

MASTER OF SCIENCE (M.S.)

The M.S. Degree Program in the Department of Cellular and Structural Biology (hereinafter referred to as the Program) offers training in areas of anatomical sciences and biotechnology. The curriculum prepares students seeking a Master of Science degree for a fulfilling biomedical career, in academic, industrial or clinical settings. The overall mission of the Program is to prepare the next generation of life-long learners and critical thinkers, prepared to design and execute innovative basic and translational research, and to address the most important and challenging knowledge gaps in basic biology, human health and disease. There are two parallel tracks in the Program: Anatomical Sciences and Biotechnology Tracks with some overlapping requirements but distinct curricula. The program of graduate study (i.e. the track elected) leading to the Master's Degree will depend upon the student and the professional career for which the student is preparing. A Committee on Graduate Studies (COGS) oversees all aspects of the Program.

Cell Systems and Anatomy Admission Requirements

Students beginning graduate study ordinarily matriculate during the fall semester, which starts mid-August. Spring semester admission (January start date) will not be considered except in very unusual circumstances.

The following are the basic admission criteria to the Program. On a case-by-case basis and at the discretion of the M.S. Admissions Committee and with approval of COGS and the Graduate Faculty Council (GFC), one or more admission requirement(s) may be waived.

Applicants are required to have a minimum of a Bachelor's degree in a Life Science or Biomedical Engineering from an accredited institution and a minimum GPA of 3.0/4.0. Applicants should have received credit for courses taken in:

- Biology 1- A minimum of 2 years of general biology with labs for science majors.
- Chemistry 1- A minimum of 1 year general chemistry and organic chemistry
- Physics- A minimum of 1 year of general physics
- Mathematics- minimum of 1 semester of calculus

1 course should include laboratory experience

All applicants must take the Graduate Record Examination (GRE). The GRE must be taken within the last 5 years and the TOEFL, if required, within the last 2 years. A personal statement is required.

In addition to the GRE, international applicants are also required to take one of two English proficiency tests: Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS: Academic module only). The minimum required scores for the TOEFL are 550 for the paper test and 68 for the internet test. The minimum score on the academic International English Language Testing System (IELTS) is 6.5.

Three letters of recommendation are required.

The admission committee uses a holistic approach in making its decision. Consideration is given to a candidate's research experience, grade point average, personal statement, GRE score, interviews, letters

of recommendations, and to how they match up against other interested applicants.

Cell Systems and Anatomy Degree Requirements

All students require a minimum of 30 semester credit hours (SCH) and a minimum overall GPA of 3.0 to graduate with a M.S. degree. See Academic Plans of Study - Anatomical Sciences and Biotechnology for details of required and elective coursework. In addition, all master's candidates must register for Thesis for at least one semester in order to graduate. Students in the Anatomical Sciences track register for "Anatomical Sciences Thesis/CSBL 6060" and students in the Biotechnology track register for "Thesis" CSBL 6098. All students must successfully defend their thesis and be recommended by the program COGS for approval of their degree to the Dean of the Graduate School of Biomedical Sciences.

A student must maintain an overall cumulative grade point average (GPA) of ≥ 3.0 ("B" average) each semester to continue in good academic standing. Student should receive a "B" or better in their core courses. If a student receives a grade that is worse than a "B" in core courses, or a grade that is worse than a "C" in one of the courses, or a final grade of a "C" in more than one course in the curriculum, he/she shall be dismissed from the program unless an appeal from the student is approved by COGS. If the cumulative GPA drops below 3.0, the student shall be placed on academic probation. While on probation, a student must maintain a "B" average in all courses in which he/she is enrolled. If the GPA drops below 3.0 in any semester during the probationary period or remains below 3.0 for one calendar year, the student shall be dismissed from the program unless an appeal from the student is approved by COGS. If remediation of a course is agreed upon by a course director and COGS, the director(s) of a required course will determine the mechanism for remediation. However, course directors are not required to remediate students. Situations that involve potential remediation will be resolved on a case by case basis. A student who is not required to remediate a required course may not engage in the remediation process with the intent of improving his/her original grade. This policy will be reviewed annually.

