Joint Health Sciences

Joint Health Sciences offers interdisciplinary M.S. and Ph.D. programs including:

- M.S. in Anatomical Science
- Ph.D. programs in Graduate Biomedical Sciences
- M.S. in Multidisciplinary Biomedical Science
- Ph.D. program in Neuroengineering

ANSC-Anatomical Science Courses

ANSC 601. Human Gross Anatomy. 4 Hours.
Course provides a comprehensive survey of the gross anatomy of the human along with functional and applied anatomy as it relates to common clinical findings.

ANSC 601L. Human Gross Anatomy Lab. 1 Hour.
Lab component of Human Gross Anatomy.

ANSC 602. Gross Anatomy Supplement. 1 Hour.
This course provides students with a step-by-step guide to beginning an education-based research project. Students will create their own anatomy education research project following the topics in the course. Topics include: ethics of research, IRB documents, writing a research question and hypothesis, designing a survey, identifying a sample population, reviewing existing literature, appropriate use of statistical tests, and more.

ANSC 618. Histology of Mammalian Organ Systems. 3 Hours.
This course will cover the specialized cell biology and microscopic anatomy for each of teh mammalian organ systems, as well as consider current research with regards to each system. The objective is to understand how cells organize into tissues and organ systems and how these systems function in the body, as well as appreciate the microscopic appearance of cells, tissues and organs.

ANSC 655. Neuroscience. 3 Hours.
Have you every wanted to know where the amygdala sits in the brain, or how the brainstem connects to the thalamus and basal ganglia? Would you like to know about processing in the spinal cord, and how this information is sent to and from the cortex? This course will show you how to find any structure in the nervous system, and how these regions interact to control body movements, give rise to sensory perception, generate emotions and experiences, make decisions, and create personality. Each week will use interactive didactic sessions, anatomical drawing exercises, real brain lab experiences, radiographic imaging, and small group medical case discussions, to break down the brain into manageable components, to see how its outer coverings, blood supply, gray and white matter are structurally and functionally organized to make you who you are. This course may be beneficial for students considering careers in the medical, dental or optometry fields, along with those wanting to pursue graduate research in neuroscience. Students without a general neuroscience background may consider taking NBL 230 or PY 253 (recommended but not required).

ANSC 656. Human Embryology. 2 Hours.
This course uses didactic lectures, lab exercises and student presentations to help students gain an understanding of the major events in human development from gastrulation to birth. Individual units focus on the developmental processes of specific organ systems. the course uses an anatomical focus to describe the morphological characteristics of the developing embryo/fetus. The biochemical and molecular biology of development are only briefly discussed. morphology and anatomy are also related to clinical presentation of birth defects. Offered summer terms.

ANSC 657. Medical Imaging. 1 Hour.
Students will learn to obtain and interpret ultrasound images by practicing techniques on classmates and reading existing ultrasound images. Other radiograph images (X-ray, MRI) will also be used to help students understand planar anatomy and its relationship to 3D anatomy. Students will learn the basics of the technology behind the different medical techniques to provide a fuller understanding of image interpretation.

ANSC 695. Teaching Practicum. 3 Hours.
Students will act as supplemental instructors in a variety of anatomy lab courses, complete their own (or in teams) whole-body prosection, and prepare and present 2-3 hours of new lecture content for anatomy.

ANSC 696. Research Project. 1-6 Hour.
Students will develop an original research project in medical education, clinical anatomy, or other anatomy research. Students will be evaluated on their ability to formulate an anatomically relevant research question, review the existing literature, and communicate their findings via a poster or oral presentation to department.

GGSC - Genetics Genomic Sci Courses

GGSC 610. Genetic Basis of Human Disease. 3 Hours.
This course will focus on the medical applications of genetics and genomic technologies. Topics covered include, but are not limited to major forms of chromosomal abnormalities, mutations and genetic disorders, genetic risk assessment and population genetics, and genomic approaches to diagnosis.

GGSC 615. Aquatic Animal Models of Human Disease. 3 Hours.
This course will cover the basic anatomy, biology, life history, husbandry, and research applications for a variety of aquatic organisms used as animal models of human disease in biomedical research. Species discussed will include zebrafish, Medaka, Xiphorous, Onchorynchus, Xenopus, and Axolotls.

GGSC 620. Applications of Bioinformatics. 3 Hours.
Introduction to computational tools and bioinformatics databases used in the fields of genetics and genomic sciences. This course will cover a wide variety of different bioinformatics applications, which will be taught through use of available on-line bioinformatics resources. Topics covered include large-scale genomic databases, sequence analysis systems, protein sequence analysis, structural bioinformatics, protein folding, and homology modeling.

GGSC 635. Zebrafish as a Model for Biomedical Research. 3 Hours.
This course will focus on the biology, husbandry, and management of zebrafish used as an animal model of human disease in biomedical research. The course is suitable for undergraduate and graduate students. Topics will include anatomy, physiology, systems design, water quality management, behavior and enrichment, spawning and larviculture, nutrition and live feeds, diseases, quarantine, biosecurity, and regulatory compliance.

GGSC 665. Research Techniques for Aquatic Animals of Human Diseases. 4 Hours.
This course will focus on the techniques and procedures used for research with aquatic animal models of human disease. Lecture and lab approaches are used.

GGSC 670. Principles of Pharmacogenetics. 3 Hours.
Most of the drugs that we use today were developed with the assumption that the same drug will work equally well in all the patients that have the same disease. However, there is considerable variability between individual patients - both in the therapeutic response and the adverse effects of the same drug - that is largely determined by the differences in their genotypes. Pharmacogenetics and pharmacogenomics study the genetic determinants of drug response, with the goal to identify genetic variants that can be used to predict the efficacy of a particular drug in a particular patient and to avoid adverse drug reactions. This will ultimately enable implementation of personalized treatment options, by selecting the drugs that will have the best efficacy and the least toxicity for each individual patient. This course will introduce students to the basic principles of pharmacogenetics, demonstrate examples of drug/genotype interactions, highlight the available pharmacogenetic resources, and discuss the potential benefits, as well as limitations and challenges of pharmacogenetics and personalized medicine.

GGSC 690. Model Systems for Genetic Disorders. 3 Hours.
Invertebrate and non-human vertebrate species are commonly used in scientific research work to provide significant insights into human genetic processes and disease. This course focuses on the different methods and strategies by which researchers use these systems for genetic and genomic analyses of human biology and relevant disorders. Model organisms covered include, but are not limited to nematodes (C. elegans), fruit flies (Drosophila sp.), zebrafish (Danio rerio), and mice (Mus musculus).

GGSC 691. Personalized Genomic Medicine. 3 Hours.
Significant developments in the fields of genetics and genomics are making it possible to tailor medical care to the specific needs of patients. New diagnostic tests, up to and including whole genome sequencing, provide increasingly powerful tools for the identification of the genetic basis of both rare and common disorders. Better understanding of the causes of disease are permitting drugs to be developed that precisely target disease mechanisms, increasing the efficacy and avoiding side effects. These and other new advanced are leading to major changes in healthcare delivery and provide the consumer with new opportunities and complex choices. This course will focus on exploring state-of-the-art genetic, genomic, and informatic tools now available to enable personalization of healthcare.

