PHYSIOLOGY

*IMPORTANT Note About the Doctor of Philosophy in Physiology Degree*

This program is no longer accepting students at this time as this field of study is now a discipline within the new Integrated Biomedical Sciences (IBMS) Program. All information in this section of the Catalog is for the current Physiology students only.

Physiology is the study of the structure, and function, and integration of the human body. In the pioneering days, research efforts were primarily directed at tissues and organs. This research continues to this day and has resulted in a comprehensive picture of the function of the human body. As molecular and genetic methods have come of age, physiologists have implemented these techniques to elucidate the molecular mechanisms that underlie physiological function. It is now clear that in order to develop a complete understanding of the normal and dysfunctional human body, we must ask questions at all levels, from the molecular to the cellular, to the organ, to the whole organism.

Courses

CSBL 3005. Advanced Anatomy. 0 Credit Hours.
Selected students will participate in lectures, detailed dissections, presentations, and teaching of Pre-Matriculation students in the gross anatomy laboratory. A special project or readings in the surgical anatomy literature will be assigned. This elective is considered to be a full-time commitment (40 hours per week). Students are expected to 1) attend all lectures given in the Pre-Matriculation program, 2) to teach in all scheduled laboratory sessions, 3) to prepare and present prosections, 4) to help prepare a laboratory examination, 5) to write and present a literature review on an original topic of interest to the student related to the region of the body being studied.

Courses

IBMS 5000. Fundamentals Of Biomedical Sciences. 8 Credit Hours.
This core course covers the fundamentals of biochemistry, molecular biology, cell biology, organismal and systems biology, and microbiology and immunology. The course is designed for first-year graduate students matriculating into the Integrated Biomedical Sciences Program (IBMS).

IBMS 5008. Lab Rotations. 1-3 Credit Hours.
This course provides an opportunity for students to participate in research activities in the laboratories of faculty members in different disciplines to learn laboratory skills and to gain an introduction to the research fields of faculty members.

IBMS 6090. Seminar. 1.5 Credit Hour.
This course is required of all students in the IBMS program, except of those who have signed up for Final Hours. Students are required to attend a minimum of 16 seminars per semester and to complete a requirement to demonstrate their attendance and participation. To fulfill the minimum number of seminars, students may include seminars offered by disciplines other than their own in which they are enrolled. However, to enroll, students should obtain permission from the course Section Director affiliated with the appropriate discipline. The course numbers of the individual course sections are INTD 6090-1GEN, 6090-2BA, 6090-3CB, 6090-4CGM, 6090-5MIM, 6090-6MBB, 6090-7NS and 6090-8PP for the IBMS Disciplines: Biology of Aging (BA), Cancer Biology (CB), Cell Biology, Genetics & Molecular Medicine (CGM), Molecular Biophysics & Biochemistry (MBB), Molecular Immunology & Microbiology (MIM), Neuroscience (NS), and Physiology & Pharmacology (PP). Some students who have not declared a discipline, and have obtained the approval of their academic advisor and the Senior Associate Dean of the GSBS, may sign up for INTD 6090-1GEN. Grading will be Satisfactory or Unsatisfactory. A list of seminars from all disciplines will be posted on the Graduate School Web site. Each Section Director will determine, for the relevant IBMS-6090 section, the policy for tracking student’s attendance and participation in seminars.

IBMS 6097. Research. 0.5-12 Credit Hours.
This course is required of all students in the IBMS program, except of those who have signed up for Final Hours. Students are required to attend a minimum of 16 seminars per semester and to complete a requirement to demonstrate their attendance and participation. To fulfill the minimum number of seminars, students may include seminars offered by disciplines other than their own in which they are enrolled. However, to enroll, students should obtain permission from the course Section Director affiliated with the appropriate discipline. The course numbers of the individual course sections are INTD 6090-1GEN, 6090-2BA, 6090-3CB, 6090-4CGM, 6090-5MIM, 6090-6MBB, 6090-7NS and 6090-8PP for the IBMS Disciplines: Biology of Aging (BA), Cancer Biology (CB), Cell Biology, Genetics & Molecular Medicine (CGM), Molecular Biophysics & Biochemistry (MBB), Molecular Immunology & Microbiology (MIM), Neuroscience (NS), and Physiology & Pharmacology (PP). Some students who have not declared a discipline, and have obtained the approval of their academic advisor and the Senior Associate Dean of the GSBS, may sign up for INTD 6090-1GEN. Grading will be Satisfactory or Unsatisfactory. A list of seminars from all disciplines will be posted on the Graduate School Web site. Each Section Director will determine, for the relevant IBMS-6090 section, the policy for tracking student’s attendance and participation in seminars.

