2026-2027
COURSE CATALOG

MCW
GRADUATE SCHOOL

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Bioinformatics

BIIN 17150 Bioinformatics of Systems Biology
3 Credit Hours
This course provides the framework for learners to better understand biology using many types of bioinformatics data and analyses. Each data type defines a system that can be analyzed alone or integrated with other layers of data to gain a better contextual understanding of each. Science is typically reductionist, yet Systems Biology is more holistic thinking. Systems biology is a different way of thinking about answering scientific questions. Thus, learners will learn and discuss how bioinformatics and systems biology can be used together to drive research and Precision Medicine. Learners will be instructed in practical aspects of how genomics and epigenomics data is input, stored, searched, analyzed, and interpreted. Finally, ways to integrate among the data layers to solve real biologic questions. We will use information derived from large-scale public datasets; exampled used seek to provide learners with a better understanding of physiology, disease etiology, and more. Learners will complete practical computer lab analyses that are designed to provide the skills needed for a class project that each student will complete, present, and receive feedback on. The learner's project presentation should summarize the approaches and data used, plus findings or results. In summary, this course will provide skills and concepts for more integrated and holistic thinking about genomics and bioinformatics, oriented towards solving real biologic questions from a systems biology standpoint.

Prerequisites: For Marquette University (MU) Learners:
- BIOL 5201, which covers basic RNA-Seq analysis and interpretation.
- BIOL 1004 and CHEM 2112, which may be taken concurrently.
- COSC 2100 or consent of the instructor.

For MCW learners and those outside of MCW and MU:
There is not a formal pre-requisite requirement. Contact the course directors to demonstrate your readiness. We recommend that learners have a background in biology, genetics, and use of the R programming language.

BIIN 17294 Practicum for Research Development in Bioinformatics
3 Credit Hours
This course will provide students who are enrolled in the MS in Bioinformatics Program with the opportunity to participate in bioinformatics research within a biomedical laboratory.

Biochemistry

BIOC 02002 Master's Thesis Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including thesis credits, but have not yet completed the writing of the Thesis.

Continuation status is limited to three consecutive terms following the completion of Thesis credits.

BIOC 02003 Doctoral Dissertation Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including dissertation credits but have not yet completed the writing of the Dissertation. Continuation status is limited to three consecutive terms following the completion of Dissertation credits.

BIOC 02207 Enzyme Kinetics Receptor Binding
1 Credit Hours
This course covers both the theoretical framework and practical aspects of enzyme kinetics and receptor binding studies. Topics covered include basic steady state kinetics including the determination and meaning of Km and Vmax values for simple and multi-substrate reactions, determination of the binding properties and kinetic consequences of common reversible inhibitors (competitive, non-competitive, uncompetitive, mixed), slow-on, slow-off inhibitors, and irreversible inactivators. Dissociation constants and procedures for determining them will be discussed for both enzymes and macromolecular receptors. Practical methodologies for determining pre-steady state kinetics will be presented. Practical aspects of designing kinetic studies will be discussed and later sessions of the course will involve some reading and discussion of studies in the literature that illustrate ways in which studies of enzyme kinetics or receptor binding advanced the study of particular enzymes and other macromolecules. Over the 6-week duration of the course each student will prepare a short project report in which they describe the design of a series of kinetic or receptor binding studies that draw on the teachings of the course and are related to the work they propose to carry out for their dissertation.

BIOC 02211 Medical Genetics
2 Credit Hours
The goal of this three-week fall semester course is to provide students with the basic science foundation in the principles and concepts of Genetics and to build a bridge between the science of genetics and its relevance to translational medicine. Genetic concepts and principles that will be conveyed to students include but are not necessarily limited to the areas of molecular biology, early human embryological development, classical genetics, and modern genetics. This will be accomplished during didactic lectures, clinical case studies, and an individual shadowing experience in a Genetics clinic. The information received will also enable students to better appreciate and understand the genetic components of subsequent courses in the Graduate curriculum.

BIOC 02226 Biophysical Techniques in Biochemistry
3 Credit Hours
This course will introduce the basic theory and practical applications of an array of biophysical techniques commonly used in biochemical research. Optical, fluorescence, and magnetic resonance spectroscopies, x-ray crystallography, mass spectrometry and kinetics techniques are just a sampling of the topics covered in this comprehensive course.

BIOC 02230 Biomolecular NMR Structure and Molecular Recognition

1 Credit Hours

Nuclear magnetic resonance spectroscopy (NMR) is a powerful tool for the interrogation of biomolecular structure and interactions at atomic resolution. Structural genomics efforts have produced refinements in the methodology for three-dimensional protein structure determination, such that new structures can be solved in a matter of weeks using increasingly automated processes. This course begins with a description of the quantum mechanical basis for multidimensional NMR using the product operator formalism. This powerful operator algebra rigorously predicts the propagation of the nuclear spin wavefunction under a time-independent Hamiltonian operator governing interactions between nuclear spins and between spins and static or transient magnetic fields, enabling the development of increasingly complex pulse sequences for multidimensional, multinuclear NMR measurements of biomolecules. Simple pulse sequences for magnetization transfer and isotope editing are described using product operators and combined into more complex two- and three-dimensional pulse schemes for triple-resonance correlation of nuclei in proteins. Systematic application of these NMR methods to the sequence-specific assignment of isotopically-enriched proteins will then be linked to the interpretation of other of types of NMR data (nuclear Overhauser effect; scalar and dipolar couplings) that report directly on tertiary structure. The balance of the course will consist of practical, hands-on training in basics of 2D/3D NMR data acquisition, processing and analysis, as well as interactive computer tutorials on the chemical shift assignment and 3D structure determination processes.

BIOC 02235 Biomolecular NMR Protein Dynamics and Binding

1 Credit Hours

NMR spectroscopy is one of the most powerful tools of contemporary structural biology. Multiple NMR applications will enable the student to do structural, thermodynamic, and kinetic analyses of proteins and nucleic acids under physiological conditions with site-specific resolution. The course Biomolecular NMR: Structure and Molecular Recognition provides a general foundation of NMR spectroscopy and is a pre-requisite. The current course Biomolecular NMR: Protein Dynamics and Binding extends discussion of NMR to topics of protein dynamics, conformational transitions and ligand binding as monitored by NMR methods to extract site-specific thermodynamic and kinetic parameters.

BIOC 02240 Contemporary X-ray Crystallography

1 Credit Hours

X-ray crystallography is the main method that is used to elucidate 3-dimensional structures of macromolecules and biomolecular complexes, and capable of revealing structural details at high resolutions. Powered by modern synchrotron-based light sources and state-of-the-art computer programs, contemporary crystallographic research has provided mechanistic insights into complex cellular functions such as gene transcription and translation. While crystallographic computer programs are openly available, the use of these packages by biologists who do not have a theoretical comprehension of crystallography can be unproductive. This course is designed to teach non-crystallographers the capability to intelligently use crystallographic programs that are available in the form of bundled software. Attendees will learn systematically the central theory behind the crystallographic tools in use today and hence grow an appreciation of the physical process that takes place

during an experiment to determine the structure of a protein or nucleic acid. A central aim of this is to generate stimulating discussions that will help the students to grasp the essence of macromolecular crystallography.

BIOC 02248 Structural Basis - Macromolecules
1 Credit Hours
With the explosion of the number of three-dimensional structures of biological macromolecules that have been determined, it is imperative to learn how to study their structures in detail and learn the molecular basis for their functions. This course discusses the mechanism of action and the relationship between structure and function of selected groups of biological macromolecules. The molecules studied range from enzymes (both soluble and membrane-bound) to proteins involved in signal transduction and in epigenetic gene regulation. At the end of the course, the student will attain the skills to analyze the relationship between structures and functions of proteins.

BIOC 02251 Advanced Molecular Genetics
3 Credit Hours
The background to six different specific topics in molecular genetics is presented in an initial lecture followed by several discussion sessions in which research papers from that area are presented and critically evaluated. Emphasis is placed on developing the ability to critically read and evaluate experimental approaches and data from original research papers. Examples of topics include: the DNA binding properties of proteins; regulation of gene expression at the translation level; mechanisms of DNA replication; regulation of gene expression by enhancer elements; and DNA transposition mechanisms.

BIOC 02276 Special Topics in Biochemistry
1 Credit Hours
Students are expected to develop an advanced understanding of various aspects of special topics in biochemistry through introductory lectures, outside readings, and in-class discussions.

BIOC 02295 Reading and Research
1-9 Credit Hours
The course of study for Reading and Research is designed by each student with his/her advisor to focus on readings in literature in the student's field, to build bibliographic resources for the dissertation, and to conduct supervised, independent research.

BIOC 02299 Master's Thesis
1-9 Credit Hours
Students in the Ph.D. degree program who cannot or elect not to complete that program may be allowed to transfer to the Master's program. This transfer must be approved by the student's advisor, the Program Director, the Chair, and the Graduate School. To transfer to the Master's Program, the student must be in good academic standing according to regulations established by the Graduate School.

BIOC 02301 Seminar
1 Credit Hours
This course gives students practice in presenting and evaluating their research data. Solutions to research problems encountered are also discussed. This course is required beginning in the second semester of the second year and continues throughout each student's program.

BIOC 02399 Doctoral Dissertation
1-9 Credit Hours
This course is required for the completion of the PhD degree. The PhD candidate must submit a dissertation based on original research of a high scholarly standard that makes a significant contribution to knowledge in their chosen field.

Bioethics

BIOE 10002 Master's Continuation
0 Credit Hours
This is a form of registration available to students who have completed all the required coursework but have not yet completed the writing of the thesis or final paper. Continuation status is limited to three consecutive terms.

BIOE 10200 Clinical Bioethics I
3 Credit Hours
This course provides an introduction to medical ethics in the clinical setting. It consists of daily rounds with various medical or surgical teams in selected hospital treatment areas, plus a weekly session to discuss and analyze issues encountered.

BIOE 10201 Medical Ethics
3 Credit Hours
This course familiarizes students with the theoretical and philosophical aspects of the varied topics in medical ethics. It provides an important foundation for further study of bioethics, focusing on the principles of bioethics and some salient legal and clinical cases. The format includes lectures, followed by small-group discussions. In the second year, graduate students are able to act as a small-group discussion leader for this course. In this way, the student gains valuable experience in the teaching of bioethics.

BIOE 10203 Justice and Health Care
3 Credit Hours
This course will provide an overview of Justice and Health Care. We will begin with a close look at a number of philosophical perspectives on distributive justice, including John Rawls' Theory of Justice, Utilitarianism, Equality of Opportunity, various theories of Equality, and the concept of Triage. Students will then apply these perspectives to issues in access to healthcare/health insurance coverage, genetic enhancement, and the distribution of risks and benefits of medical research. The second part of the course will focus on the effects of managed care on contemporary medical practice in the US. In particular, students will

examine how managed care arrangements alter the physician-patient relationship, the factors which have led to the development of managed care reimbursement systems, state and federal health care plans, and in particular the Oregon Plan.

BIOE 10205 Introduction to Hospital Medicine
3 Credit Hours
This course provides an introduction to human pathophysiology and the functioning of a contemporary medical center. It consists of discussions of human pathophysiology and discussions with hospital professionals about their role in patient care.

BIOE 10206 Ethics and the Law
3 Credit Hours
This course explores the legal and ethical issues impacting physician conduct, regulation, and professionalism. The course will provide a general overview of the various factors that influence physician conduct and regulation, such as codes of ethics, licensing requirements, the court system, and ethics mechanisms such as ethics committee and institutional review boards.

BIOE 10207 Introduction to Research Ethics
3 Credit Hours
This course provides students with a comprehensive introduction to the ethical issues involved in scientific, animal and human subjects research. After a brief look back at the history of research ethics, students will spend time considering issues that impact research in both the laboratory setting and in the clinical setting. This course provides the necessary research ethics instruction required to satisfy the United States Public Health Service Policy on Instruction in the Responsible Conduct of Research for institutions receiving research funds from the Department of Health and Human Services.

BIOE 10209 Clinical Topics in Bioethics
3 Credit Hours
This course will provide an overview of the major areas of clinical bioethics. These are the topics that clinical ethicists commonly wrestle with in their role as consultation leaders, ethics committee members and teachers of contemporary bioethics. These have not yet been resolved to everyone's satisfaction. Students will examine informed consent, decision making, the role of advance directives, treatment limitations, and appropriate end of life care. Further, students will look at the role of both physician and nurse in these dilemmas as well as the role of the ethics committee. Finally, students will tackle some more global issues that are still within the clinical arena--such as epidemiology and the concerns with emergency preparedness, institutional ethics, and research ethics.

BIOE 10210 Philosophical Bioethics
3 Credit Hours
In this course, students will explore the foundations of philosophical ethics in the West, and how early themes shape current work in philosophical bioethics. To this end, students will read works by Aristotle, Kant, and Mill, focusing on their theoretical approaches to ethics. Detailed discussion will focus on the ethics theories known as virtue theory, casuistry, deontology, utilitarianism, communitarianism, and principlism, considering both their

historical origins and modern interpretations. Students will apply these theories to topical themes of moral development, abortion, assisted death and others, nothing their strengths and weaknesses.

BIOE 10211 Ethics Beyond the Acute Care Setting
3 Credit Hours
This course examines ethical issues in rehabilitation care, psychiatric care, hospice, long-term care, dental care, and other settings. The focus is on developing a framework and language in which to discuss and analyze moral problems in these settings. Care settings to be covered may vary.

BIOE 10214 Research Practice and Health Improvement
3 Credit Hours
This is an upper-level ethics course offered completely online for individuals interested in learning about issues related to research ethics. It will address the following topics: basic research concepts, quality improvement and assurance in hospital/clinical settings, public health practice, and community engaged participatory research. There are no prerequisites.

BIOE 10216 Race and Trust in Biomedical Research
3 Credit Hours
Using the ethical principle of social justice, this course will provide an overview of society's role in promoting or ensuring individual and collective health through biomedical research. The course will examine how attitudes toward race and difference have impacted protections of basic human rights in biomedical research, document past and present abuses in biomedical research, and examine how lack of trust stemming from past abuses impacts the ability to attain, maintain, and promote well-being through biomedical research.

BIOE 10220 Critical Approaches to Bioethics
3 Credit Hours
Various alternative approaches in ethics and biomedical ethics will be explored in order to provide a broad understanding of the range of critical social and philosophical thought on biomedical issues.

BIOE 10222 Ethics Integrity in Science
1 Credit Hours
Offered in Spring and Summer Terms
This course provides the basis for understanding the ethical issues related to basic scientific and medical research, including animal and human subject research, fraud and misconduct, and governmental, institutional, and researcher responsibilities.

BIOE 10223 Law and Bioethics
3 Credit Hours
This course provides an introduction to legal principles and legal precedent relevant to issues in bioethics, aimed at providing the foundation for understanding relevant law concerning these issues.

BIOE 10225 Religion and Bioethics
3 Credit Hours
This course will examine the diverse range of religious resources that are pertinent to the field of bioethics. Students will explore topics in bioethics, such as euthanasia, abortion and informed consent from the perspectives of various religious traditions.

BIOE 10226 Regulatory Issues in Human Subject Research Protections
3 Credit Hours
There is no question that the fruits of research have fueled medical progress. Yet, the history of research involving human subjects is not unblemished. Federal regulations, based on ethical principles set forth in the Belmont Report, now govern much of the research undertaken in the United States. In this course, we will explore the history and substance of research regulations in the United States, the application of the regulations to specific research issues, and situations where the regulations do not provide clear guidance.

BIOE 10228 Current Topics in Research Ethics
3 Credit Hours
Rapidly evolving scientific and technologic capabilities in medicine combined with an ever-increasing demand to translate these scientific developments to the bedside presents new challenges to regulating human subjects research. This course seeks to keep pace with many of these new and emerging challenges, providing students an opportunity to critically examine the ethical and legal implications of these topics. Specific topics for analysis will be drawn from the current medical literature, popular press, and evolving policy guidance.

BIOE 10231 Bioethics Consulting Committees
1 Credit Hours
Through attendance of ethics committee meetings and ethics consultations, this course will familiarize students with both the theoretical and practical aspects of institutional and consultative ethics. This course is required for students with no professional experience in clinical bioethics.

BIOE 10233 Issues in Pediatrics Ethics
3 Credit Hours
This course will discuss the question of children's rights, the social value of children, and cross-cultural issues of childhood. The objective of the course is to examine our individual assumptions about childhood and parenting that form the basis of approaches to pediatric ethics.

BIOE 10234 Ethics Human Reproduction
3 Credit Hours
This course will provide an opportunity for students to explore some of the ethical issues related to human reproduction, including assisted reproductive technologies, genetics, and cloning. Students will also examine the various religious and philosophical arguments, as well as international perspectives, surrounding issues of human reproduction.

BIOE 10240 History Meaning of Ethics Professionalism in Medicine
3 Credit Hours
Medical ethics and professionalism have meant different things to different people for literally thousands of years. In this course, we will explore the history and meanings of medical ethics and medical professionalism from ancient times through contemporary challenges. We will delve into a variety of schools of thought on what it means, or should mean, to be a physician-learning from each other and through readings from disciplines including history, law, sociology, economics, political science, and philosophy. Special attention will be paid to the social roles of physicians, to the roles of professional associations, and the evolution of Codes of Ethics in medicine. The first part of the course is intended to be primarily historical in nature, providing an overview of the history of medical professionalism. In the second part of the course, we will delve more deeply into the sociology of professions, ending with an exploration of contemporary ways of understanding professionalism in medicine. In the third part of the course, we will delve into several specific, contemporary challenges facing the medical profession and approaches to these challenges. Throughout the course, we will use specific cases as examples to develop and illustrate methods of analysis.

BIOE 10245 Philosophical Neuroethics
3 Credit Hours
Neuroscience and neurotechnologies are generating knowledge about the nature of consciousness, moral emotions, free will, and concepts of mind and self. While some of these latter concepts are philosophical in nature, they have nonetheless practical, ethical, and sociopolitical significance that demands critical evaluation. New findings in neuroscience are increasingly applied in clinical, legal, and social contexts: 1) neurostimulation technologies provide alternative treatments for debilitating neurological disorders (e.g., Parkinsonism, Treatment-Resistant Depression), 2) neuroimaging technologies are used increasingly for forensic purposes (e.g., lie detection), and 3) neurodevices are developed to enhance cognitive performance (e.g., military applications) or control/alter behavior (moral bioenhancement). Emerging neurotechnologies are likely to impact nearly every aspect of human existence and society at large. This course focuses on the historical, philosophical, and ethical issues arising from advances in neuroscience/ neurotechnologies in the broader social milieu.

BIOE 10248 Clinical Neuroethics
3 Credit Hours
Neuroscience and neurotechnologies are generating knowledge about the nature of consciousness, moral emotions, free will, and concepts of mind and self. While some of these latter concepts are philosophical in nature, they have nonetheless practical, ethical, and socio-political significance that demands critical evaluation. New findings in neuroscience are increasingly applied in clinical, legal and social contexts: 1) neurostimulation technologies provide alternative treatments for debilitating neurological disorders, 2) neuroimaging technologies are used increasingly for forensic purposes, and 3) neurodevices are developed to enhance cognitive performance or control/alter behavior. Emerging neurotechnologies are likely to impact nearly every aspect of human existence and society at large. This course focuses on the ethical, social, and practical issues arising from advances in neuroscience/neurotechnologies in the clinical context.

BIOE 10262 Mastering Human Subjects Protections Meetings Members and Processes
3 Credit Hours
This course is an advanced examination of the concepts, theories, and principles of IRB decision-making designed for experienced (3 years or more) IRB members. The course will consider ways to satisfy regulatory requirements and ethical review for biomedical research with focus, efficiency, and depth. The course will pay particular attention to distinguishing between major regulatory or ethical questions, on one hand, and non-critical questions or change requests, on the other. The course will also review ways that IRB Chairs and IRB members can more quickly illuminate differences of opinion in a way that allows thoughtful committee resolution of controversial impasses.

BIOE 10275 Special Topics in Bioethics
3 Credit Hours
This course focuses on topics of special interest in bioethics. Examples of topics include research ethics, ethical issues in mental health, and political issues in bioethics and public health.

BIOE 10291 Teaching Medical Ethics
3 Credit Hours
This course will develop the theoretical foundation and practical application of educating students in medical ethics, including systematic design of instruction, utilizing needs assessments, and the various methods of instruction. The course includes a practicum in application of methods of small-group instruction.

BIOE 10295 Reading and Research
1-3 Credit Hours
This independent study course is available to all Master's degree-seeking students, and awards credit for pursuing background reading and new research in areas of particular student interest.

BIOE 10297 Masters Consultation
1–2 Credit Hours
This course will familiarize and train student in the theoretical and practical aspects of ethics consultation through a seminar, supervised practical experience in doing ethics consultations, and writing summaries and reporting these consultations at monthly ethics committee meetings.

BIOE 10298 Journal Club
1 Credit Hours
This journal club is a student and faculty forum for the discussion of a variety of contemporary issues in bioethics. Its informal setting allows for open discussion on wide ranging topics.

BIOE 10299 Master's Thesis
3–6 Credit Hours
Students may choose to undertake and complete research culminating in a master's thesis. Both scholarly and quantitative research are acceptable. This research is directed by a member of the Bioethics faculty.

BIOE 10444 Research Ethics Discussion Series
1 Credit Hours
Prerequisite: BIOE 10222 Ethics and Integrity in Science
Offered in Spring Term
The course is directed by members of the Bioethics Faculty and provides facilitated discussions of a series of topics in research ethics. Discussions are led by members of the Basic Science faculty and are focused on ethical issues that commonly come up in biomedical research. The course is meant to not only reinforce the basic ethics taught in the online course Ethics and Integrity in Science (Bioethics 10222B), which is a prerequisite, but also to explore the gray areas of the individual topics. The intent is to offer students illustrative examples of ethical issues that might arise in their careers, to emphasize the ethical principles that apply in such situations, and the provide practical guidance on how these types of situations should be correctly handled. This course is offered as a discussion series. Students are expected to attend and participate in the discussion.