INFO - Informatics Courses

INFO 601. Introduction to Bioinformatics. 3 Hours.
Introduction to bioinformatics and computational biology, with emphasis on concepts and application of informatics tools to molecular biology. It covers biological sequence analysis, gene prediction, genome annotation, gene expression analysis, protein structure prediction, evolutionary biology and comparative genomics, bioinformatics databases, cloud computing, basic R-based data analysis, simple programming skills using Perl, Linux/Unix environment and command lines, visual analytics, and social/legal aspects of open science. It will have a class research project component.
Prerequisites: INFO 510 [Min Grade: C]

INFO 602. Algorithms in Bioinformatics. 3 Hours.
This course introduces various fundamental algorithms and computational concepts for solving questions in bioinformatics and functional genomics. These include graph algorithms, dynamic programming, combinatorial algorithms, randomized algorithms, pattern matching, classification and clustering algorithms, hidden Markov models and more. Each concept will be introduced in the context of a concrete biological or genomic application. A broad range of topics will be covered, ranging from genome annotation, genome reconstruction, microarray data analysis, phylogeny reconstruction, sequence alignments, to variant detection.
Prerequisites: INFO 601 [Min Grade: C]

INFO 603. Biological Data Management. 3 Hours.
The introduction of biological data management concepts, theories, and applications. Basic concepts such as relational data representation, relational database modeling, and relational database queries will be introduced in the context of SQL and relational algebra. Advanced concepts including ontology representation and database development workflow will be introduced. Emerging big data concepts and tools, including Hadoop and NoSQL, will be introduced in the context of managing semi-structured and unstructured data. Application of biological data management in biology will be covered using case studies of high-impact widely used biological databases. A class project will be required of all participants.
Prerequisites: INFO 601 [Min Grade: C]

INFO 604. Next-generation Sequencing Data Analysis. 3 Hours.
This course is aimed to equip participants with the essential knowledge and skills required to begin analyzing next-generation sequencing data and carry out some of the most common types of analysis. The topics covered in-depth during this course are the analysis of RNA-Seq, ChIP-Seq data, ATACseq data, and Single-cell data, with an optional Variant Calling session. The sessions will also include Introduction to next-generation sequencing (NGS) technologies, common NGS data analysis issues, applications of sequencing technologies, introduction to bioinformatics file formats (e.g. FASTQ, bam, bed) and bioinformatics toolkits. At the end of this course, participants will have the expertise to perform these data analysis independently.
Prerequisites: INFO 601 [Min Grade: C]

INFO 610. Programming with Biological Data. 3 Hours.
Course is a 4-week session, class meets 4 days a week from 9:00am-11:30am (in person). This course provides students necessary bioinformatics data and programming skills using Linux, high-performance computing, data-wrangling, MySQL (weeks 1 and 2) and R or Python programming (week 3 and 4). Emphasis will be placed on best practices for conduct of reproducible research. The focus will be on practical computing, programming and data management concepts that can be applied to bioinformatics and data analysis problems.

INFO 611. Intermediate Statistical Analysis I. 3 Hours.
Students will gain a thorough understanding of basic analysis methods, elementary concepts, statistical models and applications of probability, commonly used sampling distributions, parametric and non-parametric one and two sample tests, confidence intervals, applications of analysis of two-way contingency table data, simple linear regression, and simple analysis of variance. Students are taught to conduct the relevant analysis using current software such as the Statistical Analysis System (SAS).

INFO 612. Visual Analytics for Bioinformatics. 3 Hours.
In this course, we will explore the use of visualization techniques as a concise and effective way to help analyze, understand, interpret and communicate complex biological data. Principles of design, visual rhetoric/communication, and appropriate usage will be introduced. We will cover representation of different data types, concentrating on those generated by data-rich platforms such as next-generation sequencing applications, flow/mass cytometry, and proteomics, and will discuss the use of visualization techniques applied to assessing data quality and troubleshooting. Various topics including dimension reduction, hierarchical visualizations, unsupervised learning, graph theory, networks/layouts and interactivity will be discussed. We will review the algorithmic underpinnings of various methods that lead to their appropriate and effective use. Finally, we will review a variety of genomics/bioinformatics-related visualization tools that are available. We will use Matlab throughout the course to create beautiful and effective visualizations.
Prerequisites: INFO 603 [Min Grade: C]

INFO 651. Systems Biomedicine of Human Microbiota. 3 Hours.
The human microbiota is the collection of microorganisms (bacteria, archaea, fungi and viruses) that reside within human tissues and biofluids. Such resident microorganisms compose the majority of cells in human bodies and are key contributors to human development, health, and disease. However, most studies focus on genomics and microbiome statistical representations alone, while spatial-temporal analysis, multi-source data integration and modeling are necessary to predict and understand interactions between microorganisms, human hosts, and the environment. This course will highlight state-of-the-art microbiome/microbiota research and provide essential training in mathematical, computational and systems biology to derive integrative and predictive models of microbiota-host interactions in the context of human health and disease.
Prerequisites: INFO 601 [Min Grade: C] and (MA 560 [Min Grade: C] or BME 670 [Min Grade: C])

INFO 662. Biomedical Applications of Natural Language Processing. 3 Hours.
Students will be introduced to Natural Language Processing (NLP) including core linguistic tasks such as tokenization, lemmatization/stemming, POS tagging, parsing and chunking. Applications will focus on Deep Learning methods using pytorch with a focus in information extraction including Named Entity Recognition, semantic role labeling, word sense disambiguation, normalization, summarization, question answering and text classification. Applications and data will have a biomedical focus, but no biology or medical background is required.

INFO 671. Clinical Informatics Seminar I. 1 Hour.
For master's student only. Students will learn how to prepare, present, and critique research presentations in clinical informatics by attending seminar presentations made by presenters. Seminars are presented by graduate students, faculty, visitors, or online speakers. Students must show evidence of prior preparation, active participation, and documented comprehension of the topics.
Prerequisites: INFO 501 [Min Grade: C]

INFO 672. Clinical Informatics Seminar II. 1 Hour.
For master's student only. Students will learn how to prepare, present, and critique research presentations in clinical informatics by attending seminar presentations made by presenters. Seminars are presented by graduate students, faculty, visitors, or online speakers. Students must show evidence of prior preparation, active participation, and documented comprehension of the topics.
Prerequisites: INFO 671 [Min Grade: C]

INFO 673. Clinical Informatics Journal Club. 0-1 Hours.
Students will learn how to read, present, and critique primary research publications in clinical informatics. Journal club participants will present high-impact recent journal publications selected by course instructors and learn how to read the paper, write critiques, and organize analysis insights into review papers. Students must show evidence of prior preparation prior to journal clubs and write critiques to show comprehension of the topics throughout the semester.

INFO 680. Implementation and Evaluation of Clinical Systems. 3 Hours.
Health information technology (HIT) tools such as Electronic Health Records (EHRs) are used to facilitate management of patient care data, to computerize clinical workflows, and to support health professionals in their medical decision making process. As a result of the U.S. Federal Government incentive program known as Meaningful Use, EHRs have been adopted on a national scale and are now used in almost every health care organization across the country. Although the literature exploring the impact of HIT adoption and use has also increased, previous studies have produced mixed results, leaving unanswered questions as to the impact of HIT on quality of care, patient safety, and health care providers' productivity. In this course, students will be introduced to project management tools and techniques commonly used for managing implementation of HIT systems as well as research approaches to conduct systematic evaluations of the impact of these systems on health care outcomes and organizations. This foundational course is intended for informatics majors and students in allied fields (e.g., health, biological, or computer sciences) who are interested in exploring implementation methods applicable to HIT systems such as EHRs and their components, as well as quantitative, qualitative, and mixed-methods approaches to conduct evaluations of HIT adoption and use. It is primarily intended for students who will pursue research careers in biomedical informatics and is the third course in a three-part series.
Prerequisites: INFO 697 [Min Grade: C]

INFO 690. Data Mining & Statistical Learning. 3 Hours.
Students will learn to discover and implement meaningful insights and knowledge from data. This course covers major concepts and algorithms of data mining. The course will be taught using the SAS Enterprise Miner program. The final project will demonstrate all the data mining techniques covered in the course and furthermore expose students working with real data. At the end of the course students will be proficient in utilizing data mining techniques to exploit data patterns and behavior, gain insider understanding of the data, and produce new knowledge that healthcare decision-makers can act upon. Furthermore, SAS Certified Predictive Modeler certification exam will be offered at the end of the course. Instructor permission is required.

INFO 691. Bioinformatics Seminar I. 1 Hour.
For master's student only. Students will learn how to prepare, present, and critique research presentations in bioinformatics by attending seminar presentations made by presenters. Seminars are presented by graduate students, faculty, visitors, or online speakers. Students must show evidence of prior preparation, active participation, and documented comprehension of the topics.
Prerequisites: INFO 601 [Min Grade: C]

INFO 692. Bioinformatics Seminar II. 1 Hour.
For master's student only. Students will learn how to prepare, present, and critique research presentations in bioinformatics by attending seminar presentations made by presenters. Seminars are presented by graduate students, faculty, visitors, or online speakers. Students must show evidence of prior preparation, active participation, and documented comprehension of the topics.
Prerequisites: INFO 691 [Min Grade: C]

INFO 693. Bioinformatics Journal Club. 2 Hours.
Students will learn how to read, present, and critique primary research publications in bioinformatics. Journal club participants will present high-impact recent journal publications selected by course instructors and learn how to read the paper, write critiques, and organize analysis insights into review papers. Students must show evidence of prior preparation prior to journal clubs and write critiques to show comprehension of the topics throughout the semester.