IBMS 6098. Thesis. 1-9 Credit Hours.
Registration for at least one term is required for M.S. candidates. Prerequisite: Admission to candidacy for the Master of Science degree is required.
IBMS 7001. Qualifying Exam. 1 Credit Hour.
The objective of the Qualifying Examination (QE) is to determine if a student has met programmatic expectations with regard to: i) Acquiring a level of scientific reasoning and a knowledge base in his/her field of study appropriate for a graduate student at the current stage of training; ii) Demonstrating skills of problem-solving and development of experimental strategies designed to test hypotheses associated with a specific scientific problem; and iii) Demonstrating the ability to defend experimental strategies proposed for solving scientific problems. Successful completion of the QE is required for Advancement to Candidacy and continuation in the IBMS Ph.D. program. During the Spring semester of Year 2 (4th semester overall) of the student's program, the QE will be administered by a faculty committee approved by a student's Discipline leadership. Each IBMS discipline will administer the QE process for its students so as to achieve the goals of the discipline while satisfying the expectations of the IBMS graduate program. In general, the QE requires the solving of a relevant unsolved problem in the biomedical sciences by writing a research proposal based on an idea conceived and developed by the student, followed by an oral defense-of-proposal to explore the student's problem-solving process, and the soundness of the student's experimental design. Following the QE, a report will be submitted by the chair of the examination committee to the student's discipline leadership indicating the outcome of the exam and any recommendations that may be required to foster further academic progress by the student. IBMS 7001 is divided into 7 modules overseen by the 7 IBMS Disciplines, each that is responsible for providing its students with a detailed description of the examination process, and for ensuring that the programmatic expectations and goals of the QE are met.

IBMS 7010. Student Journal Club & Research Presentation. 1-2 Credit Hours.
This course is designed to provide graduate students with experience in critical reading of the primary literature, seminar preparation and presentation, data analysis and interpretation, and group-based learning as they relate to the graduate program in Integrated Biomedical Sciences. This course is required of all students in the IBMS program starting in their second year except of those who have signed up for Final Hours. Students are required to attend a minimum of 16 total presentations per semester (journal club or research presentations) and to complete a requirement to demonstrate their attendance and participation. Students are also required to present one journal club presentation per semester until they are Advanced to Candidacy. Once Advanced to Candidacy, the student will present one journal club presentation per academic year and one research presentation per academic year such that the student is giving at least one presentation in each semester. To enroll, students should obtain permission from the course Section Director affiliated with the appropriate discipline. The course numbers of the individual course sections are INTD 7010-1GEN, 7010-2BA, 7010-3CB, 7010-4CGM, 7010-5MIM, 7010-6MBB, 7010-7NS and 7010-8PP for the IBMS Disciplines: Biology of Aging (BA), Cancer Biology (CB), Cell Biology, Genetics & Molecular Medicine (CGM), Molecular Biophysics & Biochemistry (MBB), Molecular Immunology & Microbiology (MIM), Neuroscience (NS), and Physiology & Pharmacology (PP). Some students who have not declared a discipline, and have obtained the approval of their academic advisor and the Senior Associate Dean of the GSBS, may sign up for INTD 7010-1GEN. Grading will be by letter grade (A, B, C, etc.). A list of journal clubs from all disciplines will be posted on the Graduate School Web site. Each Section Director will determine, for the relevant IBMS 7010 section, the policy for tracking student's attendance and participation and will be responsible for assigning a final grade.