Biomedical Engineering

BIOM 35003 Doctoral Dissertation Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including dissertation credits, but have not yet completed the writing of the Dissertation. Continuation status is limited to three consecutive terms following the completion of Dissertation credits.

BIOM 35284 Computational Methods in Biomedical Research
3 Credit Hours
Nearly every area of modern research in biology and biomedical science is targeted in one way or another on gaining quantitative understanding of the behavior of biological systems. This course will focus on practical techniques for simulation and analysis of biological systems, developed largely through application-driven examples. Examples will be developed to a depth at which models will be used to analyze real biological or physiological data. To accomplish this, the important details of the underlying biological systems must be described along with complete step-by-step development of model assumptions, the resulting equations, and computer code. Necessary prerequisites are a proficient understanding of undergraduate calculus, familiarity with introductory concepts of linear algebra, and access to any conveniently available language or programming environment such as Fortran, C, Matlab, or Mathematica.

BIOM 35285 Mathematical Biology
3 Credit Hours
This course teaches the students how to express physiological problems in equations and how to solve such equations. Emphasis on physiological problem-solving methods rather than mathematical theory. Topics include the application of matrices, differential equations, and numerical analysis to problems in bioelectricity, biomechanics, and optics.

BIOM 35295 Reading and Research
1-9 Credit Hours
The course of study for Reading and Research is designed by each student with his/her advisor to focus on readings in literature in the student's field, to build bibliographic resources for the dissertation, and to conduct supervised, independent research.

BIOM 35399 Doctoral Dissertation
1-9 Credit Hours
This course is required for the completion of the PhD degree. The PhD candidate must submit a dissertation based on original research of a high scholarly standard that makes a significant contribution to knowledge in their chosen field.

BIOM 5220 Embedded Biomedical Instrumentation
3 Credit Hours
Fundamentals of digital circuit design and analysis and the application to embedded biomedical instrumentation. Topics include microprocessor principles and programming and system design constraints for medical electronics. Laboratory provides applications of concepts introduced in class. (See Marquette University course catalog for class section registration)

BIOM 5320 Biomedical Instrumentation Design
3 Credit Hours
Problems in instrumentation relating to physiological measurements in the laboratory and clinic. Electronic devices for stimulus as well as measurement of physiological quantities. Design of actual instruments. Features include mechanical design, accessory design and safety requirements. (See Marquette University course catalog for class section registration)

BIOM 5400 Transport Phenomena
3 Credit Hours
Applications of mass momentum and mechanical energy balances to biomedical fluid systems Study of physiological phenomena with an emphasis on cardiovascular systems and blood rheology See Marquette University course catalog for class section registration

BIOM 5410 Applied Finite Element Analysis
3 Credit Hours
This course will familiarize the student with the finite element (FE) method as applied to biomedical applications, with emphases on musculoskeletal /orthopaedic problems in computational solid mechanics and applications in computational fluid dynamics. At the conclusion of the course, the student will be familiar with the basic theory of the FE method and the applications thereof; the difference between accuracy and validity in the context of FE modeling; appropriate materials selection for musculoskeletal tissues; various modeling techniques; and the challenges associated with anatomic modeling. Students will complete tutorials and problems on ANSYS software for hands-on learning of FE software widely used in industry.

At the end of the course students will:

• Understand basic principles of the finite element method applied to computational solid mechanics (ABET Learning Objectives 1, 2, 6 & 7)
• Be able to simulate finite element problems using ANSYS software (ABET Learning Objectives 1, 2, 6 & 7)

(See Marquette University course catalog for class section registration)

BIOM 5420 Biomaterials Science and Engineering
3 Credit Hours
Designed to introduce the uses of materials in the human body for the purposes of healing, correcting deformities and restoring lost function. The science aspect of the course encompasses topics including: characterization of material properties, biocompatibility and past and current uses of materials for novel devices that are both biocompatible and functional for the life of the implanted device. Projects allow students to focus and gain knowledge in an area of biomaterials engineering in which they are interested. (See Marquette University course catalog for class section registration)

BIOM 5500 Medical Imaging Physics
3 Credit Hours
Examines how light, X-rays, radiopharmaceuticals, ultrasound, magnetic fields, and other energy probes are generated and how they interact with tissues and detectors to produce useful image contrast. Addresses practical issues such as beam generation, dose limitations, patient motion, spatial resolution and dynamic range limitations, and cost-effectiveness. Emphasizes diagnostic radiological imaging physics, including the planar X-ray, digital subtraction angiography mammography, computed tomography, nuclear medicine, ultrasound, and magnetic resonance imaging modalities. (See Marquette University course catalog for class section registration)

BIOM 5510 Image Processing for the Biomedical Sciences
3 Credit Hours
Introduces biomedical image processing. Topics explored include: the human visual system, spatial sampling and digitization, image transforms, spatial filtering, Fourier analysis, image enhancement and restoration, nonlinear and adaptive filters, color image processing, geometrical operations and morphological filtering, image coding and compression image segmentation, feature extraction and object classification. Applications in diagnostic medicine, biology and biomedical research are emphasized and presented as illustrative examples. (See Marquette University course catalog for class section registration)

BIOM 5520 Optics for Biomedical Engineering
3 Credit Hours
Optics is the science and technology of how light is generated, propagates, interacts with matter and is detected. It is one of the fastest growing high-tech industries worldwide and has found applications in the areas of information technology, healthcare and life science, sensing, lightning, energy and manufacturing. This course introduces students to the fundamentals of optics, including geometrical (or ray) optics and wave optics. The geometrical optics discusses light reflection, refraction, lenses, mirrors, prisms, fiber optics, GRIN lens and simple imaging systems. The wave optics focuses on wave equations,

superposition, diffraction, interference, polarization, dispersion, and electro-optic effects. The course aims to prepare students for more advanced topics, such as fluorescence imaging, optical microscopy, diffuse optical tomography, optical coherence tomography, and optical spectroscopy. (See Marquette University course catalog for class section registration)

BIOM 5600 Neural Engineering
3 Credit Hours
Basic principles of neural engineering, properties of excitable tissues, quantitative models used to examine the mechanisms of natural and artificial stimulation. Basic concepts for the design of neuroprosthetic devices for sensory, motor and therapeutic applications. Design issues including electrode type, biomaterials, tissue response to stimulating electrodes and stimulus parameters for electrical stimulation and artificial control. Examples of how engineering interfaces with neural tissue show increasing promise in the rehabilitation of individuals of neural impairment. (See Marquette University course catalog for class section registration)

BIOM 5610 Rehabilitation Robotics
3 Credit Hours
This course provides an overview of the fundamental principles of rehabilitation robotics, including robot kinematics, dynamics, control, motion planning, social robotics, and human-machine interaction, and human-centered design. The course is designed to provide students with a comprehensive understanding of rehabilitation robotics, its applications, and its future prospects. (See Marquette University course catalog for class section registration)

BIOM 5700 Systems Physiology
3 Credit Hours
Analyses of the underlying physiologic and bioengineering aspects of the major cell and organ systems of the human from an engineer's point of view. Classic physiologic approaches used to introduce topics including cell functions, nervous system, nerve, muscle, heart, circulation, respiratory system, kidney, reproduction and biomechanics. Design problems including models of cell-organ-system function and problems in biomechanics illuminate topics covered. Computer techniques and relevant instrumentation are incorporated. Experts on related topics are invited to speak as they are available. (See Marquette University course catalog for class section registration)

BIOM 5710 Analysis of Physiological Models
3 Credit Hours
Development of continuous (compartmental) and distributed-in-space-and-time mathematical models of physiological systems and molecular events. Analytical and numerical methods for solving differential equations of the initial and boundary value types. Simulation of model response, and estimation of model parameters using linear and nonlinear regression analysis. (See Marquette University course catalog for class section registration)

BIOM 5720 Cardiopulmonary Mechanics
3 Credit Hours
Examination of the physiological behavior of the cardiovascular and pulmonary systems from an engineering perspective. Emphasis is on understanding the mechanical basis of physiologic phenomena via experimental models. (See Marquette University course catalog for class section registration)

BIOM 5931 Topics in Biomedical Engineering
1–3 Credit Hours
Course content announced prior to each term. Students may enroll in the course more than once as subject matter changes. Possible topics include biomechanics, experimental methods, neuroanatomy, telemetry, etc. Register with Marquette University.

BIOM 6120 Introduction to the Finite Element Method
3 Credit Hours
Introduces finite element analysis as applied to linear, static problems. Application to problems in plane strain, plane stress, and axisymmetry. Development of shape functions and element stiffness matrices. Although primarily structural analysis, also considers problems in heat transfer and fluid mechanics. Use of user-written and packaged software. (See Marquette University course catalog for class section registration)

BIOM 6200 Biomedical Signal Processing
3 Credit Hours
Introduces students to statistical processing of biomedical data. Topics include: data acquisition, probability and estimation, signal averaging, power spectrum analysis, windowing, digital filters and data compression. Students complete several computer projects which apply these processing methods to physiologic signals. (See Marquette University course catalog for class section registration)

BIOM 6210 Advanced Biomedical Signal Processing
3 Credit Hours
Covers modern methods of signal processing encountered in the bio-medical field including parametric modeling, modern spectral estimation, multivariate analysis, adaptive signal processing, decimation/interpolation, and two-dimensional signal analysis. Students complete several computer projects which apply these modern techniques to physiologic data. Prereq: BIEN 6200 or BIOM 6200 (See Marquette University course catalog for class section registration)

BIOM 6301 Clinical Needs Finding
3 Credit Hours
Provides students with the tools and mindset to be able to identify needs within the clinical environment. A key element presented is the ability to employ observational research techniques to identify capability gaps, employed workarounds, and undiscovered opportunities – without exclusively relying on what the end user communicates. Topics include clinical terminology and common devices, stakeholder perspectives, U.S. FDA regulatory requirements, international standards, systems and inclusive design

methodologies, observation and ethnographic skills, and bioethical considerations. (See Marquette University course catalog for class section registration)

BIOM 6302 Clinical Observation
3 Credit Hours
Provide students with an immersive, experiential learning opportunity within the clinical environment. Students will complete a series of immersion experiences with different clinics to facilitate clinician-designer interactions that cannot otherwise be easily replicated. These interactions will help designers to identify new opportunities, improve medical devices, or create new approaches to solve problems often encountered by clinicians and medical professionals. Students will also complete the simulation lab experience as part of their immersion experience.
This course provides two experiential learning components. First, the student will be scheduled to complete a hands-on, practical exercise in one of the simulation centers (e.g., use a medical device simulator to understand the kinesthetic requirements and haptic responses that the clinician observes). Second, the student will complete a series of in-person, clinical observations. The student will then reflect upon these experiences by completing a "Clinical Experience Report" for each clinical observation. (See Marquette University course catalog for class section registration)

BIOM 6430 Advanced Tissue Engineering
3 Credit Hours
Explores advanced topics in the scientific field of tissue engineering, a discipline of biomedical engineering that uses a combination of living cells, biomaterials, and biomechanical and biochemical stimuli to restore or replace damaged or diseased biological tissues. Covers advanced topics in foundational sciences as applicable to the engineering of living tissues. Students select applications of tissue engineering, review recent academic research as reported in the scientific literature, and present their findings to the class. Example tissue applications to be covered include: skin, blood vessels, nervous tissue, heart tissue, heart valves, tendons, ligaments, bone, muscle, pancreas, bladder and whole organs. Prereq: BIEN 5430 recommended. (See Marquette University course catalog for class section registration)

BIOM 6440 Biomedical Engineering Analysis of Trauma
3 Credit Hours
An engineering analysis of the physiological changes following impact to the head, spinal cord, and limbs, and electrical events and effects on tissues are treated. (See Marquette University course catalog for class section registration)

BIOM 6450 Musculoskeletal Biomechanics 1
3 Credit Hours
Emphasizes the interrelationship of force and motion as related to anatomic structure and function. Examines the forces and motions acting in the skeletal system and the various techniques used to describe them. Highlights current concepts as revealed in the recent scientific and engineering literature. Topics include: bone mechanics, joint mechanics, gait kinematics, instrumentation and measurement of biomechanical phenomena, and

computer modeling of the musculoskeletal system. (See Marquette University course catalog for class section registration)

BIOM 6451 Musculoskeletal Biomechanics 2
3 Credit Hours
Advanced concepts of kinematics and mechanics as they apply to the fields of biomechanics and rehabilitation Covers aspects of gait bone and joint surgery and soft tissue surgery Detailed study of joint mechanics implant applications and mobility device function is performed Includes advanced analysis and modeling as well as laboratorybased final project Prereq BIEN 6450 or BIOM 6450

BIOM 6500 Mathematics of Medical Imaging
3 Credit Hours
Begins with an overview of the application of linear systems theory to radiographic imaging (pinhole imaging, transmission and emission tomography), and covers the mathematics of computed tomography including the analytic theory of reconstructing from projections and extensions to emission computed tomography and magnetic resonance imaging. Topics may also include three-dimensional imaging, noise analysis and image quality, and optimization. Contains advanced mathematical content.

BIOM 6600 Neuromotor Control
3 Credit Hours
Overview of current issues in neuromotor control and movement biomechanics. Special emphasis on the study of normal and impaired human movement. Topics include: muscle mechanics, biomechanics of movement, neural circuitry, strategies for the neural control of movement (including a discussion of adaptation and motor learning) and potential applications of biomedical engineering techniques to the study and improvement of impaired motor function. (See Marquette University course catalog for class section registration)

BIOM 6610 Rehabilitative Biosystems
3 Credit Hours
Examines the plastic changes in biological systems that occur in response to targeted stimuli. These processes involve responses by cells to chemical, mechanical, or electrical stimuli (which may be related), which may be influenced or directed using engineering techniques. Examines the homeostasis of physiologic systems and their response to pathologic and rehabilitative stimuli. Examines engineering applications involving the diagnosis and rehabilitation of musculoskeletal, neurologic and cardiopulmonary biosystems in the context of the underlying cellular mechanisms. (See Marquette University course catalog for class section registration)

BIOM 6620 Modeling Rehabilitative Biosystems
3 Credit Hours
Mathematical modeling is a widely used tool for gaining insight into mechanisms underlying complex rehabilitative biosystems. This course introduces larger-scale mathematical models of various physiological systems of interest in rehabilitation (e.g., metabolic, musculoskeletal, cardiovascular, neurorehabilitative). For each, simulations are used to further our

understanding of dynamic performance, and adaptive processes in response to physiological/pathophysiological stresses and rehabilitative interventions. (See Marquette University course catalog for class section registration)

BIOM 6710 Cellular and Molecular Bioengineering
3 Credit Hours
Students will develop a comprehensive understanding of advanced concepts in applied cellular and molecular bioengineering. Main topics will include cellular biomechanics with an emphasis on the molecular bioengineering, biotransport phenomena, and tissue engineering with a focus on the cardiovascular and endocrinology system. Through developing an understanding of cellular biomechanics, students will learn bioengineering approaches related to cellular manipulation at the molecular level to develop novel therapeutic approaches. An emphasis will also be placed on cellular scaffolds utilized for tissue engineering and the development of artificial organs, as well as other bioengineering therapeutic applications. Each student will be required to develop an independent project focused on addressing a critical barrier in the field of their choosing that integrates the topics taught in the course. (See Marquette University course catalog for class section registration)

BIOM 6931 Topics in Biomedical Engineering
3 Credit Hours
Subject matter variable as determined by needs of biomedical graduate students. Students may enroll more than once as the subject matter changes. Possible topics: biostatistics, experimental methods, neuro-anatomy, etc.

BIOM 6953 Seminar in Biomedical Engineering
0 Credit Hours
Scholarly presentations on current topics in biomedical engineering and related areas by visiting professors, resident faculty and graduate students. Attendance is required of all full-time graduate students. SNC/UNC grade assessment. Mandatory for all full-time BIEN/BIOM graduate students. (See Marquette University course catalog for class section registration)

Biophysics

BIOP 03002 Master's Thesis Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including thesis credits but have not yet completed the writing of the Thesis. Continuation status is limited to three consecutive terms following the completion of Thesis credits.

BIOP 03003 Doctoral Dissertation Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including dissertation credits but have not yet completed the writing of the

Dissertation. Continuation status is limited to three consecutive terms following the completion of Dissertation credits.

BIOP 03220 Introduction to Magnetic Resonance
3 Credit Hours
The course provides basic knowledge for students who will continue to study ESR or NMR. The material covers magnetic resonance of the hydrogen and helium atoms, NMR spectra in liquids, basic ESR of radicals in solution, trapped radicals in solids, triplet states, spin relaxation, molecular rate processes, and double resonance. An understanding of matrix elements, eigenvalues, angular momentum, and tensor vector is recommended.

BIOP 03223 Electron Spin Resonance
3 Credit Hours
The aim of the course is to provide an introduction to the theory and practical applications of modern electron spin resonance (ESR) spectroscopy. Basic ESR theory, biological free radical spectroscopy, relaxation and motional phenomena, spin labeling and transition metal ESR are among the topics covered.

BIOP 03226 Biophysics Techniques in Biochemistry
3 Credit Hours
This course will introduce the basic theory and practical applications of an array of biophysical techniques commonly used in biochemical research. Optical and magnetic spectroscopies, X-ray crystallography and kinetics techniques are a sampling of the topics covered in this comprehensive course.

BIOP 03228 Fundamentals of Cryo-Electron Microscopy
1 Credit Hours
Fundamentals of Cryo-Electron Microscopy is a 6-week graduate course (3 hours/week) that blends concise lectures with guided practicals to build operational fluency in cryo-EM. Students will learn core theory and execute a streamlined single-particle workflow using an instructor-provided dataset to generate a validated map and fitted model. By the end of the course, students will understand basic cryo-EM principles and practical strategies for sample preparation, data collection, image processing, and 3D reconstruction of macromolecular assemblies.

BIOP 03230 Nuclear Magnetic Resonance
3 Credit Hours
This course is designed as an introduction to nuclear magnetic resonance (NMR) and nuclear magnetic resonance imaging (MRI). Emphasis will be given to theory and application of modern MRI techniques.

BIOP 03233 Biomolecular NMR of Protein Assemblies Theory and Applications
1 Credit Hours
This course will focus on the theory and applications of solid-state NMR (ssNMR). The course starts with a basic introduction to NMR spectroscopy followed by spin physics and experimental design for protein assembly analysis. Several examples from the current literature will also be discussed to understand the current state-of-art of this technology.

BIOP 03238 Magnetic Resonance Imaging
3 Credit Hours
This course will provide students with a solid foundation in the basic principles of magnetic resonance imaging (MRI). The focus of the course will be on the basic physical principles underlying the magnetic resonance phenomenon, and how to make an MR image, which will include spatial encoding, pulse sequences, k-space and recent advances in rapid imaging.

BIOP 03239 Functional MRI Contrast Mechanisms and Applications
3 Credit Hours
The use of magnetic resonance imaging (MRI) to evaluate tissue function will be described. The course will be dedicated to discussing functional MRI (FMRI) methods that use both endogenous contrast (labeled water, deoxygenated blood) and exogenous (injectable) MR contrast agents to image tissue function. The theory and physiology necessary for understanding the MR contrast mechanisms, together with the practical knowledge necessary for performing the MR experiments, will be discussed. Demonstrations of functional MRI experiments will be included.

BIOP 03240 Fourier Transformation
3 Credit Hours
This course provides basic knowledge for students who will continue to study EPR or MRI. Material will cover the theory of Fourier transforms, digital transforms, MRI image generation, Fourier image reconstruction, and digital signal processing. An understanding of calculus and matrix algebra is recommended.

BIOP 03242 Techniques of Molecular Cell Biology
2 Credit Hours
This course is designed to expose graduate students to the technical and practical aspects of techniques currently used in molecular and cell biology.

BIOP 03245 Molecular Modeling and Simulations
3 Credit Hours
This course will introduce the concepts of advanced molecular modeling and molecular dynamics simulation methods. It will cover topics on protein databases, sequences, protein structure prediction (comparative and de novo, including recent deep-learning algorithms), advanced molecular dynamics simulations, and analysis (electrostatic calculations, enhanced sampling, binding affinities, and integration with experiments). The course will first introduce the concepts and then apply them in weekly hands-on workshops and a final project on a system of the student's choice.

BIOP 03251 Free Radicals in Biology
3 Credit Hours
Topics to be discussed include: the nature of free radicals; radical initiation, propagation, termination; free radical reactions of biological interest; and the role of free radicals in physiological and pathological processes.

BIOP 03254 Advanced X-Ray Crystallography
3 Credit Hours
The student will receive both didactic lectures on the physics of X-ray diffraction, diffraction symmetry, reciprocal space, crystals and their diffraction properties; and calculations related to the actual solution of a crystal structure. All students will make extensive use of a computer in the laboratory exercises leading to the total solution of a crystal structure for a biologically active molecule composed of 20-30 atoms. Heavy atom and probability-based structure solutions will be explored.

BIOP 03260 Special Topics in Molecular Biophysics
3 Credit Hours
This is an advanced course dealing with special topics including free radicals in biology, spin relaxation, metal ions in biology, X-ray crystallography, and photobiology.

BIOP 03290 Biophysics Journal Club
1 Credit Hours
A journal article or topic of interest focused on general biophysics topics will be presented and discussed each week, led by a faculty expert. The learning objectives include a broader understanding of how biophysical approaches are applied in biomedical science research, improved critical thinking skills and critical literature assessment, and gaining experience in preparing and delivering oral presentations.

BIOP 03292 Molecular Dynamics Journal Club
1 Credit Hours
A journal article or topic of interest focused on molecular modeling and simulations in structural biology and bioinformatics will be presented by one student and discussed by all each week, led by a faculty expert. The learning objectives include a greater depth of understanding of how molecular dynamics simulations are used in biomedical science research, improved critical thinking skills, critical literature assessment, and gaining experience in preparing and delivering oral presentations.

BIOP 03296 NMR Journal Club
1 Credit Hours
A journal article or topic of interest focused on NMR spectroscopy of complex assemblies will be presented by one student and discussed by all each week, led by a faculty expert. The learning objectives include a greater depth of understanding of how NMR spectroscopy is used in biomedical science research, improved critical thinking skills and critical literature assessment, and gaining experience in preparing and delivering oral presentations.