INFO 695. Special Topics in Bioinformatics. 3 Hours.
Topics of current research interest, such as metagenomics, microbiome, computational medicine, complex systems, deep learning in biology, artificial intelligence in biomedical, and translational bioinformatics applications. May be repeated as different sections taught by different instructors for credit. Permission of instructor is required.

INFO 696. Introduction to Biomedical Informatics Research. 3 Hours.
Biomedical informatics is the art and science of collecting, representing and analyzing patient and biomedical information and translating insights from the information into better health and new medical discoveries. The spectrum of informatics applications ranges from molecules (bioinformatics) to individuals and populations (clinical and public health informatics). We will examine the scientific field and research methods that form the foundation for biomedical informatics research. The course will include didactics, readings, hands-on tool explorations, and a summative work product. This foundational course is intended for informatics majors and students in allied fields (e.g., health, biological, or computer sciences) who are interested in exploring the field of informatics.

INFO 697. Biomedical Informatics Methods. 3 Hours.
Biomedical informatics is the art and science of collecting, representing and analyzing patient and biomedical information and translating insights from the information into better health and new medical discoveries. The spectrum of informatics applications ranges from molecules (bioinformatics) to individuals and populations (clinical and public health informatics). We will examine the scientific field and research methods that form the foundation for biomedical informatics research. The course will include didactics, readings, and applications in applying research methods, culminating in a research plan in grant proposal format and review by a mock panel. This foundational course is intended for informatics majors and students in allied fields (e.g., health, biological, or computer sciences) who are interested in exploring the field of informatics. It is primarily intended for students who will pursue research careers in biomedical informatics and is the second course in a two-part series.
Prerequisites: INFO 696 [Min Grade: C]

INFO 698. Bioinformatics Master's Projects. 1-6 Hour.
Admission to bioinformatics master's program (Plan B: "Project Option") is required. Independent study to conduct bioinformatics research projects, guided by the instructor as the mentor. Permission of instructor and graduate program director is required.

INFO 699. Bioinformatics Master's Thesis Research. 1-6 Hour.
Admission to bioinformatics master's program (Plan A: "Thesis Option") is required.

INFO 701. Introduction to Bioinformatics. 3 Hours.
Introduction to bioinformatics and computational biology, with emphasis on concepts and application of informatics tools to molecular biology. It covers biological sequence analysis, gene prediction, genome annotation, gene expression analysis, protein structure prediction, evolutionary biology and comparative genomics, bioinformatics databases, cloud computing, basic R-based data analysis, simple programming skills using Perl, Linux/Unix environment and command lines, visual analytics, and social/legal aspects of open science. It will have a class research project component.

INFO 702. Algorithms in Bioinformatics. 3 Hours.
This course introduces various fundamental algorithms and computational concepts for solving questions in bioinformatics and functional genomics. These include graph algorithms, dynamic programming, combinatorial algorithms, randomized algorithms, pattern matching, classification and clustering algorithms, hidden Markov models and more. Each concept will be introduced in the context of a concrete biological or genomic application. A broad range of topics will be covered, ranging from genome annotation, genome reconstruction, microarray data analysis, phylogeny reconstruction, sequence alignments, to variant detection.
Prerequisites: INFO 701 [Min Grade: C]

INFO 703. Biological Data Management. 3 Hours.
The introduction of biological data management concepts, theories, and applications. Basic concepts such as relational data representation, relational database modeling, and relational database queries will be introduced in the context of SQL and relational algebra. Advanced concepts including ontology representation and database development workflow will be introduced. Emerging big data concepts and tools, including Hadoop and NoSQL, will be introduced in the context of managing semi-structured and unstructured data. Application of biological data management in biology will be covered using case studies of high-impact widely used biological databases. A class project will be required of all participants.
Prerequisites: INFO 701 [Min Grade: C]

INFO 704. Next-generation Sequencing Data Analysis. 3 Hours.
This course is aimed to equip participants with the essential knowledge and skills required to begin analyzing next-generation sequencing data and carry out some of the most common types of analysis. The topics covered in-depth during this course are the analysis of RNA-Seq, ChIP-Seq data, ATACseq data, and Single-cell data, with an optional Variant Calling session. The sessions will also include Introduction to next-generation sequencing (NGS) technologies, common NGS data analysis issues, applications of sequencing technologies, introduction to bioinformatics file formats (e.g. FASTQ, bam, bed) and bioinformatics toolkits. At the end of this course, participants will have the expertise to perform these data analysis independently.
Prerequisites: INFO 701 [Min Grade: C]

INFO 710. Programming with Biological Data. 3 Hours.
Course is a 4-week session, class meets 4 days a week from 9:00am-11:30am (in person). This course provides students necessary bioinformatics data and programming skills using Linux, high-performance computing, data-wrangling, MySQL (weeks 1 and 2) and R or Python programming (week 3 and 4). Emphasis will be placed on best practices for conduct of reproducible research. The focus will be on practical computing, programming and data management concepts that can be applied to bioinformatics and data analysis problems.

INFO 711. Intermediate Statistical Analysis I. 3 Hours.
Students will gain a thorough understanding of basic analysis methods, elementary concepts, statistical models and applications of probability, commonly used sampling distributions, parametric and non-parametric one and two sample tests, confidence intervals, applications of analysis of two-way contingency table data, simple linear regression, and simple analysis of variance. Students are taught to conduct the relevant analysis using current software such as the Statistical Analysis System (SAS).

INFO 712. Visual Analytics for Bioinformatics. 3 Hours.
In this course, we will explore the use of visualization techniques as a concise and effective way to help analyze, understand, interpret and communicate complex biological data. Principles of design, visual rhetoric/communication, and appropriate usage will be introduced. We will cover representation of different data types, concentrating on those generated by data-rich platforms such as next-generation sequencing applications, flow/mass cytometry, and proteomics, and will discuss the use of visualization techniques applied to assessing data quality and troubleshooting. Various topics including dimension reduction, hierarchical visualizations, unsupervised learning, graph theory, networks/layouts and interactivity will be discussed. We will review the algorithmic underpinnings of various methods that lead to their appropriate and effective use. Finally, we will review a variety of genomics/bioinformatics-related visualization tools that are available. We will use Matlab throughout the course to create beautiful and effective visualizations.

INFO 751. Systems Biomedicine of Human Microbiota. 3 Hours.
The human microbiota is the collection of microorganisms (bacteria, archaea, fungi and viruses) that reside within human tissues and biofluids. Such resident microorganisms compose the majority of cells in human bodies and are key contributors to human development, health, and disease. However, most studies focus on genomics and microbiome statistical representations alone, while spatial-temporal analysis, multi-source data integration and modeling are necessary to predict and understand interactions between microorganisms, human hosts, and the environment. This course will highlight state-of-the-art microbiome/microbiota research and provide essential training in mathematical, computational and systems biology to derive integrative and predictive models of microbiota-host interactions in the context of human health and disease.
Prerequisites: INFO 701 [Min Grade: C] and (MA 560 [Min Grade: C] or BME 670 [Min Grade: C])

INFO 762. Biomedical Applications of Natural Language Processing. 3 Hours.
Students will be introduced to Natural Language Processing (NLP) including core linguistic tasks such as tokenization, lemmatization/stemming, POS tagging, parsing and chunking. Applications will focus on Deep Learning methods using pytorch with a focus in information extraction including Named Entity Recognition, semantic role labeling, word sense disambiguation, normalization, summarization, question answering and text classification. Applications and data will have a biomedical focus, but no biology or medical background is required.