Anatomical Sciences Track

First Year

Fall		Credit Hours
TSCI 5070	Responsible Conduct Of Patient-Oriented Clinical Research	2
CSBL 6060	Anatomical Sciences Thesis	0.5
CSBL 5074	Introduction to Research	0.5
INTD 5047	Neuroanatomy	2
CSBL 5030	Basic Histology	1
CSBL 5060	Advanced Histology	2
Total Credit Hours:		8.0

First Year

Spring		Credit Hours
CSBL 5022	Inter-professional Human Gross Anatomy	5.5
CSBL 6059	Stem Cells & Regenerative Medicine	1
CSBL 6060	Anatomical Sciences Thesis	0.5

CSBL 5023	Development	1
Total Credit Hours:		8.0

Second Year

Fall		Credit Hours
CSBL 6071	Supervised Teaching**Supervised Teaching (Medical or Dental Gross Anatomy) *must be done in the 2nd year either semester	3
CSBL 6072	Presentation Skills	0.5
CSBL 6060	Anatomical Sciences Thesis	3.5,7.5
Total Credit Hours:		7.0-11.0

Second Year

Spring		Credit Hours
CSBL 6060	Anatomical Sciences Thesis	5.5,2.5
CSBL 6072	Presentation Skills	0.5
CSBL 6071	Supervised Teaching*Supervised Teaching (Medical or Dental Gross Anatomy) *must be done in the 2nd year either semester	1-12
Total Credit Hours:		7.0-15.0

Biotechnology Track**First Year**

Fall		Credit Hours
IBMS 5000	Fundamentals Of Biomedical Sciences	8
CSBL 5074	Introduction to Research	0.5
TSCI 5070	Responsible Conduct Of Patient-Oriented Clinical Research	2
Total Credit Hours:		10.5

First Year

Spring		Credit Hours
CSBL 6097	Research	5
CSBL 5095	Experimental Design And Data Analysis	3
Total Credit Hours:		8.0

Second Year

Fall		Credit Hours
CSBL 6097	Research	7.5
CSBL 6072	Presentation Skills	0.5
Total Credit Hours:		8.0

Second Year

Spring		Credit Hours
CSBL 6098	Thesis	3
CSBL 6072	Presentation Skills	0.5
Total Credit Hours:		3.5

Cell Systems and Anatomy Objectives/Program Outcomes**Anatomical Science Track**

Students will have the ability to review, interpret and critically evaluate scientific literature related to areas of biomedical science relevant to the anatomical sciences in general and specifically to their project. Students will be trained to review and interpret original scientific literature through coursework and in their examination of the literature.

Students will have the ability to communicate effectively in written and verbal presentations. Students will learn to effectively communicate ideas in written format via coursework, examinations and their research and to communicate ideas/concepts in verbal presentations during progress report seminars, research advisory committee meetings, oral examinations/thesis defenses, and participation in scientific meetings.

Students will demonstrate foundational knowledge and expertise in a select area appropriate to the project. Students will be able to define, explain, and apply key concepts and fundamental principles related to the areas of anatomical science.

Students will demonstrate fundamental knowledge of ethics in biomedical research. Students will be able to recognize ethical dilemmas and behave in accordance with ethical standards of conduct in the design, implementation, analysis, and dissemination of scientific research.

Students will have the ability to teach human anatomy in the health professions environment. Students will be able to teach human gross anatomy, histology and/or neuroanatomy at graduate level.

Biotechnology Track

Students will have the ability to review, interpret and critically evaluate scientific literature related to areas of biomedical science relevant to cellular and molecular biology in general and specifically to their project. Students will be trained to review and interpret original scientific literature through coursework and in their research.

Students will have the ability to conduct original biomedical research. Students in the program will be able to analyze, plan, organize, and conduct high quality biomedical research under the direction of supervising professors and guidance of research advisory (thesis) committees as appropriate.

Students will have the ability to communicate effectively in written and verbal presentations. Students will learn to effectively communicate ideas in written format via coursework, examinations and their research and to communicate ideas/concepts in verbal presentations during progress report seminars, research advisory committee meetings, oral examinations/thesis defenses, and participation in scientific meetings.

Students will demonstrate foundational knowledge and expertise in a select area appropriate to the research project. Students will be able to define, explain, and apply key concepts and fundamental principles related to the areas of biomedical science relevant to their track and to their specific research projects.

Students will demonstrate fundamental knowledge of ethics in biomedical research. Students will be able to recognize ethical dilemmas and behave in accordance with ethical standards of conduct in the design, implementation, analysis, and dissemination of scientific research.

Courses

CSBL 3005. Advanced Anatomy. 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.

CSBL 4000. Special Topic. 4 Credit Hours.

This is a self-designed course created by both the student and the department to cover a specific topic. A Course Approval Form must be completed along with documentation of the designed course description.

CSBL 4001. Anatomy of the Newborn. 4 Credit Hours.

Detailed gross dissection and study of newborn specimen with special emphasis on developmental origins as well as features and relationships differing from the adult; combined with library study of developmental malformations. Course fees: Lab fee \$30.

CSBL 4002. Regional Anatomy. 4 Credit Hours.

Anatomy associated with one of the usual medical or surgical specialties, such as gastroenterology, neurology, orthopedics, obstetrics and gynecology, etc. Activities include detailed dissection, presentation of dissected material, assigned readings, and individual project. Course fees: Lab fee \$ 30.

