



**Biochemistry & Cancer Biology
Discipline Handbook
2020-2021**

Check that

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 Biochemistry & Cancer Biology.

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Biochemistry & Cancer Biology Discipline

Rafal Fudala, Ph.D., Graduate Advisor

Carl E. Everett Education & Administration Building – EAD-116B

817-735-0102

Rafal.Fudala@unthsc.edu

Graduate Faculty: Basha, Basu, Bunnell, Chaudhary, Das, Fudala, Gatch, Jones, P. Mathew, S. Mathew, Mathis, Prokai, Ranjan, Sankpal, Thyagarajan, Vishwanatha

The Biochemistry and Cancer Biology program is an interdisciplinary program that offers both MS and PhD degrees. The goal of this program is to provide students with rigorous education and training in biomedical sciences with a specialty in Biochemistry and Cancer Biology. Students receive training through original research, formal classroom education, problem-based learning, seminars, and journal clubs. The program includes faculty members from several departments engaged in various aspects of biochemical, biophysical and cancer research.

The specific research interests of faculty cover a wide range of topics, including signal transduction, posttranslational protein modification in health and disease, protein structure and function, protein-ligand and protein-protein interactions, metabolism, molecular carcinogenesis, tumor immunology, cancer immunotherapy, stem cell biology, tumor invasion and metastasis, tumor microenvironment, cancer therapeutics, drug resistance, drug metabolism, adenovirus-mediated gene therapy, drug delivery, drug discovery, nanotechnology, molecular imaging of cancer and epigenetic effects on cancer risks. The interdisciplinary research also includes investigation of the link between cancer with other disorders. The research projects employ state-of-the-art molecular, cellular and biochemical techniques that include genomics, proteomics, mass spectrometry, molecular cloning, gene targeting, FACS analysis, advanced fluorescence spectroscopy, optical imaging and advanced molecular technology.

Students may choose major professors from any department according to their research interests. In addition, students will be able to utilize the resources and expertise of faculty members with diverse backgrounds from several departments. During the first year, students will acquire sufficient background in biological sciences, including biochemistry, molecular biology, cell biology, pharmacology, microbiology and immunology. The students will have the opportunity to rotate in research laboratories in any department prior to selecting their thesis advisors. Students will take two discipline specific courses. They will be able to select additional elective courses from any department based on their needs and interests. MS students are expected to graduate in 2 years whereas PhD students usually require 5 years to complete their degree.

Biochemistry & Cancer Biology Graduate Faculty and Their Research

Faculty and Position

Riyaz M. Basha, Ph.D.

Associate Professor
Pediatrics



Research Interests

Dr. Basha's research is in the area of experimental therapeutics. The aberrant expression of certain molecular markers is associated with aggressive disease and poor prognosis in a variety of human malignancies. His lab is working on targeting c-Met (a receptor for hepatocyte growth factor), Specificity protein 1 (Sp1) transcription factor and survivin or baculoviral inhibitor of apoptosis repeat-containing 5 (BIRC5), an inhibitor of anti-apoptotic protein for enhancing therapeutic efficacy in cancer. These markers are associated with resistance to chemo- and radiation therapies and impact the disease progression and prognosis of cancer patients. We are testing certain investigational agents that have the ability to target these candidates focusing on developing strategies to improve therapeutic efficacy in breast cancer, Ewing sarcoma, medulloblastoma, neuroblastoma, ovarian and pancreatic cancers using preclinical models and clinical specimens. We are also evaluating the combination of investigational agents and standard chemotherapeutic agents to enhance the therapeutic efficacy and reducing morbidity. In addition, cancer health disparities and the combination therapies using investigational agents to induce immune response to kill cancer cells is also being investigated. Collaborating with the Oncologists at Cook Children's on the projects designed to exploit the genomic biomarkers, genomic profiling/sequencing for identifying precise therapeutic options for pediatric malignancies. Dr. Basha is actively working with the collaborators (physicians and translational researchers) in DFW area and other institutions including NCI-designated comprehensive cancer centers for developing less toxic and effective strategies for treating human cancers.