BIOP 03297 Journal Club MRI
1 Credit Hours
Selected papers in theory, practice, and applications of electron and nuclear magnetic resonance will be read and discussed in separate sessions.

BIOP 03298 Journal Club EPR
1 Credit Hour
EPR Journal Club is a required course for Molecular Biophysics graduate students. It is offered each spring and fall semester, and introduces students to the various aspects of EPR via published studies in the scientific literature. Course Directorship is rotated each semester. The Course Director (CD) selects a topic for the semester, and each student selects one or more published papers pertaining to that topic, in conjunction with the CD. Selected papers are distributed to the class for prior reading. Each student presents their selected paper(s) to the class, along with any introduction to the area of study, and the class critically reviews the paper. Students will encounter aspects of EPR that they may not have previously encountered through either classes or their research, but which may be of value to their doctoral research or future research, teaching, or other careers.

BIOP 03299 Master's Thesis
Students in the Ph.D. degree program who cannot or elect not to complete that program may be allowed to transfer to the Master's program. This transfer must be approved by the student's advisor, the Program Director, the Chair, and the Graduate School. To transfer to the Master's Program, the student must be in good academic standing according to regulations established by the Graduate School.

BIOP 03300 Seminar
1 Credit Hours
Weekly invited seminar speakers present their research on Molecular Biophysics and Magnetic Resonance Imaging and other selected topics. This is a required course for all Biophysics students except those taking dissertation.

BIOP 03399 Doctoral Dissertation
1-9 Credit Hours
This course is required for the completion of the PhD degree. The PhD candidate must submit a dissertation based on original research of a high scholarly standard that makes a significant contribution to knowledge in their chosen field.

Biostatistics

BIOS 04002 Master's Thesis Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including thesis credits but have not yet completed the writing of the Thesis. Continuation status is limited to three consecutive terms following the completion of Thesis credits.

BIOS 04003 Doctoral Dissertation Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including dissertation credits but have not yet completed the writing of the

Dissertation. Continuation status is limited to three consecutive terms following the completion of Dissertation credits.

BIOS 04200 Biostatistics I
3 Credit Hours
This course is designed to familiarize students with statistical methods used in the public health and biomedical sciences. We will focus on descriptive statistics, elements of probability theory, estimation, tests of hypotheses, methods of categorical data tabulation and analysis.

BIOS 04201 Biostatistics II
3 Credit Hours
A continuation of Biostatistics I. Topics include statistical methods for categorical data, regression and correlation, and analysis of variance.

BIOS 04214 Design Analysis of Clinical Trials
3 Credit Hours
This course covers issues in clinical trials including the clinical trial protocol, sources of bias in clinical trials, blinding, randomization, sample size calculation; phase I, phase II, phase III and hybrid trials; interim analysis, stochastic curtailment, Bayes designs, and administrative issues in study design.

BIOS 04220 Research Seminar
1 Credit Hours
Students present plans for an analysis of research projects and research data. Projects and examples from classical and current literature are also discussed by students and faculty.

BIOS 04221 Biomedical Applications and Consulting
3 Credit Hours
The course focuses on the theory of consulting, communication and statistical techniques most often used in consulting. Biomedical applications, practical experience in the real consulting setting and writing statistical reports are key components of the course.

BIOS 04222 Statistical Consulting
3 Credit Hours
This course is designed for students to gain experience in statistical consulting by working with the biostatistics faculty members on various consulting projects.

BIOS 04223 Biomedical Applications and Consulting 2
2 Credit Hours
The course focuses on theory of consulting, verbal and written communication, and statistical techniques most often used in consulting and biomedical applications. Students will gain practical experience in real consulting setting.

BIOS 04224 Biostatistical Computing
3 Credit Hours

This course will cover the details of manipulating and transforming data required for statistical analysis, such as reshaping the data from a per-case to a per-event within a case and vice-versa. It will also cover the techniques necessary to write functions and macros in both SAS and R for developing new/modified data analysis methods. Students are expected to be facile in the use of computers before they take this course. LaTeX document production system is also introduced.

BIOS 04231 Statistical Models & Methods I
3 Credit Hours
This course will cover statistical models and analyses for count data and contingency tables, basic nonparametric methods including sign, rank-sum, and signed-ranks tests, simple linear regression model and inference, checking model assumptions, correlation analysis, one-way and two-way analysis of variance. Emphasis is on models, their application to data and interpretation. SAS will be used throughout the course.

BIOS 04232 Statistical Models & Methods II
3 Credit Hours
Factorial, nested, split-plot and repeated measures designs, multiple regression and variable selection, multiple comparisons, logistic regression, discriminant analysis, principal components and factor analysis, rates and proportions, introduction to survival analysis.

BIOS 04233 Introduction to Statistical and Machine Learning
3 Credit Hours
This course will provide an introduction to statistical learning. Core topics include variable selection, penalized linear regression such as lasso, dimension reduction including principal component analysis, flexible regression techniques including kernel smoothing/smoothing splines/generalized additive models/regression trees, support vector machine, clustering, and random forests. Other topics that can be covered include but are not limited to ridge regression, group lasso, fused lasso, adaptive lasso, SCAD, Bayesian lasso, Bayesian group lasso, Bayesian CART, BART, Neutral network, feature screening, graphical models, and quantile regression.

BIOS 04240 Statistical Inference I
3 Credit Hours
This course introduces fundamental concepts and theory in statistics. Topics cover set theory, random variables, distributions of random variables, transformation and expectations, exponential families, joint/marginal/conditional distributions for multiple random variables, random samples, and convergence concepts.

BIOS 04241 Statistical Inference II
3 Credit Hours
This course introduces advanced concepts and theory in probability and statistics. Topics cover the sufficiency and likelihood principles, methods of moments, maximum likelihood estimators, Bayes estimators, methods of evaluating estimators, likelihood ratio tests, Bayesian tests, most powerful tests, interval estimation, and asymptotic evaluations.

BIOS 04275 Applied Survival Analysis
3 Credit Hours
Basic parameters in survival studies; Censoring and truncation, Competing risks; Univariate estimation including the Kaplan-Meier and Nelson-Aalen estimator; tests comparing two or more populations, the log rank test; Semi-parametric regression, the Cox model; Aalens Additive hazards regression model; regression diagnostics.

BIOS 04285 Introduction to Bayesian Analysis
3 Credit Hours
This course introduces basic concepts and computational tools for Bayesian statistical methods. Topics covered include one and two sample inference, regression models and comparison of several populations with normal, dichotomous and count data.

BIOS 04295 Reading and Research
1-9 Credit Hours
The course of study for Reading and Research is designed by each student with his/her advisor to focus on readings in literature in the student's field, to build bibliographic resources for the dissertation, and to conduct supervised, independent research.

BIOS 04299 Master's Thesis
1-9 Credit Hours
Students in the Ph.D. degree program who cannot or elect not to complete that program may be allowed to transfer to the Master's program. This transfer must be approved by the student's advisor, the Program Director, the Chair, and the Graduate School. To transfer to the Master's Program, the student must be in good academic standing according to regulations established by the Graduate School.

BIOS 04313 Advanced Statistical Computing
3 Credit Hours
Numerical algorithms useful in biostatistics including likelihood maximization using the Newton-Raphson method, numerical integration using quadrature and Monte Carlo methods, interpolation using splines, random variate generation methods, the data augmentation algorithm, Markov chain Monte Carlo and the Metropolis-Hastings algorithm.

BIOS 04363 Advanced Statistics I
3 Credit Hours
This course covers both the theoretical framework and practical aspects of likelihood-based inference. Topics covered include main elements of likelihood inference, properties of likelihood, exponential families and generalized linear models, large sample properties of likelihood-based inference, likelihood-based regression models, generalized estimating equations, empirical likelihood, partial likelihood, observed data likelihood, and other likelihood related topics of a smaller scope. Over the duration of the course each student will prepare a report project on an assigned topic. This project will be presented in class in two parts. The first student presentation will be on theoretical aspects of the project (20 minutes during one of the regular sessions) and second presentation should describe its practical application (15 minutes on a separate session, a week before the final exam).

BIOS 04364 Advanced Statistics II
3 Credit Hours
A mathematically rigorous survey of selected topics in the theory of statistical inference such as sequential analysis, robust procedures, resampling plansjackknife and bootstrap, decision theory, minimax analysis and variance components.

BIOS 04365 Linear Models I
3 Credit Hours
Review of matrix algebra and vector spaces, multivariate normal distribution and quadratic forms, least squares estimation, testing nested models, weighted least squares, one-way ANOVA, testing contrasts, multiple comparison, partial and multiple correlation coefficients, polynomial regression, lack-of-fit tests.

BIOS 04384 Statistical Genetics
3 Credit Hours
Fundamental elements of mathematical and population genetics, and statistical theory of the methods of human genetic analysis. Topics include Hardy-Weinberg equilibrium, models for polygenic and multifactorial inheritance, variance components estimation familial aggregation, linkage and association analysis, disequilibrium mapping and ascertainment problems.

BIOS 04385 Advanced Bayesian Analysis
3.5 Credit Hours
A combination of Bayesian principles, tools and methods; emphasis is on models, computations and analysis. Likelihood function, prior, posterior and predictive distributions, Bayes factors, HPD regions, conjugate and noninformative priors in the exponential family, Markov chain Monte Carlo methods for the generalized linear model, hierarchical models, restricted parameter spaces and censored data, examples of Bayesian analyses of complex biomedical models.

BIOS 04386 Theory of Survival Analysis
3 Credit Hours
Analysis of survival data using counting process techniques. Topics include the mathematical theory of counting process, censoring and truncation, estimation of the survival and cumulative hazard functions, extensions of k sample nonparametric tests to censored and truncated data, proportional hazards and additive hazards regression models.

BIOS 04391 Special Topics
1–3 Credit Hours
This course focuses on topics of special interest in biostatistics.

BIOS 04399 Doctoral Dissertation
1–9 Credit Hours
This course is required for the completion of the PhD degree. The PhD candidate must submit a dissertation based on original research of a high scholarly standard that makes a significant contribution to knowledge in their chosen field.

BIOS 24150 Bioinformatics in Omics Analysis
3 Credit Hours
The course aims to introduce modern statistical and computational methods in high-throughput omics data analysis. The first half of the course focuses on fundamental statistical and computational methods applicable in different types of high-throughput omics data. The second half covers selected important topics in bioinformatics and aims to give students a systematic view of the omics data analysis. The goals of the course include: (1) to motivate students from quantitative fields into omics research (2) to familiarize students from biological fields with a deeper understanding of statistical methods (3) to promote inter-disciplinary collaboration atmosphere in class. Students are required to have a basic statistical training (i.e. elementary statistics courses, basic calculus, and linear algebra) and basic programming proficiency (R programming is required for homework and the final project).

BIOS 24160 Concepts in Probability and Statistics
3 Credit Hours
The course is designed for graduate students who have a background in statistics but would benefit from a review of the basic concepts in probability and statistics. Given that students entering the new MS program in Biostatistics may be diverse mathematical backgrounds, there is a need for a course which would provide them with necessary preparation for taking more advanced courses in statistics, both theoretical and applied.

BIOS 24297 Capstone Project
1–3 Credit Hours
The course is the culmination of the MS program in Biostatistics. Students will complete a project integrating their statistical analysis, data science, and application domain knowledge. The project results in a written report and presentation which will improve students' ability to communicate effectively about statistics and data science in written and oral form using both technical and nontechnical language. In addition, the project will enable students to expand their professional portfolio of coding samples, written reports and presentations.

Basic & Translational Science

BTSI 21150 Boundaries of Science and Medical Practice
1 Credit Hours
Translational Science will be explored through term-based learning with class discussion of assigned cases. At the end of the course, the students will describe and analyze the use of appropriate clinical and translational research techniques, evidence-based medicine and outcomes research methods; identify gaps between basic science knowledge and clinical practice for specific clinical questions pertinent to their area of research; propose the steps needed to apply basic science knowledge to outline possible experiments that are feasible and compliant with regulatory and ethical issues; and identify significant clinical questions/hypotheses that would benefit from translational research programs.

BTSI 21285 Independent Study
0.5–1 Credit Hours
Self-directed study course for students enrolled in the Basic & Translational Science (BTS) PhD Concentration. Involves completion of advisor-guided project. Advisors must be identified by student and approved by the Basic & Translational Science director. Course may be completed for .5-1 credits each semester. Course serves to complement and expand the current curriculum offered through the BTS PhD graduate concentration.

BTSI 21301 Basic and Translational Science Seminar
0.5 Credit Hours
The Basic and Translational Science Seminar is designed to help students develop skills to communicate translational scientific research across disciplines. It provides opportunities for students to network with experienced investigators and a forum to share and discuss research ideas. While attending this course, students will present their own research and provide feedback on the presentations of their peers. Clinicians and researchers from broad disciplines are encouraged to attend and provide feedback as well. Students present a small subset of their research that they are an expert in, such as the unique design of a study, an experimental approach, a solution to a barrier in research, or a novel finding. Presentations are designed to be interactive, with minimal slides and engagement from the audience. All students are required to present at least one seminar related to their own research.

Cell & Developmental Biology

CDBI 31002 Master's Thesis Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including thesis credits but have not yet completed the writing of the Thesis. Continuation status is limited to three consecutive terms following the completion of Thesis credits.

CDBI 31003 Doctoral Dissertation Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including dissertation credits but have not yet completed the writing of the Dissertation. Continuation status is limited to three consecutive terms following the completion of Dissertation credits.

CDBI 31140 Clinical Human Anatomy I
5 Credit Hours
The Clinical Human Anatomy course teaches students the structural and functional aspects of the human body. Students explore the macroscopic anatomy and three-dimensional relationships of organs, organ-systems, regions of the body, cross-sections and spaces. Learning experiences are reinforced with cadaveric dissection and a variety of imaging techniques - such as plain films (Xrays), CT, and MRI scans - that relate to clinical practice.

Aside from medical knowledge, the course nurtures teamwork, interpersonal and communication skills, and reinforces professionalism at all times.

CDBI 31141 Clinical Human Anatomy II
2 Credit Hours
The Clinical Human Anatomy course teaches students the structural and functional aspects of the human body. Students explore the macroscopic anatomy and three-dimensional relationships of organs, organ-systems, regions of the body, cross-sections and spaces. Learning experiences are reinforced with cadaveric dissection and a variety of imaging techniques - such as plain films (Xrays), CT, and MRI scans - that relate to clinical practice. Aside from medical knowledge, the course nurtures teamwork, interpersonal and communication skills, and reinforces professionalism at all times.

CDBI 31152 Human Development
1 Credit Hours
Normal and abnormal development of the human body is covered in course work that includes development of organ systems as well as experimental embryology and teratology. Graduate students prepare a paper on a selected topic in development.

CDBI 31153 Cell Tissue Biology
4 Credit Hours
Structural and functional organization of specific cells and subcellular components, tissues, and organs is presented. The student must learn to identify and describe microscopic structures and to understand their functional relationships with other tissues and organs.

CDBI 31154 Neurobiology of Pain
1 Credit Hours
This course will provide students with an overview of pain neurobiology. By the end of this course, students should be able to: 1. Describe the molecular mechanisms underlying noxious stimuli detection and transmission in the peripheral and central nervous systems. 2. Illustrate the peripheral and central anatomical circuits important for pain sensation and perception. 3. Easily and appropriately discuss concepts that are part of the pain basic science vernacular (e.g., "nociceptor" "gate theory", "wind up", "central sensitization") 4. Identify important questions that have yet to be answered in the field of pain basic science.

CDBI 31205 Integrated Neuroscience - Medical School
6 Credit Hours
Medical School Course. This course utilizes a multidisciplinary approach to present current knowledge about integrated structural and functional properties of the mammalian nervous system. Current knowledge of the mechanisms underlying the maintenance of such neural properties will be described at the molecular, cellular, and multicellular levels. In addition to lectures and laboratory sessions, selective clinical correlations will be presented to highlight known pathological mechanisms underlying certain neuronal disease states and to demonstrate modern diagnostic and therapeutic techniques currently in use in the clinic.

CDBI 31207 Introduction to Neuroscience
2 Credit Hours
This course provides an introduction to the neurosciences. A brief but integrated overview of neuroanatomy, neurophysiology and neurochemistry will be provided. The course consists of both lectures and laboratory exercises.

CDBI 31210 Advanced Clinical Human Anatomy
6 Credit Hours
Detailed study of the developmental aspects and adult structures of the human body, organized regionally. Regional specialization is flexible and according to the needs of the student.

CDBI 31257 The Biology of Vision
3 Credit Hours
This course covers core fundamentals in ocular biology and vision. Emphasis is placed on anatomy, pathology, and cellular function within the eye. In addition, visual processing within the central nervous system will also be presented. Core topics include: overall eye globe anatomy, development of neural and non-neural systems, basic retinal circuitry and physiology, phototransduction, cell biology of photoreceptor cells and the retinal pigment epithelium, central anatomy and higher order processing, energy metabolism in the visual system, emmetropization and myopia, aqueous humor physiology, glaucoma, photoreceptor diseases, and cornea biology.

CDBI 31262 Stem Cells in Disease and Development
1 Credit Hours
Integrated analysis of the contribution of developmental biology and stem biology to the study of childhood disease and development, is a course for advanced graduate students whose dissertation project focuses on understanding the molecular mechanisms underlying childhood disease through the use of stem cell and/or developmental biology. This course uses original literature as platform for discussing novel and High impact advanced made in stem cell and developmental biology. The aim is to encourage critical discussion of recent technical and conceptual advances in the field and to encourage the integration of such finding into the students' own research projects. Students will be graded on the extent and quality of their input into class discussions as well as through a series of short exams.

CDBI 31295 Reading and Research
1-9 Credit Hours
The course of study for Reading and Research is designed by each student with his/her advisor to focus on readings in literature in the student's field, to build bibliographic resources for the dissertation, and to conduct supervised, independent research.

CDBI 31298 Journal Club
1 Credit Hour
Critical reviews of current research topics.

CDBI 31299 Master's Thesis
1-9 Credit Hours
Students in the Ph.D. degree program who cannot or elect not to complete that program may be allowed to transfer to the Master's program. This transfer must be approved by the student's advisor, the Program Director, the Chair, and the Graduate School. To transfer to the Master's Program, the student must be in good academic standing according to regulations established by the Graduate School

CDBI 31301 Seminars in Cellular Biology
1 Credit Hours
This course consists of scholarly presentations on current topics in cellular biology and related areas by visiting professors, resident faculty, post-doctoral fellows, and graduate students. Attendance is required for all full-time Cell and Developmental Biology graduate students, except those with pre-approved relevant scholarly conflicts.

CDBI 31399 Doctoral Dissertation
1-9 Credit Hours
This course consists of scholarly presentations on current topics in cellular biology and related areas by visiting professors, resident faculty, post doctoral fellows, and graduate students. Attendance is required for all full-time Cell and Developmental Biology graduate students, except those with pre-approved relevant scholarly conflicts.

Clinical & Translational Science

CTSI 20002 Master's Thesis Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including thesis credits but have not yet completed the writing of the Thesis. Continuation status is limited to three consecutive terms following the completion of Thesis credits.

CTSI 20101 Introduction to Clinical and Translational Science
3 Credit Hours
The goal of this course is to help students understand the foundations of translational science, develop an understanding of the benefits and difficulties associated with translational research, and to understand and evaluate the role of interdisciplinary and team science in translational research. Coursework will include weekly reading of peer-reviewed manuscripts, assignments, and a final project. Weekly classes will include discussion of reading, and assignments are designed to allow practice of critically reading and planning translational science projects. The course will meet once per week for a total of 18 weeks.

CTSI 20151 Introduction to Epidemiology
3 Credit Hours
This course provides an introduction to the concepts, principles, and research methods specific to epidemiology. Students will learn about population health, how to select appropriate study designs for collecting evidence for medical practice, how to summarize evidence for medical practice and how to translate evidence into medical practice. By the end of the course, students should be able to apply the skills learned to assess the health of a population, describe determinants of health, and select an appropriate study design to evaluate population health. The course will meet once per week for a total of 18 weeks.

CTSI 20160 Foundations in Health Services Research
3 Credit Hours
The course will provide the student with a broad understanding of health services research design and methodology. By the end of the course, the student will be able to understand the key theories that serve as the foundation of health services research. Coursework will include weekly reading of two textbooks on the foundation of health services research and clinical research design, and key peer-reviewed manuscripts. Weekly classes will include discussion of reading and the final project will afford students the opportunity to learn how to and practice transforming a research idea into a NIH R03 level grant application.

CTSI 20220 Clinical Statistics I
3 Credit Hours
This is an introductory course in evidence discovery that demonstrates the concepts and application of statistical techniques/tools, given the role of statistics as an information science. The course is intended to inform and provide quantitative skills for graduate students interested in undertaking research in clinical medicine, epidemiology, public health, translational and biomedical sciences. This course emphasizes the basic dogma of statistics namely the central tendency theorem as well as sampling as the core of statistics. With the characterization of statistics as descriptive and inferential, the descriptive arm of statistics is stressed in this course namely summary statistics. Basic probability concepts are covered to stress the importance of sampling prior to reliable inference from the sample data. Sample estimation of the population and the precision (confidence interval) are described as well as the hypothesis testing notion in inferential statistics. The parametric and non-parametric methods are introduced with the intent to describe the methods as applicable to continuous (ratio, interval, cardinal) and discrete (categorical binary, dichotomous) data.

CTSI 20241 Translational Genomics
3 Credit Hours
The primary goal of this course is to teach students how to develop a research program to ask relevant genetic questions in the clinical setting utilizing the molecular genetics toolbox. To this end, students will be provided with background in molecular genetics strategies and study designs as well as an understanding of common genetics questions emanating from the clinic so that they will be better able to make connections between bench and bedside. In addition, they will be challenged to think creatively and through a translational focus during course-long case studies and group projects.