CSBL 4004. Selected Research Project. 4 Credit Hours.

Individual research projects to be arranged between the student and faculty members with whom he/she wishes to work.

CSBL 4005. Advanced Anatomy. 4 Credit Hours.

Selected students are required to participate in lectures, detailed dissections, presentations of prosected material, and teaching in the first year medical gross anatomy laboratory. Special projects, activities, and assigned readings in the surgical anatomy and history of anatomy literature. Course fees: Lab fee \$30.

CSBL 4017. Advanced Neuroanatomy. 4 Credit Hours.

Selected students will be assigned a special project and readings in the neuro anatomical literature. Course Fees: Lab fee \$30.

CSBL 4024. History of Anatomy In Situ: Reawakening & Development of Anatomy in the 14th - 18th Century Italy. 4 Credit Hours.

An in-depth study of the awakening and development of anatomy in 14th - 18th century Italy, visiting the sites where this occurred in Padua, Bologna, and Florence. The course consists of one week of didactic lectures and discussion prior to two weeks in Italy visiting anatomical museums and two of the oldest universities in the world, and ending with a week of student presentations based on a paper focusing on a historical, social, or scientific issue arising during this period in the Italian medical schools and currently relevant to the students' chosen field of medicine.

CSBL 4025. Anatomy Mentored Teaching. 4 Credit Hours.

The Mentored Teaching Elective allows 3rd and 4th year medical students to serve as teaching assistants for the spring CSBL 5022 Inter-professional Human Gross Anatomy course. CSBL 5022 serves students in the occupational therapy, physical therapy, physician assistant and biomedical engineering programs, and students in the Masters of Anatomy graduate program. Teaching assistants will serve as instructors for laboratory dissections which cover the central and peripheral nervous systems, vertebral column and back, the upper and lower limbs, head and neck, body wall, thorax, abdomen, pelvis, and perineum. Other teaching assistant duties include preparation of prosection specimens for teaching and demonstration, lab practical exam setup and grading, and preparation and presentation of a brief topical review relevant to anatomy. Applicants should have attained a minimum grade of B in Language of Medicine and in Musculoskeletal/Dermatology and exhibit the highest standards of professionalism. Enrollment is by permission of the Undergraduate Medical Education Office and by the course directors.

CSBL 5007. Methods In Cell Biology. 1 Credit Hour.

Through a combination of lectures and demonstrations, the instructors will introduce students to techniques which are currently being used in cellular biology laboratories. The emphasis will be on the applications themselves, their uses, limitations, and the necessary controls. The following topic areas will be covered: imaging and microscopy, immunological techniques, bioinformatics (DNA and protein), rodent anatomy and histology, cytogenetics, and in vitro cell growth and transfection.

CSBL 5012. Physician Assistant Gross Anatomy. 5 Credit Hours.

This course will cover the basic principles of human anatomy. Lectures are correlated with laboratory sessions in which students will learn human gross anatomy of the adult through the study of cadaver prosections, bones, models, atlas drawings and radiographs. Emphasis will be placed on basic systems anatomy as they apply to the physician's assistant. Course Fees: Gross Anatomy fee \$30.00.

CSBL 5013. Gross Anatomy. 6 Credit Hours.

This course will teach structural and functional anatomy of the normal human body. Lectures will serve as introductory information for the laboratory dissections to follow and to clarify the interactions of the various anatomical components to accomplish the function of the body. The course will cover the central and peripheral nervous systems, vertebral column and back, head and neck, body wall, thorax, abdomen, pelvis, and perineum, and the upper and lower limbs. Special emphasis will be placed on the laboratory experience in which the learner will perform a detailed dissection of the entire human body in order to achieve an understanding of the three-dimensional relationships and thus the interactive function of the body. These dissections will be supplemented by the study of prosected specimens, models skeletons, and other demonstration materials. Course fees: Lab fee \$30 Human Materials fee \$865.

CSBL 5015. History Of Anatomy. 2.5 Credit Hours.

The history of anatomy course is designed to acquaint medical, dental, and graduate students with the history of medicine and especially with the physicians and scientists who made essential discoveries in human anatomy. Using a biographical approach, the course is presented as a seminar with lectures, assigned readings and student presentations.

CSBL 5016. Dental Gross Anatomy. 6 Credit Hours.

The focus of this course is the structure of the human body, with emphasis on the functional anatomy of the trunk, neck, head, and nervous system. Regional dissection of a human cadaver, by groups of students, is supplemented by individual study of prosections, models, skeletons, and other demonstration materials and is guided by lectures, conferences, and films. The first part of the course, which deals with the anatomy of the thorax and abdomen, presents a general overview of the functional architecture of most major body systems. The emphasis is on principles of structure, to allow development of a holistic understanding of human biology, both normal and pathological. The latter half of the course is devoted to study of the head and neck; greater emphasis will be placed on anatomical relationships with obvious reference to clinical dentistry. Course Fees: Human materials fee: \$865 Lab fee: \$30.