INFO 773. Clinical Informatics Journal Club. 1 Hour.
Students will learn how to read, present, and critique research publications in clinical informatics. Journal Club participants will present high-impact recent journal publications selected by course instructors and learn how to read the paper, write critiques, and organize analysis insights into review papers. Students must show evidence of prior preparation prior to journal clubs and write critiques to show comprehension of the topics throughout the semester.

INFO 780. Implementation and Evaluation of Clinical Systems. 3 Hours.
Health information technology (HIT) tools such as Electronic Health Records (EHRs) are used to facilitate management of patient care data, to computerize clinical workflows, and to support health professionals in their medical decision making process. As a result of the U.S. Federal Government incentive program known as Meaningful Use, EHRs have been adopted on a national scale and are now used in almost every health care organization across the country. Although the literature exploring the impact of HIT adoption and use has also increased, previous studies have produced mixed results, leaving unanswered questions as to the impact of HIT on quality of care, patient safety, and health care providers' productivity. In this course, students will be introduced to project management tools and techniques commonly used for managing implementation of HIT systems as well as research approaches to conduct systematic evaluations of the impact of these systems on health care outcomes and organizations. This foundational course is intended for informatics majors and students in allied fields (e.g., health, biological, or computer sciences) who are interested in exploring implementation methods applicable to HIT systems such as EHRs and their components, as well as quantitative, qualitative, and mixed-methods approaches to conduct evaluations of HIT adoption and use. It is primarily intended for students who will pursue research careers in biomedical informatics and is the third course in a three-part series.
Prerequisites: INFO 797 [Min Grade: C]

INFO 790. Data Mining & Statistical Learning. 3 Hours.
Students will learn to discover and implement meaningful insights and knowledge from data. This course covers major concepts and algorithms of data mining. The course will be taught using the SAS Enterprise Miner program. The final project will demonstrate all the data mining techniques covered in the course and furthermore expose students working with real data. At the end of the course students will be proficient in utilizing data mining techniques to exploit data patterns and behavior, gain insider understanding of the data, and produce new knowledge that healthcare decision-makers can act upon. Furthermore, SAS Certified Predictive Modeler certification exam will be offered at the end of the course. Instructor permission is required.

INFO 791. Bioinformatics Seminar I. 1 Hour.
For doctoral student only. Students will learn how to prepare, present, and critique research presentations in bioinformatics by attending seminar presentations made by presenters. Seminars are presented by graduate students, faculty, visitors, or online speakers. Students must show evidence of prior preparation, active participation, and documented comprehension of the topics.
Prerequisites: INFO 701 [Min Grade: C]

INFO 792. Bioinformatics Seminar II. 1 Hour.
For doctoral student only. Students will learn how to prepare, present, and critique research presentations in bioinformatics by attending seminar presentations made by presenters. Seminars are presented by graduate students, faculty, visitors, or online speakers. Students must show evidence of prior preparation, active participation, and documented comprehension of the topics.
Prerequisites: INFO 791 [Min Grade: P]

INFO 793. Bioinformatics Journal Club. 2 Hours.
Students will learn how to read, present, and critique primary research publications in bioinformatics. Journal club participants will present high-impact recent journal publications selected by course instructors and learn how to read the paper, write critiques, and organize analysis insights into review papers. Students must show evidence of prior preparation prior to journal clubs and write critiques to show comprehension of the topics throughout the semester.

INFO 794. Advanced Bioinformatics Journal Club. 2 Hours.
Students will learn how to read, present, and critique primary research publications in bioinformatics. Journal club participants will present high-impact recent journal publications selected by course instructors and learn how to read the paper, write critiques, and organize analysis insights into review papers. Students must show evidence of prior preparation prior to journal clubs and write critiques to show comprehension of the topics throughout the semester.
Prerequisites: INFO 793 [Min Grade: P]

INFO 795. Special Topics in Bioinformatics. 3 Hours.
Topics of current research interest, such as metagenomics, microbiome, computational medicine, complex systems, deep learning in biology, artificial intelligence in biomedical, and translational bioinformatics applications. May be repeated as different sections taught by different instructors for credit. Permission of instructor is required.

INFO 796. Introduction to Biomedical Informatics Research. 3 Hours.
Biomedical informatics is the art and science of collecting, representing and analyzing patient and biomedical information and translating insights from the information into better health and new medical discoveries. The spectrum of informatics applications ranges from molecules (bioinformatics) to individuals and populations (clinical and public health informatics). We will examine the scientific field and research methods that form the foundation for biomedical informatics research. The course will include didactics, readings, hands-on tool explorations, and a summative work product. This foundational course is intended for informatics majors and students in allied fields (e.g., health, biological, or computer sciences) who are interested in exploring the field of informatics.

INFO 797. Biomedical Informatics Methods. 3 Hours.
Biomedical informatics is the art and science of collecting, representing and analyzing patient and biomedical information and translating insights from the information into better health and new medical discoveries. The spectrum of informatics applications ranges from molecules (bioinformatics) to individuals and populations (clinical and public health informatics). We will examine the scientific field and research methods that form the foundation for biomedical informatics research. The course will include didactics, readings, and applications in applying research methods, culminating in a research plan in grant proposal format and review by a mock panel. This foundational course is intended for informatics majors and students in allied fields (e.g., health, biological, or computer sciences) who are interested in exploring the field of informatics. It is primarily intended for students who will pursue research careers in biomedical informatics and is the second course in a two-part series.
Prerequisites: INFO 796 [Min Grade: C]

INFO 799. Bioinformatics Research for Dissertation. 1-12 Hour.
Admission to candidacy is required.

MIC-Microbiology Courses

MIC 600. The Microbiome in Health and Immunity. 3 Hours.
This course will review the functions of the immune system and discuss the role of the microbiome in health and disease. This course will use a personal microbiome analysis project to develop information literacy, critical thinking, and communication skills while investigating the interplay between the microbiota and immune system components. Additional topics including the role of the microbiome in maintaining gut health, influencing the gut-brain axis, and nutrient synthesis will also be discussed.
Prerequisites: MIC 275 [Min Grade: C]

MIC 601. Foundations in Immunology: The Innate Immune System. 3 Hours.
This course will introduce the cells, receptors, signaling pathways and soluble mediators associated with the innate immune response. The basic components of the innate immune system will then be discussed in the context of their role in the physical, physiological, phagocytic and inflammatory barriers that comprise the innate immune system. Importantly, emphasis will be placed on the molecular and cellular mechanisms that are used by the innate immune system to detect and respond to microbial pathogens to provide the first line of defense.
Prerequisites: MIC 275 [Min Grade: C]

MIC 602. Foundations in Immunology: The Adaptive Immune System. 3 Hours.
This course will provide an in-depth analysis of the cells (T, B and antigen presenting cells), tissues (primary and secondary) and soluble factors (cytokines and chemokines) that comprise the adaptive humoral immune response. The course will examine how cells of the adaptive immune system discriminate self from non-self, including the nature of antigen receptors, the types of antigens recognized and the signals involved in the generation of effector cells that mediate the response.
Prerequisites: MIC 275 [Min Grade: C]

MIC 603. Foundations in Immunology: Microbial Pathogen-Immune System Interaction. 3 Hours.
This course will provide an overview of major concepts related to virulence mechanisms utilized by microbial pathogens and their effect on the host immune response. Emphasis will be placed on important virulence factors/mechanisms associated with bacterial, viral and fungal pathogens and how these alter various components of the innate and adaptive immune responses to allow escape of the pathogen and its survival. This course will introduce the concept of emerging infectious diseases and how their spread is related to their ability to escape detection by the immune system.
Prerequisites: MIC 401 [Min Grade: C] and MIC 402 [Min Grade: C]

MIC 604. Foundations in Immunology: Immunologically-Mediated Diseases. 3 Hours.
This course will focus on the role of the immune system, including the molecular and cellular processes, that contribute to morbidity and mortality associated with immunodeficiency (congenital and acquired), asthma/allergy, autoimmunity (systemic and organ-specific), transplantation and inflammatory syndromes associated with heart disease, cancer, chronic neurological disease and diabetes.
Prerequisites: MIC 401 [Min Grade: C] and MIC 402 [Min Grade: C] or MIC 601 [Min Grade: C] and MIC 602 [Min Grade: C]

MIC 660. Introduction to the Immune System. 3 Hours.
The objective of this Course is to provide a concise overview of the immune system, its cellular and molecular components, and their function in relation to host protection against pathogens. Students will follow clear principles by which these different components of the immune system interact with each other to ensure an effective immune response. Students will learn how the immune system is capable of such enormous diversity in terms of the foreign antigens that it can specifically recognize and react against, while at the same time avoiding similar responses against our own cells, tissues and organs. By describing paradigmatic examples of these immune response mechanisms in the context of exposure to typical bacteria and viruses, a solid basic foundation for subsequent immunology courses will be provided, including those courses that are focused on immune-mediated diseases, immune protection against cancer and its evolution during tumor progression, vaccines, and immune-based therapeutics in immune-mediated and other diseases. Throughout the course, Students will be encouraged to consider the concept of immune balance in in terms of how over-reactivity of the immune mechanisms they will be learning about can lead to excessive (or chronic) inflammation or autoimmunity, and why certain key physiological and life-style factors can adversely affect this balance and are therefore recognized as urgent topics in biomedical research and medicine. Undergraduate-level Biochemistry or Cell Biology must be taken before registering for this course.