Alakananda Basu, Ph.D.

Professor
Microbiology, Immunology &
Genetics

Dr. Basu's research is focused on signal transduction, especially in the context of cancer chemotherapy. Since an ability of cancer cells to evade cell death contributes to cancer and resistance to chemotherapeutic drugs, a major research effort is to investigate how signal transduction pathways regulate cell survival and cell death. She has been studying how various signaling pathways, such as protein kinase C, Akt, mTOR/S6 kinase (S6K) and mitogen-activated protein kinases regulate apoptosis (a genetically programmed cell death), autophagy (a process by which a cell recycles its own components to survive under stressful or nutrient-derived conditions) and cellular senescence (loss of proliferative capacity of cells). Cellular, molecular and



biochemical approaches as well as state-of-the-art technologies, such as proteomics and genomics are used to determine how an intervention with a signaling pathway can be exploited for cancer therapy. Another area of her research is to investigate the molecular mechanism(s) of drug resistance. The ultimate goal of her research is to identify novel targets for cancer therapy, exploit intracellular signaling systems to develop innovative strategies to treat cancer and identify potential biomarkers to predict patient response to cancer therapy.

Bruce Bunnell, Ph.D.
Chairman and Professor
Microbiology, Immunology &
Genetics



Dr. Bunnell's research program is focused on both 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 MSC with the immune system and how the cells inhibit robust anti-inflammatory effects in vivo. He is interested in applying these cells or products from these cells as a therapeutic intervention for both immune diseases such as Multiple Sclerosis, wound repair, and bone regeneration. He is currently working towards a human clinical trial for the treatment of osteoarthritis, rotator cuff injury and Multiple Sclerosis using autologous stem cells. He is also interested in defining the role of adipose stem cells in the manifestation of the subcutaneous adipose tissue disorder of unknown origins, called Lipedema, which is characterized by the symmetric buildup of adipose tissue (fat) in the legs and arms that is often severely painful. Dr. Bunnell has an area of focus on the development and application of engineered tissues. The approach combines scaffolds (native or lab-generated) in combination with various stem cell populations. Native scaffolds are generated by decellularizing human tissues using a combination of enzymes and salts to strip away the cells and leave an intact scaffold behind. The scaffold is then repopulated using stem cells alone or in conjunction with terminally differentiated cells in an attempt to make a functional organ. He is also developing microphysiological systems (MPS), which are bioreactor or chip-based in vitro models of complex organ systems that retain all of the functions of native organs. He is currently working as part of a team constructing an MPS of a human knee to model osteoarthritis. Once completed, the system will be used to study tissue interactions, disease mechanisms and novel therapeutics.

Pankaj Chaudhary
Assistant Professor
Microbiology, Immunology &
Genetics



Dr. Chaudhary has a broad interest in cancer biology, but the majority of the work is directed towards basic and translational research of breast and prostate cancer. The research in Dr. Chaudhary's laboratory focuses on various aspects of carcinogenesis, particularly the molecular mechanisms underlying breast and prostate tumor growth, angiogenesis and metastasis. A major focus of his work has been on the molecular basis of Annexin A2 function in promoting triple-negative breast cancer metastasis and angiogenesis. Dr. Chaudhary's laboratory demonstrated that Annexin A2 derived from triple-negative breast cancer exosomes promotes angiogenesis and aggressive metastasis in triple-negative breast cancer. Increased expression of Annexin A2 is frequently observed in triple-negative breast cancer. Dr. Chaudhary's findings demonstrated that Annexin A2 overexpression is associated with racial variation and is a potential prognostic candidate for triple-negative breast cancer in African-American women. In addition, Dr. Chaudhary established that Annexin A2 could potentially be used as an important therapeutic target in triple-negative breast cancer. Currently, Dr. Chaudhary's laboratory is validating these findings and determine if Annexin A2 contributes to the disproportionate occurrence in triple-negative breast cancer and clinical outcome in African-American women.