CSBL 5019. Gross Human Anatomy For Graduate Students. 6 Credit Hours.

This course will teach structural and functional anatomy of the normal human body. Lectures will serve as introductory information for the laboratory dissections to follow and to clarify the interactions of the various anatomical components to accomplish the function of the body. The course will cover the central and peripheral nervous systems, vertebral column and back, head and neck, body wall, thorax, abdomen, pelvis and perineum, and the upper and lower limbs. Special emphasis will be placed on the laboratory experience in which the learner will perform a detailed dissection of the entire human body in order to achieve an understanding of the three-dimensional relationships and thus the interactive function of the body. These dissections will be supplemented by the study of prosected specimens, models skeletons, and other demonstration materials. Permission of course director if required to enroll. Course fees: Human materials fee \$ 865 Lab fee \$30.

CSBL 5020. Dental Neuroscience. 1.5 Credit Hour.

This course will present the student with the basics of neuroanatomy underlying somatosensory perception, special senses, orofacial reflexes, and common neurological disorders. The emphasis will be on neuroanatomical pathways relevant to the head and neck, especially those mediated by the trigeminal system. The course also will include consideration of motor pathways and the special senses, disorders of which will necessarily influence treatment plans developed by future dental practitioners. Acquisition of a basic understanding of the neuroanatomical pathways discussed in lectures will be reinforced by laboratory sessions with representative images of brain and spinal cord sections.

CSBL 5022. Inter-professional Human Gross Anatomy. 5.5 Credit Hours.

This courses will teach structural and functional anatomy of the normal human body. Lectures will serve as introductory information for the laboratory dissections to follow and to clarify the interactions of the various anatomical components to accomplish the function of the body. The course will cover the central and peripheral nervous systems, vertebral column and back, the upper and lower limbs, head and neck, body wall, thorax, abdomen, pelvis, and perineum. Special emphasis will be placed on the laboratory experience in which the learner will perform a detailed dissection of the entire human body in order to achieve an understanding of the three-dimensional relationships and thus the interactive function of the body. The dissections will allow the student to understand the anatomical basis for disease and dysfunction in organ systems and their applications to clinical practice. They will be supplemented by the study of prosected specimens where possible, models skeletons, and other demonstration materials.

CSBL 5023. Development. 1 Credit Hour.

The course provides a survey of concepts in developmental biology (induction, cell-cell interactions, morphogen gradients, morphogenetic movements, transcription regulation, organogenesis) using experimental examples from both invertebrate and vertebrate embryos. The first set of lectures will focus on gametogenesis, fertilization, and early developmental events, such as cleavage, midblastula transition, gastrulation, and axis formation. The second set of lectures will explore the fates of germ layers in the contexts of cell type-specific differentiation and cell-cell interactions during organogenesis.

CSBL 5024. Genomics. 1 Credit Hour.

This course covers historical aspects of the Genomic project and high throughput methods (microarray, SAGE, proteomics, etc.) to perform global analysis of gene expression; the course also provides an overview of new biological fields such as systems biology, functional genomics, and comparative genomics. The students will have the opportunity to become familiarized with tools, methods, databases, and approaches used to extract biological information from global analyses. Hands-on training on biological databases and classes covering examples of the use of genomics to answer questions related to cancer and diseases is an important part of the course, helping the students to visualize how genomics can be used in their own research projects.

CSBL 5025. Genetics. 1 Credit Hour.

This course is designed to provide an overview of genetic research. Topics to be covered include: cytogenetics, mitochondrial genetics, cancer genetics, linkage analysis, complex traits, population genetics, animal models, sex determination, and epigenetics.

CSBL 5026. Stem Cell Biology. 1 Credit Hour.

This course is an up-to-date overview on current topics in stem cell biology. It is intended for the (future) basic scientist who is interested in studying the regulatory mechanisms of stem cells as well as for the (future) clinician who is interested in how stem cell biology will continue to impact patient care. Topics that will be discussed are: (1) basic biology and stem cells, including embryonic stem cells, adult stem cells, stem cells in different tissues and model systems; (2) microenvironment-mediated; (3) epigenetic regulators of stem cells; (4) stem cells in medicine, including regenerative medicine, cancer and aging; and (5) ethics.

CSBL 5030. Basic Histology. 1 Credit Hour.

This course is designed to provide students in the Anatomical Sciences track of the M.S. degree program an introduction to microscopic cell structures and relevant functions followed by study of the four basic human tissues (epithelial, connective, muscle and nervous tissues). In addition, a few specialized tissues (blood cells, bone, cartilage and lymphoid tissues) will be examined in depth to develop skill in understanding function in relation to viewing microscopic anatomical features. Overall, this course is meant to provide a foundation for the understanding of the microscopic architecture of the organ systems of the body and the role these play in normal activity and disease processes. Lectures, independent study (self-directed learning), and laboratory experiences will be used in teaching the fundamentals of human histology.

