Integrative Physiology Discipline Handbook 2020-2021

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

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Integrative Physiology Discipline

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Physiology is an essential foundation for clinical and experimental medicine. The physiologist seeks an understanding of the physical and chemical mechanisms of biological processes. Integrative physiology is the study of the function of living organisms and their various components. It encompasses normal and abnormal function and ranges in scope from an understanding of basic molecular and cellular functions to a cognizance of biological control systems and of the integration of bodily functions among multiple organ systems.

The faculty maintain active and productive research programs with special emphasis on cardiovascular physiology. Research interests of the faculty include autonomic neuroscience, neuroendocrinology, lipoprotein-based drug delivery, hypertension, cardiac hypertrophy and failure, cardiac resuscitation, cardiac opioids, coronary circulation, adaptation to exercise and hypoxia, effects of aging and obesity, neurophysiology, stroke and neuroprotection, renal physiology and pathology, and calcium signaling. Faculty programs are funded by extramural sources including the American Heart Association, the National Institutes of Health, American Osteopathic Association, Department of Defense, and Private Industry.

Students may enter the discipline after completing course work and laboratory rotations as required by the Graduate School of Biomedical Sciences. The discipline offers advanced courses designed to integrate the fundamental processes of molecular biology and neurophysiology with organ system functions. Students participate in teaching and seminars and receive extensive training in techniques of contemporary physiological research. Doctor of Philosophy (Ph.D.) and Master of Science (M.S.) students perform original, publishable research, and present their research findings at national scientific meetings. One to two years are required to complete the M.S. degree requirements. Three to five years are required to complete the Ph.D. degree requirements.

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

Integrative Physiology Graduate Faculty and Their Research

Johnathan D. Tune, Ph.D.
Chairman and Professor, Department of Physiology & Anatomy
Category III

Research in the Tune laboratory focuses on the regulation of myocardial oxygen delivery, contractile function and metabolism in health and disease. The primary goal centers on elucidating mechanisms of impaired coronary and cardiac function in the setting of obesity and diabetes. More specifically, experiments are designed to delineate putative mechanisms responsible for the regulation of coronary blood flow, identify factors that contribute to the initiation and progression of coronary vascular dysfunction and disease, and protecting the heart from irreversible ischemic damage. Studies routinely include a series of highly integrative experimental approaches which utilize both in vivo and in vitro approaches in large animal models of disease.

J. Thomas Cunningham, Ph.D.
Associate Dean of Research, GSBS and Regents Professor, Department of Physiology & Anatomy
Category III

Our laboratory studies the role of the central nervous system in the regulation of the cardiovascular system and water and electrolyte balance. We study how the brain participates in the normal maintenance of blood pressure and fluid balance, a process called homeostasis. We also investigate how changes in these CNS processes contribute to water retention associated with heart or liver disease and chronic diseases such as hypertension. Our goal is to achieve a better understanding of how the CNS contributes to health and diseases though its interactions with the cardiovascular system.

Styliani Goulopoulou, Ph.D.
Assistant Professor, Department of Physiology & Anatomy
Category III

Dr. Goulopoulou's laboratory aims to understand the causes of pregnancy complications that endanger the health and life of the mother and the baby during and after pregnancy. The characteristics of preeclampsia, a disease that occurs only during pregnancy, include maternal high blood pressure and inability of the placenta to transfer nutrients and oxygen to the baby, putting both mother and baby at risk for health problems and death. Unfortunately, we do not know what causes preeclampsia and there is no available cure for this disease. Dr. Goulopoulou and her research team are testing whether certain molecules that are released from dead cells are elevated in the maternal blood and cause the symptoms of preeclampsia, and if treatments to stop these molecules and their actions can prevent preeclampsia. Understanding the causes of preeclampsia will help mothers and babies live healthy and long lives.

Lisa Hodge, Ph.D.
Associate Professor, Department of 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.

Rong Ma, M.D., Ph.D.
Professor, Department of Physiology & Anatomy
Category III

We study renal physiology and pathology using both *in vitro* (cell culture) and *in vivo* (animal models) approaches. Our research focuses on Ca^{2+}-conductive channels, particularly transient receptor canonical (TRPC) channels and store-operated channels, in glomerular mesangial cells and podocytes of the kidney, and vascular smooth muscle cells. Our major interests include molecular mechanisms for regulation of TRPC and store-operated channels, physiological relevance of TRPC and store-operated channels in kidney and blood vessels, and the association of the channel dysfunction with kidney and vascular diseases, such as diabetic nephropathy and vasculopathy.