Hriday Das, Ph.D.
Professor
Pharmacology & Neuroscience



The long-term goal of Dr. Das' research is to develop cost-effective clinically-useful drug therapies for the treatment of neurodegenerative diseases. Presenilin-1 (PS1) is a transmembrane protein which functions as ER Ca²⁺ leak channel and is the catalytic subunit of the PS1/ γ -secretase complex. PS1/ γ -secretase is involved in the proteolytic processing of type 1 membrane proteins including amyloid precursor protein (APP) and Notch-1 receptor. Mutations of the PS1 gene cause early-onset familial Alzheimer's disease by altering PS1/ γ -secretase mediated processing of APP. Same pathogenic mutations of the PS1 gene also potentiate IP3R-mediated Ca²⁺ liberation from ER to cytoplasm. Transcriptional regulation of the PS1 gene appears to modulate both PS1/ γ -secretase activity and ER Ca²⁺ leak channel. His laboratory has shown that PS1 expression can be regulated by the JNK signal transduction pathway involving tumor suppressor protein p53. One goal of this research is to understand how wild type p53 and cancer causing mutations of p53 differentially regulate the processing of APP and Notch1 as well as PS1-mediated ER Ca²⁺ leak channel. Another goal is to test the hypothesis that JNK and mTOR inhibitors prevent neuronal cell death by inhibiting PS1 transcription and PS1-mediated ER Ca²⁺ leak channel activity. He is also studying how regulation of PS1 may control cell growth and proliferation via

Erb4, a transmembrane receptor tyrosine kinase that regulates cell proliferation and differentiation.

Rafal Fudala, Ph.D.

Assistant Professor
Microbiology, Immunology &
Genetics



Dr Fudala in his current ongoing studies is using fluorescence-based methods such as: laser confocal microscopy, fluorescence resonance energy transfer (FRET), fluorescence lifetime imaging microscopy (FLIM), fluorescence correlatin spectroscopy (FCS) 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 cancer (malignant melanoma, bladder cancer) and cardiovascular diseases detection. Dr. Fudala's major current projects include: new paptide-based approach to improve specificity in cancer treatment, novel approaches to study viscoelectric properties of mucin in cellular microenvironments, and fluorescence-based detection of hyaluronidase and metalloproteinases. Currently, Dr. Fudala's interests also include developing high-density lipoproteins (rHDL) based nanoparticles to deliver drugs to cancer cells *via* HDL receptor SR-B1.

Michael Gatch, Ph.D.

Associate Professor
Pharmacology & Neuroscience



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

Harlan Jones, Ph.D.

Associate Professor
Microbiology, Immunology &
Genetics

Dr. Jones conducts biomedical and health disparity research to identify mechanisms of disease pathogenesis involved in cancer, infectious, and inflammatory diseases that disproportionately affect underrepresented minority populations. His research



program has identified novel mechanisms through which neuroendocrine factors mediate host cellular immune and respiratory inflammatory responses against pneumococcal disease, asthma, and lung cancer, elucidated potential roles through which microbial species directly respond to corticotropin releasing hormone and other hormones to escape host defenses. His most recent research, defining use of “bacterio-mimetic” components for immune-based targeted nanoparticle cancer therapeutics forms the basis of this application. Dr. Jones is a recipient of the UNTHSC Outstanding Graduate Faculty Award and National Role Model Award. He also serves as Director of the Center for Diversity and International Programs at UNTHSC.

Porunelloor Mathew, Ph.D.
Professor
Microbiology, Immunology &
Genetics



Dr. Mathew’s research is in the area of Cancer Immunology, specifically the molecular mechanism by which Natural Killer (NK) cells recognize and eliminate cancer cells. NK cells are a subpopulation of lymphocytes that play an important role against tumor metastasis and various viral and bacterial infections. NK cell functions are controlled by a balance between positive and negative signals through various receptors. We have identified, cloned and characterized several 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 Emlipiciti) 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 LLT1 and PCNA in immune escape by breast cancer, prostate cancer, and pancreatic cancer.