CSBL 5032. Dental Histology. 5 Credit Hours.

Through lectures, demonstrations, and laboratory work, students in this course will be given the opportunity to study the microscopic structure of the basic tissues and organs of the human body, followed by details of the embryologic development and microscopic structure of the various organs of the oral cavity. Current concepts in cellular biology are presented during the portion of the course in which they are most relevant. The general purpose of this course is to give students the opportunity to become acquainted with the basic embryology, cytology, and histology of normal human tissues and organs, thereby providing a foundation of knowledge for the understanding of normal activity and disease processes. Course Fees: Included in general lab fee. \$48 microscope fee for the Freshman year includes this course.

CSBL 5033. Brain Health Journal Club. 1 Credit Hour.

A journal club with an emphasis on brain health. The scope of the journal club is broad, with topics ranging from molecular mechanisms to the impact of injuries on behavior. Brain injuries ranging from stroke, spinal cord injury and traumatic brain injury (TBI) to age-associated neurodegeneration will be emphasized. Scientific articles on relevant or state-of-the-art techniques will also be encouraged. On a rotating basis, participants will be expected to present to the group either a paper of interest and relevance to their work or an update on their ongoing research or some combination of the two. PowerPoint slides are discouraged in favor of a chalk talk when presenting to the group.

CSBL 5060. Advanced Histology. 2 Credit Hours.

This course, designed for students enrolled in the Anatomical Sciences track of the MS degree program in Cell Systems & Anatomy, will examine the microscopic architecture of organs and their higher level organization into systems performing specific functions. Topics covered will include the integumentary, cardiovascular, respiratory, gastrointestinal, endocrine, urinary and male and female reproductive systems. The goal of this course is to enable students acquire knowledge of normal histological structure of organs and organ systems using light and electron microscopy, thereby providing a strong basis for the sound understanding of cell and tissue morphology in health and disease. The course will include lecture, laboratory and self-directed student learning. A prerequisite for this course is Basic Histology.

CSBL 5074. Introduction to Research. 0.5 Credit Hours.

This course is required of all MS students in the Anatomy Track in Cellular & Structural Biology and is available to the Biotechnology Track students. Students will have the opportunity to learn about the research interests of faculty in the program. This course will introduce students to the research strategies and help them identify a mentor and committee members.

CSBL 5077. Scientific Writing. 2 Credit Hours.

This course will provide students with the opportunity to develop skills in scientific writing and the presentation of research results. It will emphasize learning-by-doing-and-re-doing. Students will be required to write something every week. The capstone project for students will be to write a grant proposal and defend it in front of the class. One hour per week will be devoted to lecture and critique of published work; the other hour will consist of critique and revision of student writing by other students, as well as by the course director. Topics to be covered include: (1) fundamentals of writing clearly, (2) principles of revision, (3) effective presentation of data, (4) fundamentals of oral presentation, (5) writing/presenting to the appropriate audience, (6) how to write background/introductory sections, (7) how to write materials and methods, (8) how to write the discussion section, and (9) how to constructively critique one's own and others writing.

CSBL 5083. Practical Optical Microscopy. 1 Credit Hour.

This course will be a one-hour elective for graduate students consisting of eight (8) one-hour lectures plus eight (8) one-hour laboratories. The course focuses on the practical aspects of using optical microscopes. The objectives are to teach students the fundamental principles of optical microscopy and to provide them with hands-on experience using the optical instrumentation in the Institutional Imaging Core.

CSBL 5089. Graduate Colloquium. 2 Credit Hours.

This course is designed to provide graduate students with training in evaluating the scientific literature and in presentation of research in a seminar or journal club format. The course will focus on critical thinking, including evaluation of existing literature, interpretation of experimental results, and comparison of alternative models and interpretations. These tools are essential both for oral presentations and for writing grant proposals and manuscripts. Emphasis will be placed on evaluation of the science, organization of the manuscript, and on oral presentation skills.

CSBL 5091. Special Topics. 1-9 Credit Hours.

No description available.

CSBL 5095. Experimental Design And Data Analysis. 3 Credit Hours.

The purpose of the course is to provide an introduction to experimental design and statistical analysis. The emphasis of the course will be on the selection and application of proper tests of statistical significance. Practical experience will be provided in the use of both parametric and nonparametric methods of statistical evaluation. Among the topics to be covered are: data reduction, types of distributions, hypothesis testing, scales of measurement, chi square analysis, the special case of the comparison of two groups; analysis of variance; a posteriori multiple comparisons tests, tests of the assumptions of parametric analyses, advanced forms of the analysis of variance, linear regression, and correlation analysis. This course involves the use of statistical software; therefore, access to a laptop or a computer with web access for classes and examinations is required.