Scott Maddux, Ph.D.
Assistant Professor, Department of Physiology & Anatomy

Compared to most primates, including fossil humans such as Neanderthals, humans living today possess extraordinarily flat faces. In fact, our "orthognathic" face is so distinctive, it's one of the primary features used to identify our species, Homo sapiens. However, while universally recognized as a defining feature of our species, there is no consensus among scientists as to why we evolved such flat faces. My lab employs cutting-edge technologies and innovating experimental modeling to investigate this question. Currently, we are using medical imaging (e.g., CT, MRI, laser scanning) and 3D modeling methods to better understand the role climate has played in shaping facial anatomy and thermoregulatory function in humans from around the globe. Additionally, we are collaborating with scientists in Russia to study anatomical and hormonal

changes in the domesticated fox, which has shown reductions in facial length as a consequence of experimental selection for less aggressive behavior.

Robert Mallet, Ph.D.
Graduate Advisor and Regents Professor, Department of Physiology & Anatomy
Category III

Our research is focused on developing novel treatments to protect the heart and brain from damage inflicted by heart attack, stroke and cardiac arrest. These conditions, which result from interruptions in the blood flow to the heart and brain, are among the leading causes of death and disability in the United States. We have discovered that intermittently breathing air with reduced oxygen content, i.e. hypoxia, triggers adaptations in the heart and brain that enable these organs to withstand interruptions in their blood flow, greatly decreasing the resultant damage. Our current studies are defining the antioxidant and anti-inflammatory mechanisms responsible for the robust heart and brain protection afforded by intermittent hypoxia.

Keisa Mathis, Ph.D.
Assistant Professor, Department of Physiology & Anatomy
Category III

The primary focus of the Mathis Laboratory is to investigate neuroimmune mechanisms that contribute to the pathogenesis of hypertension and renal injury. We are interested in systemic lupus erythematosus (SLE), an autoimmune disease and major risk factor for hypertension that primarily affects young women. The autonomic dysfunction and chronic inflammation in SLE makes it an ideal disease to study neuroimmune interactions that may lead to alterations in the kidney and, ultimately, hypertension. We are currently investigating the role of the vagally-mediated, cholinergic anti-inflammatory pathway in the development of chronic inflammation and hypertension in a mouse model of SLE using integrative physiological approaches complimented with molecular, cellular and immunological techniques. The clinical implications of our research may benefit not only patients with SLE and essential hypertension, but also those with other chronic inflammatory diseases.

Rachel Menegaz, Ph.D.
Associate Professor, Department of Physiology & Anatomy

My research explores the growth and function of cranial tissues, particularly the structures involved in feeding. The biomechanical demands imposed by diet are known to affect chewing behavior and joint kinematics and, over time, the growth trajectories of the craniofacial skeleton and its associated soft tissues. By modulating diet, we are able to affect the overall growth of these tissues, bone quality in the jaws, integrity of the jaw joint (TMJ), dental occlusion, and masticatory muscle structure. I am particularly interested in how early life history events (such as weaning and dental eruption/replacement) affect feeding, growth, and adult morphological outcomes. Current research themes include: 1) Variation in maturation rates among tissues of the masticatory complex and how this affects

feeding performance and plasticity. What happens during the transition between infant-like suckling and adult-like chewing, and what are the structural and behavioral constraints that limit efficient feeding during early childhood? 2) The role of type I collagen in the growth of the craniofacial skeleton. How do collagen disorders, such as osteogenesis imperfecta, affect the facial phenotype? What behavioral and/or pharmaceutical interventions are effective in recovering the phenotype and function in these disorders?