CTSI 20253 Methods in Grant Preparation
3 Credit Hours
The purpose and goal of this course is to present advanced principles of National Institutes of Health (NIH) Grant preparation. Topics to covered will include: Writing with a purpose and intent; writing statements of innovation and significance; research design; and translational research. The course will also address how to succinctly state overall and specific hypotheses and specific aims with affirmation and relevance. The course will suggest specific writing styles with the intent of clearly stating the importance of the specific aims, and bringing them to fruition and purpose. Special attention will be placed on how to write in a manner which presents proposal aims in an important and timely manner. The course will stress writing styles which relate distinct importance and purpose in a manner which relates novelty in the experimental design. Most of the course will cover the 12 page RO1 application. However, some time will also be devoted to other specific types of awards (i.e., mentored K awards, training grants, and programmatic initiatives). This course is recommended for individuals who have already located funding resources and are currently working on one or more grant proposals.

CTSI 20260 Introduction to Dissemination and Implementation Science
3 Credit Hours
The course is an introduction to dissemination and implementation and science research methods both theoretical and applied. By the end of the course the student will be able to understand the science of dissemination and implementation, and applied methods for dissemination and implementation. Coursework will include weekly reading of peer-reviewed manuscripts and one introductory textbooks on dissemination and implementation science. Weekly classes will include discussion of reading and course projects are designed to allow practice of critically reading and planning implementation research.

CTSI 20290 Research Elective
3 Credit Hours
Students will select a mentor of their choice and will develop a novel research study using either their mentor's data or publicly available data to answer their question. Mentors will be expected to guide students and to serve as a content expert to effectively provide feedback and ensure adequate scientific rigor is achieved for their projects. Course deliverables will include a publication ready manuscript to be submitted for publication at the end of the summer, and a scientific poster to be presented at MCW Research Day. Students will meet with their research mentor weekly and participate in weekly didactic learning sessions over the course of 9 weeks during the summer.

CTSI 20299 Master's Thesis
0.5-6 Credit Hours
A total of 6 Master's Thesis credits are required for program completion. All students will complete a master's thesis describing a translational or clinical research project in which he or she participated in both the design and execution. The Committee will be comprised of a thesis mentor and two additional faculty members (one of whom is a biostatistician). The Committee will approve the project in advance, will provide guidance and supervision of the project, and will critique and, if appropriate, approve the thesis.

CTSI 20302 Research Seminar
3 Credit Hours
The goal of this course is to provide Master's students protected time to develop their thesis questions and to provide students with an opportunity to receive feedback on their thesis project at regular intervals in a structured format. By the end of the course students will be able to develop a research question, conduct a comprehensive literature review, select appropriate methods to answer the research question, and present their findings in written and oral formats. This course will also teach students how to provide constructive criticism and to effectively evaluate the work of their peers. Coursework will include developing a systematic review, providing constructive critiques of the work of other students in the seminar, developing a PowerPoint presentation, and developing a scientific poster presentation. All students will be expected to provide feedback to their classmates and will receive feedback from their peers and the course director.

Genetic Counseling

GECO 40110 Bioethics in Precision Medicine
3 Credit Hours
This course will explore the historical, philosophical, rhetorical, and ethical foundations of precision medicine and analyze the bioethical issues raised by this new medical paradigm they manifest in a variety of clinical, biomedical, and health policy contexts.

GECO 40130 Prenatal Genetics
3 Credit Hours
In this course, students will be introduced to the various aspects of prenatal genetics including normal and abnormal pregnancy and fetal development. Students will become familiar with genetic testing and screening options that are used to investigate risk for genetic conditions in pregnancy and appropriate clinical applications of these tests. Using maternal, familial, and fetal factors, population data, and genetic screening and testing results, students will formulate personalized risk assessments. Topics such as infertility, pregnancy loss, termination, and other pregnancy management options will be explored. Students will appreciate the psychosocial elements specific to prenatal genetic counseling and continue to develop skills in presenting information in a balanced manner.

GECO 40140 Cancer Genomics
3 Credit Hours
This course will familiarize students with hereditary cancer syndromes and the underlying causes of cancer. The interdisciplinary care of cancer patients will also be explored through case-based study. Students will gain knowledge of various cancer risk assessment models and genetic testing options. Students will incorporate genetic test results with personal and family history information to create a personalized risk assessment for a variety of indications. Students will learn to appreciate different psycho-social considerations affecting families with cancer. This is a required course for MSGC program offered every Spring term for 1st year MSGC students.

GECO 40145 Medical Genomics
3 Credit Hours
This course aims to familiarize students with a medical genetics evaluation typical to what would be seen in the pediatric or adult genetics clinic. Students will appreciate the interprofessional collaboration required for the diagnosis and management of children and adults with complex disease. Students will be introduced to a plethora of genetic conditions spanning multiple disease categories. A differential diagnosis and genomic testing plan will be formulated using information gathered from thorough chart review, birth, family, and developmental histories, and the physical exam. Students will be able to determine the clinical significance of genetic testing results.

GECO 40150 Genetic Counseling I: Skills Practice
2 Credit Hours
Students will be introduced to the history and evolution of the genetic counseling profession. Students will be oriented to fundamental genetic counseling skills including pedigree construction, pedigree analysis, case preparation, contracting, documentation, and risk assessment. Students will begin to consider legal, ethical, social, and cultural issues related to genetic counseling and will be encourages to explore their own values and biases. Development and adaptation of oral and written communication skills to various audiences will be issues such as licensing, professional development and lifelong learning.

GECO 40155 Genetic Counseling II: Theory Practice
2 Credit Hours
This course prepares students to conduct a full genetic counseling session including case preparation facilitation of session components, and follow-up. Students will expand upon their interviewing skills, develop case conceptualization ability, and hone their patient education skills. Utilizing standardized patients and in-class clinically based role play, students will learn to recognize psychosocial aspects of the genetic counseling session and apply their developing counseling skills. Students will engage in course activities to develop further their communication abilities (oral and written), apply advanced risk assessment, and example professional boundaries. Students will have the opportunity to enhance personal skill development through giving and receiving feedback with peers and supervisors.

GECO 40156 Genetic Counseling III: Psychosocial Issues
2 Credit Hours
This course builds on Genetic Counseling 2: Theory and Practice by further exploring psychological aspects of the genetic counseling process. Students will learn to apply counseling theories in the development of their clinical communication skills. Students will learn to integrate client factors including cultural, socioeconomic, emotional, behavioral, disability, gender, and educational status into the genetic counseling session. Students will develop more advanced techniques to address the psychosocial impact of a genetic condition on the family, complex interpersonal dynamics, and unique issues that may occur in genetic counseling. Continued professional development will be emphasized by exploration of personal strengths, limitations, values, and biases as they relate to genetic counseling.

GECO 40157 Genetic Counseling IV: Advanced Topics
2 Credit Hours
This course will prepare students for life beyond the classroom with a focus on honing skills needed to become an independent successful genetic counselor. Students will develop an appreciation for the growth of the genetic counselling field and for life-long learning inherent in the profession. Discussion of current and emerging topics will put students in a position to become leaders in the field. As future practitioners in their communities, students will appreciate the scope and complex nature of health disparities and embrace cultural humility. In addition, students will also develop habits to build resilience necessary for personal growth and self-care.

GECO 40160 Research Methodologies
2 Credit Hours
This course is designed to build a foundation to help students formulate their research thesis topics. Students will learn about a variety of research methodologies, including quantitative and qualitative approaches. They will be exposed to various clinical and research informatic tools. Students will identify and critically review scientific literature, evaluate research hypotheses, identify various aspects of the research process, study design, data management and analysis. Throughout this course there will be an emphasis on conducting research responsibly, ethically, and with integrity. We will highlight various opportunities that genetic counselors have for research involvement. This introductory course aims to instill the value of research as it applies to the practice of genetic counseling, and its implications for the community.

GECO 40203 Molecules to Cells for Genetic Counselors
4 Credit Hours
This course is designed to provide students with necessary background knowledge in cell biology, molecular genetics, biochemistry, and embryology as it pertains to clinical genetics. There will be emphasis on the clinical relevance of these topics and how abnormalities in these cellular processes can lead to human disease. In addition, students will be introduced to different genetic and biochemical testing and screening options that are commonly used to diagnose genetic disorders.

GECO 40293 Clinical Practicum I
3 Credit Hours
The overall goal of clinical practicums is to develop genetic counseling skills, acquisition of the genetic counseling practice-based competencies, prepare students to enter the workforce, and be able to operate successfully in a variety of different roles and specialties. The clinical practicums will be facilitated by the Director of Fieldwork Training and will be based on curriculum schedule along with clinical supervisor and clinic schedule. Throughout the practicum, students will apply their knowledge in a supervised clinical setting and will participate in clinical cases. Clinical Practicum I consists of 16 total clinical days under supervision of a certified genetic counseling under a specific area of practice. Students may begin to document participatory cases in their logbook in this practicum. Students should demonstrate a beginning level of proficiency in as many domains as possible within the practice-based competencies as defined by the Accreditation Counseling for Genetic Counseling. These students will train in clinical settings in a developmental fashion to acquire

a set of skills to become competent in all aspects of genetic counseling. They will be expected to spend 8-hour days at clinical sites, unless other arrangements have been made or approved by clinical supervisors. The rotation is planned with the primary clinical supervisor. Students will receive formal evaluation throughout the practicum by their supervisors at 3 different time points throughout the rotation with their primary supervisors as well as the Director of Fieldwork Training. They will establish goals for each rotation and expectations alongside their clinical supervisor to help them attain growth towards the practice-based competencies. Students will also participate in various case conferences and tumor boards as part of their supplemental fieldwork experiences.

GECO 40294 Laboratory Foundations

3 Credit Hours

The purpose of the laboratory practicum is to introduce students to the many different types of tests involved in clinical as well as research genetics, to start to develop the skills necessary to understand and communicate genetic testing strategies and results, and to encourage students to think about the roles genetic counselors can play in the testing process. This practicum will function as a "rotation" with students moving through different experiences in small groups. The practicum will expose students to different molecular, cytogenic, and biochemical tests and help them develop an understanding for how these tests are performed and when they are appropriate. Students will have the opportunity to see how an individual sample moves from the point of collection through the laboratory and ultimately into a research or clinical report for several specific testing modalities, helping them to think about how to explain the testing process to patients, providers, and other audience.

GECO 40295 Genetic Counseling Clinical Practicum II

3 Credit Hours

The overall goal of clinical practicums is to develop genetic counseling skills, acquisition of the genetic counseling practice-based competencies, prepare students to enter the workforce, and build skills so students will be able to operate successfully in a variety of different roles and specialties. The clinical practicums will be facilitated by the Director of Fieldwork Training and will be based on curriculum and clinic schedule along with clinical supervisor availability. Throughout the practicum, students will apply their knowledge in a supervised clinical setting and will participate in clinical cases. Clinical Practicum II consists of 16 total clinic days under supervision of a certified genetic counselor within a specific area of practice. Students will continue to document participatory cases in their logbook and should demonstrate a beginning to intermediate level of proficiency in as many domains as possible within the practice-based competencies as defined by ACGC.

GECO 40296 Genetic Counseling Clinical Practicum III

3 Credit Hours

The overall goal of clinical practicums is to develop genetic counseling skills, acquisition of the genetic counseling practice-based competencies, prepare students to enter the workforce, and be able to operate successfully in a variety of different roles and specialties. The clinical practicums will be facilitated by the Director of Fieldwork and will be based on curriculum and clinic schedule along with clinical supervision availability. Through the practicum, students will be applying their knowledge in a supervised clinical setting and will

participate in clinical cases. Clinical Practicum III consists of 16 total clinical days under the supervision of a certified genetic counselor within a specific area of practice. Students will be documenting participatory cases in their logbook throughout the practicum. Students should demonstrate an intermediate level of proficiency in as many domains as possible within the practice-based competencies as defined by the ACGC.

GECO 40297 Genetic Counseling Clinical Practicum IV

3 Credit Hours

The overall goal of clinical practicums is to develop genetic counseling skills, acquisition of the genetic counseling practice-based competencies, prepare students to enter the workforce, and be able to operate successfully in a variety of different roles and specialties. The clinical practicums will be facilitated by the Director of Fieldwork and will be based on curriculum and clinic schedule along with clinical supervision availability. Through the practicum, students will be applying their knowledge in a supervised clinical setting and will participate in clinical cases. Clinical Practicum IV consists of 16 total clinical days under supervision of a certified genetic counselor within a specific area of practice. Students will be documenting participatory cases in their logbook throughout the practicum. Student should demonstrate an intermediate/advanced level of proficiency in as many domains as possible within the practice based competencies as defined by the ACGC.

GECO 40298 Genetic Counseling Clinical Practicum V

3 Credit Hours

The overall goal of clinical practicums is to develop genetic counseling skills, acquisition of the genetic counseling practice-based competencies, prepare students to enter the workforce, and be able to operate successfully in a variety of different roles and specialties. The clinical practicums will be facilitated by the Director of Fieldwork and will be based on curriculum and clinic schedule along with clinical supervision availability. Through the practicum, students will be applying their knowledge in a supervised clinical setting and will participate in clinical cases. Clinical Practicum V consists of 16 total clinical days under supervision of a certified genetic counselor within a specific area of practice. Students will be documenting participatory cases in their logbook throughout the practicum. Student should demonstrate an advanced level of proficiency in as many domains as possible within the practice-based competencies as defined by the ACGC.

GECO 40299 Genetic Counseling Research Thesis

1–3 Credit Hours

Thesis credits are required for program completion. The culminating experience for students in the MCW MS Genetic Counseling Program is a formal thesis research project focused on the practice of genetic counseling in which she or he participated in the design, execution, data analysis, and rite-up. Working on the research thesis allows students to develop skills that enhance intellectual development and critical, flexible thinking. Our research program is driven by the interests of the individual student and takes advantage of the wide variety of genomics initiatives across our MCW community and the state of Wisconsin. The timeline for the thesis project begins in the Fall of the first year in the Research Methodologies & Informatics course when students identify a research question they are interested in studying, complete a comprehensive literature review on the subject, and identify a thesis advisor(s). Continuation of the research process happens within this Research Thesis course throughout

the rest of the Program. Students will secure a Thesis Committee comprised of their primary thesis advisor (Committee Chair) and two additional faculty members. The Committee will approve the project in advance, will provide guidance and supervision of the project, and will critique and, approve the final thesis. Students present their results in local and regional forums, including the Genetic Counseling Colloquium in the final term of the Program near graduation, and are strongly encouraged to submit their findings as abstracts to regional or national conferences, and for publication.

GECO 40301 Genetic Counseling Seminar
1 Credit Hours
This course promotes lifelong education for the profession of genetic counselling through exposure to interdisciplinary events, engagement in community activities, and activities aimed at professional and personal development. Students will give effective presentations tailored to a variety of audiences. Students will identify community engagement opportunities to promote a deeper understanding of patient experience.

Global Health Equity

GLHE 29100 Community Health Needs Assessment
2 Credit Hours
Understanding the health needs of communities is central to the success of programs designed to address the most pertinent health challenges of vulnerable communities. Participants will get an understanding of why community health needs assessments are necessary. They will delve into the steps taken in designing, conducting and analyzing the findings of a health needs assessment, with a focus on rural communities in developing country settings. They will get insights on the types of data needed for a health needs assessment and the indicators used for this type of assessment in the context of rural communities in low income country settings. Participants will be introduced to concept of community participation and the approaches and tools used for such consultation. Some concepts and examples on how to co-create solutions with communities to address their health needs will be discussed.

GLHE 29110 Introduction to Chronic Diseases in Global Health
2 Credit Hours
This course will provide an introduction to chronic disease. The major groups of chronic diseases that will be discussed in this course include: cardiovascular disease, cerebrovascular disease, major forms of cancer, diseases of the respiratory tract, metabolic and digestive diseases, musculoskeletal diseases, and neurodegenerative diseases. Specifically, it will describe the major causes of chronic disease morbidity and mortality around the world, and how the risk of disease varies with regions. It will discuss major public health efforts to reduce disparities in chronic health around the world. Students will have the opportunity to develop country reports on specific chronic diseases, reports of global and public health efforts within those countries, as well as demonstrate the ability to identify opportunities for specific health interventions and create

evidence-based programs aimed at chronic diseases with a focus on cultural values, integration of community assets and resources.

GLHE 29160 Infectious Disease Epidemiology
2 Credit Hours
This course addresses the epidemiological, clinical, and practical issues important to the study of infectious diseases of public health significance. The epidemiology of selected infectious diseases commonly occurring nationally or internationally, or of potential use as a bioterrorism weapon, will be discussed in detail. Subjects discussed include; immunizations, microbiology tools for the epidemiologist, nosocomial infections, outbreak epidemiology and emerging infectious diseases.

GLHE 29165 Ethics in Qualitative Research
2 Credit Hours
This course examines ethical considerations beyond regulatory approval. Together, we assist in laying a foundation in ethical qualitative research practices as well as considering ethical treatment of special populations, and the development/evolution of one's own ethical stance.

GLHE 29219 Introduction to Global Health Equity
3 Credit Hours
The Centers for Disease Control and Prevention have reported that ten great public health achievements worldwide in the last decade have been their science and programmatic role in global health including the prevention of HIV/AIDS, tuberculosis control, access to safe water and sanitation, control of neglected tropical disease, reductions in child mortality, vaccines, malaria prevention and control, and tobacco control. In seeking to address and understand complex global health concerns, the MS GHE Program is uniquely positioned to enlist multidisciplinary faculty to present the world's burden of disease and propose solutions to decrease health disparities. A focused approach to local and global health issues adds value to public health professionals' roles. As the Unites States becomes increasingly more globally diverse, there is a growing need to understand and serve the global populations in our own neighborhoods and communities. By training our future public health professionals to be culturally sensitive and world thinkers they can better understand the unique distinctions each culture brings.

GLHE 29220 Statistics for Global Health
2 Credit Hours
This course will provide a foundation for statistical analysis in global health research using Stata software. First we will cover research design and data collection, including questionnaire design, sample selection, sampling weights and data cleaning. Second, we will emphasize the use of code or command files in Stata to ensure that students are taught how to write programs. Third, the students will learn how describe statistical results for technical and non-technical audiences. The students will be introduced to univariate, bivariate, logistic regression and linear regression analyses. The students learn to formulate a research question that addresses a sustainable developmental goal, analyze data using existing international data sets, and interpret the results. They will learn to present their results

to the scientific community as well as to local communities and will prepare a final research paper.

GLHE 29232 Interprofessional Foundations of Public Health Research Methods
3 Credit Hours
This interdisciplinary course integrates principles of basic epidemiology and research methodology with an emphasis on interprofessional education. Students from genetic counseling, public health, global health, and precision medicine will learn alongside one another, building collaborative skills while exploring various research methods used to improve population health. The course examines research methods and their applications including descriptive epidemiology, research ethics, literature reviews, study designs, and translating evidence into practice across disciplines. Students will engage with quantitative, qualitative, and mixed methods research methodologies, critically evaluate scientific literature, and practice effective scientific writing. Ethical and responsible conduct of research is emphasized throughout, with special consideration for how research findings can influence clinical practice, public health policy, and global health interventions.
Practical application is central to the course: students will gain hands-on experience accessing, analyzing, and communicating data to diverse audiences, while also developing the skills to design research studies and evaluate hypotheses. By fostering collaboration across disciplines, this course prepares students to translate evidence into action in ways that advance health equity, precision medicine, and community impact
both locally and globally.

GLHE 29235 Fragile Lives Understanding Vulnerability in Old Age
2 Credit Hours
In bioethics, vulnerability is a very important concept along with ethical principles such as autonomy, justice, beneficence, integrity, and dignity. The notion is an integral part of several international ethical and legal guidelines such as the Nuremberg Code and the Belmont report which aimed to protect the vulnerable from inhuman medical practices. Despite being at the heart of bioethical inquiry, the concept of vulnerability has no clear-cut definition. Vulnerable populations are generally believed to include (but are not limited to) minors, incapacitated adults, prisoners, institutionalized individuals, minorities, refugees, nomads, homeless persons, unemployed, poor persons, pregnant women, women, and older persons. This labeling approach to vulnerability has been strongly criticized in the bioethics literature for being broad and thus lacks discrimination of individual and situation differences.

GLHE 29236 Digital Storytelling for Public Health
1 Credit Hours
The translational aspects of Public Health sciences require creative approaches to stakeholder engagement, communication, and trust building. Digital storytelling has become recognized methodology to build relationships for community engagement as well as generate useful qualitative data. The latter are particularly useful for developing cultural context in health communication. This course will provide an overview of how indie filmmaking techniques can be used to efficiently produce digital stories. We will also present examples of how this process facilitates community (stakeholder) engagement for research projects.

GLHE 29237 Global Health Issues Moving From Evidence to Impact
3 Credit Hours
GLHE-29237 is a research-based, practice-oriented course that equips students with the mindsets and skillsets to transition from problem recognition to sustained action in global health, utilizing an intelligence-informed, evidence-to-impact approach inspired by Tom Frieden, M.D.'s (2025, MIT Press) "Formula for Better Health." Students identify priority global health issues, analyze quantitative and qualitative datasets and evidence, and evaluate existing policies, programs, and practices (also known as P-cubed or P3) using structured analytic frameworks that identify gaps, leverage points, and likely implementation barriers. Building on these assessments, they design practical advocacy and change strategies—clarifying needs and objectives, defining a concrete "ask," selecting targets and allies, crafting tailored messages based on research-based analytics, and sequencing tactics over time—aligned with key Formula components such as strong programs, data-driven management, and political commitment. The course emphasizes equity, ethics, and socio-behavioral power dynamics, encouraging students to acquire and integrate community perspectives, employ engaged/ participatory approaches, and incorporate a disparity-based harm reduction lens into their proposed solutions. Through applied projects, case and content discussions, and peer feedback, students produce real-world products such as advocacy briefs, campaign plans, and monitoring and evaluation dashboards and scorecards that demonstrate how rigorous analysis can be translated into effective P-cubed change strategies and beneficial outcomes in diverse global health settings.
There are no formal prerequisites for this course, except a strong interest in examining the major issues facing GHC leaders in depth. Students who have taken the GHE 29275 course or other similar courses on how to do research will find this elective course to be a complementary skillset builder.