IBMS 7099. Dissertation. 1-12 Credit Hours.
This course is required of all students in the IBMS program, except of those who have signed up for Final Hours. Students are required to attend a minimum of 16 seminars per semester and to complete a requirement to demonstrate their attendance and participation. To fulfill the minimum number of seminars, students may include seminars offered by disciplines other than their own in which they are enrolled. However, to enroll, students should obtain permission from the course Section Director affiliated with the appropriate discipline. The course numbers of the individual course sections are INTD 6090-1GEN, 6090-2BA, 6090-3CB, 6090-4CGM, 6090-5MIM, 6090-6MBB, 6090-7NS and 6090-8PP for the IBMS Disciplines: Biology of Aging (BA), Cancer Biology (CB), Cell Biology, Genetics & Molecular Medicine (CGM), Molecular Biophysics & Biochemistry (MBB), Molecular Immunology & Microbiology (MIM), Neuroscience (NS), and Physiology & Pharmacology (PP). Some students who have not declared a discipline, and have obtained the approval of their academic advisor and the Senior Associate Dean of the GSBS, may sign up for INTD 6090-1GEN. Grading will be Satisfactory or Unsatisfactory. A list of seminars from all disciplines will be posted on the Graduate School Web site. Each Section Director will determine, for the relevant IBMS-6090 section, the policy for tracking student's attendance and participation in seminars. Registration is only permitted following a student's admission to candidacy for the PhD degree, approval of the dissertation research proposal and approval of the membership of the candidate's Supervising Committee.

Courses

PATH 4001. Hematology - University Hospital. 4 Credit Hours.
During this selective, through daily experience, consultations, and conferences, students will have the opportunity to learn to use CBCs, blood films, bone marrow studies, and other hematologic laboratory data in the diagnosis of basic hematologic, lymphoid, and coagulation disorders. This selective can be tailored according to the needs of individual students. The student interested in primary care can become involved in the performance of common laboratory tests done in the office. Daily contact with the pathologist will provide guidance in selection and proper utilization of laboratory testing for a specific patient's problem. For the student interested in pathology and laboratory medicine, the organization, management, maintenance of quality control, and consultative role of the Hematology Laboratory will be emphasized. During the selective period, a student may be assigned to spend one week in flow cytometry, molecular genetics, or cytogenetics.

PATH 4002. Blood Banking. 4 Credit Hours.
This selective is to acquaint the student with transfusion practices including the indications, dosage, expected benefits and risks of the different blood components, and the performance of therapeutic apheresis. The student will also be exposed to basic immuno-hematology and blood-banking techniques of acquiring, processing, testing, and transfusing blood components. Under the direction of the pathologist, a transfusion medicine fellow, a pathology resident, and a technical specialist in blood banking, the student will be required to perform basic techniques, participate in resolving the problems of patients having difficulties in transfusion, and evaluate the appropriateness of transfusion episodes. The selective can be tailored to offer more experience in transfusion practices for patient care or in organization, management, quality control, and other factors important to the student who may consider laboratory medicine as a chosen field. Students are required to participate in consultations and education programs offered by the blood bank.
PATH 4003. Hematology/Blood Banking. 4 Credit Hours.
This combination selective between the Hematology Laboratory and the Blood Bank may be arranged if student so desires.

PATH 4007. Pathology Research. 4 Credit Hours.
The course involves participation in a selected facet of ongoing research projects being conducted by a faculty member with assigned responsibilities for technical performance, reading, and interpretation of results.

PATH 4012. Anatomic Pathology: Fine Needle Aspiration. 4 Credit Hours.
Students will be given the opportunity to learn the technique of fine needle aspiration (FNA) biopsy. Direct supervision by faculty, cytology fellow and/or pathology resident in the method of specimen procurement and preparation of the FNA specimen occurs after initial instruction by the course director or their designee for palpable lesions. Participation at radiologically guided or endoscopically guided FNAs is also observed. Students are required to learn basic Modified-Giemsa staining with preliminary evaluation for adequacy of aspirate. There will be exposure to basic interpretation of FNA material from smears and cell blocks with emphasis on selection of ancillary testing along with clinical correlation. A separate clinic time is NO longer available and FNAs are done on an "on-call" basis from UHS cytopathology. Exposure to other areas of anatomic pathology that pertain to quality improvement of clinical medicine skills will also be made available. The experience may be customized depending on the student's future interests (pathology as a future vocation versus students planning on other fields of medicine).