MIC 661. Immune-mediated Diseases. 3 Hours.
The objective of this Course is to condense knowledge of the cellular and molecular components of the immune system and their function in relation to host protection against pathogens (covered in the previous Masters Immunology Program course MBS 696 ST: Introduction to the Immune system) into clear paradigmatic principles by which these different branches of the immune system interact with each other and other biological systems such as the microbiome to maintain normal immune balance. Students will learn how modifications of immune cell development or function associated with genetic, pathogenic and environmental factors affect this balance, promoting immune hypersensitivities, causing immune deficiency, or predisposing to the development of autoimmune diseases. Systemic Lupus Erythematosus and Multiple Sclerosis will be used as prototypical examples of systemic and organ-specific autoimmunity respectively to exemplify key aspects related to the pathogenic mechanisms, clinical features, therapeutics, and potential future curative approaches built from basic immunological research utilizing animal models.
Prerequisites: MIC 660 [Min Grade: C]

MIC 665. Current Topics in Immunology. 3 Hours.
The current topics courses will in general cover current topics related to immunology, host defense, and immune-based therapeutics. This specific course will examine the factors influencing the disease course of COVID-19 and current treatment and prevention options with an emphasis on discussing the appropriate immune response that leads to mild symptoms and clearance of SARS-CoV-2 and the immune dysregulation that contributes to severe COVID-19. Topics in viral infection with an emphasis on coronaviruses and the concept of spillover will be discussed. Additionally, anti-viral responses of the innate and adaptive immune responses, concepts in immune regulation, and their application in developing vaccines and therapeutics to prevent and treat COVID-19 will be covered.
Prerequisites: MIC 660 [Min Grade: C]

MSTP-Med Science Training Prog Courses

MSTP 793. Basic Research Forum. 1 Hour.
This course is for entering MD-PHD students to meet the GBS Core-Course requirements. The following list consists of desirable competencies for enrolled MD-PHD students to achieve while in this course: (a) Learn fundamental topics in biomedical research that will not be covered in SOM courses; (b) Fill gaps in curriculum between GBS707/709; and (c) Introduce topics that may be of interest for future lab rotations.

MSTP 794. Translational Research Seminar. 1 Hour.
The CAMS Translational Research Seminar series, required fall, spring and summer semesters, invites UAB faculty (PhD, MD, MD-PhD or MPH) who are conducting translational research to present their work to students in the MSTP. The goal of the presentation is three fold: (a) to inform students about the career path of the investigator, (b) to provide them with information regarding the initiation and conduct of translational research, and (c) to expose students to current developments in basic and clinical research. There are two to three sessions each year in which panels or round tables discuss topics, including mentor selection, preparation for residency, residency selection, and the overall UAB MSTP experience. Lecturers give a 45-minute presentation followed by a 15-minute question and answer session. This course is open only to MD-PhD students.

MSTP 795. Continuing Clinical Education. 1 Hour.
This course is designed to maintain clinical skills and knowledge during students' dissertation research years. MSTP students will take the course every fall semester and spring semester during their PhD dissertation phase. Each semester, students will be required to complete seven course components. Some components serve to maintain clinical skills and includes students conducting a resident-supervised clinical encounter as well as completing one half day of shadowing. Other components serve to maintain or bolster clinical knowledge and include students attending case conferences and/or participating in simulation sessions. This course is open only to MD-PhD students.

MSTP 796. Anatomy Lab TA Opportunity. 1 Hour.
From 23 TOTAL dissections between the MS1 and MS2 years, students choose any 6 dissections to teach depending on their availability. Overview: MS4 students will serve as Anatomy Teaching Associates for MS1 and MS2 students during scheduled lab times to make preclinical training more robust and clinically relevant. Course benefits for MS4 students: - Small-group anatomy training aimed to improve knowledge of anatomy & dissection skills. - Teaching & mentoring experience of students with less clinical experience. - Flexible schedule: Preferred dissections may be changed up to 1 week before the preclinical scheduled lab time. Format: - Students will attend a 1-hour orientation session addressing effective teaching techniques in August of the entering year (accommodation for absence can be made on a case-by-case basis). - The week prior to their chosen dissections, students will receive 2 hours of small group training in SOM lab under the directions of trained UAB Anatomist and Course Director Dr. Resuehr. During this training, students will perform the relevant cadaveric dissection which will be saved for demonstration during the preclinical lab. -TAs will be assigned to a group of preclinical students during their scheduled lab time to help answer questions. Particular emphasis will be placed on providing preclinical students with clinical correlates. Learning Objectives: - Dissect and identify all associated structures of their chosen dissections emphasizing the relation of structures to each other and common pathologies. - Understand common anatomical variations (if applicable). - Understand anatomically relevant information pertaining to clinical procedures. - Understand geriatric changes. - Mentor and teach students with less experience.

MSTP 798. MSTP Non-Dissertation Hours. 1-8 Hour.
Laboratory research pre-qualification. Only open to MSTP students.

MSTP 799. MSTP Dissertation Hours. 1-8 Hour.
Dissertation research. Only open to MSTP students.
Prerequisites: GAC Z

NBL-Neurobiology Courses

NBL 600. Special Topics in Neurobiology 1. 3 Hours.
This course covers different topics that have to do with Neurobiology.

NBL 601. College of Basic Cognition & Clinical Neuroscience. 3 Hours.
The Colloquium in Basic, Cognitive and Clinical Neuroscience is a faculty seminar. The Colloquium will expose students to cutting edge research programs and technologies from approximately 25 faculty each year who serve as mentors for the Undergraduate Neuroscience Major and Graduate Neuroscience Program. Faculty will also discuss strategies for development of careers in medicine and research. Students will prepare by reading an assigned research article authored by the speaker and be prepared for a group discussion. Class meets for one and a half hours a week.

NBL 610. Synapses, Neurons and Brains. 3 Hours.
Molecular Neuroscience will provide students an advanced understanding of how the brain works with a focus on protein function. Everything the brain does is built upon the actions of proteins, many of which are completely unique to the brain. Together we will work to thoroughly understand the exact molecular mechanisms utilized by the brain to support the complex function of our most fascinating organ. Topics covered will include brain morphogenesis, axonal outgrowth, synapse formation, neurotransmitter biosynthesis, intracellular signaling, and the blood brain barrier. This lecture course is designed to fulfill a neuroscience major's requirement for an advanced course. Non-neuroscience majors should seek course master approval before enrolling and must have a significant background in biology and/or chemistry. Students will be required to purchase a text. Grades will be assigned based on points accumulated through weekly quizzes, cumulative exams, and written reports. It is strongly recommended that students have undergraduate coursework in biology and chemistry prior to taking this class.

NBL 620. No Self Control. 3 Hours.
Survival of self and species has been evolutionarily wired into the brain. Largely, involving sub-cortical networks, animals are strongly rewarded through beneficial outcomes and driven away from aversive situations. Overseeing these opposing subconscious determinants of motivated behavior is a pre-frontal cortical command center, which along with additional systems that provide for experiential memory and emotional significance, guide the choices we make. This course will provide the participant with an introduction to the neuronal pathways that underlie normal decision making, with a major focus on how this circuitry becomes compromised during addiction. These topics should be relevant to students interested in biomedicine, health professions or counseling. NBL 355 or NBL 610 recommended but not required.