GLHE 29238 Global Health Initiatives
2 Credit Hours
Global Health Initiatives (GHIs) such as the Global Fund to Fight AIDS,
Tuberculosis and Malaria (Global Fund), the President's Emergency Plan for AIDS Relief (PEPFAR), and the World Health Organization (WHO) among others, have been instrumental in the rapid acceleration of programs targeting specific diseases such as HIV, TB, malaria, malnutrition, maternal and child health in low- and middle-income countries (LMIC). At the same time, other non-communicable diseases such as cancer, mental health, substance use, diabetes and cardiovascular disease have been relatively neglected in LMICs, even as the global burden such diseases create is growing. Early GHIs were created in response to rapidly growing public health crises and were implemented in an emergency fashion. The urgency of implementing these early GHI's limited the extent to which their implementation was rigorously evaluated. However, some retrospective research has complained that early GHI efforts developed parallel health systems to those already established in the countries where GHI were being implemented. This was in some ways necessary due to deficiencies in health resources, but over time, it contributed to further weakening of health systems by drawing health personnel away from the national system to the better paid positions in GHI funded clinics and projects. More recently, GHIs have attempted to correct this by involving government health services in HIV prevention and treatment strategies and working with the civil sector, including grassroots organizations that serve key populations who belong to

marginalized groups. The purpose of this course is to critically examine the GHIs' roles in addressing public health emergencies and the effects of these efforts on the health care system and health of populations living in LMICs. The first part of the course provides an overview of the major political, financial, and social structural organizations involved in global health policy. These include international development and financial organizations and institutions, national governments, nongovernmental organizations rooted in civil society, and private sector entities. In the second half of the course students explore specific case studies in global health policy that illustrate policymaking and implementation successes and challenges.

GLHE 29239 Ethics and Global Health
3 Credit Hours
This course will be in the intersection between bioethics, global public health, and international biomedical research and practice. It will look at global health issues and their ethical challenges from the perspective of culturally diversity communities and their local experience related to health and health care. This course engages in a debate of the main ethical issues of clinical practices in health care and research institutions and health care actions in global health. It aims to provide students resources and practical skills to handle ethical dilemmas and lead decision making processes in clinical contexts, related to research with human subjects, healthcare delivery, and public health policies. To achieve this goal, this course is divided into two parts: First, it examines the foundational structures of bioethics, letting them to be challenged by pluralistic worldviews. Second, it discusses ethical dilemmas and concrete clinical situations in which students are challenged to lead decision-making processes in order to deal with moral stress and to address ethical dilemmas, at the same time that high ethical standards are considered. In addition, participants will be exposed to firsthand data from ethnographic and participatory action research in global health, and challenged to read authors that show especial consideration for the voices and experiences of vulnerable and historical marginalized populations.

GLHE 29240 Multicultural Mental Health Guidelines for Working with First Nations Persons
3 Credit Hours
This course is designed to familiarize students with essential, and largely Pan-cultural information about the mental health issues facing the First Nations populations of North America. First Nations persons include those also generally referred to as American Indians, Alaska Natives, and Native American Indians. Demographic, historical, sociopolitical, and inter- and intra-ethnic contexts critical to understanding the First Nations will be addressed. Specific knowledge constructs such as historical context, identity formation, acculturation, enculturation, language, family and community values, religion and spirituality. Traditional beliefs about health and illness, gender role socialization, and social class are emphasized. Attention will be given to contemporary issues facing the First Nations that influence service delivery and the receipt of care. Culturally relevant interventions are presented.

GLHE 29242 Planetary Health
3 Credit Hours

This interdisciplinary course explores the emerging field of Planetary Health, which examines the interdependent relationships between human health, civilization, and the natural systems that sustain life. Students will investigate environmental changes, theoretical framesworks, and global health impacts, crtically analyzing how climate disruption, biodiversity loss, and social inequities intersect to shape health and outcomes and resilience. Through thematic content in planetary health foundsations, environmental degradation and displacement, food, and farming, the health sector, and systems change, the course prepares future public health professionals to lead sustainable and equitable health initiatives in a rapidly changing world.

GLHE 29245 Health and Forced Migration
2 Credit Hours
Introduction to displaced populations and refugee health with special attention to: vulnerable populations; the intersection of human rights, health policy, and health systems; and the health consequences of forced migration. This course will describe some aspects of the causes for populations to flee their homelands, common ways refugee camps are set up and structured, frequently seen health effects of displaced populations, the vulnerable sub-groups within displaced populations, and the legal and ethical challenges of the displaced. This course is suitable to anyone interested in the effects of forced migration on global health.

GLHE 29250 How to Build Health Research Partnerships with Native American Communities
2 Credit Hours
Working with Native American communities to conduct health research presents unique challenges. Many of these challenges align with community-based participatory research principles. However, the unique socio-political context of Native American tribal groups requires that health professionals reach beyond standards best practices. This course will provide the contextual information to navigate cultural competency, historical distrust, and government-to-government policy necessary to build durable health research partnerships with Native American Groups.

GLHE 29275 Global Health Consulting and Research
3 Credit Hours
This course is an applied, project-focused, "real-world" overview for individuals in healthcare consulting. Healthcare consultants, whether in professional services firms (PSFs), post-secondary institutions or hybrid organizations conduct a full range of field research methods, practices, processes for examining complex, global health equity-related phenomena for various clients. Students will learn about planning, executing, and evaluating research that is applicable to advising with respect to relevant needs to help organizations serve their stakeholders more effectively, efficiently, and efficaciously. Special attention will be paid to newer research models that utilize innovations and emerging technologies to support the researcher in investigating equity-related questions and needs.

GLHE 29279 Internship Preparation Cultural and Ethical Global Engagement
1 Credit Hours

Experiences in global health have proven to be invaluable in shaping the interests and careers of students. Participation in global health educational and research activities is associated with increased likelihood of addressing health disparities and the social determinants of health. However, there are also potential pitfalls associated with sending students to research arenas in which they are unfamiliar- processes are different, the resources available for research may be limited, there are language and cultural barriers, and students face safety issues pertaining to travel and occupational exposures. This type of experience is a means for professionals-in-training to learn important lessons about health disparities and cultural diversity. This course will provide a step by step guide to prepare students for a successful internship.

GLHE 29280 Career Development
1 Credit Hours
The goal of the Career Development course is to increase your skills and readiness for the next step in student's professional development, whether that is medical school, other professional degree programs, or a career after graduation. To achieve this goal, students will be working with their peers, current medical and graduate students, and a diverse range of faculty to write an application cycle calendar, personal statement, and CV/resume, and to execute individual and group mock interviews.

GLHE 29290 Global Health Equity Internship
2 Credit Hours
Completion of a global health internship is a required component of the MS Global Health Equity program. The internship is an applied experience where students will collaborate with a global health organization in a specific geographical setting to complete a small project, program evaluation, or other educational or research activity. The primary purpose of completing an academic internship is to better understand the theories, ideas, and practices of global and public health by actively engaging in a hands-on, experiential learning experience. An internship will augment the student's classroom learning and offer an opportunity and environment in which to learn. At the end of the internship, students will prepare a digital story of their learning outcomes and present it to program staff, faculty, internship partners, and stakeholders.

GLHE 29295 Readings and Research
1-2 Credit Hours
This is an independent study course; the student is to independently conduct research in their chosen thesis topic. The number of credits selected by the students determines the number of hours per week that must be dedicated to working on the Readings and Research Plan. The student is responsible for finding a faculty member who is willing to work with the student; together they will establish learning goals, deliverables, resources, timeline, and mechanism for feedback.

GLHE 29299 Thesis Work
1–6 Credit Hours

Thesis work is a required component of the MS in Global Health Equity Program. It is a planned, supervised, and evaluated practical experience designed to enhance and complement the educational training. Students are encouraged to choose a thesis placement that aligns with their career interests.

GLHE 29325 Global Maternal and Child Health
2 Credit Hours
Global Maternal and Child health is an essential elective to the MS Global Health Equity program as maternal and child health is a large field in which many students have interest in pursuing as a career. The course instructor has specific expertise in this field and will provide as well rounded perspective of global maternal and child health issues. The current curriculum does not offer a course on this topic, this course is an essential addition to the program.

Graduate School

GRAD 00295 Scientific Exploration
1–9 Credit Hours
Scientific Exploration

GRAD 01000 Developing Soft Skills
1 Credit Hours
Have you ever heard the terms 'soft skills', 'hard skills', 'transferable skills'? Do you know these skills are necessary to obtain a job after you graduate? If not, don't panic! This course can help. This course is designed to help you identify the types of skills required to be competitive in today's job market. You will learn what skills are most desirable to hiring managers across a spectrum of employment sectors such as academia, industry, government, and for- and not-for-profit industries. The specific soft skills covered include: communication (speech, written, on-line, mentoring management and leadership (teamwork, project and time management, personnel management and leadership styles and professionalism and wellness (conflict and feedback, professionalism in the workplace, your personal well-being). The course will meet in person during the summer semester for 1 hour per week, for a total of 11 weeks. An additional 1 hour per week will be required for the student to accomplish pre-work, readings and assignments. Classes will be taught by the course directors, and instructors from MCW and other institutions. This course will be didactic and conversational. We will strive to deliver content in an engaging way. Those registered for the course should be prepared to actively participate in large and small group settings.

Healthcare Technologies Management

HCTM 14200 Survey of Biomedical Engineering Technology
3 Credit Hours
This course is a review of biomedical technologies employed in medicine for the diagnosis, treatment and prevention of chronic and acute diseases. The goal of the course is to familiarize students with the operating principles, economic aspects of technology use in clinical practice. Over the duration of the course each student will prepare three reports and one lecture on the use of technology in medicine.

HCTM 14211 Biomedical Technology Standards and Regulations
2 Credit Hours
An overview of standards and regulations that impact on the development, acquisition, and management of health care technologies.

HCTM 14212 Ethics of Technology Utilization
1.5 Credit Hours
Ethics applied to the utilization and management of health-care technologies in a patient-care setting, including topics such as beneficence, nonmaleficence, quality-cost, resource allocation and personal-public conflicts, technology diffusion models and controls, clinical research and research integrity, and patient rights and confidentiality.

HCTM 14230 Product Development of Medical Devices
2 Credit Hours
Activities required for the design, development, and commercialization of new medical devices. Design, testing, regulatory, and legal requirements will be presented along with project evaluation and management methods. Issues involving management of the product development process will be discussed.

HCTM 14298 Special Topics for Healthcare Technologies Management
0.5 Credit Hours
Special Topics for Healthcare Technologies Management

Interdisciplinary Biomedical Sciences

INBS 16205 Introduction to Biomedical Research V
1 Credit Hours
This course evaluates the student commitment to the laboratory rotation, submission of the written report, and overall professionalism within the program.

INBS 16206 Introduction to Biomedical Research VI
1 Credit Hours
This course evaluates the student commitment to the laboratory rotation, submission of the written report, and overall professionalism within the program.

INBS 16210 Introduction to Biomedical Research
1–9 Credit Hours

This course includes an IDP Onboarding Program consisting of 3-week introductory sessions and visits to the constituent programs, as well as three 5-week lab rotations with potential faculty mentors in the fall term. Additional 1-3, 5-week rotations with potential mentors will continue in the spring term.

INBS 16215 Foundations in Biomedical Sciences I
3 Credit Hours
This new course will be a didactic based course that will provide the background for understanding the biochemical basis of life. Students will learn about thermodynamic principles that drive biochemical and enzymatic reactions, protein structure and protein dynamics and the thermodynamic principles that define these structures and their interactions with other biomolecules, the principles that define their functional activities and then an application of this knowledge to an understanding of metabolic pathways. Students will also learn how foundational biochemical principles apply to certain physiological settings in health and disease and how pharmacological intervention can modulate physiological responses. The format of the course involves lectures and review sessions which are designed to promote class discussion of the relevant material.

INBS 16216 Foundations in Biomedical Sciences II
3 Credit Hours
This is an interdisciplinary course that provides students with a foundation in the areas of gene expression, and basic and contemporary cell biology. The material is primarily presented in lecture format, but significant number of discussion sections and data interpretation discussions are also included. Students are expected to gain fundamental knowledge in the areas of gene regulation, translational and posttranslational control and cellular architecture.

INBS 16217 Foundations in Biomedical Sciences III
3 Credit Hours
Module III builds on the cell biology fundamentals introduced in the latter part of Modules I and II. This course starts with three lectures on cell signaling and a discussion of a primary research article on the topic. This forms the basis of Exam 1. The second part focuses on proteins specialized for ion flux and transport. Themes are exemplified by case studies on several diseases that affect either epithelial transport or excitable cells. Exam 2 captures this material. The third and last part of the course focuses on DNA homeostasis, genetic principals, and the basis of stem cells and cancer. Exam 3 closes out the Fall semester.

INBS 16218 Foundations in Biomedical Sciences IV
3 Credit Hours
This course is designed to give students fundamental introductory concepts impacting the fields of Microbiology and Immunology, Neurobiology and Pharmacology in three modules. Topics were selected and the three modules integrated based on the essential concept that human biological responses and development are shaped by chemical cues. The impact on human biology from contact or colonization with microorganisms and the innate and adaptive immune responses to contact are discussed in the first module. Module 2 focuses on the physiological aspects of how signals are perceived and interpreted by the human nervous system. Module 3 communicates fundamental aspects of pharmacology,

emphasizing the molecular and cellular levels of signaling and signal transduction. Each session was designed to incorporate current analytical methods, computational and statistical aspects of data analysis and clinical or practical impacts on human health and disease.

INBS 16242 Techniques in Molecular Cell Biology

2 Credit Hours

The primary objective for this course is to provide information and conceptual knowledge of a number of the most common techniques required for biomedical research. The information presented in this course should facilitate comprehension of the scientific literature and introduce procedures that students will commonly use in their research projects. The lecture materials will present the theory behind each technique, the practical limitations of each technique and the questions that each technique addresses. Additional lectures will assist the student in using bioinformatics and biostatistics methods and in preparing results for publication. The course emphasizes the following core competencies: biomedical knowledge of a variety of commonly used research techniques, research skills through understanding published literature and experimental design, critical and creative thinking through the ability to judge information in the literature related to the techniques covered, interpersonal and communication skills through class participation and discussion and written exams, professionalism by interacting respectively with others in the class, arriving to class on time and being prepared to participate, and lifelong learning by developing new learning and independent thinking skills.

INBS 16245 Statistics for Basic Sciences

1 Credit Hours

This is a course designed for graduate students preparing for research in laboratory and experimental sciences. It focuses on descriptive statistics, elements of probability theory, estimation, tests of hypotheses, methods of categorical data tabulation and analysis. After completion of the course, students should be able to develop an appropriate study plan to explore a biomedical research question and execute simple statistical analysis of the data collected in a study. Emphasis is on understanding concepts, learning to apply statistical techniques, and getting familiar with statistical software. Students will also learn how to read, interpret, and critically evaluate statistical concepts in the literature.

INBS 16265 Introduction to Organ Systems Physiology

2 Credit Hours

Organ Systems Physiology is a first year elective course that focuses on the classic topics in physiology - the science of regulation and control systems - including the Physiology of the Cell, Muscle, Cardiovascular, Pulmonary, Renal, GI, Endocrine, and Reproduction. It will also introduce the students to animal models in physiological research appropriate for the topic at hand. It will follow and build on the planned new first year first semester Graduate School course that will run from August-February. The course will be comprised of (1) formal lectures by Dr. Raff, (2) formal lectures by senior graduate students and post-doctoral fellows who (a) volunteer to teach with permission from their PI and (b) are auditioned by Dr. Raff to ensure high quality, and (3) Journal Club in which the students will present and discuss journal articles using animal models in physiology. The course will meet twice a week (1.5 hrs/session; 3 hrs/week) for a total of 12 weeks.

INBS 16266 Bacterial Diversity the Microbiome
1 Credit Hour
This interdisciplinary course will provide students with a solid foundation in the molecular and physiological basis of bacterial diversity with a particular focus on those organisms that comprise the gut microflora. The interaction between bacteria and viruses or phages will also be highlighted. The course will be paper with chalk-talk style discussion sessions designed to promote discussion of the literature.

INBS 16267 Protein Chemistry Applications
1 Credit Hours
Protein Chemistry Applications is a course suitable for all students interested in developing critical thinking skills through literature examples of protein activity and its regulation. Students and instructors will discuss literature that illustrates the in vitro reconstitutions, proteins structure/activity, and methods and logic of experimental design including critical control experiments. In addition, the discussions will include methods learned in the first-year curriculum that might have been applied but were not. From these analyses, students will hone their critical thinking and communication skills. Grading for this course will be based on 100 total points: 48 pts for classroom participation (metric attached) and 52 pts for a student-directed presentations/discussions (metric attached). At least three instructors will be involved in the grading of final presentations and the final score to be an average of each instructor's total score. The course will be capped at a maximum of 12 students; a minimum of 4 students will be required to offer this course. Instructors for this course will include current faculty members participating in the Biochemistry Graduate Program. The course will be offered every Spring semester. An overarching goal of the course is to prepare students for understanding the methods and logic underlying experimental design in modern biomedical research.

INBS 16268 Protein Chemistry Principles
1 Credit Hours
Protein Chemistry Principles is a course suitable for all students interested in developing critical thinking skills through literature examples of protein activity and its regulation. In this course, students and instructors will use the primary literature to learn and apply the practical formalisms in protein chemistry – including thermodynamics, kinetics, enzymology, and chemical biology – to the regulation of protein activity. Biology is governed by thermodynamic and kinetic principles, but these principles are often abstract to students. The purpose of this course is for students to develop utility in thermodynamic and kinetic principles and apply them to biological systems. The course will emphasize literature examples and expect students to learn these principles by working through problem sets provided by instructors. Students will be able to differentiate when thermodynamics or kinetics likely govern a given biological system and have a framework by which to analyze new systems. In addition, classroom discussions will include alternative methods and their relative merits. From these analyses, students will hone their critical thinking and communication skills. Grading for this course will be based on 225 total points: 90 pts for one in-class 90 min exam (90 pts, 10pts/lecture, 40% of grade), 90 pts for a student-directed presentations/discussions (metric attached, 40% of grade), and 45 pts on overall student participation in instructor-led discussion sessions (metric attached, 20% of grade). The course

will be capped at a maximum of 12 students; a minimum of 4 students will be required to offer this course. Instructors for this course will include current faculty members participating in the Biochemistry Graduate Program. The course will be offered every Spring semester. An overarching goal of the course is to prepare students for understanding the methods and logic underlying experimental design in modern biomedical research.

INBS 16269 Basic Immunology
1 Credit Hours
The purpose of this course is to introduce basic concepts in immunology through lectures, readings from texts, and current journals. The course is geared toward students interested in contemporary concepts of cellular and molecular immunology. The course has been designed to integrate fundamental concepts in immunology with the goal of students being able to understand and critically evaluate the complex nature of immune interactions and immune dysfunction regardless of their specific research focus. The participating faculty are from diverse backgrounds with unique expertise. Students will learn fundamental concepts in immunology with topics including innate and adaptive immunity, the cellular basis of the immune response, antigens presentation and antibodies, molecular basis for generating immunologic diversity, and regulation of immune responses. In the final block of the course, students will integrate their knowledge of the immune system and apply it to disease. This course is mutually exclusive with INBS 16270 - students that complete INBS 16269 will be unable to enroll in INBS 16270 because the content overlaps between the courses.

INBS 16270 Integrated Microbiology and Immunology
3 Credit Hours
The purpose of this course is to introduce basic and integrated concepts in immunology and cellular microbiology through lectures, readings from texts and current journals. The course is geared toward students matriculating into the Microbiology and Immunology (MI) Graduate Program as well as any student interested in contemporary concepts of cellular microbiology, immunology, and host-pathogen interactions. The course has been designed to integrate fundamental concepts in immunology and microbiology with the goal of students being able to understand and critically evaluate the complex nature of host-pathogen interactions and immune dysfunction regardless of their specific research focus. Students will learn fundamental concepts in immunology and gain an appreciation of the basic properties of bacteria and virus structure, replication, and pathogenesis. In the final block of the course, students will integrate their knowledge of pathogens and the immune system. This course is mutually exclusive with INBS 16269 - students that complete INBS 16270 will be unable to enroll in INBS 16269 because the content overlaps between the courses.

INBS 16272 Graduate Neuroanatomy
0.5 Credit Hours
Graduate Neuroanatomy is a lab-based course intended to accompany MCW Course 12212A.: Fundamentals of Neuroscience. The purpose of this course is to introduce 1st year PhD students to the anatomy of the human nervous system.

INBS 16273 Advanced Cell Biology
3 Credit Hours

Advanced Cell Biology is an upper level, 3-credit hour cell biology course that focuses on a variety of advanced topics in contemporary Cell Biology. Students will gain an in depth understanding of specific selected topics through the use of a variety of resources including web-based webinars and podcasts, detailed in-class discussion of papers from the scientific literature and through preparation and presentation of a lecture on a cell biological topic directly relevant to the student's own research interests. Lectures by faculty will be minimized.

INBS 16274 Metabolism

1 Credit Hours

This new elective course will be mailnly a didactic based course that will comprehensively review subjective important to metabolism. the topics coverd will range from carbohydrate metabolism to oxidative phosphorhlation to lipid and amino acid metabolish. There will be a strong focus of these topics in health and disease, especially as they related to the cardiovascular system, cancer, diabetes and immune system function. The depth of coverage within each topic will not necessarily be comprehensive, but there may be a few aspects of each topic that will be able highlighted by focusing on landmark studies or recent developments from published research articles. Although there will be a specific assignment textbook, students will be encouraged to read relevant chapters from Fundamentals of Biochemistry. Professors will also have the option to provide a specific reading list from either the Fundamentals Textbook, original scientific papers and/or review articles required for reading.

