposition, and aging-associated chronic inflammation (termed inflammaging). The Su lab has several well-designed research projects with unique animal models, reagents, and knowledge necessary.

Jamboor K. Vishwanatha, Ph.D.
Regents Professor, Microbiology, Immunology & Genetics
Graduate Faculty Full Member
https://experts.unthsc.edu/en/persons/jamboor-vishwanatha
Dr. Vishwanatha's research is in cancer molecular biology and experimental therapeutics. His laboratory has established the role of Annexin A2 in extracellular matrix (ECM) degradation and angiogenesis. They identified the function of a novel gene C17orf37 in cancer cell migration and invasion that resulted in a new nomenclature of the gene as migration and invasion enhancer 1 (MIEN1). Their current studies have established Annexin A2 as a novel biomarker for triple negative breast cancer. In other projects, his laboratory has developed sustained release polymeric nanoparticles for targeted delivery of biologicals for cancer therapy. 2) Prostate cancer, molecular markers for progression of oral dysplasia, biological response modifiers, nanoparticle mediated gene delivery.

August Woerner, Ph.D.
Assistant Professor, Microbiology, Immunology & Genetics
Graduate Faculty Associate Member *https://experts.unthsc.edu/en/persons/august-woerner*
My research is in the areas of bioinformatics, population genetics and genomics. My research team's active projects are highly varied, though most relate to forensic genetics and computation. Our recent research includes special topics in microbial forensics, proteomics, and whole genome mixture deconvolution. Most of our research is either method-focused, where we introduce new algorithms or approaches (including machine learning methods) to help answer important questions in forensic genetics and genomics, or it is data-focused, where we leverage data science techniques to help characterize, visualize and better-understand "big data". Often these two scientific perspectives build

on each other; we learn (and/or train algorithms to learn) from large datasets, and we use this information to create better and more powerful inferential tools and techniques.

Roxanne Zascavage, Ph.D.
Assistant Professor, Microbiology, Immunology & Genetics
Graduate Faculty Associate Member
https://experts.unthsc.edu/en/persons/roxanne-zascavage
My research focuses on the generation of improved protocols and processes for genetic analyses in various fields. I work on developing novel forensic applications, including microbial community interrogation for forensically relevant information (geolocation, PMI, etc.) and next-generation sequencing-based human identification, as well as qPCR-based microbial analysis for vector carrying pathogens. Additionally, I am interested in the impact of the mitochondrial DNA on health and aging, especially the cyto-nuclear interactions that contribute to late onset diseases.

Yan Zhang, Ph.D.
Assistant Professor, Microbiology, Immunology & Genetics
Graduate Faculty Associate Member
https://experts.unthsc.edu/en/persons/yan-zhang
My interest is how the microbiome and host interact in health and disease. My research aims to understand the role of the microbiome in disease development (such as tick-borne disease, phenylketonuria, Alzheimer's disease, inflammation after severe injury, etc.). Our projects include tick microbiomes and disease-associated human microbiomes using genomic and metagenomic approaches to investigate the microbial community dynamics. We also provide services for Next Generation Sequencing (MiSeq) and develop bioinformatics and statistical tools for metagenomic analysis.

Requirements

The requirements below are in addition to the SBS requirements listed in the SBS Degree Programs chapter of the UNTHSC Catalog. Additional guidance, forms and evaluation rubrics can be found at SBS Forms and Guidelines website.

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 6201, MIMG 6202, and MIMG 6203.

I. REQUIRED COURSES

Advanced Immunology (MIMG 6201) – 2 SCH
Fundamentals of Microbiology (MIMG 6202) – 2 SCH
Advanced Cell Biology (MIMG 6203) – 2 SCH

- A PhD student who receives "C's" or "F's" in any discipline-specific required course (MIMG 6201, MIMG 6202, or MIMG 6203) must retake the course(s) in their entirety the following year and will be delayed in taking their oral qualifying exam. If the PhD student receives "A's" and/or "B's" upon retaking the course(s), they will be allowed to take the oral qualifying exam.