Stephen Mathew, Ph.D.
Assistant Professor
Microbiology, Immunology &
Genetics

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



Michael Mathis, Ph.D.
Professor & Dean GSBS
Pharmacology & Neuroscience

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 LIT1 in prostate cancer, breast cancer, ewing sarcoma, and lupus.



Laszlo Prokai, Ph.D.
Professor
Pharmacology & Neuroscience

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.



Dr. Prokai is recognized nationally and internationally for his work on discovery, bio-organic and medicinal chemistry of central nervous system agents, as well as on neuropeptides, proteomics and mass spectrometry. His cancer research interests focus on (i) prevention of estrogen-related malignancies associated with hormone therapy by discovering and developing compounds with improved safety and selectivity compared to current estrogen products, and (ii) proteomic assessment of (a) the impact of oxidative stress in cancer and during chemotherapy, and (b) signaling events associated with cancer. Other interests include combinatorial and rational drug discovery, brain- and eye-targeted drug therapy, the role of oxidative stress and posttranslational protein modifications in health and disease, neurosteroids and metabolomics.

Amalendu Ranjan, Ph.D.
Assistant Professor
Microbiology, Immunology &
Genetics



Dr. Ranjan's primary research interest is in the area of nanomedicine and nanotherapeutics for cancer and other diseases. He is a biochemical/biomedical engineer trained in the fields of nanotechnology, drug delivery, modeling, optimization and scale up of nanoparticle formulation. He uses biodegradable and biocompatible polymeric or lipo-polymeric nanoparticles with the ability to tailor the release kinetics of drugs from these nanoparticles. He has the expertise in encapsulating various types of hydrophobic, hydrophilic and small molecule drugs in nanoparticles for cancer and other disease therapies. His research also includes nanotechnology based gene delivery. This platform has also been used for designing theranostic agents where in a dye can be encapsulated along with a drug and later tracked in vivo for imaging and evaluated for therapy. All such technologies may find use in imaging and therapy of cancer, infectious diseases, cardiovascular and neurodegenerative diseases. His research specialization includes optimization and scale-up of these nanotherapeutics/theranostics for making large batches for pre clinical studies.

Umesh Sankpal, Ph.D.
Research Assistant Professor
Pediatrics



Dr. Sankpal's research interests are in developing innovative approaches for cancer treatment and diagnosis. The strategy involves identifying novel anti-cancer compounds that target cancer specific genes and work synergistically with the standard treatments of chemotherapy and radiation. The proteins currently being targeted are the specificity protein (Sp) family of transcription factors and anti-apoptotic protein Survivin. Various cell based assays, animal models, and gene expression analysis is used to determine the underlying molecular mechanism. Another area of research being pursued is health disparity in breast cancer, which manifests in the form of significantly higher mortality rates for black women compared to white women. Among the many factors associated with this racial disparity, Dr. Sankpal is studying the inherent differences in biology of the tumors between the two groups. The current project is focused on identifying differentially expressed markers (RNA or protein) between the two racial groups and to develop these for use in diagnosis or as a therapeutic target.

Jamboor Vishwanatha, Ph.D.
Professor
Microbiology, Immunology &
Genetics

Dr. Vishwanatha's research is in cancer molecular biology and experimental therapeutics. His laboratory has established the role of Annexin A2 in 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 MIEN1 (Migration and Invasion Enhancer 1). 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.

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 Biochemistry & Cancer Biology Discipline.

I. REQUIRED COURSES

Molecular and Cell Biology of Cancer (MIMG 6250) – 2 SCH: offered each spring

Receptors and Second Messenger Signaling (MIMG 6435) – 2 SCH: offered every fall

Kinases and Phosphatases (MIMG 6436) – 2 SCH: offered every fall

MS students should consult with the graduate advisor to decide which advanced courses they should take.