INBS 16275 Understanding Cell Signaling Through Therapeutic Drugs

2 Credit Hours

This course will present advanced concepts in cellular signaling by analyzing the signaling niechanisnis responsible for the therapeutic benefit, unanticipated toxicity, and limited effectiveness of particularly well-known drugs that target specific signal transduction pathways. The topics are designed to promote an enhanced understanding of the complexities of multiple signaling pathways, and a sophisticated appreciation of how these pathways are integrated to produce cellular responses. The course has a translational emphasis by focusing on the multiple molecular actions of current FDA-approved drugs, as well as discontinued drugs that are removed from the market due to unanticipated toxicity or limited effectiveness. Lectures presented by the instructors will provide an in-depth overview of different signaling pathways, and manuscript discussions will promote additional advanced analysis that will creatively engage the students.

INBS 16276 Developmental and Stem Cell Biology

3 Credit Hours

The course provides a detailed introduction to Developmental and Stem Cell Biology. The course uses an advanced graduate style format including lectures, in-class paper discussions, and departmental seminars from experts in the field. Students will prepare and present a lecture on a developmental and stem cell biology topic directly relevant to each student's own research interests. Students will also provide feedback to their peers in the form of brief critiques of individual presentations.

INBS 16278 Functional Genomics

3 Credit Hours
This course will use a variety of didactic lecture, paper discussions, and hands on bioinformatics learning to provide students with fundamentals in genomics, transcriptomics, proteomics, genetic manipulation, epigenetics, protein modeling and molecular simulation. Theory, practical applications, and analysis methods will be taught.

INBS 16290 Professional Development I
1 Credit Hours
Emphasis in this course will be placed on oral and written communication, critical literature review, and responsible conduct in research. Students will learn good practices for peer review, and perform interactive exercises to review each others' work.

INBS 16291 Professional Development II
1 Credit Hours
Professional Development follows a multidisciplinary approach to promote individual career development in the biomedical sciences. The course includes lectures, discussion, sessions, seminars, and hands-on activities. Topics of particular emphasis are oral and written communication and rigor and ethics in scientific research.

INBS 16292 Writing a Scientific Paper
1 Credit Hours
This course will present a step-by-step approach to putting together a scientific paper. Students will be divided into groups of 3, and these groups will stay together for the duration of the course. Each group will be given an identical set of data with which to compose a manuscript. Each week, a different aspect of paper writing will be discussed, and students will be given a take home assignment to write that particular component of the paper within the small groups. In the final week of the class, the finished papers will be peer reviewed by 2 other groups and a member of the faculty. The course will be graded on attendance, successful and timely completion of the assignments and evaluation of the final manuscript.

INBS 16293 Writing an Individual Fellowship
2 Credit Hours
This course provides a systematic approach towards writing a F31-like individual research fellowship. Topics include the organization of the NIH, how the NIH invites investigators to submit applications to support their doctoral studies, how PhD trainees and their mentors respond to these invitations, and how the NIH reviews a fellowship application. A weekly didactic session will be presented to the entire group of students who will have weekly individual writing assignments to complete and will have a weekly small group session to share their progress towards the completion of their writing assignments. Each student will identify a mentor-approved research topic that will be developed into a fellowship proposal, emphasizing the writing of a Summary, Specific Aims Page, and Research Plan as outlined in PA-19-195 and SF-424(F). Writing a Scientific Paper (16-292) is a prerequisite for this course.

INBS 16295 Preliminary Reading and Research
3 Credit Hours

IDP Reading and research in the laboratory with your declared dissertation mentor.

Microbiology & Immunology

MIIM 25002 Master's Thesis Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including thesis credits but have not yet completed the writing of the Thesis. Continuation status is limited to three consecutive terms following the completion of Thesis credits. Prerequisite: Master's Thesis 25299

MIIM 25003 Doctoral Dissertation Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including dissertation credits but have not yet completed the writing of the Dissertation. Continuation status is limited to three consecutive terms following the completion of Dissertation credits. Prerequisite: Dissertation 25399

MIIM 25202 General Microbiology
5 Credit Hours
The content of this course is identical to that of 05201 without the laboratory portion. This comprehensive course covers the fundamental principles of microbiology, including the subdisciplines of immunology, virology, bacteriology, microbial genetics, mycology, and parasitology. The student is expected to acquire an understanding of the pathogenic properties of disease organisms, their physiology, and their structure. The student should be able to relate this information to the actions of antimicrobial agents and to immunological responses that contribute to disease.

MIIM 25210 Principles of Laboratory Animal Science
1 Credit Hours
A one-credit hour course surveying the issues fundamental to the successful use and care of animals in biomedical research. Students will gain knowledge of an array of core topics in laboratory animal science, including: understanding and navigating ethical and regulatory frameworks in which animal research occurs; basic biology and care of common laboratory species; managing rodent breeding colonies; contemporary issues in laboratory rodent genetics; important sources of non-experimental variables in animals research, including nutrition, microbial status, and pain; strategies for minimizing pain and distress in animal subjects; and basic techniques in laboratory rodent handling and restraint.

MIIM 25230 Current Topics in Microbiology and Immunology
2 Credit Hours

This advanced course consists of introductory lectures on a selected topic followed by in-depth discussions of original research articles on topics such as bacterial invasion, virulence factors, immune evasion, virus-host interactions, T-cell functions, and viral regulatory proteins.

MIIM 25236 Cellular Microbiology
3 Credit Hours
This course, offered in alternating years, explores contemporary concepts of cellular microbiology and microbial/viral pathogenesis through a series of formal lectures and discussions of original research articles. The emphasis is on host/pathogen relationships and the interface between bacterial or viral infection and the molecular biology of eucaryotic cells. Students will gain an appreciation of the basic properties of bacterial and viral pathogens, the processes leading to acute and chronic infections,the strategies that these agents utilize to enter and traffic through cells, and how these agents exploit host cell mechanisms to regulate gene expression and genomic replication.

MIIM 25251 Advance Molecular Genetics
3 Credit Hours
Specific topics in molecular genetics are explored through a combination of lectures and sessions in which research papers are presented and critically evaluated. Emphasis is placed on developing the ability to critically read and evaluate experimental results from original research papers. Specific topics for this course, which vary from one year to the next, include: cancer genetics, gene therapy, meiotic recombination, and DNA repair.

MIIM 25259 Mucosal Immunology
1 Credit Hours
This focused immunology course on the mucosal immune system introduces students to advanced concepts and biomedical research relevant to human health and disease at the mucosal surface.

MIIM 25260 Mucosal Pathogenesis
1 Credit Hours
Mucosal Pathogenesis is an upper-level, 1 -credit hour Microbiology course that focuses on the interactions of microbial pathogens with cells of the mucosal epithelium. Students will gain a detailed and comprehensive understanding of specific infectious microbial pathogens, and the mechanisms utilized by these microorganisms to associate, invade, and/or cause disease at the mucosal surface. Microorganisms to be discussed include those that target the respiratory tract, the gastrointestinal tract, and the genital/urinary tract. The course will comprise a combination of formal lectures by instructors, and group discussions of scientific papers from the recent literature. Students will be evaluated through a single take-home exam the comprises 80% of the final grade. The remaining 20% of the final grade will be determined by student participation in lecture discussions or assigned readings. The course will meet twice a week for a total of 6 weeks.

MIIM 25261 Bacterial Toxin Mucosal Cell Interactions
1 Credit Hours

Bacterial Toxin-Mucosal Cell Interactions is a 1 credit hour upper-level Microbiology course that addresses the interactions between bacterial toxins and mucosal cells. The goal of this course is to provide students an appreciation of how bacterial toxins that target mucosal cells function as virulence factors and are utilized as vaccines and for clinical therapies. The course format will meet for 6 weeks during the third block of the fall semester (weeks 13-18). Cellular and Molecular Immunology (05-234) or Cellular Microbiology (05-236) are a prerequisite for this course.

MIIM 25262 Tumor Immunology

1 Credit Hours

Tumor Immunology is an upper-level, 1-credit hour Microbiology/immunology course that will focus on the interactions of tumor cells with various components of the immune system. These interactions are complex, and immune-based strategies for treating cancer have had limited success in the clinic. This course will examine the following:(a) how the immune recognizes tumor cells as foreign, (b) immune strategies for targeting cancer, (c) barriers to achieving effective tumor immunity, (d) monitoring the immune response to cancer, and (e) use of animal models to study the interactions between tumor cells and the immune system. The goals of the course will be to gain an in-depth understanding of the complex interactions between tumor cells and the immune system, and to learn how animal models can be used to better understand these interactions. While the course will be heavily weighted towards the discussion of important papers in the field of Tumor Immunology, it will also involve didactic lectures. Students will be evaluated through attendance and participation (30% of final grade) and a final exam (70% of final grade). The course will meet twice a week for a total of 6 weeks.

MIIM 25263 Signaling in the Immune System

1 Credit Hours

Signaling in the Immune System is an upper-level, 1-credit hour Microbiology course that focuses on how cell signaling processes shape and determine the activity of the immune system. Topics to be discussed include how cell signaling modulates cell development, antigen recognition, cell activation and migration. The course will consist of formal lectures by instructor and group discussions from scientific papers. Students will be evaluated by a single closed-book exam (60% of final grade). The final 40% of the student's grade is determined by attendance and active participation in group discussions.

MIIM 25265 Immunological Tolerance

1 Credit Hours

Immunological Tolerance is an upper-level 1 credit hour Microbiology & Molecular Genetics course that focuses on the multiple mechanisms responsible for maintaining self-tolerance. Failure of self-tolerance results in autoimmune diseases that can affect every organ system of the human body. Conversely, the induction of self-tolerance may also be exploited for therapeutic purposes. In this mini-course, we will consider the general features and mechanisms of self-tolerance in T cells and B cells. These mechanisms include (1) anergy, (2) deletion by apoptosis, and (3) suppression by regulatory T cells. In addition, this course will consider selecting models of autoimmunity that have proven to be effective tools in our effort to understand tolerance as a complex biological process. In addition to formal lectures by the instructors, the course will feature group discussions of seminal papers that

have shaped current thinking in the field. Students will be evaluated by their participation during group discussion and by a single take-home final examination. Each component will contribute equally to the final grade. The course will meeting twice weekly for 6 weeks.

MIIM 25266 Clinical Immunology
1 Credit Hours
Clinical Immunology is an upper-level, 1-credit hour Microbiology course that will provide advanced information and conceptual knowledge regarding the human immune system in health and disease. Specific topics will include primary and secondary immunodeficiencies, autoimmune diseases (systemic autoimmune diseases and autoimmune diseases of the skin and gastrointestinal tract), atopic diseases, HLA and bone marrow transplantation. The course will comprise a combination of formal lectures by instructors, and group discussions of scientific papers from recent literature. Students will be evaluated through a single exam that comprises 50% of the final grade. The remaining 50% of the final grade will be determined by student participation in lecture discussions or assigned readings. The course will meet twice a week for a total of 6 weeks.

MIIM 25267 Bacterial Diversity and the Microbiome
1 Credit Hours
This interdisciplinary course will provide students with a solid foundation in the molecular and physiological basis of bacterial diversity with a particular focus on those organisms that comprise the gut microflora. The interaction between bacteria and viruses or phages will also be highlighted. The course will be paper with chalk-talk style discussion sessions designed to promote discussion of the literature.

MIIM 25269 Advanced Bacterial Physiology
1 Credit Hours
Advanced Bacterial Physiology is a 1 credit hour Microbiology course that focuses on fundamental and diverse aspects of bacterial physiology. Students will gain an understanding of the mechanisms bacteria use to execute, coordinate and control basic cellular processes such as macromolecular synthesis, nutrient utilization and metabolism, signal transduction, and stress responses. The course focuses on critical evaluation and discussion of papers from primary literature. These discussions will be augmented by short didactic presentations of background material by the course director to place the paper's topic and findings in context.

MIIM 25270 Advanced Virology
3 Credit Hours
Concepts in virology are illustrated by selected appropriate model systems of animal viruses. Topics include viral replication, genetics, antivirals, and virus-host interactions.

MIIM 25271 Membranes and Organelles
1 Credit Hours
Membranes and Organelles is an upper-level, 1-credit hour cell biology course that focuses on the topics of membrane protein trafficking and membrane biogenesis. Students will gain a detailed understanding of organelles and membrane protein trafficking and degradation, membrane vesicle fusion, secretion, and membrane biogenesis. The course will consist in

part of readings of seminal papers describing the genetic screens for sec and vps mutants, as well as the Rothman in vitro vesicle fusion experiments. These experiments provide the first description of the proteins we know today to be involved in membrane protein fusion, secretion, and trafficking. After gaining grounding in the design and outcome of these historic screens, the class will focus on what is known today about the initial proteins identified in the original ground-breaking screens. The newer areas of membrane biology will follow similar format, examining the discovery of paradigm, and delving into what is known today. Students will be evaluated by participation in paper discussion (40%) and an in-class paper presentation (60%). The course will meet twice a week for 6 weeks.

MIIM 25272 Innate and Adaptive Immunity
2 Credit Hours
This is an intermediate/advanced immunology course to explore the experimental basis of immunology through lectures, readings from texts, and current immunological journals. Topics covered include the cellular basis of the immune response, antigens, antibodies, and molecular basis for generation of immunologic diversity, regulation of the immune response, and innate and adaptive immunity. Integrated Microbiology & Immunology (INBS-16270), MCWfusion curriculum phase 1 (for MSTP students), a full-semester undergraduate immunology course, or instructor's written consent is a prerequisite. This course is taught concurrently with the first 12 weeks of Advance Immunology (MIIM-25273). You can only register for EITHER Innate and Adaptive Immunity (2 credits) OR Advanced Immunology (3 credits), but not both.

MIIM 25273 Advanced Immunology
3 Credit Hours
This is an advanced course to explore the experimental basis of immunology through lectures, readings from texts, and current immunological journals. Topics covered include the cellular basis of the immune response, antigens, antibodies, and molecular basis for generation of immunologic diversity, regulation of the immune response, innate and adaptive immunity, and diseases of the immune system. Integrated Microbiology & Immunology (INBS-16270) or instructor's written consent is a prerequisite.

MIIM 25275 Advanced Bacterial Genetics
1 Credit Hours
Advanced Bacterial Genetics is 1 credit hour Microbiology course that focuses on fundamental and diverse aspects of bacterial genetics. Students will gain an understanding of the mechanisms bacteria use to acquire or transfer genes, regulate expression of their genes, and defend their genomes against enemies. The course will be a mix of instructor-led didactic sessions augmented with critical evaluation and discussion of papers from the primary literature.

MIIM 25276 Basic Bacteriology
1 Credit Hours
The course is geared toward students matriculating into the Microbiology and Immunology (MI) Graduate Program as well as any student interested in contemporary concepts of cellular microbiology and host-pathogen interactions. The course has been designed to introduce fundamental concepts in bacteriology and progress to students being able to

understand and critically evaluate the complex nature of host-pathogen interactions. The participating faculty have unique areas of expertise but histories of collaborative science. Students will learn fundamental concepts in topics including bacterial structure and metabolism, genetics and regulation of gene expression, and different lifestyles individually and as part of communities, and interactions with the host in bacterial pathogenesis.

MIIM 25277 Basic Virology
1 Credit Hours
The course is geared toward students matriculating into the Microbiology and Immunology (MI) Graduate Program as well as any student interested in contemporary concepts of cellular microbiology and host-pathogen interactions. Students will learn fundamental concepts in topics including virus structure, replication, and pathogenesis. This includes processes leading to acute and chronic infections, the strategies that these agents utilize to enter and traffic through cells and exploit host cell processes for regulated gene expression, and technical approaches to study pathogens.

MIIM 25280 Classical Papers in Microbiology and Immunology
1 Credit Hours
Classical Papers in Microbiology and Immunology (M&I) is a course suitable for all students in the Microbiology and Immunology graduate program. Through this course, instructors and students will review, discuss, and critique notable papers from the last century that have made seminal contributions to the fields of molecular biology, bacteriology, virology, immunology, biochemistry, and/or genetics. The impact of these contributions in the present day will also be discussed. In addition to instructor-identified papers, students will also choose and formally present a recent paper for discussion that they feel has made a substantive contribution to the biomedical sciences. Papers to be discussed are expected to vary between semesters depending on the topic of discussion and instructor(s) facilitating the discussion. Ultimately, this course is expected to provide students with an expanded knowledge base of seminal papers in the broad fields of microbiology and immunology.

MIIM 25285 One Health Perspectives on Infectious Agents
2 Credit Hours
The purpose of this course is to introduce students to concepts and expertise not currently available in any other course on the MCW campus. The faculty will be multidisciplinary, consisting of physicians and veterinarians to provide perspectives and expertise on human and animal health, respectively, as well as basic scientists to provide expertise on pathogens in each category to be covered. An expert on Public Health and Global Health will provide expertise in these areas as well as in basic epidemiology to lead off the course and provide a foundation on which the rest of the course is constructed. Each didactic session each week will be co-led by a team including, at minimum, a physician, a veterinarian, and a basic scientist, who will together choose a paper that will be discussed by the students in the second session of the week. The design of the course is to provide students with fundamental knowledge of diseases caused by a variety of infectious agents in both humans and animals, and the mechanisms that the pathogens use to cause disease. Some types of pathogens, e.g., viruses and bacteria, are covered in other coursework, but others, including parasites and fungi, are not. Prions are covered only in the "Classic Papers" course in M & I. There is no assigned textbook, but the students will be expected to read and critically evaluate one

paper per week on the pathogen class of the week. Students will be evaluated on participation in discussions during class hours, and on an NIH-style Specific Aims page covering a pathogen of their choice from the One Health perspective, including significance of the pathogen to human, animal, and economic health impacts at the bare minimum. The Aims should address a mechanism of infection and/or disease caused by the pathogen of their choice. Pathogens covered in detail in class may not be chosen by any student for the Aims page.

MIIM 25289 Career Internships in the Biomedical Sciences
0 Credit Hours
Career Internships in the Biomedical Sciences is a 0-credit training course that will provide students in the Graduate Program in Microbiology and Immunology with an opportunity to complete a semester-long internship in a biomedical science career outside the postdoc-faculty pathway. Currently, this new course is being developed with three internship modules (Teaching, Clinical Microbiology, and Research Core Management); however, it is expected that new internship opportunities will be developed in the future to address additional student interests. Each internship has been developed such that students will gain direct hands-on experience in the career opportunity. Each internship also includes extensive opportunity for one-on-one mentoring with individuals experienced in that career pathway (i.e. site directors, course directors, research core managers, etc.). As part of each internship, students are required to complete a "scholarly activity" that will employ the use of information and/or techniques that have been acquired during the training period. Finally, site directors and/or other participants active in the student's training during the internship will complete evaluations providing the student with feedback regarding their performance during the internship.

MIIM 25290 Career Development Training in the Biomedical Sciences
1 Credit Hours
Career Development Training in the Biomedical Sciences is a 1-credit career training course that will provide students in the MCW Graduate School with a broad overview of the skills needed to identify and prepare for career opportunities following graduation. In particular, the course will help students develop key documents and/or skill sets to facilitate future career planning including career assessment, career goal setting, career exploration and networking, job search strategies, building resume/CV, writing statements, interview skills, and negotiating job offers. At the end of the course, students will complete an individual career plan/career portfolio that is based on goals and interests.

MIIM 25295 Reading and Research
1-9 Credit Hours
The course of study for Reading and Research is designed by each student with his/her advisor to focus on readings in literature in the student's field, to build bibliographic resources for the dissertation, and to conduct supervised, independent research.

MIIM 25298 Immunology Journal Club
1 Credit Hours

The purpose of this course is to learn, evaluate and present cutting edge immunological research topics from leading journals to gain knowledge of new immunological findings and to stay current with emerging technologies. Students will attend and present in a weekly independently organized immunology journal club. During the semester, students will be required to attend the journal club and write a short paragraph after each presentation regarding what they learned. This should include: The knowledge gap being addressed, the hypothesis being tested, strengths and weaknesses of the study and resulting conclusions. If a journal club is not scheduled for a particular week, the students will be required to attend an independently organized immunology work-in-progress series. For the students' presentations, students will select a research paper of immunological focus from a list of preapproved journals. While the student can choose any topic of interest, the selection will require approval from the course director. The presentation will consist of a PowerPoint style presentation including the following information: Why the student selected the article, the knowledge gap being addressed, background information supporting the hypothesis, the hypothesis being tested, discussion of the approaches and experimental data, strengths and weaknesses of the study and conclusions including potential future directions. Ultimately, this course is expected to provide students with an expanded knowledge base of current topics in the broad field of immunology.

MIIM 25299 Master's Thesis
1-9 Credit Hours
Students in the Ph.D. degree program who cannot or elect not to complete that program may be allowed to transfer to the Master's program. This transfer must be approved by the student's advisor, the Program Director, the Chair, and the Graduate School. To transfer to the Master's Program, the student must be in good academic standing according to regulations established by the Graduate School.

MIIM 25301 Research in Progress Course
1 Credit Hours
This course aims to train students to evaluate scientific presentations critically. All G3* students in the Microbiology and Immunology program must enroll in the course in the Fall and Spring semesters. Students must attend the weekly departmental "Research in Progress" (RIP) series and submit written evaluations of each presentation. The course leader will review the written evaluations and provide feedback/suggestions when required. In addition, immediately following RIP presentations given by G3 M&I students, students will convene in person to have brief conversations in which they will ask questions and provide constructive scientific and stylistic feedback to the presenter. The course will be graded on a "pass/fail" scale. To receive a passing grade, students must attend all RIP presentations, submit evaluations for RIP presentations, actively participate in every post-G3 RIP discussion, and present their own RIP. * G3 = second year in the Department. Students will enroll in this course the year after they complete their qualifying exam

MIIM 25302 Scientific Communication
1 Credit Hours

Scientific Communication will focus on teaching students to communicate through a variety of presentation types to a variety of audiences. During each lecture, students will receive didactic instruction and complete in-class activities to develop skills in each area. Students will apply this knowledge by giving three required presentations (conference talks, elevator pitches, and poster presentations) throughout the semester. Students will also learn how to receive and incorporate constructive feedback and how to "think on their feet" by answering questions during their presentations and learning to give chalk talks.

MIIM 25399 Doctoral Dissertation
1-9 Credit Hours
This course is required for the completion of the PhD degree. The PhD candidate must submit a dissertation based on original research of a high scholarly standard that makes a significant contribution to knowledge in their chosen field.