CSBL 6015. Selective Topics In Oncology: Gynecological Cancers. 2 Credit Hours.

This advanced elective course for the Cancer Biology Track provides a unique learning experience intended to prepare students in the emerging research areas of gynecological cancers for designing research experiments using pre-clinical and clinical research materials. The entire course comprises a small-group format in which students interact closely with a group of faculty who has active research or clinical programs focusing on molecular, clinical, and therapeutic areas of gynecological cancers.

CSBL 6021. Animal Models. 3 Credit Hours.

The relevant biology, applicability, and practical use of a number of animal models to biomedical research is covered. Invertebrate (e.g., *C. elegans*) and vertebrate (e.g., fish and rodents) model systems are included in the course. Strengths and weaknesses of each organism that render them particularly valuable as animal models are emphasized. Experimental approaches and tools that are utilized in conjunction with each animal model are rigorously examined. The course is taught from primary scientific literature using classic historical publications and recent publications.

CSBL 6040. Gross Anatomy Mentored Teach. 1 Credit Hour.

The Gross Anatomy Mentored Teaching Elective allow students in the Integrated Biomedical Sciences Program, School of Health Professions, and other qualified students to serve as preceptors for the spring CSBL 5022 Interprofessional Human Gross Anatomy course. CSBL 5022 serves students in the occupational therapy, physical therapy, physician assistant and biomedical engineering programs, and students in the Masters of Anatomy graduate program. Preceptors will serve as instructors for laboratory dissections which cover the central and peripheral nervous systems, vertebral column and back, the upper and lower limbs, head and neck, body wall, thorax, abdomen, pelvis, and perineum. Other preceptor duties include preparation of prosection specimens for teaching and demonstration, lab practical exam setup and grading, and preparation and presentation of a brief topical review relevant to anatomy. Students enrolling in this elective must have taken an approved human gross anatomy course (as determined and agreed upon by the course directors) with a minimum final grade of B within the previous five years.

CSBL 6048. Biology of Aging. 4 Credit Hours.

Biology of Aging is the core course of the Biology of Aging Track. The course consists of two modules: Aging and Longevity Mechanisms and Molecular and Cellular Mechanisms of Aging. The purpose of this course is to provide students with the most up-to-date information on the current understanding of the aging process. This advanced interdisciplinary graduate course provides experimental understanding of the interrelated areas of aging and age-related diseases. Faculty from several departments will be involved in teaching this course, which will cover the molecular and cell biology of aging, model systems used for aging studies, age-related changes in organs and tissues, and age-related diseases.

CSBL 6049. Cellular and Molecular Mechanisms of Aging. 2 Credit Hours.

This course provides up-to-date information on the current understanding of cellular and molecular mechanisms that contribute to aging. The focus is on investigation of specific mechanisms of aging including oxidative stress, nutrient sensing signaling pathways, stem cells and senescence, and genome stability. Experimental design and analysis, including pros and cons of approaches used to gain knowledge and how to appropriately interpret data, will be discussed throughout the course. The relationship between age-related changes in function and potential contributions age associated diseases will be examined via recently published research.

CSBL 6050. Aging and Longevity Mechanisms. 2 Credit Hours.

This module will focus on and evaluate several approaches used to modulate longevity and how these are used to discover the genetic, physiological and intracellular foundation of aging processes. The course will consist of interactive lectures complemented by guided reading of currently research papers. Students will be taught to hone critical reading skills and develop testable hypotheses to carry research forward. Topics will include: Genetics of Aging, Exceptional Longevity, Pharmacological Interventions, Calorie Restriction, Healthspan and Pathology of Aging.

CSBL 6058. Neurobiology Of Aging. 2 Credit Hours.

The nervous systems of many species, including humans, show obvious declines in function as a result of increasing age. In addition to the gradual decline observed in neural function, it is clear that increasing age also results in increased susceptibility of the nervous system to degenerative diseases such as Alzheimer's Disease, Parkinson's Disease, and Amyotrophic Lateral Sclerosis. This course will focus on recent findings and topics related to the underlying pathology of aging in the nervous system and the relationship of aging to neurodegenerative disease.

CSBL 6059. Stem Cells & Regenerative Medicine. 1 Credit Hour.

The fields of stem cells and regenerative medicine are rapidly evolving and have great potential to change the way medicine is practiced. This course will encompass topics from basics of tissue specific stem cell biology to pre-clinical animal models, strategies and progress in regenerative medicine. We will discuss some of the most current research being done in regenerative medicine from stem cell transplantation to biomaterials. Prerequisite: INTD 5000.