Vicki Nejtek, Ph.D.
Associate Professor, Department of Physiology & Anatomy

My laboratory is interested in studying how people with mild brain trauma, mood problems, medical diseases, and/or addiction problems will react to treatments and how their responses to treatment might differ among others without such problems. We are also interested in studying the brain and biology of those with mild brain trauma, mood problems, medical diseases, and/or addiction problems as we look for clues to identify the people who might be more at-risk for developing Alzheimer's and Parkinson's disease than others. Active research includes longitudinal outcomes research, matched-control cross-sectional biomarker studies to predict risks for Alzheimer's and Parkinson's disease, community-based program effectiveness, and treatment response research in the following populations: co-occurring disorders, addiction, veterans with mild traumatic brain injury (mTBI) with and without posttraumatic stress disorder (PTSD), veteran spouses and their children, and at-risk grade school children with adverse childhood experiences. Research in the Reeves lab includes collaboration with physical therapists, orthopedic surgeons, and area clinicians to investigate pathological issues from an anatomical and biomechanical perspective. Recent research involves ultrasound diagnosis of ankle injuries and surface mapping of the dorsal scapular nerve for use in pain management. Other areas of research include K-12 science outreach programs for teachers and students interested in the biomedical sciences. Other activities include the training of health care professionals utilizing cadavers from the Center's Willed Body Program. Training activities occur in the Bioskills and Simulation Training facility. In addition, this facility supports research collaborations with orthopedic surgeons in the DFW area.

Rustin Reeves, Ph.D.
Professor, Department of Physiology & Anatomy

Research in the Reeves lab includes collaboration with physical therapists, orthopedic surgeons, and area clinicians to investigate pathological issues from an anatomical and biomechanical perspective. Recent research involves ultrasound diagnosis of ankle injuries and surface mapping of the dorsal scapular nerve for use in pain management. Other areas of research include K-12 science outreach programs for teachers and students interested in the biomedical sciences. Other activities include the training of health care professionals utilizing cadavers from the Center's Willed Body Program. Training activities occur in the Bioskills and Simulation Training facility. In addition, this facility supports research collaborations with orthopedic surgeons in the DFW area.

Caroline Rickards, Ph.D.
Associate Professor, Department of Physiology & Anatomy
Category III

The general research interests of the Cerebral & Cardiovascular Physiology Laboratory encompass understanding vital organ perfusion in humans under stress. The laboratory is specifically focused on the regulation of brain blood flow and oxygenation during stressors that challenge cerebral perfusion such as traumatic hemorrhage, cardiac arrest, and stroke. A major research focus has been on the early detection of hemorrhagic injury in trauma patients, characterizing physiological differences between individuals with high versus low tolerance to this stress. In addition to investigating these physiological mechanisms, we also collaborate with academic, industry, and government partners to develop and test sensor technologies that may improve the early detection of tissue hypoperfusion in clinical settings. We also study potential therapies that may improve cardiovascular and cerebrovascular tolerance to hypoperfusion, including resistance breathing, oscillatory perfusion therapy, and occlusive exercise.

Brandy M. Roane, Ph.D.
Associate Professor, Department of Physiology & Anatomy

Research projects include clinical, laboratory, and public health studies such as experimentally manipulating sleep parameters and examining how these changes impact obesity-related behaviors such as physical activity and eating. The overarching goal of all work conducted in the Sleep Research Lab is to better understand how sleep may act as an environmental variable altering the trajectory of chronic medical conditions and psychopathology. Understanding how sleep influences these conditions would contribute greatly to health and wellness, as sleep is a targetable behavior.

Steven Romero, Ph.D.
Assistant Professor, Department of Physiology & Anatomy
Category III

Dr. Romero's Human Vascular Physiology Laboratory has two broad research themes. The first research theme centers on investigating how the human vascular system adjusts and adapts to exercise and environmental stress in healthy and diseased populations. The second research theme centers on investigating the vascular and functional maladaptations that accompany various diseases (e.g. peripheral arterial disease, aging, burn survivors), in addition to identifying novel therapies that may mitigate such detrimental changes.

Damon Schranz, DO
Associate Professor, Family Medicine and Osteopathic Manipulative Medicine

Dr. Schranz serves as the director of both the two-month family medicine clerkship and the longitudinal preceptorship programs for his department. He is the co-course director for clinical medicine for 1st-year students. In addition to educational responsibilities, he is in active practice as a family physician at the university's satellite clinic where he also serves as preceptor for the Family Medicine Residency program. Dr. Schranz has published several articles for the ACOFP newsletter and the Journal of the American Osteopathic Association, and has presented abstracts at the North American Primary Care Research Group, Society for Teachers of Family Medicine, and the American Osteopathic Association. He has completed fellowships in academic medicine and health policy.