II. SEMINAR COURSES, JOURNAL CLUB COURSES, AND WIPS

Signal Transduction (MIMG 5210) – 2 SCH (Spring)

Seminar in Cell Motility (MIMG 5121) – 1 SCH (Fall & Spring)

Seminar in Current Topics (MIMG 5140) – 1 SCH (Fall & Spring)

All PhD students are required to register for Journal club courses once a year. All MS and PhD students are required to present their research during Works in Progress Seminar (WIPS) once per year beginning in their second year.

III. ELECTIVE (ADVANCED AND TECHNIQUE) COURSES:

Offered every fall and spring:

Introduction to Confocal Microscopy (MIMG 5202)-1 SCH

Offered every fall:

Cellular and Molecular Fluorescence (MIMG 6220) – 2 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 every spring:

Bioimaging (MIMG 5201) - 3 SCH

Offered in “even” fall semesters:

Drug Discovery & Design (PHRM 6270) - 2 SCH

Offered in “odd” fall semesters:

Advanced Molecular Biology: Techniques and Principles (MIMG 6202) - 2 SCH

Offered in “odd” spring semesters:

Advanced Biophysical and Biochemical Methods (MIMG 6360) - 3 SCH

Biomedical Mass Spectrometry (PHRM 6361) -1-2 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.

<i>Dept</i>	<i>Course Number</i>	<i>Title</i>	<i>SCH</i>	<i>Semester to be Completed</i>
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
		<i>Subtotal</i>	<i>12</i>	
<i>Milestones to be completed: Selection of Major Professor, Change of Discipline</i>				
BMSC	5160	Biomedical Ethics	1	Spring year 1
BMSC	5315	Principles of Scientific Communication	2	Spring year 1
BMSC	5998	Individual Research	2-6	Spring year 1
MIMG	6250	Molecular and Cell Biology of Cancer	2	Spring year 1
		Journal Club/Current Topics	1-2	Spring year 1
		Elective courses	0-2	Spring year 1
		<i>Subtotal</i>	<i>12</i>	
<i>Milestones to be completed: Designation of Advisory Committee, Degree Plan. The Research Proposal must be filed prior to enrollment in Thesis (BMSC 5395).</i>				
BMSC	5395	Thesis	3-6	Summer year 1
		Elective Courses	0-3	Summer year 1
		<i>Subtotal</i>	<i>6</i>	
		<i>Total for Degree</i>	<i>30</i>	

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.

<i>Dept</i>	<i>Course Number</i>	<i>Title</i>	<i>SCH</i>	<i>Semester to be Completed</i>
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	6204	Fundamentals of Biomedical Science IV	2	Fall year 1
		Subtotal	12	
<i>Milestones to be completed: Selection of Major Professor, Change of Discipline</i>				
BMSC	5160	Biomedical Ethics	1	Spring year 1
BMSC	5315	Principles of Scientific Communication	2	Spring year 1
BMSC	5998	Individual Research	2-5	Spring year 1
MIMG	6250	Molecular and Cell Biology of Cancer	2	Spring year 1
MIMG	5210	Signal Transduction Journal Club	2	Spring year 1
		Journal Club/Current topics	0-1	Spring year 1
		Elective courses	0-2	Spring year 1
		Subtotal	12	
<i>Milestones to be completed: Designation of Advisory Committee, Degree Plan</i>				
BMSC	6998	Individual Research	2-6	Summer year 1
		Elective Courses	0-4	Summer year 1
		Subtotal	6	
<i>Milestone to be completed: Oral Qualifying Examination</i>				
BMSC	6998	Individual Research	4-8	Fall year 2
		Journal Club/Seminar in current topics	1-3	Fall year 2
		*Advanced courses	0-4	
		Elective Courses	0-6	Fall year 2
		*Required to take MIMG6435 & MIMG6436 courses.		
		Subtotal	12	
BMSC	6998	Individual Research	2-8	Spring year 2
		Journal Club/Seminar in current topics	1-3	Spring year 2
		Elective Courses	0-6	Spring year 2
		Subtotal	12	