CSBL 6060. Anatomical Sciences Thesis. 1-8 Credit Hours.

Designed as an alternative to a "bench research"- based thesis, this longitudinal course for the Anatomical Sciences track in the Masters Program will culminate in the production of a thesis ideally suitable for adaptation as a scholarly publication in a peer-reviewed journal. The thesis should focus on assessment of an unanswered and important question on a relevant and approved subject, involve in-depth research and demonstrate critical thinking on the part of the student. A student in the Anatomical Sciences Track will meet with the Course Director during the spring semester of his/her first year in the program to begin to identify a research area and specific topic(s) for his/her thesis proposal. Areas of focus include (but are not limited to) the following: 1) Clinical Anatomy - anatomy related to medical procedures and/or training of health professionals; 2) Anatomical Variations - comparative research utilizing human cadavers in the gross anatomy laboratories or comparative research in animal models; 3) Anatomical Sciences Education - education research on anatomy teaching methods and approaches to teaching anatomy to health professions students; 4) History of Anatomy - research on the development of human anatomical studies, comparative anatomy concepts, anatomy education, or involving other applications of the humanities to anatomical sciences (e.g. medical illustration, literature, music); 5) Human and rodent micro-anatomy /histology; or 6) Anatomical aspects of a biomedical research endeavor.

CSBL 6064. Genes & Development. 4 Credit Hours.

Genes and Development is the core course of the Genetics, Genomics, and Development Track. The course consists of four modules: genetics, genomics, developmental biology, and stem cell biology. Basic concepts in genetics such as cytogenetics, mitochondrial genetics, cancer genetics, linkage analysis, complex traits, population genetics, animal models, sex determination, and epigenetics will be presented. The genomics section will include historical aspects of the genome project and high throughput analysis. The students are introduced to new techniques in global analysis as well as have hands-on experience. The developmental biology section provides a survey of concepts in developmental biology (induction, cell-cell interactions, morphogen gradients, morphogenetic movements, transcriptional regulation, organogenesis) using experimental examples from both invertebrate and vertebrate embryos. The stem cell biology section includes the following topics: basic biology of stem cells, including embryonic stem cells, adult stem cells, stem cells in different tissues and model systems; microenvironment-mediated and epigenetic regulators of stem cells; stem cells in medicine, including regenerative medicine, cancer, and aging; and ethics. Required for the Genetics, Genomics & Development Track.

CSBL 6068. Cancer Biology Core 1; An Introductory course. 1 Credit Hour.

This course introduces the key features of cancer biology. In particular this course will provide initial insight into the clinical presentation and the cellular processes involved in cancer biology. In addition will be an initial presentation of molecular oncology. Topics examined include oncogenes, tumor suppressor genes, apoptosis, control of cell cycle regulation, and control of cellular growth and proliferation. Required for Cancer Biology Discipline. Prerequisites: INTD 5007 (or INTD 6007 and INTD 6009).

CSBL 6069. Cancer Biology Core 2; Advanced Cancer Biology. 2.5 Credit Hours.

This course is designed to provide a detailed representation of cancer biology, from progression, standard of care and molecular alterations that drive recent diagnoses and therapeutic strategies. In addition, this course will offer an overview on special populations affected by cancers and models used in the investigation of cancer. Included are basic experimental methods, mouse models, ex vivo systems, molecular profiling and clinical trials. The conceptual notions on clinical trials of cancer drugs and the process of development of novel therapeutic drugs in cancer will be discussed. Required for Cancer Biology Discipline. Prerequisites: INTD 5007 (or INTD 6007 and INTD 6009) and CSBL 6068.

CSBL 6070. Cancer Biology Preceptorial. 0.5 Credit Hours.

This is a discussion-based course to help unify our cancer biology students. The idea is to work in a small team based manner for students to disseminate knowledge that they are obtaining by participating in advanced courses of different topics by presenting the topic, methods and relevance to cancer biology to their peers. The intent is that participating students will discuss the topic in detail to understand how it might be useful to cancer biology research, in effect an active learning process. The goal is to provide an integrated multidisciplinary view on cancer research. Prerequisites: CSBL 6068 and CSBL 6069.

CSBL 6071. Supervised Teaching. 1-12 Credit Hours.

This course consists of participation in the teaching program of the first-year medical, dental, or health professions curriculum. Semester hours vary depending on the time spent in teaching.

CSBL 6072. Presentation Skills. 0.5 Credit Hours.

This course is designed to provide graduate students in the CSB masters program the opportunity to develop their skills in oral presentation. The course will focus on critical thinking, clear and concise presentation of research endeavors, and communicating science to the public, to students, and to other scientists. The course will meet for 1 hour every other week and is intended for MS students in their second year of study. Part I (Fall Semester) will focus on general scientific presentation skills.