NBL 624. This is your brain on drugs: Neuropsychopharmacology. 3 Hours.
People have long exploited the brain's responses to a wide variety of chemicals to alter their experiences in the world. These drugs have had profound effects on individuals and societies, both positive and negative. This course will cover the neurological basis of the response to these drugs, their psychological effects, mechanisms of action that underly them, and the pharmacology of drugs in the brain and body. Students should also be able to identify different drug classes, the relationships between drugs and society, and the history of how we have understood different drugs. NBL 230 is recommended.
Prerequisites: NBL 230 [Min Grade: C]

NBL 625. Methods in Human Neuroimaging. 3 Hours.
The ability to perform neuroimaging studies on awake human individuals has produced a conceptual revolution in the study of human cognition. This course will examine the methods and techniques in human neuroimaging with the primary goal of building basic understanding of how these tools work. The course will explore techniques, such as single cell recordings, deep brain stimulation, electroencephalography, magnetoencephalography, and diffusion weighted imaging, and focuses on functional magnetic resonance imaging. By the end of the course, students will have gained basic knowledge in the field and will be able to read and critically assess scientific journal articles that make use of a variety of neuroimaging methods. The secondary and implicit goal of this course is to create and nurture, in students, a genuine interest in neuroscience and neuroimaging.
Prerequisites: NBL 356 [Min Grade: C] or NBL 655 [Min Grade: C] or NBL 656 [Min Grade: C]

NBL 633. Diseases of the Nervous System. 3 Hours.
Molecular mechanisms and treatments for neurological, psychiatric, and injury based disorders and diseases of the nervous system. Topics include neurodevelopmental disorders (including intellectual disability and autism spectrum disorders), neurological disorders (including neurodegenerative and demyelinating disease), neuropsychiatric disorders (including depression disorders and schizophrenia), and injury to the nervous system (including stroke and traumatic brain and spinal cord injury).
Prerequisites: NBL 356 [Min Grade: C] or NBL 655 [Min Grade: C] or NBL 656 [Min Grade: C]

NBL 634. Mechanisms of Memory. 3 Hours.
Molecular, cellular, systems and medical components of neuroscience, with an emphasis on cognition and cognitive disorders. Covers topics ranging from genes and molecules to human behavior, using cognitive function and clinical cognitive disorders as the unifying theme, with a focus on learning and memory and disorders of these processes.

NBL 644. Memento Mori: neurodegeneration from cradle to coffin and bench to bedside.. 3 Hours.
We all die. We live in a wealthy enough country that many of us will survive long enough to die with a neurodegenerative disease. As the population ages, neurodegenerative diseases are becoming more and more common, so it's important to understand them and figure out how to treat them. This course will cover multiple neurodegenerative diseases, from ones that begin in childhood to slow-progressing diseases that occur late in life. We will discuss approaches to treat the diseases, the basics of the therapeutic pipeline, basic disease mechanisms, and common themes across neurodegeneration.
Prerequisites: NBL 230 [Min Grade: C] and (NBL 433 [Min Grade: C] or NBL 633 [Min Grade: C])

NBL 655. Synapses, Neurons and Brains. 3 Hours.
Introduction to the cellular and molecular biology, biochemistry, biophysics, genetics and function of the mammalian nervous system. This course will emphasize the development, anatomy, cellular and molecular biology and biochemistry of neurons and glial cells, and introduce electrical, biophysical and chemical signaling within and across neurons.

NBL 656. From Systems to Cog Neuro. 3 Hours.
Introduction to the cellular and molecular biology, biochemistry, biophysics, genetics and function of the mammalian nervous system. This course will emphasize mechanisms of synaptic transmission, sensory systems, neuropharmacology, and synaptic plasticity; and introduce the molecular basis of diseases and disorders of the central and peripheral nervous systems.

NBL 657. Neurogenetics. 3 Hours.
This is an upper level interdisciplinary course that links key concepts in genetics to neurological disease. It will provide students with an understanding as to how mutations lead to disease and what kinds of research is involved in studying genetic disorders. This course will also include a research and service learning component to incorporate experience-based learning into the classroom.
Prerequisites: BY 123 [Min Grade: C]

NBL 684. Don't Sleep on this class: biological rhythms and sleep. 3 Hours.
Earthly creatures have adapted to light-dark cycles created by the earth's rotation. Complex biological behaviors and even cellular changes have these twenty-four–hour cycles, called circadian rhythms. This course will dive into the basis of these rhythms: exogenous zeitgebers and molecular clocks; and their consequences. Perhaps the most prominent behavioral rhythm is sleep, so we will distinguish between sleep and circadian rhythms, learn what sleep is, why we sleep, and what the consequences of circadian and sleep disruption are. NBL 230 is recommended.
Prerequisites: NBL 230 [Min Grade: C]

NBL 698. Research Practice in Neurobiology. 1-6 Hour.
Project or research activity supervised by faculty.

NBL 700. Introduction to Cellular and Molecular Neurobiology. 3 Hours.
Topics in Neurobiology.

NBL 703. Nuerobiology Seminar Series. 1 Hour.
Current research topics in neurobiologypresented by visiting scholars and campus faculty.

NBL 707. Cognition & Cognitive Disorder. 1 Hour.

NBL 711. Medical Neuroscience. 5 Hours.

NBL 720. Membrane Excitability Biophysics. 3 Hours.
The course will consist of 7 topics covered over 8 weeks (including course orientation): Properties of lipid bilayers, Ions in solution, Ion channel permeability and selectivity, Ligand-dependent channel gating, G-protein-coupled receptor kinetics, Transporters and Pumps, and Voltage-dependent channel gating. For each topic a faculty member will present an overview lecture and students will present a single mini-lecture on a more focused concept within the topic. The mini-lecture will be based on published literature and should be discussed before presentation with the topic leader. It should be a formal PowerPoint lecture lasting a maximum of 20 min.

NBL 723. Experimental Design. 1 Hour.
In depth and specialized training for our Roadmap Scholars in hypothesis development, experimental design and scientific writing. During this course, Roadmap Scholars will develop an NRSA, or similar, grant proposal.

NBL 725. Seminar Practice in Cellular and Molecular Neuroscience. 1 Hour.
The course will provide guidance and practice in the presentation of research seminars. It will also provide a forum for students to become actively involved in listening to seminar presentations and partcipating in speaker questioning. Once during the course each student will present a 50 minute seminar describing his/her current research, during which the other students and participating faculty will ask questions and provide comments and suggestions. Following the presentation the student will receive a constructive critique from the faculty.

NBL 729. Mechanisms of Signal Transduction. 1-3 Hour.

NBL 730. Neurobiology of Disease. 3 Hours.
Major advances have been made in understanding diseases of the nervous system at a cellular and molecular level. Several new findings have had therapeutic implications and have resulted in the development of novel drugs or new disease management strategies. This course intends to review the most common brain and CNS disorders. It will offer a brief clinical introductionto the disease, but will emphasize reviewing current knowledge of the disease at a cellular and molecular level. The course will be taught by several UAB professors who have active research programs directed at studying nervous sys. diseases. The course is designed for advanced graduate and medical students who have a good neurobiology background with NEUR702/NBL750/NBL7.

NBL 735. Statistics for Biomedical Science. 3 Hours.

NBL 740. Mechanisms of Memory. 4 Hours.
This course integrates the molecular, cellular, systems, and medical components of the core curriculum with an emphasis on cognition and cognitive disorders. Thus, the course covers topics ranging from genes and molecules to human behavior, using cognitive function and clinical cognitive disorders as the unifying theme, with a focus on learning and memory and disorders of these processes.

NBL 741. Writing and Presenting. 1 Hour.
Roadmap Scholars will be expected to attend and present posters or talks describing their research at international meetings, such as the Society for Neuroscience annual meeting. We will develop a course to assist the students in writing their abstracts, as well as designing their presentation for the meeting. This course will assist the Neuroscience Roadmap Scholars in developing their presentation skills as neuroscientists.