PATH 4015. Forensic Pathology. 2 Credit Hours.
Daily responsibilities include the observation of forensic autopsies. Other responsibilities will include crime scene investigation, courtroom, and/or deposition exposure. During the rotation period, the student is expected to spend some time within the toxicology laboratory and must arrange this with the chief toxicologist. Near the end of the rotation, the student is expected to present a talk on a topic of current forensic interest to the staff during weekly case review. The student will be assessed by attendance, type and frequency of activities performed, and subjective evaluations by the medical examiner staff. This forensic pathology rotation must be pre-approved by the course director for both time period and length of rotation; recommended during the fourth year of medical school following core rotation in general autopsy and surgical pathology, though those rotations are not required.

PATH 4104. Naturopathic Medicine: Evidence-Based Critique. 0.5 Credit Hours.
This course strives to overcome the animosity between conventional and unconventional medicine by openly discussing and evaluating some of the naturopathic methods using the tools of evidence-based medicine. The objective of this course is to build basic knowledge about the mainstreams of naturopathic medicine such as fito-therapy, acupuncture and other reflexologies, Asian and European dietary systems, as well as stimulatory methods such as fasting and homeopathy. For each of these systems, diagnosis and treatment will be discussed from the evidence-based perspective.

PATH 4105. Evidence Based Medicine in Everyday Practice. 0.5 Credit Hours.
This course includes theory and methodological foundation, definitions and overview of evidence-based medicine, practical considerations, and reporting in evidence-based medicine.
PHYL 5028. Fundamentals of Physiology. 2 Credit Hours.
Fundamentals of Physiology is a 2 credit hour course designed to provide students with a basic understanding of mammalian physiology. Students will be exposed to overarching concepts and contemporary perspectives regarding the normal function (physiology) of the organs and systems of organs of the human body. Lectures will focus on fundamental functions of the cardiovascular, renal, respiratory, gastrointestinal, and endocrine systems. This course aims to blend targeted student learning outcomes with critical thinking skills to enhance student understanding of integrative systems biology as an aid to success in the field of biomedical research. Upon successful completion of this course, students will have knowledge of physiological principles of individual organs and systems and a basic appreciation for how interactions between these systems integrate to subserve healthy function. This course is centered on the principle that doctoral students must take personal responsibility for their own learning. As an upper level course, all lectures will be interactive. Lectures will be built around assigned readings. Therefore, each student will be expected to actively engage with faculty and fellow students during lectures to facilitate and enhance the learning experience. Prerequisite: IBMS 5000 or at the discretion of the course directors.

PHYL 5030. Biology of Pain. 2 Credit Hours.
Biology of Pain is a 2.0 credit hour course that provide students with fundamentals of sensory transduction and pathways for pain. It covers the basic principles of how sensory neurons are regulated at the periphery as well as centrally, how pain is perceived in the brain and different therapeutic options of pain management. This course will be divided into specific lectures focused on neuronal and non-neuronal involvement, peripheral and central pathways of pain, assessment, pharmacology and treatment of pain as well as several important clinical states causing pain in various diseased conditions. Upon successful completion of this course, students will have a comprehensive knowledge of the core principles of physiology, basic biology and pharmacology of pain. Prerequisites: IBMS 5000 or at the discretion of the course directors.

PHYL 5041. Excitable Membranes. 1 Credit Hour.
This course addresses fundamental mechanisms of cell excitability in neurons and other excitable tissues. The format is a combination of lectures, readings, discussions, a laboratory demonstration, and online simulations (where available). Examples of the latter include activities to simulate the resting membrane potential and action potentials. The module will emphasize contemporary issues in the scientific literature as well as translational science where dysfunction in ion channels underlie common disorders such as Alzheimer's Disease, Myasthenia Gravis, Cystic Fibrosis, Long QT Syndrome, and Epilepsy to name just a few. PHYL 5041 is a co-requisite for Fundamentals of Neuroscience I as it is the first module of that course, but it also can be taken as a standalone one-hour course.

PHYL 5042. Cardiovascular Physiology. 1 Credit Hour.
This course explores the physiological mechanisms by which the cardiovascular system carries out its principle function. Mechanisms that produce and regulate cardiac pumping, organ blood flow, capillary fluid and solute exchange, and arterial blood pressure are examined. The nature and importance of various local, neural, and hormonal mechanisms are emphasized. Integrated control of cardiovascular function in situations requiring cardiovascular adjustments (e.g., exercise, blood pressure alterations) are also covered. Students may take the full series but are only required to take three out of the four courses (PHYL 5041, 5042, 5043, and 5044).
PHYL 5043. Respiratory & Renal Physiology. 1 Credit Hour.
This course covers the physiology of respiratory and renal function in the human body. Our focus is on basic mechanisms of function, role in body homeostasis, as well as dysfunction of both systems associated with pulmonary and renal disease. Two sessions are set aside for discussion around significant advances in each field. One or more recently published articles will serve as the focus for each of these discussions sessions. Students may take the full series but are only required to take three out of the four courses (PHYL 5041, 5042, 5043, and 5044).