CSBL 6073. Selective Topics In Oncology: Gynecological Cancers. 2 Credit Hours.

This is an advanced elective course for the Cancer Biology Track. The course is a unique learning experience in preparing students in the emerging research areas of gynecological cancers for designing research experiments using preclinical and clinical research materials. The entire course is a small-group format in which student interact closely with a group of faculty who have active research or clinical programs focusing on molecular, clinical, and therapeutic areas of gynecological cancers.

CSBL 6074. Molecular Aspects Of Epigenetics. 2 Credit Hours.

The purpose of this course is to develop an understanding of the molecular aspects of epigenetics. This advanced course will be a unique learning experience that prepares the student to evaluate and design new research in the areas of epigenetic processes including imprinting, gene silencing, X chromosome inactivation, position effect, reprogramming, and the process of tumorigenesis. This module concerns epigenetic mechanisms. Topics include: DNA methylation, histone modifications, epigenetics and stem cells, cancer epigenetics, RNA interference and epigenetics, bioinformatics and epigenetics, and translational epigenetics. This course will include a didactic program and student discussion. For the student discussion module, faculty and students will jointly discuss key publications that serve to bridge the gap between the student's prior understanding of the field and the state of the art in that area.

CSBL 6075. Cancer Biology Enrichments Course. 0.5 Credit Hours.

This course is a series of enrichment presentations to the students, either in lecture format, visit to labs or attendance of a conference. The goal is to give secondary reinforcements of the didactic components of the core courses on cancer biology. Required for Cancer Biology Discipline.

CSBL 6090. Seminar. 1-9 Credit Hours.

Attendance and participation in the regularly scheduled department seminar series is required each semester the course is offered. The activities included in the seminar course are attendance at invited seminars, journal club, and the student presentations including student annual progress and final dissertation and thesis presentations.

CSBL 6094. Advanced Neuroanatomy. 0.5 Credit Hours.

This course in neuroanatomy is offered to graduate students seeking to advance their knowledge beyond the fundamental level. The course consists of reading from more advanced texts and current anatomical literature as well as dissection of deep white matter tracts within the cortex. The student must also complete a 20-page paper on a neuroanatomical topic.

CSBL 6095. Functional Genomic Data Analysis. 2 Credit Hours.

This course covers basics of genomic data analysis. Focus is on general computational methods, their biomedical basis, and how to evaluate analysis results. Qualitative algorithm descriptions are expected. Prerequisites: CSBL 5095 or Equivalent.

CSBL 6097. Research. 1-12 Credit Hours.

This course consists of independent, original research under the direction of a faculty advisor.

CSBL 6098. Thesis. 1-12 Credit Hours.

This course consists of instruction in the preparation of the thesis. Registration for at least one term is required of M.S. candidates. Admission to candidacy for Master of Science degree is required.

CSBL 6165. Medical Genetics. 3 Credit Hours.

This course provides an introduction to the basic concepts of medical genetics and current areas of medical genetic research. The course reviews basic genetic concepts including the principles of Mendelian and nontraditional inheritance, cytogenetics, molecular genetics, quantitative and population genetics, and discuss important medical aspects of genetic counseling and pedigree analysis, dysmorphology, cancer genetics and counseling for inherited cancers, developmental genetics, prenatal diagnosis, newborn screening, and pharmacogenetics. Diagnosis and current research toward treatment and cure of common genetic disorders affecting metabolism, reproduction, the endocrine system, the functioning of the eye and the nervous system are discussed. An important aspect of the course will be a discussion of ethical issues in medical genetics. A basic background in genetics, cell biology, and biochemistry is assumed. Prerequisites: A basic background in genetics, cell biology, and biochemistry.

CSBL 7014. Anatomy 1. 5 Credit Hours.

This course provides the basic principles of human anatomy. Students have the opportunity to learn human anatomy as it relates to function through the study of bones, cadaver prosections, models, atlas drawings and photographs, and their own bodies. Concentration is on osteology, radiology, arthrology, neuromuscular, vascular, and basic systems anatomy as they apply to physical therapy. Course fees: Lab Assistance fee \$10 per hour Gross Anatomy Lab fee \$30.

CSBL 7099. Dissertation. 0.5-12 Credit Hours.

Registration for at least one term is required of Ph.D. candidates. Prerequisites: admission to candidacy for Doctor of Philosophy degree.

CSBL 8010. Anatomy 2. 2 Credit Hours.

This course reinforces principles of human anatomy studied in CSBL 7014. Students study human anatomy as it relates to function through cadaver dissection. Concentration is on osteology, radiology, arthrology, neuromuscular, vascular, and basic systems anatomy as they apply to physical therapy. Course fees: Lab Assistance fee \$10 per hour Gross Anatomy Lab fee \$30 Human Materials fee \$865.