NBL 743. Methods in Neuroimaging. 3 Hours.
Cognitive neuroscience research has provided valuable insights into the workings of the human brain. The techniques used in cognitive neuroscience span from postmortem brain studies to neuroimaging studies. The ability to perform neuroimaging studies on awake human individuals engaged in cognitive, social, sensory, and motor tasks has produced a conceptual revolution in the study of human cognition. This course will comprehensively examine the methods and techniques in neuroimaging with the primary goal of building fundamental knowledge in the concepts and techniques of neuroimaging. By the end of the course, students will have gained basic knowledge in the field and will be able to read and critically assess scientific journal articles that make use of a variety of neuroimaging methods. The secondary and implicit goal of this course is to create and nurture, in students, a genuine interest in neuroscience and neuroimaging. The course will explore techniques, such as single and multi cell recordings, deep brain stimulation, electroencephalography, functional magnetic resonance imaging, and diffusion tensor imaging. This course will be an apt venue for graduate students interested in neuroscience research to build a platform for continuing studies.

NBL 745. Professional Development Course. 1 Hour.
Today’s researchers, scientists, and academics face an increasingly competitive world. We will create a professional development course for our UAB Neuroscience Roadmap Scholars to provide support for their aspiration to become independent and successful neuroscientists.

NBL 752. Developmental Neuroscience. 3 Hours.
The course will utilize the scientific literature and faculty lectures to cover a broad range of topics related to the mechanisms of building a brain. The topics covered range from neural induction in early development, to axonal guidance and synapse formation, to neuro-gial interactions in the adult nervous system. Grades will be based on two exams and student participation in class discussions.

NBL 755. Mind/Brain. 3 Hours.

NBL 758. Synaptic Dynamics. 3 Hours.
A student-driven discussion of the molecular and physiological properties of synapses, this course explores the molecular physiology underlying the control of neurotransmitter release and the postsynaptic response. Quantal theories of synaptic transmission will be discussed with respect to anatomical and physiological differences between central synapses and the neuromuscular junction. Synaptic plasticity mechanisms will also be discussed.

NBL 770. Glial Biology in Medicine. 3 Hours.
This course will cover the role of astrocytes, oligo-dentrocytes and microglia in both the normal development and function of the nervous system, and also their role in injury and disease. Presentations will be student led, with the assistance of the faculty.
Prerequisites: NBL 700 [Min Grade: C] or CMB 754 [Min Grade: C] or NBL 712 [Min Grade: C]

NBL 771. Innovative Techniques, Methods and Models in Neuroscience. 1 Hour.
This is a Journal Club style course that will consist of topics related to innovative methods in neuroscience. Students will read and discuss papers on groundbreaking techniques, such as CRISPR/Cas9 systems, optogenetics, CLARITY, flow cytometry and DREADDs. Each week one student will be responsible for presenting the seminal paper discussing the novel technique, providing advantages, disadvantages and limitations of the technique. The class as a whole will then discuss a paper in which the novel technique was applied. The goal of this course is to equip the next generation of neuroscientists to understand the next generation of neuroscience techniques. Class Assignments and Preparation: All students are required to read the assigned manuscript and be prepared to discuss the method and data presented in the manuscript, as well as potential limitations/pitfalls of the approach considered.

NBL 772. Special Topics i n Neurobiology II. 1-3 Hour.
This course will draw on the cutting edge knowledge, expertise and information provided by the spring Neurobiology Seminar program. There will be two one-hour meetings per week. Prior to each seminar, students will discuss a review article pertinent to the seminar topic, and a recent research paper from the speaker's lab. Following the seminar, new findings presented will be discussed. Students will also have the opportunity (optional) of meeting the speaker at lunch prior to the seminar or at a post-presentation reception.

NBL 773. Molecular Brain Aging JC. 1 Hour.
Across the body, age-related protein expression changes underlie the aging process. This journal club focuses on understanding normal brain aging at the cell and molecular level. We will discuss papers that show how both central and peripheral protein expression differences effect cellular function of brain to promote age-related change.

NBL 775. Special Topics in Neurobiology III. 1 Hour.
The aging process is amazing. One person could choose to not exercise, eat fatty foods with abandon, and engage in other risky behaviors but still live to 100 relatively disease free. Meanwhile another develops dementia in their 70s after living a life doing all the “right” things for their body. Often in our desire to prevent and treat disease, we do not spend time studying normal aging process, and thus we don’t understand the system we are working within. To effectively target disease requires a thorough understanding not only of disease mechanism but also of how the brain changes during aging. Even when the cognitive aging process does not directly result in development of disease, the changes that occur effect quality of life and could be targeted for intervention. This journal club will focus on exploring papers investigating how the aging process impacts the brain.

NBL 779. Journal Club Topics. 1 Hour.
Journal Club Topics.

NBL 780. Selected Topics in Neurobiology I. 3 Hours.
This course covers different topics that have to do with Neurobiology.

NBL 781. Selected Topics in Neurobiology II. 1 Hour.
This course covers different topics that have to do with Neurobiology.

NBL 782. Neuroimaging Journal Club. 1-2 Hour.
The Neuroimaging Journal Club was created to encourage the discussion of papers and research related to brain imaging. Modalities discussed including but not limited to magnetic resonance imging (MRI), functional magnetic resonance imaging (fMRI), diffusion tensor imaging (DTI), magnetic resonance spectroscopy (MRS), and electroencephalography (EEG).

NBL 784. Synaptic Transmission and Ion Channel Journal Club. 1 Hour.
The Synaptic Transmission & Ion Channels Journal Club provides a forum for discussion and analysis of papers related to electrophysiology of neurons and astrocytes at the level of synapses and circuits. It is focused primarily on electrophysiological methods.

NBL 785. Neurobiology Journal Club-Synaptic Plasticity. 1 Hour.

NBL 786. Cell Death Mech Journal Club. 1 Hour.
Discussion and critical evaluation of seminal or current papers on a broad topic of cell death methanisms in health and diseases, with special emphasis on autophagic mechanisms impact on cell death.

NBL 788. Biology of Glial Cells Journal Club. 1 Hour.
This journal club covers contemporary primary articles on the biology of glial support cells, their role in normal brain function and Neurological disease.

NBL 789. Neurobiology Journal Club. 1 Hour.

NBL 791. Developing Critical Thinking and Analytical Skills. 1 Hour.
One of the key skills that every graduate student needs is the ability to think critically and to analyze data. Many graduate students have not been instructed in how to read the scientific literature, so NBL791 will include sessions for the Neuroscience Roadmap Scholars on how to read and critique a scientific paper. We will select examples of well-constructed journal articles and help the students to learn how to understand, interpret, and evaluate the findings.

NBL 792. Neuro Lab Bench. 3 Hours.
This course is about preparing students in work pertaining to the preparation of PhD candidates in the neurosciences for collecting data from the nervous system: 3 credits. No prerequisites required. It is expected that the student has access to and familiarity with computers. Books: Lab Math, A handbook of Measurements, Calculations, and other Quantification Skills for Use at the Bench by Dany Spencer Adams.

NBL 798. Non-Dissertation Research in Neurobiology. 1-12 Hour.
Research hours in the lab.

NBL 799. Dissertation Research in Neurobiology. 1-12 Hour.
Research hours in the lab.
Prerequisites: GAC Z

PHR-Pharmacology Courses

PHR 611. Physiological Principles of Pharmacology & Toxicology. 3 Hours.
This course will provide a broad but rigorous overview of physiological principles of pharmacology & toxicology. The course includes five separate “modules”, each taught by faculty of UAB Dept. Pharmacology & Toxicology. Each module has separate review session(s) and exams. In addition, each module will have small group problem-based learning (PBL) sessions (see below). There will be one exam specific for each module. At the end of the course, students will be assigned a drug from a pre-assigned list and discuss its pharmacology and toxicology, in the form of a PPT presentation. Students will be graded for their performance on exams, completing PBL assessments, student presentation, and participation in live PBL sessions.