II. SEMINAR COURSES, JOURNAL CLUB COURSES, AND WIPs

Seminars in Microbiology, Immunology and Genetics (MIMG 5140) – 1 SCH
Journal Club in Immunology (MIMG 5122) – 1 SCH
Journal Club in Cell Biology (MIMG 6141) – 1 SCH
Journal Club in Microbiology (MIMG 5180) – 1 SCH

- All CBIM students are required to register for a journal club course during every long semester beginning in the fall of year 2. 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 CBIM students are required to present their research in Seminars in Microbiology, Immunology and Genetics, 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 SCH for PhD students from the following (other courses can be substituted according to the research project of the student)

Offered in the fall:
Mitochondria and Complex Disease (MIMG/PHRM 6200) - 2 SCH
Immune Responses Against Pathogenic Microorganisms (MIMG 6204) - 2 SCH

Fundamentals of Virology (MIMG 6205) - 2 SCH
Advanced Molecular Biology: Techniques and Principles (MIMG 6206) - 2 SCH
Animal Models of Immunological Diseases (MIMG 6207) - 2 SCH
Practical Fluorescence for Biomedical Science (MIMG 6210) - 2 SCH
Receptors and Second Messenger Signaling (MIMG 6435) - 2 SCH
Kinases and Phosphatases (MIMG 6436) - 2 SCH
Histology (PHAN 5400) - 2 SCH

Offered in the spring:
Bioimaging (MIMG 5201) - 2 SCH
Emerging Role of the Microbiome in Health and Disease (MIMG 5500) - 2 SCH
Molecular and Cell Biology of Cancer (MIMG 6250) - 2 SCH
Clinical Immunology (MIMG 6355) - 3 SCH

Offered in the summer:
Introduction to Flow Cytometry (MIMG 5150) - 1 SCH
Methods in Molecular Biology (PHRM 6440) - 4 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, as shown below. 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	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	6204	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 for MS students	1	Spring year 1
MIMG	5140	Seminars in Micro, Immuno & Genetics	1	Spring year 1
MIMG	6201	Advanced Immunology	2	Spring year 1
MIMG	6202	Fundamentals of Microbiology	2	Spring year 1
MIMG	6203	Advanced Cell Biology	2	Spring year 1
		Journal Club Course	1	Spring year 1
		Subtotal	***12***	

Milestones to be completed: Designation of Advisory Committee, Degree Plan, Annual Progress Report. The Research Proposal must be filed prior to enrollment in Thesis (BMSC 5395).				
BMSC	5108	Transferable Skills	1	Summer year 1
BMSC	5998	Individual Research for MS students	3-6	Summer year 1
		Advanced Courses	0-3	Summer year 1
		Subtotal	***6***	
BMSC	5998	Individual Research for MS students	3-6	Fall year 2
		Advanced Courses	0-3	Fall year 2
		Journal Club Course	1	Fall year 2
		Subtotal	***12***	
BMSC	5395	Thesis	3-6	Spring year 2
BMSC	5998	Individual Research for MS students	3-6	Spring year 2
		Advanced Courses	0-3	Spring year 2
		Subtotal	***12***	
Milestones to be completed: Annual Progress Report, Presentations at RAD and Department Seminar (WIP)				
		Total for Degree (30 minimum)	***54***	

- *Between 1-6 SCH Research hours can be applied to the 30 SCH degree total*
- *Up to 3 SCH Thesis hours can be applied to the 30 SCH degree total*
- *Between 4-6 SCH elective advanced discipline courses are required in the 30 SCH degree total*
- *Additional SCH of research, thesis and advanced course hours can be taken.*

Additional guidance, forms and evaluation rubrics for milestones can be found at SBS Forms and Guidelines website.

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. The degree plan must include 8-10 SCH of elective advance course from the discipline.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	6150	Lab Rotations	2	Fall year 1
BMSC	6200	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	6204	Fundamentals of Biomedical Science IV	2	Fall year 1
		Subtotal	***12***	
Milestones to be completed: Selection of Major Professor, Change of Discipline				