Master of Medical Physiology

MMPY 41100 Foundations of Medicine
0–6 Credit Hours
The goal of the Foundations of Medicine Block is to establish a strong, broad foundation of basic scientific knowledge to prepare Phase 1 learners for future systems-based units. This block integrates concepts of biochemistry, cell biology, genetics, physiology, anatomy, microbiology, pharmacology and biostatistics to form a wide base of knowledge related to cell and tissue biology, organ systems, patients and communities, which are applied to solve clinical problems in the context of patient-based scenarios. Learning experiences are reinforced with small group discussions, interpretation of molecular diagnostic tests, and laboratory activities.

MMPY 41110 Hematology Immunology
5 Credit Hours
The Heme/Immunology block is designed to teach medical students the biochemical, genetic and physiological etiology of hematological and immunological pathologies and physiological responses to infection. The course will be anchored by hematopoiesis and concern the biology of hematopoietic stem cell progeny. This will include the physiology and pathophysiology of red blood cells, white blood cells and platelets, and related pathologies including: immune system disorders, autoimmunity, leukemia and lymphoma, and clotting disorders. In addition, the course will introduce treatment modalities, including pharmacology, vaccination, transplant and transfusion. The course will be divided into three sections: (i) immunology, (ii) leukemia and lymphoma, and (iii) hematology. Basic science content will be provided in parallel to small group case-based learning sessions and histopathology laboratories, which will be designed to emphasize and expand upon the pathophysiology.

MMPY 41120 Musculoskeletal Skin
4 Credit Hours

MSS will introduce students to the foundational science of muscle, bone and skin anatomy through didactics which will include online pre-work, in class lectures, case-based discussion and lab sessions. Integrated case studies will examine the development, structure and function of skin, skeletal muscle, cartilage, ligament and bone anatomy through examination of pathology, radiology, immunology, cell biology, pharmacology, anatomy, physiology, and developmental biology. Additionally, students will learn about neoplasms, injuries, infections, and degenerative disorders commonly
seen for each system. At the conclusion of the unit, students will recognize common skin and musculoskeletal disease states and communicate effectively using accepted anatomical terminology. This course involves pre-work in the form of webcasts, narrated PowerPoints, reading assignments and quizzes via Brightspace. Following weekly case discussions, there will be a summative session to ensure students understand the main takeaways from the discussion. Additional opportunities to reinforce major concepts may be available through online quizzes and post-work
assignments.

MMPY 41130 Gastroenterology and Nutrition
5 Credit Hours
The Gastrointestinal and Nutrition block is a four-week course that describes and defines the normal structural components of the digestive system and reviews the physiologic processes of the cells and tissues of those organs. That foundational knowledge of gastrointestinal system functions will be expanded upon to describe the genetic, nutritional, and immunological mechanisms that underlie human gastrointestinal diseases. This course integrates foundational cell and molecular biology, immunology, pharmacology, pathology, anatomy, and physiology concepts to provide learners with an understanding of gastrointestinal system tissue functions. Knowledge of these concepts will also aid learners in recognizing and identifying the presentation and abnormal physiology of gastrointestinal components during various disease states. Learning activities in the gastrointestinal unit include synchronous and asynchronous didactic sessions, gross anatomy, histology, and pathology laboratory sessions, and small group case-based discussions focused on various gastrointestinal pathologies and disease states.

MMPY 41150 Medical Humanities I Foundation of Character Development
0–0.5 Credit Hours
The goal of this course is to provide the knowledge, skills and expertise necessary to promote Master's in Medical Physiology (MMP) student personal and professional identities formed by character and caring and the autonomous practice of human flourishing. This course is largely consistent with the first 5 weeks of The Good Doctor course in the MCWfusion curriculum (INTE 12103), but with some content and assessments adapted for MMP students. This course includes competencies pertaining to character and professional development, ethics, wellbeing, health equity, communication, and interprofessional practice. This course is predominantly for content requiring a degree of psychological safety. This course will be operationalized both through learning communities as well as through large group and small group lecture and asynchronous learning activities. MMP students will be assessed through participation, reflective writing, and individualized learning plans.
MMPY 41151 Medical Humanities II Ethics Communication Leadership and Wellbeing
2 Credit Hours

The goal of this course is to provide the knowledge, skills and expertise necessary to promote Master's in Medical Physiology (MMP) student personal and professional identities formed by character and caring and the autonomous practice of human flourishing. This course is largely consistent with the second 18 weeks of The Good Doctor course in the MCWfusion curriculum (INTE 12103), but with some content and assessments adapted for MMP students. This course includes competencies pertaining to character and professional development, ethics, wellbeing, health equity, communication, and interprofessional practice. This course is predominantly for content requiring a degree of psychological safety. This course will be operationalized both through learning communities as well as through large group and small group lecture and asynchronous learning activities. MMP students will be assessed through participation, reflective writing, and individualized learning plans.

MMPY 41200 Graduate Human Anatomy
4 Credit Hours
The Graduate Human Anatomy course teaches students the structural aspects of the human body and their clinical correlates. Students explore the macroscopic anatomy and three-dimensional relationships of organs, organ-systems, regions of the body, cross-sections, and spaces. Learning experiences are reinforced with cadaveric dissection and a variety of clinical imaging techniques, including plain films (X-rays), CT and MRI scans. Aside from medical knowledge, the course nurtures teamwork, interpersonal and communication skills, and professionalism. The course continues the anatomy component of the Phase 1 MCWfusion curriculum, specifically the Cardiovascular, Respiratory, Renal, and Endocrine/Reproductive Blocks. The course comprises webcast lectures and body donor dissections and is graded on letter scale.

MMPY 41280 Career Development Training
2 Credit Hours
The goal of the MMP Career Development Training course is to increase your skills and readiness for medical school and graduate school applications. To achieve this goal, you will be working with your peers, current medical and graduate students, and diverse range of faculty to write an application cycle calendar, personal statement, and CV/resume, and to execute individual and group mock interviews. Importantly, this course has
been designed specifically for MMP students, and does not overlap with other graduate or medical school courses at MCW. Ultimately, MMP Career Development Training will provide timely and important preparation for applying to medical or graduate school, and for your continuing education and careers in science and medicine.

Neuroscience

NSCI 12221 Advanced Systems Neuroscience
3 Credit Hours
Readings and discussion in cellular, molecular, and developmental neurobiology. Among the topics covered in this course are ion channels and the ionic basis of potentials; mechanisms of synaptic transmission; neurotransmitter receptors and their receptors; sensory signal transduction and neural development.

NSCI 12237 Cellular Molecular Neurobiology
3 Credit Hours
Readings and discussion in cellular, molecular, and developmental neurobiology. Among the topics covered in this course are ion channels and the ionic basis of potentials; mechanisms of synaptic transmission; neurotransmitter receptors and their receptors; sensory signal transduction and neural development.

NSCI 12271 Fundamentals of Neuroscience
3.5 Credit Hours
Fundamentals of Neuroscience follows a multidisciplinary approach to current knowledge about the structural and functional properties of the nervous system. The mechanisms of the nervous system are described at the molecular, cellular, systems and complex brain function levels. The course includes in-class lectures, lab sessions, interactive seminars from prominent scientists (video archives), and paper discussions. The purpose of this course is to introduce graduate students to the structure and function of the human nervous system.

NSCI 12277 Cognitive Neuroscience
2 Credit Hours
Cognitive neuroscience examines human brain information processing at the level of large-scale neurobiological systems. Some examples include information processing that underlies learning and retrieving concepts, comprehending and producing language, directing and maintaining attention, and recognizing sensory objects. Each session in this course will begin with a 1-hour contextual lecture, followed by review and discussion of a relevant landmark paper, or two shorter papers with opposing views. Emphasis will be placed on understanding the processing models central to each domain, the extent to which these models are supported by empirical evidence from neuroimaging, and the relevance of the field to a variety of human brain disorders.

NSCI 12295 Reading and Research
1-9 Credit Hours
This course is offered in the fall and spring semester. In fall, it consists of a 6 week block introducing techniques used in neuroscience research, to introduce students to laboratory work and different lab environments, and then 3x 6-week laboratory rotations blocks with potential research mentors. In spring, it consists of additional rotations and/or more in-depth laboratory experience with the student's chosen mentor.

NSCI 12298 Neuroscience Journal Club
1 Credit Hours
Weekly readings will be selected from both contemporary and historical literature in neuroscience. Informal discussions will include participation from both neuroscience faculty and students.

Pharmacology & Toxicology

PHTX 07002 Master's Thesis Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including thesis credits but have not yet completed the writing of the Thesis. Continuation status is limited to three consecutive terms following the completion of Thesis credits.

PHTX 07003 Doctoral Dissertation Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including dissertation credits but have not yet completed the writing of the Dissertation. Continuation status is limited to three consecutive terms following the completion of Dissertation credits.

PHTX 07225 Ion Channels Signal Transduction
3 Credit Hours
This course provides discussion of the function of ion channels in mammalian cells. This course provides an in-depth presentation of mechanisms of drug action at a level designed for doctoral students in the Biomedical Sciences. The emphasis is on ion channel structure, function and regulation as well as the action of drugs and toxins that interact with ion channels.

PHTX 07226 Current Concepts of Cancer Biology
3 Credit Hours
This course provides students with basic knowledge of cancer biology. Topics include signaling pathways that promote malignancy and metastasis, cancer susceptibility genes, and chemoprevention.

PHTX 07237 Modern Drug Discovery Development
3 Credit Hours
Modern Drug Discovery and Development is an interdisciplinary course with an emphasis on state-of-the-art techniques, concepts and advances in drug discovery and development today. The course will provide an understanding of the fundamental concepts of therapeutic target identification and drug design, high throughput screening, preclinical testing, pharmaceutical optimization, human clinical trials, and drug commercialization.

PHTX 07250 Current Topics in Cancer Pharmacology
1 Credit Hours
This course consists of student-led discussions of primary literature. The course director will be available to assist students in their presentations of journal articles and will also assist in facilitating discussions amongst the class. The course will feature a blend of historical and current journal articles, including literature that focuses on structure-activity relationships of drugs and relevant biological variables in the study of pharmacology.

PHTX 07252 Current Topics in Cardiovascular Pharmacology
1 Credit Hours

Participating faculty will advise and assist students with presentation of journal articles and lectures, and lead discussions on contemporary topics in pharmacology.

PHTX 07254 Current Topics in Neuropharmacology
1 Credit Hours
This course consists of student-led discussions of primary literature. The course director will be available to assist students in their presentations of journal articles and will also assist in facilitating discussions amongst the class. The course will feature a blend of historical and current journal articles, including literature that focuses on structure-activity relationships of drugs and relevant biological variables in the study of pharmacology.

PHTX 07256 Current Topics in Structural Biology and Therapeutics
1 Credit Hours
This course is structured around student-led discussions of primary literature, providing a platform for in-depth exploration of pivotal research articles. Under the guidance of the course director, students will actively engage in presenting and critically evaluating journal articles. The course emphasizes a comprehensive approach by incorporating both historical milestones and contemporary breakthroughs, with a specific focus on literature pertaining to structure-activity relationships of drugs and pertinent biological variables in the field of pharmacology. The course director will play a crucial role in supporting students throughout their presentations and fostering collaborative discussions within the class, ensuring a rich and interactive learning experience.

PHTX 07260 Skill Enhancement through Experiential Development (SEED)
1 Credit Hours
This course supports graduate student professional development through experiential learning, and includes portfolio building, learning how to engage community partners and policymakers, and faculty-guided independent work focused on trainee-identified professional goals. Students will work with faculty mentors to establish an individualized development plan focused on teaching, community engagement, policy, industry, or independent academic research that includes experiential learning and professional milestones and will participate in instructor-guided biweekly learning community meetings at which they will discuss their experiences in addition to building a professional development portfolio.

PHTX 07295 Reading and Research
1-9 Credit Hours
The course of study for Reading and Research is designed by each student with his/her advisor to focus on readings in literature in the student's field, to build bibliographic resources for the dissertation, and to conduct supervised, independent research.

PHTX 07299 Master's Thesis
1-9 Credit Hours
Students in the Ph.D. degree program who cannot or elect not to complete that program may be allowed to transfer to the Master's program. This transfer must be approved by the student's advisor, the Program Director, the Chair, and the Graduate School. To transfer to

the Master's Program, the student must be in good academic standing according to regulations established by the Graduate School.

PHTX 07301 Seminar
1 Credit Hour
Weekly invited seminar speakers present their research on selected topics. This is a required course for all Pharmacology & Toxicology students except those taking dissertation.

PHTX 07399 Doctoral Dissertation
1–9 Credit Hours
This course is required for the completion of the PhD degree. The PhD candidate must submit a dissertation based on original research of a high scholarly standard that makes a significant contribution to knowledge in their chosen field.

Physiology

PHYS 08002 Master's Thesis Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including thesis credits but have not yet completed the writing of the Thesis. Continuation status is limited to three consecutive terms following the completion of Thesis credits.

PHYS 08003 Doctoral Dissertation Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including dissertation credits but have not yet completed the writing of the Dissertation. Continuation status is limited to three consecutive terms following the completion of Dissertation credits.

PHYS 08205 Advanced Physiology
3 Credit Hours
Integrative and systems physiology fosters breakthroughs in all areas of life sciences, and a complete understanding of physiology requires an in-depth understanding of normal biological processes to understand how these processes breakdown in cardiovascular, circulatory, respiratory, renal, endocrine and other diseases. In this advanced physiology course, students gain knowledge through mastery of fundamental physiological concepts and principles as a foundation for advanced study at the graduate level and to build a firm foundation for cutting edge research skills in physiology and related disciplines. A major focus of this course is to learn fundamental physiological principles and gain skills in presentation and critical reading/reasoning of primary literature through a combination of self-directed learning (pre-work) and presenting published papers. Organ Systems Physiology completions preferred.

PHYS 08207 Introduction to Neuroscience

2 Credit Hours
This course provides an introduction to the neurosciences. A brief but integrated overview of neuroanatomy, neurophysiology and neurochemistry will be provided. The course consists of both lectures and laboratory exercises.

PHYS 08208 Current Topics - Physiology
1 Credit Hours
This course will cover several physiological topics, including hypertension, obesity, genetics, cardiorenal and respiratory diseases and others. The efforts of the class this semester will focus on the development of an understanding of various critical physiological processes and pathophysiological complications. Furthermore, special attention will be paid to a critical evaluation of effective presentations and topical materials in different areas of physiology.

PHYS 08210 Endocrine Reg & Comn Disease
1 Credit Hours
Each session consists of three parts: (a) Instructor Introduction; (b) Presentation of a Review article by a student; and (c) Presentation of a research article by a student. Each student is expected to study these articles and actively participate in critical evaluation of the paper.

PHYS 08212 Critical Reading in Respiratory Physiology
1 Credit Hours
Discussion and student presentation formats will be utilized to develop skills for extraction of information, critical thinking, oral and written communication of primary Respiratory Physiology literature.

PHYS 08223 Bioinformatics Tools and Tactics
1 Credit Hours
This introductory course is targeted at anyone who needs to understand and use online bioinformatics tools and analyses as part of their research activities. It focuses on providing the background understanding and practical methods suitable for the functional annotation and interpretation of proteins or genes derived from microarray analysis, proteomics, genome-wide association studies and similar experimental techniques. The online resources covered will be centered around mammalian biology (human, rat, mouse) but resources from other species may be covered where appropriate. The course will be a mixture of lecture/discussion combined with practical sessions in the computer lab.

PHYS 08229 Essential Physiological Genomics
2 Credit Hours
This course covers genome sequence, functional genomic analysis, genome and gene manipulation, and grant writing. The students will learn about the latest advances in the field of physiological genomics, how to apply genomic approaches to study complex physiological problems and how to develop a grant proposal.

PHYS 08230 Physiological Genomics

5 Credit Hours
This course will cover topics in Physiological Genomics at an advanced level emphasizing the tools and techniques that are available to investigators exploring the relationship between genotype and phenotype. Material will be selected to emphasize high throughput screening and Bioinformatics techniques. Specific examples of applications of physiological genomics to important research problems will be discussed. Students will acquire the expertise required to develop a research proposal and will participate in a mock study section to witness the process by which grants are reviewed.

PHYS 08253 Advanced Renal Physiology
1 Credit Hours
This course is an in-depth survey of selected important topics in renal physiology that will be taught at an advanced level appropriate for a senior graduate student. The material in this course will emphasize classical and modern research approaches and techniques, original research papers, and the development of oral presentation skills. The knowledge gained from this course should be sufficient for a doctoral student in Physiology.

PHYS 08255 Advanced Cardiovascular Physiology
1 Credit Hours
This course will use a guided approach to reading of selected contemporary literature in cardiovascular physiology to explore the relationships between genetic and environmental influences on the development and progression of major cardiovascular diseases including Hypertension, Heart failure and Metabolic Syndrome. The course will combine didactic lectures with class discussion and will help students to develop skills for extraction of information, critical thinking, and oral and written communication on concepts in Cardiovascular Physiology.

PHYS 08270 Current Concepts in Cardiovascular Biology
3 Credit Hours
This lecture course explores the pathogenic mechanisms that underlie cardiovascular disease, the leading cause of death in the United States and other industrialized countries. This course covers foundational principles of cardiovascular physiology and pathophysiology with special emphasis on topics related to the CVC's Signature Programs and Affinity Groups. Unique features of the course include the integration of basic and clinical research, intentional pairing of predoctoral students with postdoctoral fellows, presentations by students and fellows on selected topics, and a section on "Current Topics in Cardiovascular Sciences" such as racial inequity, COVID-19, and social determinants of health. In addition to advancing education in cardiovascular biology and pathophysiology, major goals are to increase knowledge in translational medicine and enhance peer-to-peer mentoring.

PHYS 08273 Special Topics in Neuroscience
1 Credit Hours
The objective of this course is to critically evaluate, discuss and debate the strengths and weaknesses of a particular contemporary literature neuroscience study and understand the study's broader relation to neuroscience and how this hypothesis changed the field. Each semester the course will choose a new overlying theme (e.g. neural plasticity, rhythm

generation, sleep, learning and memory, development, locomotion, neuro-computational studies, etc.) and applicable literature.

PHYS 08275 Special Problems in Physiology
1 Credit Hours
Readings and/or research under the direction of a faculty member in a specialized field of physiology. Under specific circumstances, may be substituted for formal courses. The Course Director as soon as possible after recovery.

PHYS 08295 Reading and Research
1-9 Credit Hours
The course of study for Reading and Research is designed by each student with his/her advisor to focus on readings in literature in the student's field, to build bibliographic resources for the dissertation, and to conduct supervised, independent research.

PHYS 08299 Master's Thesis
1-9 Credit Hours
Students in the Ph.D. degree program who cannot or elect not to complete that program may be allowed to transfer to the Master's program. This transfer must be approved by the student's advisor, the Program Director, the Chair, and the Graduate School. To transfer to the Masters Program, the student must be in good academic standing according to regulations established by the Graduate School.

PHYS 08301 Seminar
1 Credit Hour
Weekly invited seminar speakers present their research on selected topics.

PHYS 08399 Doctoral Dissertation
1 Credit Hour
This course is required for the completion of the PhD degree. The PhD candidate must submit a dissertation based on original research of a high scholarly standard that makes a significant contribution to knowledge in their chosen field.

Precision Medicine

PRME 42002 Master's Thesis Continuation
0 Credit Hours
Master's Thesis Continuation

PRME 42100 Introduction to Precision Medicine
3 Credit Hours
Introduction to Precision Medicine offers 10 applied learning sessions led by directors of PM Education courses. Students initiate a professional development plan and write and present reports explaining PM concepts, demonstrating research in practice, and judging the validity of PM information.

PRME 42145 Omics Technology in Precision Medicine
3 Credit Hours
The 'Omics Technology in Precision Medicine Course is designed to provide students with a comprehensive understanding of the core laboratory and analytical techniques used in clinical and translational research for the genetic understanding of an individual's disease. Through a structured exploration of essential concepts in genomics, transcriptomics, bioinformatics, and functional genomics, students will gain exposure and experience with the tools and technologies that drive personalized healthcare advancements. This course is important in that it focuses on the practical and applied aspects of utilizing individual genetic profiles, a rapidly growing field that holds transformative potential for patient care. By understanding the
advantages and biases of these laboratory and analytical technologies, students will be prepared to contribute to research and clinical efforts that aim to enhance diagnostic accuracy, improve therapeutic effectiveness, and personalize disease management for diverse populations.

PRME 42155 Epigenomics for Precision Medicine
3 Credit Hours
This course is designed to introduce students to Epigenetics and Epigenomics, an important foundation of modern medicine, in particular as an advanced discipline of Precision Medicine. Epigenomics refers to the inheritance of traits independent of the coding capacity of the DNA and is highly influenced by the environment. Fortunately, epigenomic dysregulations that cause diseases are often amenable to therapeutic intervention, thereby auguring the birth of novel therapeutics. Additionally, like genomics, epigenomics is providing promising biomarkers for diagnosis, prognosis and real-time surveillance of disease progression. In this course, students will discuss molecular mechanisms underlying epigenetic events, the tools for the design and execution of research in this discipline, how to generate and analyze epigenomic data, and the application of Epigenomics to diagnostics, prognostics, and treatments.

PRME 42170 Medical Genetics Undiagnosed and Rare Diseases
3 Credit Hours
Medical Genetics, Undiagnosed and Rare Diseases allows students to examine the application of genomics to core clinical systems and applying that knowledge to personalized management of patients. Experts in their respective fields will present interactive guest lectures in weekly sessions.

PRME 42175 Pharmacogenomics for Precision Medicine
3 Credit Hours
This elective course is essential and important to Precision Medicine Education of interested enrolled clinician learners. The topic is a session in the Introduction to PM course and harmonizes with the other courses. The topic is also included in a therapeutics chapter in the 8th edition of the classic textbook Thompson & Thompson Genetics in Medicine.

PRME 42185 Cancer Precision Medicine
3 Credit Hours
This course provides an overview of the molecular basis of cancer, the role of germ-line and somatic alterations in the development/ progression of cancer and the various precision assay methodologies utilized in cancer diagnosis, prognostication and treatment.