PHR 612. Systems Physiology and Pharmacology I. 3 Hours.
This course will introduce the student to the use, mechanism of action and physiological properties of major families of drugs that affect the cardiovascular system, autonomic nervous system (ANS) and central nervous system (CNS). Lectures will provide an overview of nervous system / cardiovascular physiology and pathophysiology that results from various diseases, disorders and injuries, the drugs used to treat these conditions and their mechanisms of action. Both classical drugs and newer classes of drugs will be discussed for both their therapeutic value and also their use in different research settings. This course will be taught using a combination of traditional didactic lectures and student participation through discussion of seminal research papers and presentations.

PHR 613. Systems Physiology and Pharmacology II. 3 Hours.
This course will introduce drug use, mechanism of action and physiological properties of major drug families, with a focus on specific organ systems (endocrine, gastrointestinal and renal systems). In addition, this course will also cover specific classes of drugs for cancer treatment specifically related to the organ systems covered in the course. This course is divided into three “modules”. Each module has its own exam. In addition, there are graded student presentations at the end of the semester, topics of discussion to be determined.

PHR 614. Drug Discovery and Development. 3 Hours.
The course will provide an overview of the drug discovery and development process. Topics will include (among others): Target identification and validation, High-Throughput Screening, Hit discovery, Lead optimization, Preclinical testing, Safety requirements, Clinical trials, IND, NDA, Patents, and Federal regulations. The course will highlight multidisciplinary nature of drug discovery and the roles of biologists, medicinal chemists, pharmacologists, regulatory agencies, and investors in the process. Real-life case stories highlighting successful and unsuccessful drug development examples will be introduced for discussions, as well as some current examples of early stage biotech startups.

PHR 615. Pharmacokinetics and Biopharmaceutics. 3 Hours.
Pharmacokinetics is the study of the time-course of drugs in physiological systems. This includes the fate of administered drugs in relation to time starting with absorption, through distribution, and elimination. Pharmacokinetics is fundamental to the understanding of observed drug effects and responses. This course is divided into three sections that are assessed independently. The first section explores the mathematical principles of pharmacokinetics using the compartmental and noncompartmental models of analysis. The second section evaluates the roles of biopharmaceutical factors in the pharmacokinetics of drugs. The last section introduces the students to hands-on pharmacokinetics analysis and modeling using an industry-standard software package.

PHR 616. Cancer Physiology and Pharmacology. 3 Hours.
This course will introduce different types or classes of chemotherapeutic agents currently used in the clinic for the treatment of cancer. These include classic chemotherapeutic agents and newer targeted agents. Students will learn the latest cancer chemotherapy and treatment strategy. Students will also learn historical aspects of cancer treatment and of drug development for this disease. Team projects will prepare students to participate in literature reviews, presentation preparation and skills, and approaches to preparing for scientific discussions and Q&A sessions.

PHR 696. Special Topics. 1-3 Hour.
Special Topics in Pharmacology.

PHR 701. Adv Prin Pharm-Sys&Pharmacok 1. 3 Hours.

PHR 702. Adv Prin Pharm-Sys&Pharmacok 2. 3 Hours.

PHR 706. Special Topics in Pharmacology. 3 Hours.

PHR 715. Pharmacokinetics and Biopharmaceutics. 3 Hours.
Pharmacokinetics is the study of the time-course of drugs in physiological systems. This includes the fate of administered drugs in relation to time starting with absorption, through distribution, and elimination. Pharmacokinetics is fundamental to the understanding of observed drug effects and responses. This course is divided into three sections that are assessed independently. The first section explores the principles of pharmacokinetics using the compartmental and noncompartmental models of analysis. The second section evaluates the roles of biopharmaceutical factors in the pharmacokinetics of drugs. The last section introduces the students to hands-on pharmacokinetics analysis and modeling using an industry-standard software package.

PHR 720. Laboratory Rotation in Pharmacology. 1-12 Hour.

PHR 735. Nucleotide Metabolism and Chemotherapy. 3 Hours.
Principles, characteristics and therapeutics of nucleotide metabolism. This course is designed for second year and above graduate students.

PHR 744. Protein Mass Spectrometry. 3 Hours.

PHR 752. Pharmacokinetic Analysis. 1 Hour.
The course will provide a detailed introduction to the analysis of pharmacokinetic data preferably generated as part of the student¿s research. Descriptions of the use of appropriate analytical programs and the interpretation of pharmacokinetic data will be the major focus of this course.

PHR 754. Model Sys for Drug Discovery. 2 Hours.
This course will focus on the use of different genetically tractable model systems and their roles in drug discovery and drug development. The course will discuss the properties, benefits and deficiencies of major model systems used in drug discovery including yeast, zebrafish, xenographs, and genetically modified mouse strains.

PHR 755. Translational Pharmacology and Drug Development. 2 Hours.
Translational pharmacology covers the principles and practice of drug development from the laboratory (bench) to the patient (bedside). This course provides an overview of the processes involved in drug development. It familiarizes the student with the drug discovery and development process including types of clinical trials, regulatory requirements and results interpretations.

PHR 790. Pharmacology Journal Club. 1 Hour.
Pharmacology Journal Club.

PHR 798. Doctoral Level Non-Dissertation Research. 1-12 Hour.

PHR 799. Doctoral Level Dissertation Research. 1-12 Hour.
Prerequisites: GAC Z

PSDO - Physician Scientist Dev Courses

PSDO 630. Physician Experience. 2 Hours.
PSDO 630 will provide practical information and experience for highly qualified students considering medical school or other health-care based professional programs. The course will emphasize real world considerations of the clincial professions including acceptance criteria, expected duration of training, average debt and compensation of various specialties. The students will also be given multiple opportunities to interact with individuals from various levels of training and backgrounds to provide focused and nuanced guidance. Finally, the course will incorporate a shadowing experience, providing students the opportunity to observe and interact with practitioners from across UAB in a variety of specialties and settings. Each student will be required to complete documentation for the UAB and Children’s hospital, as well as receiving clearance from UAB Employee Health, as well as completing an online HIPAA compliance module. Students are not permitted to shadow until each is complete.

PSDO 698. Master's Level Non-Thesis Research. 1-8 Hour.
Students may perform independent study in a research laboratory setting. This work may contribute toward the concentration credits subject to program director approval.

PSDO 699. Master's Level Thesis Research. 1-8 Hour.
Students perform independent study in a research laboratory setting. This work contributes directly to the completion of the degree and meets the degree requirements for graduation.

PSDO 700. Pathway to Grant Submission. 2 Hours.
This course is designed to give students a basic background in topics necessary to succeed as a physician scientist in today's academic medical environment. Topics to be covered include the NIH funding system, how to write a fellowship, record keeping, authorship and publication, conflict of interest, animal and human subjects, and finding a mentor (Open to MD-PhD, ARISE-MD, and DMD-PhD students).

PSDO 701. Career Development Grant Writing Workshop. 1 Hour.
This course is designed to assist postdocs, residents, fellows, and rising junior faculty with the creation and submission of a K award or equivalent grant application. Topics to be covered include the NIH funding system, how to write a fellowship, how to submit animal protocols, and how to submit IRB forms. Individuals will be given a variety of reading assignments from which they will be expected to participate in group discussions and/or presentations. They will also be expected to prepare a fellowship application that will be submitted to an NIH Funding agency.

PSDO 720. Critical Approaches & Clinical Evaluation of Kidney Disease. 1 Hour.
Enhance knowledge of kidney disease physiology to include expansion of the themes from the Mount Desert Island Biologic Laboratory (MDIBL) course on the "Origins of Renal Physiology" Promote structured critical thinking skills focused on kidney disease. Enhance experimental design skills for the development and testing of new hypotheses. Enhance constructive reviewing skills. Engage in the culture and language of medicine through exposure to a range of clinical experiences. Provide opportunities for PROmoTE scholars and clinical faculty to discuss areas where basic science and clinical medicine intersect and where new information could be beneficial. Expose PROmoTE scholars to clinical problems and a variety of team-based investigation.

PSDO 798. PSDO Non-Dissertation Research. 1-8 Hour.
Non-Dissertation research. Only open to ARISE-MD students.

PSDO 799. PSDO Dissertation Research. 1-8 Hour.
Dissertation research. Only open to ARISE-MD students.
Prerequisites: GAC Z