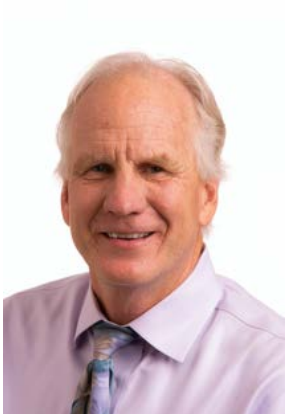
Ann Schreihofer, Ph.D.
Professor, Department of Physiology & Anatomy
Category III

The Schreihofer lab studies how the brain controls blood pressure both under normal conditions and in the presence of disorders that raise blood pressure. Currently, we are studying how obesity and metabolic syndrome contribute to hypertension and instability of blood pressure. Metabolic syndrome changes how the brain controls blood pressure, but the mechanisms are not well understood. Many with obesity find it difficult to control their body weight in the long term. As the prevalence of obesity and metabolic syndrome continues to mount, so does the cardiovascular disease that accompanies them. Many hypertension medications act within the brain to control blood pressure. Our work examines which treatments are ideal for management of cardiovascular disease with obesity by determining how the brain changes with obesity and whether current medications can reverse these changes. In addition, we are examining how obesity and metabolic syndrome may contribute to Alzheimer's related dementia, which occurs at a higher rate in people with disordered regulation of blood pressure and blood glucose.

Derek Schreihofer, Ph.D.
Associate Professor, Department of Physiology & Anatomy

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

Michael Smith, Ph.D.
Professor, Department of Physiology & Anatomy
Category III



Dr. Smith's research career has focused on human-based research that bridges systems-based physiological mechanisms to clinical application relating to cardiovascular diseases including sleep apnea, heart failure and cardiac dysrhythmias. This work has focused on physiologic assessment of abnormal responses in disease and the application to predict outcomes. During the past 25 years, his focus has been on autonomic dysfunction in sleep apnea and cardiac dysrhythmias. Current projects merge these two areas with a focus on cardiac dysrhythmias and dysrhythmia risk in sleep and sleep apnea. In addition, he has active research on predictors of sleep disorders, associated cardiovascular risks and health disparities in sleep apnea.

Albert Yurvati, D.O. Ph.D.
Professor, Department of Physiology & Anatomy; Chairman and Professor, Dept. of Medical Education
Category III

Dr. Yurvati's research interests include tissue reperfusion injury and hemorrhagic shock. The Yurvati laboratory has received funding to seek ways to lessen injury to the brain during prolonged cardiopulmonary resuscitation (CPR), shock and the effects of cardiopulmonary bypass. Dr. Yurvati also is studying novel methods of preserving kidneys to improve renal function after transplant, and to protect muscle and nerve function in limbs deprived of blood flow by tourniquets. As a board-certified cardiothoracic surgeon, Dr. Yurvati is ideally positioned to translate his research results to improve clinical treatment to protect vital organs threatened by shock or ischemia-reperfusion.

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 not more than one "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 of graduate study will be allowed to enter the Integrative Physiology Discipline and enroll in PHAN 6400. Ph.D. students in Integrative Physiology who are in good academic standing will take the Oral Qualifying Examination in the summer of year 1.

I. PhD REQUIRED COURSES

Physiology in Health and Disease (PHAN 6400) – 4 SCH

A grade of "A" or "B" in this course is required. A PhD student who receives a "C" or "F" in this course, but who is otherwise in good academic standing, will be allowed to remediate the course once, and must do so before taking the Oral Qualifying Examination.

II. SEMINAR COURSES, JOURNAL CLUB COURSES, AND WIPs

Seminar in Current Topics (PHAN 5140) – 1 SCH

- Offered in the Fall and Spring
- Minimum of 2 SCH required

Current Topics in Physiology: Works in Progress (PHAN 6385) – 1 SCH

- Offered in the Fall
- All Integrative Physiology students are required to register for the Works in Progress course (PHAN 6385) during every fall semester beginning in year 2.

III. PhD ELECTIVE (ADVANCED AND TECHNIQUE) COURSES

PhD students are required to take at least 6 SCH of advanced courses in addition to PHAN 6400. At least 3 SCH must be earned by taking PHAN advanced course(s), selected from the following list. Students may take advanced courses from PHAN or other GSBS disciplines in order to complete the 6 SCH requirement. These advanced courses should be selected in consultation with the student's major professor and advisory committee.

Offered in fall semesters:
Cardiovascular Physiology (PHAN 5300) – 3 SCH
Neurohumoral Control of Autonomic Function (PHAN 6380) – 3 SCH

Offered every spring:
Physiology & Pathophysiology of the Renal & Respiratory Systems (PHAN 5302) – 3 SCH
Courses available via the Medical Sciences Program:
Neuromuscular Physiology (PHAN 6501) – 1 SCH
Endocrine Physiology (PHAN 6502) – 2 SCH
Cardiopulmonary Physiology (PHAN 6503) – 2 SCH

Gastrointestinal-Renal Physiology (PHAN 6504) – 1 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 M.S. thesis research projects require additional semesters to complete. The typical time-to-degree for M.S. students is two years.