PHYL 5044. Metabolism/Hormones/GI System. 1 Credit Hour.
The course serves to expose students to the current state of knowledge in the field of endocrinology and metabolism, including reproductive physiology, and the related topics of the physiology of the digestive tract. Three sessions are assigned to advanced topics. In these three sessions students will engage in a discussion format centered around one recent important publication. The lecturer will lead the discussion with the aim of showing how the topics the students have been exposed to integrate one with another, providing the context for present-day discoveries.

PHYL 5045. Mammalian Physiology. 4 Credit Hours.
The course begins with fundamental processes that govern membrane transport, membrane potential, and excitation-contraction coupling. The course then proceeds to coverage of organ system function including cardiovascular, respiratory, renal, gastrointestinal and endocrine/metabolic physiology. Lecture material is enhanced by supplemental discussion of research literature encompassing molecular biology, integrative function, and pathophysiological implications. Students may take the full course but are only required to take three out of the four modules (PHYL 5041, 5042, 5043, and 5044).

PHYL 6020. Regulation of Glucose Metabolism. 3 Credit Hours.
The normal regulation of glucose metabolism will be reviewed integrating whole body, organ, cellular, and molecular control mechanisms. Dysregulation of these control mechanisms in diabetes and other common metabolic disorders such as obesity and the metabolic syndrome will be examined in detail. State-of-the-art in vivo and in vitro techniques essential for the study of normal and deranged glucose homeostasis will be discussed in depth. Diabetic microvascular (nephropathy, retinopathy, neuropathy) and macrovascular complications and their relationship to impaired glucose metabolism will be reviewed. Lastly, pharmacologic therapy of diabetes and its associated complications will be discussed.

PHYL 6071. Supervised Teaching. 1 Credit Hour.
A student enrolled in this course is expected to participate in the teaching program of the Department.

PHYL 6090. Seminar. 1 Credit Hour.
The course is comprised of research presentations by Physiology graduate students. This course is required of all students each semester.

PHYL 6091. Selected Topics Of Physiology. 2 Credit Hours.
Students must take at least two courses selected from among the offerings in: (1) Cardiovascular; (2) Cell Biology in Neural Science; (3) Endocrine and Metabolism; (4) Molecular Physiology; and (5) Ion Channels in Disease. Courses that may be substituted for one of these selections: (1) INTD 5040 - Fundamentals of Neuroscience I: Molecular, Cellular, and Developmental Neuroscience; (2) INTD 5043 - Fundamentals of Neuroscience II: Systems Neuroscience; (3) CSBL 6048 - Biology of Aging; and (4) CSBL 6058 - Neurobiology of Aging. Not all selected topics are offered each semester. Please discuss this with the Academic Coordinator for more details. Substituted courses in conflict with Physiology course schedule will require approval from COGS.

PHYL 6097. Research. 1-12 Credit Hours.
If a track chooses to give a seminar course, the specific course requirements will be determined by the track. The sub-designations for each track are: (1) Biology of Aging; (2) Cancer Biology; (3) Cell & Molecular Biology; (4) Genetics, Genomics & Development; (5) Membrane Biology & Cell Signaling; (6) Metabolism & Metabolic Disorders; (7) Microbiology & Immunology; (8) Molecular Biophysics & Biochemistry; (9) Molecular, Cellular, & Integrative Physiology; (10) Neuroscience; and (11) Pharmacology.

PHYL 6098. Thesis. 1-12 Credit Hours.
Registration for at least one term is required of M.S. candidates. Prerequisite: admission to candidacy for Master of Science degree.

PHYL 6291. Seminar 2. 1 Credit Hour.
Presentation and discussion of recent research advances by outside scientists.

PHYL 7099. Dissertation. 1-12 Credit Hours.
Registration for at least two terms is required of Ph.D. candidates. Prerequisites: admission to candidacy for the Ph.D. degree.