BMSC	5109	Values-Based Considerations in Biomedical Sciences	1	Spring year 1
BMSC	5160	Biomedical Ethics	1	Spring year 1
BMSC	5315	Principles of Scientific Communication	2	Spring year 1
BMSC	6998	Individual Research for PhD students	1	Spring year 1
MIMG	5140	Seminars in Micro, Immuno & Genetics	1	Spring year 1
MIMG	6201	Advanced Immunology	2	Spring year 1
MIMG	6202	Fundamentals of Microbiology	2	Spring year 1
MIMG	6203	Advanced Cell Biology	2	Spring year 1
		Subtotal	***12***	
Milestones to be completed: Designation of Advisory Committee, Degree Plan				
BMSC	5108	Transferable Skills	1	Summer year 1
BMSC	6998	Individual Research for PhD students	2-6	Summer year 1
		Advanced Courses	0-4	Summer year 1
		Subtotal	***6***	
Milestones to be completed: Oral Qualifying Examination, Annual Progress Report				
BMSC	6998	Individual Research for PhD students	4-7	Fall year 2
MIMG	5140	Seminars in Micro, Immuno & Genetics	1	Fall year 2
BMSC	6102	Grant Writing	1	Fall year 2
		Journal Club Course	1	Fall year 2
		Advanced Courses	2-6	Fall year 2
		Subtotal	***12***	
BMSC	6998	Individual Research for PhD students	1-5	Spring year 2
MIMG	5140	Seminars in Micro, Immuno & Genetics	1	Spring year 2
		Journal Club Course	1	Spring year 2
		Advanced Courses	2-6	Spring year 2
		Subtotal	***12***	
BMSC	6101	Responsible Conduct of Research	1	Summer year 2
BMSC	6998	Individual Research for PhD students	2-5	Summer year 2
		Advanced Courses	1-4	Summer year 2
		Subtotal	***6***	
Milestones to be completed: Research Proposal defense & approval, Student must enroll in a minimum of 2 SCH of Doctoral Dissertation once Research Proposal is approved, Annual Progress Report, Presentations at RAD and Department Seminar (WIP)				
BMSC	6395	Doctoral Dissertation	2-3	Fall year 3
		Journal Club Course	1	Fall year 3
		Advanced Courses/MIG Seminar	2-3	Fall year 3
		Subtotal	***6***	
BMSC	6395	Doctoral Dissertation	2-3	Spring year 3
		Journal Club Course	1	Spring year 3

		Advanced Courses/MIG Seminar	2-3	Spring year 3
		Subtotal	***6***	
BMSC	6395	Doctoral Dissertation	2-5	Summer year 3
		Advanced Courses	1-4	Summer year 3
		Subtotal	***6***	
Milestone to be completed: Annual Progress Report, Presentations at RAD and Department Seminar (WIP)				
BMSC	6395	Doctoral Dissertation	2-3	Fall year 4
		Journal Club Course	1	Fall year 4
		Advanced Courses/MIG Seminar	2-3	Fall year 4
		Subtotal	***6***	
BMSC	6395	Doctoral Dissertation	2-3	Spring year 4
		Journal Club Course	1	Spring year 4
		Advanced Courses/MIG Seminar	2-3	Spring year 4
		Subtotal	***6***	
BMSC	6395	Doctoral Dissertation	3	Summer year 4
		Subtotal	***3***	
Milestone to be completed: Annual Progress Report, Presentations at RAD and Department Seminar (WIP)				
		Total for Degree (minimum 90)	***93***	

- *Between 6-20 SCH Research hours can be applied to the 90 SCH degree total*
- *Between 6-30 SCH Dissertation hours can be applied to the 90 SCH degree total*
- *Between 8-10 SCH elective advanced discipline course work are required in the 90 SCH degree total*
- *Additional SCH of research, dissertation and advanced course hours can be taken. They will count toward the maximum 130 SCH permitted with in-state tuition.*

Additional guidance, forms and evaluation rubrics for milestones can be found at SBS Forms and Guidelines website.

Academic Procedures

For additional information regarding Academic Procedures, please refer to the School of Biomedical Sciences Catalog at Academic Procedures (SBS).

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 Procedures, Evaluation Rubrics and Notice of Research Proposal Seminar and Defense are available on the SBS Forms and Guidelines website.

Once a master's student has successfully advanced to candidacy, they 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 milestone 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 at least 3 months 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 student will be provided the committee roster at least two weeks prior to the exam. The committee is established by the Cell Biology, Immunology & Microbiology graduate advisor. The committee is typically comprised of faculty members that taught in the advanced core courses and develop the exam questions as a committee. 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 not attend the qualifying examination or serve on the committee. 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.

SBS Oral qualifying Examination Procedures and Evaluation Rubrics are available on the SBS Forms and Guidelines website. 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 may be allowed to transfer to the MS degree program to complete the requirements for the MS degree.

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 of the research proposal will be to a general audience, while the 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 Procedures, Evaluation Rubrics and Notice of Research Proposal Seminar and Defense are available on the SBS Forms and Guidelines website.

Once a PhD student has advanced to candidacy (completed the oral qualifying exam and research proposal milestones) they are able to enroll in a minimum of 6 SCH per semester, however, at least 2 of the 6 SCH must be in BMSC 6395 (Doctoral Dissertation). Once a PhD candidate submits the "Declaration of Intent to Graduate" Form, they can enroll in a total of 3 SCH of Doctoral Dissertation in the semester in which they will defend their dissertation (the final semester of enrollment). When the time comes, important dates, instructions and forms for graduation can be found on the SBS Graduation Information Webpage.