BMSC	6998	Individual Research	3-6	Summer year 2
2		Elective Courses	0-3	Summer year 2
		Subtotal	6	
<i>Milestone to be completed: A Research Proposal must be on file prior to enrollment in Doctoral Dissertation (BMSC 6395)</i>				
BMSC	6998	Individual Research	2-8	Fall year 3
		Journal Club/Seminar in current topics	1-3	Fall year 3
		Elective Courses	0-4	Fall year 3
		Subtotal	9	
BMSC	6998	Individual Research	3-6	Spring year 3
		Journal Club/Seminar in current topics	1-3	Spring year 3
		Elective Courses	0-3	Spring year 3
		Subtotal	9	
BMSC	6998	Individual Research	3-6	Summer year 3
		Elective Courses	0-3	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 should be based on the dissertation project and include a summary of the project, problem/hypothesis, significance of the project, background, research design and methodology. The student must meet with the advisory committee and seek their guidance 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 registration for thesis (BMSC 6950). Research proposal guidelines and the research proposal approval form 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

The Advancement to Doctoral Candidacy is a two-step process.

Step 1: Students will have to successfully complete their oral qualifying examination.

Step 2: Students will have to submit a research proposal.

A. Oral Qualifying Examination (OQE):

Purpose: This qualifying examination is to ensure that a doctoral student has sufficient mastery of fundamental principles of biomedical sciences to be successful as a Ph.D. candidate and independent researcher in the field of Biochemistry and Cancer Biology. Students are required to pass this examination before they can submit their research proposal.

Specifics:

- i. The OQE should be completed after completion of prerequisite courses, typically during the summer semester of the first year of study but no later than the second Fall semester.
- ii. The discipline graduate advisor will form a committee of four to five graduate faculty and s/he will serve as the chair of the OQE committee. If the graduate advisor is the major professor, s/he will appoint another faculty member to serve as the chair of the committee. The major professor cannot participate in the OQE. A non-voting faculty member may be allowed to observe the procedures as a mechanism for training faculty to serve on future OQE committee.
- iii. The topics of the examination will be based on the core courses and discipline-specific advanced courses.

- iv. The length of the examination will be approximately 2 h. The student will be given the question set an hour prior to the oral examination. During this time, the student will not have access to any resources, such as books, internets or colleagues. The questions should be answerable in approximately 15 min so that the students can be tested in all of the defined areas. The students will be required to answer 6 out of 12 questions. The students will have to select at least one question from different categories.
- v. Upon completion of the examination, the faculty will vote on a pass/fail grade for the student. At least 75% favorable vote will be required for the student to successfully pass. If a student does not pass, the faculty will inform the student of specific areas of weakness in writing.
- vi. If necessary, a student will be allowed to retake the oral qualifying examination once, but this must be completed before the end of the following semester. Failure on the second attempt will result in dismissal from the doctoral program, although the student will be permitted to pursue a Master of Science degree.
- vii. An evaluation document has been developed by the graduate school in order to provide students feedback on their oral qualifying exam and to ensure that the students have demonstrated the appropriate knowledge required for advancement to candidacy. The appropriate forms may be obtained from the [GSBS Forms and Guidelines website](#).

B. Research Proposal

All students are required to submit a research proposal no later than the end of the second year. The proposal should be based on the dissertation project and include a summary of the project, problem/hypothesis, significance of the project, background, research design and methodology. The student must meet with the advisory committee and seek their guidance 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 registration for doctoral dissertation (BMSC6950). Research proposal guidelines and the research proposal approval form are available on the [GSBS Forms and Guidelines website](#).