Dept	***Course Number***	***Title***	***SCH***	***Semester to be Completed***
BMSC	5150	Lab Rotations	2	Fall year 1
BMSC	6200	Introduction 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***	
Milestones to be completed: Selection of Major Professor, Change of Discipline				
BMSC	5160	Responsible Conduct of Research	1	Spring year 1
BMSC	5315	Principles of Scientific Communication	2	Spring year 1
BMSC	5998	Individual Research	0-4	Spring year 1
PHAN	5140	Seminar in Current Topics	1	Spring year 1
PHAN		Advanced Course/Electives	0-6	Spring year 1
		Subtotal	***12***	
Milestones to be completed: Designation of Advisory Committee, Degree Plan.				
BMSC	5395	Thesis	0-6	Summer year 1
BMSC	5998	Individual Research	0-6	Summer year 1
		Advanced Courses	0-3	Summer year 1
		Subtotal	***6***	
		Total for Degree	***30***	
Milestones to be completed: Research Summary (annual committee meeting), Research proposal (advancement to candidacy). The Research Proposal must be filed prior to enrollment in BMSC 5395. 30 SCH are accumulated at this point. If degree requirements are not met, student continues to register for BMSC 5395.				
PHAN	6385	Current topics in Physiology: WiP	1	Fall year 2
BMSC	5998	Individual Research	1-11	Fall year 2
BMSC	5395	Thesis	1-11	Fall year 2
		Subtotal	***12***	
BMSC	5395	Thesis	1-9	Spring year 2
PHAN	5140	Seminar in Current Topics	1	Spring year 2
		Subtotal	***9***	

		Minimum Total for Degree	***30***	

II. **Doctor of Philosophy Degree Plan** - The sample below does not imply that all requirements for graduation will be met with 90 SCH of course work. While it is possible to complete the requirements in this time frame, most doctoral dissertation research projects require additional semesters to complete. The typical time-to-degree for Ph.D. students is approximately five years.

Dept	***Course Number***	***Title***	***SCH***	***Semester to be Completed***
BMSC	5150	Lab Rotations	2	Fall year 1
BMSC	6200	Introduction to Experimental Design & Biostatistical Methods	2	Fall year 1
BMSC	6201	Fundamentals of Biomedical Science I	2	Fall year 1
BMSC	6202	Fundamentals of Biomedical Science II	2	Fall year 1
BMSC	6203	Fundamentals of Biomedical Science III	2	Fall year 1
BMSC	6203	Fundamentals of Biomedical Science IV	2	Fall year 1
		Subtotal	***12***	
Milestones to be completed: Selection of Major Professor, Change of Discipline				
BMSC	5160	Responsible Conduct of Research	1	Spring year 1
BMSC	5315	Principles of Scientific Communication	2	Spring year 1
PHAN	5140	Seminar in Current Topics	1	Spring year 1
PHAN	6400	Physiology in Health and Disease	4	Spring year 1
BMSC	6998	Individual Research (**max 40 SCH**)	4	Spring year 1
		Subtotal	***12***	
Milestones to be completed: Designation of Advisory Committee, Degree Plan				
BMSC	6998	Individual Research	1-6	Summer year 1
		Advanced Courses	0-5	Summer year 1
		Subtotal	***6***	
Milestone to be completed: Oral Qualifying Examination, Research Summary (annual committee meeting)				
BMSC	6998	Individual Research	1-10	Fall year 2
PHAN	6385	Current topics in Physiology: WiP	1	Fall year 2
		Advance Course/Electives	0-9	Fall year 2
		Subtotal	***12***	
BMSC	6998	Individual Research	1-11	Spring year 2
PHAN	5140	Seminar in Current Topics	1	Spring year 2
		Advanced Courses	0-11	Spring year 2
		Subtotal	***12***	
BMSC	6998	Individual Research	1-6	Summer year 2
		Advanced Courses	1-4	Summer year 2

		Subtotal	***6***	
Milestone to be completed: A Research Progress Summary (annual committee meeting) and approved Research Proposal (subsequently advancement to candidacy) must be on file prior to enrollment in Doctoral Dissertation (BMSC 6395). Once a student completes qualifying exam and research proposal, SCH can be reduced to 9 SCH for Fall and Spring semesters, and 6 SCH for Summer semesters.				
BMSC	6998	Individual Research	0-11	Fall year 3
PHAN	6385	Current topics in Physiology: WiP	1	Fall year 3
		Advanced Courses	0-8	Fall year 3
		Subtotal	***9-12***	
BMSC	6998	Individual Research	0-11	Spring year 3
BMSC	6395	Doctoral Dissertation (**max 12 SCH**)	0-9	Spring year 3
PHAN	5140	Seminar in Current Topics	0-1	Spring year 3
		Advanced Courses	0-8	Spring year 3
		Subtotal	***9-12***	
BMSC	6998	Individual Research	0-6	Summer year 3
BMSC	6395	Doctoral Dissertation	0-6	Summer year 3
		Advanced Courses	0-5	Summer year 3
		Subtotal	***6***	
BMSC	6998	Individual Research	0-12	Fall year 4
BMSC	6395	Doctoral Dissertation	0-12	Fall year 4
		Subtotal	***9-12***	
		Minimum Total for Degree	***90***	
130 SCH is the maximum hours for in-state tuition. In some cases, a different degree plan may be applicable. In all cases, the degree plan must be approved by the student's advisory committee and the Dean of the GSBS.				

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

The following are the coursework and SCH requirements for dual-degree students seeking the D.O. degree and either the M.S. or Ph.D. degree:

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

BMSC 6200	Experimental Design and Biostatistics	2 SCH
BMSC 5160	Responsible Conduct of Research	1 SCH
BMSC 5315	Principles of Scientific Communications	1 SCH
BMSC 5998	Individual Research for MS students	≥ 3 SCH
BMSC 5395	Thesis	≥ 3 SCH
PHAN 6385	Current Topics in Physiology: WiP (every fall)	3 SCH
PHAN 5140	Seminar in Current Topics (minimum 2 SCH)	2 SCH
PHAN/other GSBS	Elective courses	Variable

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

BMSC 6200	Experimental Design and Biostatistics	2 SCH
BMSC 5160	Responsible Conduct of Research	1 SCH
BMSC 5315	Principles of Scientific Communications	1 SCH
BMSC 6998	Individual Research	≥ 3 SCH
BMSC 6395	Doctoral Dissertation	12 SCH
PHAN 6385	Current Topics in Physiology: WiP (every fall)	3 SCH
PHAN 5140	Seminar in Current Topics (minimum 2 SCH)	2 SCH
PHAN	Physiology Advanced Course	≥ 3 SCH
PHAN/other GSBS	Advanced Course/Electives	Variable

   - Physiology in Health and Disease (PHAN 6400) can be waived if the student is in good academic standing at TCOM and has passed COMLEX-USA Level 1.
   - Aside from PHAN 6400, D.O./Ph.D. students are required to take at least 6 SCH of advanced courses, in which at least 3 SCH must be in PHAN advanced course(s).

3. The Ph.D. in Integrative Physiology as a second terminal degree For students entering the program who already have earned a terminal degree (D.O., D.V.M., M.D., Ph.D., etc.), the program requirements are those of the D.O./Ph.D. degrees listed above.

Advancement to Candidacy

I. Master of Science

Advancement to Master's Candidacy is achieved after successful completion and approval 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.** A formal public presentation of the research proposal will be followed by a private defense of the research proposal to the members of the student's advisory committee. The research proposal must be approved by the advisory committee and the Dean prior to registering for Thesis (BMSC 5395). It is expected that M.S. students will complete their Research Proposal in the Fall of year 2.

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

Once a master's student has successfully advanced to candidacy, he/she may use "M.S. 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 major 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 Integrative Physiology 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 field of Integrative Physiology. 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 Integrative Physiology graduate faculty and the student's university member. The committee is established by the Integrative Physiology Graduate Advisor. The Graduate Advisor will either chair the committee or select an alternate chair. 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 30 minutes of preparation time to review the questions and select a specified number of questions upon which he/she will be examined. The student will address the selected topics as well as any questions from the committee that may arise from the question and answer session.

Successful completion of 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 attempt 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 M.S. degree program to complete the requirements for the M.S. 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 the project's 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 submitted to the advisory committee no later than 14 days prior to the defense.** A formal public presentation of the research proposal will be followed by a private defense of the research proposal to 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 Ph.D. students will complete and defend his/her 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 "Ph.D. 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 the Fall and Spring semesters.