PRME 42283 Precision Medicine Research Plan
3 Credit Hours
This course requires students to develop a PM research question, to perform a literature review and analysis of the topic, and to create a research plan for IRB submission, if needed. The work is guided by a primary mentor and reviewed by 2 faculty advisors.

PRME 42299 Master's Thesis
3 Credit Hours
This course requires students to implement a research plan and to write a manuscript discussing the results. The work is guided by a primary mentor and reviewed by 2 faculty advisors.

Public Health

PUBH 18101 Foundations of Public Health
3 Credit Hours
This is a required course for all students enrolled in the MCW MPH dual degree program and is offered as an elective to all other currently admitted MPH students. This course provides an overview of various theories and practices in public health, as well as how public health theories and practices can be applied to the health of populations. Using the public health system as a framework, the course will address core foundational aspects of public health, public health history, 21st century public health practices, the interrelationship between law, government, and public health, and an introduction to public health emergency preparedness and response. The course will also address health determinants and health equity in the practice of public health.

PUBH 18115 Health Promotion and Disease Prevention
3 Credit Hours
This course is designed to prepare students to promote health and to prevent disease and injury using a variety of methods. It emphasizes an ecological approach addressing behavior, environment, and healthcare at levels from the individual to social policy. The content is designed for use in diverse settings, including health departments; healthcare; workplaces, schools, and other institutions; policymaking/advocacy; and non-governmental organizations. Students will assemble their own model HP/DP plan for a population and health problem of their choosing. The course will address underlying models informing HP/DP; risk and protective factors and surrogate indicators like biomarkers; population assessment; theories of health behavior and health education; locating evidence-based practices; addressing environmental and policy aspects of HP/DP; community engagement, disparities and health equity; HP/DP in healthcare; ethical issues; information and communication

technologies; and emerging opportunities in HP/DP including personalized and computer-augmented health promotion.

PUBH 18150 Public Health Law and Ethics
3 Credit Hours
The Public Health Law & Ethics course examines the use of law and ethics as tools for public health and considers how they interact with the ethical principle of justice, which underlies all law. The course assesses law and ethics in public health through an exploration of how governmental authority applies to the population and how the law addresses conflicts that arise when government power affects individuals' rights. The course focuses in particular on the challenge of applying public health law and ethics in a changing legal and social landscape while aligning public health and the law with health justice and equity.

PUBH 18155 Public Health Theory and Practice
3 Credit Hours
This course provides an overview of various theories in public health, as well as, how public health theories can be applied in individual, interpersonal, and community settings. The course will highlight various factors that contribute to public health, including biological, family, ethnic and cultural, and community stressors that affect health and well-being. The course will provide an overview of translating research into public health practice.

PUBH 18160 Racial and Ethnic Inequalities in Health
3 Credit Hours
Health disparities and health inequities remain a major social and public health problem in the US. Despite enormous health care expenditures and the remarkable medical, technological, and public health strides made in the past few decades, the challenge and burden of differences in health among specific population groups, that are either avoidable or unjust, persist. Thus, a better understanding of health disparities and inequities among racial and ethnic groups is needed. This course will provide students with an in-depth introduction to health disparities and health inequities as they pertain to specific populations in the US that have been historically disadvantaged and systematically deprived of opportunities to achieve optimal health. The course material will also include an overview of social determinants of population health. We will: (i) consider historical and contemporary debates in conceptualizing race and ethnicity (ii) examine the burden of racial and ethnic disparities in the U.S. (iii) identify and examine some of the social determinants of health and drivers of health inequity and (iv) examine theoretical and practical challenges of developing innovative strategies to eliminate health disparities and achieve health equity. The ultimate goal of the course is to help students develop the skills needed to examine individual and systemic root causes of Inequities and apply knowledge and theory of health disparities and health inequities in designing health services and program and policy interventions aimed at achieving health equity.

PUBH 18165 Principles of Public Health Data and Epidemiology
3 Credit Hours
The Principles of Public Health Data and Epidemiology course examines public health data and epidemiological concepts, including foundations of epidemiology, practical applications of public health data and epidemiology, core measures in public health,

descriptive epidemiology, sources of data, study designs and data analysis, communicating data, informatics, disease transmission and prevention, morbidity and mortality, screening tests, infectious disease causation, environmental health, and social, behavioral, and psychosocial epidemiology. The course emphasizes practical application of concepts and skills learned related to accessing, analyzing, and communicating public health data. The course provides the student with an understanding of the distribution and determinants of health and disease in population groups and supports learning in many other courses in the MPH program.

PUBH 18203 Public Health Administration
3 Credit Hours
Public health professionals require administrative skills at many levels, from managing personnel and health programs, to making and advocating for organizational and policy decisions regarding the distribution of society's scarce public health resources. This is a survey course designed to introduce 1) Local Public Health - the structure, functions, and financing of public health within the context of the U.S. healthcare system and its health policies; 2) Targeting Resources and Implementing Programs - the planning, implementation, and evaluation of programs to improve health; and 3) Funding Public Health - principles of effective finance, budgeting, grant-writing, and management strategies. In addition to tutorials, readings and case studies, students will complete assignments that are aligned with their own communities, organizations, and professional roles.

PUBH 18204 Public Health Analytics
3 Credit Hours
The overall goal of the course is to provide the students with an opportunity to delve into public health analytics by managing, analyzing, interpreting, synthesizing, and disseminating data and research findings. In addition, students will read, critically reflect, actively discuss, and write on public health research analytics. The materials in this course provide a basis for understanding concepts and applications critical to public health in the context of applied research. The students will develop knowledge and training in the areas of research, analysis, and data management in quantitative and qualitative public health research.

PUBH 18209 Community Health Assessment and Improvement
3 Credit Hours
This course provides students with a comprehensive understanding of the community health assessment and improvement planning process, focusing on achieving health equity. Students will learn to systematically assess community health needs and assets using both quantitative and qualitative data. The course emphasizes identifying priority health concerns and developing data-driven plans to address unmet needs. Students will also explore the role of social, economic, behavioral, and environmental factors that influence health outcomes, and understand the importance of multisector collaboration, community engagement, and evidence-based interventions. By the end of the course, students will be equipped to apply the Mobilizing for Action Through Planning and Partnerships (MAPP) framework, driving positive health outcomes and enhancing public health in their communities.

PUBH 18215 Infectious Diseases
3 Credit Hours
The Infectious Diseases course will emphasize the practice of public health in the following areas of infectious diseases: surveillance, outbreak investigation and control, and prevention and policy.

PUBH 18223 Public Health Policy
3 Credit Hours
This public health policy course engages students to understand, analyze, evaluate, and advocate for health policies. The course includes a textbook and other impactful readings, recorded lectures by expert faculty, and weekly evening Zoom class discussions (or Brightspace or emailed answers to questions). Students write a policy essay and opinion editorial for faculty review and the opportunity to revise and resubmit.

PUBH 18230 Community Health Program Planning
3 Credit Hours
This Community Health Program Planning course is designed to prepare learners to apply public health knowledge and skills in a community-based setting. Program planning skills are an essential competency of both public health practitioners and public health administrators and thus are a critical component of the MPH curriculum. Building on the foundation in health improvement program planning obtained in the Public Health Administration course, this course will increase the depth and breadth of learners' knowledge and skills through a theoretical and application-based curriculum.

PUBH 18232 Population Health Management
3 Credit Hours
This population health management course engages students to understand, analyze, evaluate, and contribute to population health management. The course includes a textbook and other impactful readings, recorded lectures by expert faculty, and weekly evening Zoom class discussions (or Brightspace or emailed answers to questions). Students write an essay for faculty review and the opportunity to revise and resubmit.

PUBH 18241 Health Communications
3 Credit Hours
This course is designed to explore the ways that communication impacts people's health and wellbeing, as well as their understanding of health-related topics. The course will cover multiple levels of communication, different communication channels, and the use of diverse communication media and technologies.

PUBH 18260 Community Health Program Evaluation
3 Credit Hours
The Community Health Program Evaluation course examines the basic topics related to community health program evaluation including systems thinking and program evaluation; the levels of program evaluation process; qualitative and quantitative measures; data management tools; data analysis methods; quality management; and other contextual issues, including a focus on equity, surrounding program evaluation. This course will incorporate the use of assigned readings, group projects, peer evaluation, online discussions,

written assignments, and exams to foster knowledge of material presented in the course, as well as application-based learning in evaluation of community health.

PUBH 18268 Leadership for the Public's Health
3 Credit Hours
Leadership for the Public's Health takes a broad look at leadership within public health practice. An introduction to theoretical and evidence-based research is applied to a wide range of public health leadership crises and challenges. Learners will apply knowledge and personal experiences to newly focused leadership understanding through application to practice. Leadership theory and research will connect to personal leadership, critical reflection, political acumen, and peer mentorship in creation of a professional development plan/leadership credo.

PUBH 18279 Field Placement Preparation
1 Credit Hours
This course will provide students with the foundation for the MPH Field Placement course, a required applied practice experience within the MPH program. In the Preparation course, students will connect with public health organizations and arrange their specific Field Placement projects. The course will highlight principles of human subject research as well as community-academic partnerships and will help students apply these principles in the development of their projects. Students will also begin ideation and planning toward their final culminating experience in the program, Capstone.

PUBH 18280 Field Placement
1–6 Credit Hours
This is a planned, supervised and evaluated applied practice experience that is designed to enhance and complement the student's educational development by providing practical experience in public or private organizations that address significant public health issues. Working with a site preceptor and faculty advisor, the student will develop at least two products for the site that demonstrate competency attainment and are relevant to their public health area of interest. Students will continue to plan their Capstone project as well.

PUBH 18295 Readings and Research
1–6 Credit Hours
An independent study course, under public health faculty guidance, to pursue reading and research in an area of specific student interest.

PUBH 18297 Capstone Project
3 Credit Hours
The Capstone Project is a culminating experience that requires the students to synthesize and integrate knowledge acquired in coursework and other learning experiences, and apply theory and public health principles in the development of a master's paper on significant public or community health issue or topic. This course replaces the former Project I and Project II courses.

PUBH 28003 Doctoral Dissertation Continuation
0 Credit Hour
Doctoral Dissertation Continuation.

PUBH 28106 Introduction to Community Engagement
3 Credit Hours
This is a required course in the Doctor of Public Health program. The course is designed to prepare students to apply translational knowledge and skills in community-based settings. Involving and collaborating with community in bi-directional manner are vital concepts to improving public health and the health of communities. This course provides students with the foundation for understanding communication engagement (CE) and community engagement in research (CEnR), based on principles of community-based participatory research (CBPR).

PUBH 28150 Research Theory
3 Credit Hours
This is a required course for students matriculated in the Doctor of Public Health program. The overall goal of the course is to provide the students with an opportunity to gain the foundational knowledge needed to develop a personal theory of research within public health. The materials in this course will provide the basis of this understanding and apply it to issues within public and community health. Please note that this syllabus is subject to further change or revision, as needed, to realize best the educational goals of the course and competencies of the program.

PUBH 28151 Data Collection and Analysis
3 Credit Hours
This is a required course for students matriculated in the Doctor of Public Health program. The overall goal of the course is to provide the students with an opportunity to read, critically reflect, actively discuss, and write on the research methods and analyses related to public health, including quantitative, qualitative, and mixed methods approaches. The materials in this course provide a basis of understanding concepts, theories, and applications critical to public and community health in the context of applied research. The students will develop knowledge and training in research, analysis, and data management.

PUBH 28152 Executive and Organizational Leadership
3 Credit Hours
Executive and Organizational Leadership takes a broad look at leadership within public health practice. An introduction to theoretical and evidence-based research is applied to a wide range of public health leadership crises and challenges. Learners will apply knowledge and personal experiences to newly focused leadership understanding through application to practice. Leadership theory and research will connect to personal leadership critical reflection, political acumen, and peer mentorship in creation of a professional development plan/leadership credo.

PUBH 28153 Executive Communication in Public Health
3 Credit Hours
This course is designed to explore the ways that communication impacts people's health and well-being, as well as their understanding of health-related topics by bridging theory and practice of interpersonal, organizational, and mass communication (including digital media). The use of communication strategies to inform and influence individual, community and policy level decisions that impact health will be discussed with an emphasis on cultural competency skills in order to understand, respond, and work with diverse audiences.

PUBH 28160 Public Health Research Study & Design
3 Credit Hours
This is a required course for students who matriculated in the Doctor of Public Health (DrPH) program. The overall goal of the course is to provide students with an opportunity to identify features of public health research and apply those features to areas of interest by the student. The materials in this course provide a basis of understanding concepts, theories and applications critical to public and community health.

PUBH 28170 Public Health Applied Research
3 Credit Hours
This is a required course for students matriculated in the Doctor of Public Health (DrPH) program. The overall goal of the course is to provide the students with an opportunity to read, critically reflect, actively discuss and write on the issues related to public health. The materials in this course provide a basis of understanding concepts, theories and applications critical to public and community health in the context of applied research. The students will develop knowledge and training the area of research and data management.

PUBH 28201 Public Health Practice I - Building a Foundation for Public Health
3 Credit Hours
Building a Foundation for Public Health: This course is required for students matriculating in the Doctor of Public Health program. The overall goal of the course is to provide the students with an opportunity to read, critically reflect, actively discuss, and write on the issues related to public health. The materials in this course provide a basis for understanding concepts, theories, strategies, and applications critical to public and community health.

PUBH 28202 Public Health Practice II- Building Community Partnerships and Coalitions
3 Credit Hours
This is a required course for students who matriculated in the Doctor of Public Health (DrPH) program. The overall goal of the course is to provide the students with an opportunity to read, critically reflect, actively discuss and write on the benefits of building community partnerships and coalitions. The materials in this course provide a basis of understanding concepts, theories and applications critical to public and community health.

PUBH 28203 Public Health Practice III - Strategies to Eliminate Health Disparities
3 Credit Hours
This is a required course for students who matriculated in the Doctor of Public Health (DrPH) program. The overall goal of the course is to provide students with an opportunity to read, critically reflect, actively discuss and write on the issues related to and that contribute to

health disparities. The materials in this course provide a basis of understanding concepts, theories and applications critical to public and community health and a means for designing solutions.

PUBH 28301 Doctoral Seminar
1 Credit Hour
This a student-centered, weekly seminar for students matriculating in the Doctor of Public Health Program. The seminar will consist of several types of activities: 1) presentations on content areas by faculty, community organizations, and community and academic partners in collaboration, 2) sessions focused on issues of professional development, 3) sessions focused on specific research skills or methods, 4) workshop and discussion sessions that provide students with a forum for engagement and collaboration around issues of mutual concern, 5) student presentations. A total of 6 credit hours of this course are required for graduation.

PUBH 28390 Dissertation Preparation
1–9 Credit Hours
This is an independent study course that allows students the opportunity to independently work on their dissertation topic and complete their research prior to the defense of their dissertation. The number of credits the student selects determines the number of hours per week that must be dedicated to working on the Dissertation Preparation plan. The student is responsible for finding a faculty member willing to work with the student; together, they will establish learning goals, deliverables, resources, timeline, and mechanism for feedback.

PUBH 28398 Doctoral Dissertation
1 Credit Hour
After completing all other coursework, including the Applied Practice Experience, and defending the dissertation proposal, the student must complete a field-based doctoral dissertation that is designed to influence programs, policies, or systems applicable to advanced public health practice. The practice-oriented dissertation must address a research question of the student's design and result in the production of a high-quality written product that demonstrates synthesis of foundational and concentration-specific competencies.

PUBH 28399 Doctoral Dissertation
1-5 Credit Hours
After successfully completing all other coursework, the student must complete a field-based doctoral dissertation that is designed to influence programs, policies, or systems applicable to advanced public health practice. The practice-oriented dissertation must address a research question of the student's design and result in the production of a high-quality written product that demonstrates synthesis of foundational and concentration-specific competencies. Prior to writing the dissertation, the student will develop a dissertation proposal that must be approved by the committee. At the completion of the dissertation, the student will submit the dissertation to the committee at least 30 days prior to the dissertation defense. The student is required to enroll in 10 credits for the dissertation.

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PUCH 19003 Doctoral Dissertation Continuation
0 Credit Hours
This is a form of registration available to students who have completed all of the required coursework, including dissertation credits but have not yet completed the writing of the Dissertation. Continuation status is limited to three consecutive terms following the completion of Dissertation credits.

PUCH 19150 Introduction to Epidemiology
3 Credit Hours
The course provides: 1) an overview of epidemiologic concepts; 2) an introduction to the approaches and techniques that are used to measure and monitor health status in populations; 3) an introduction to study designs to assess disease prevention and intervention; and 4) an introduction to clinical research study designs that elucidate causative factors for disease.

PUCH 19152 Global Environmental Health
3 Credit Hours
Global Environmental Health will examine environmental problems that manifest at a global scale, with implicated for human health and health equity. This course provides (1) a survey of major global environmental issues impacting human health, (2) a focused examination of global climate change, related health impacts, and approaches to environmental sustainability, mitigation, and resilience. Issues to be considered include urbanization, air quality, water and sanitation, energy, food systems, biodiversity, life cycle assessment/waste, drivers of emerging diseases, climate change, and green infrastructure. The course will consider relevant social, economic, and political factors and approaches to controlling or eliminating risks. We will apply a global health equity perspective, examining causes and effects of environmental issues and implications for vulnerable populations. Environmental health issues in both developed and developing countries will be presented.

PUCH 19201 Community Health Improvement I
3 Credit Hours
Foundations of Public and Community Health: This course is for students entering the PhD Program in Public and Community Health. The overall goal of this course is to provide students with an opportunity to read, critically reflect upon, and actively discuss the course material with classmates and the instructor. Course materials encompass a review of conceptual foundations, theoretical approaches, and critical perspectives on public health policies in the public and community health.

PUCH 19202 Community Health Improvement II
3 Credit Hours
Health Disparities and Underlying Determinants of Health: This course is for students enrolled in the PhD Program in Public and Community Health. This course will provide students with an in-depth introduction to health disparities and social determinants of population health. The course will help clinicians and other public health students and professionals develop and

strengthen their knowledge, skills, and ability to critically examine issues of health disparities and to develop a better understanding of some of the underlying social determinants of health disparities, from a multidisciplinary perspective. The ultimate goal of the course is to help students develop the skills needed to apply knowledge and theory of health disparities and determinants of health in designing health services and epidemiological studies and interventions to reduce and ultimately eliminate health disparities.

PUCH 19203 Community Health Improvement III
3 Credit Hours
Principles and Practices of Community-Academic Partnerships: Community-Based Participatory Research (CBPR) is a collaborative approach to research that combines methods of inquiry with community capacity-building strategies that bridge gaps between evidence-based knowledge and community health practices. Fundamental to creating positive change in a community is to establish processes that foster community engagement. Design and implementation of CBPR should include participation, reflection and empowerment of communities who seek to improve their health or social situations. Students will be exposed to definitions and principles commonly utilized in CBPR. Lectures, readings and discussions will expose students to various models of CBPR that originate from community-academic partnerships to implement research agendas that are dependent upon community participation. Students will identify a health issue of interest and a community organization that is working to address a health-related issue. Students will select a model of community engagement and strategically outline steps to secure community participation.

PUCH 19204 Community Health Improvement IV
3 Credit Hours
Translating Community Health Improvement into Policy: This course is for students in the PhD Program in Public and Community Health. Students will apply their knowledge of community health improvement to their understanding of health policymaking in the US. Students will gain understanding of theoretical foundations of policymaking, the policymaking process, and strategies for translating community health improvement activities into policy. Students will develop a policy and advocacy agenda for a current health policy issue.

PUCH 19210 Health and Medical Geography
3 Credit Hours
Geography and physical and social environments have important implications for human health and health care. This course will explore the intersections among geography, environments and public health, with an emphasis on geographical analysis approaches for health data, to address two key questions: (1) How can concepts from geography help us to better understand health and well-being? (2) How can geographic tools, such as Geographic Information Systems (GIS) be used to address pressing questions in health and medical research?

PUCH 19215 Injury Prevention and Public Health
3 Credit Hours
Injury is a leading cause of death and disability in the United States and globally. The aim of this course is to explore injury as a public health issue through deep investigation of the

burden of various types of injury (e.g., intentional and unintentional) and consider public health strategies for injury prevention in our communities. This course is particularly relevant to students who want to understand the burden of injury on the public's health and to develop experience considering prevention strategies and evaluating the effect of these strategies. The course will emphasize practical applications to real world problems. Students will have a full understanding of the physical and public health costs of injury as well as the value of multidisciplinary collaboration to prevent injury.

PUCH 19225 Introduction to Statistical Analysis
3 Credit Hours
This course will introduce fundamental statistical concepts, reasoning and methods that can be used for exploring, describing, and analyzing quantitative datasets. Students will become acquainted with basic statistical concepts, cleaning and organizing datasets, performing descriptive analysis and statistical reasoning, and interpreting results of univariate and bivariate analyses, hypothesis testing, and linear regression. By the end of the course, students will be able to analyze data independently using statistical software and interpret results. Coursework will include weekly reading, in-class data analyses, quizzes, two exams, and a focused course project. Course projects will enable students to independently develop research questions, acquire appropriate datasets, develop their skills in coding with data analysis software, complete statistical analyses, and interpret results.

PUCH 19226 Applied Regression Analysis
3 Credit Hours
This course will provide an introduction to the foundations and principles of regression through hands-on training in advanced regression techniques using statistical software. Statistical analyses covered will include multiple linear regression, analysis of variance, logistic, ordinal logistic regression, and mixed models. Students will become acquainted with the basics of coding and interpreting results of regression analyses, as well as diagnostics to confirm correct model fit. By the end of the course students will be able to conduct regression analyses independently and interpret results. Coursework will include weekly reading, in-class analyses, and completion of a focused course project developed throughout the semester. Course projects will allow students to develop their skill set independently coding in statistical software to complete analyses and interpreting results within the context of strengths and limitations of each test. The final project will also incorporate both literature review and developing a research question that can be analyzed using existing data.

PUCH 19229 Survey Research Methods
3 Credit Hours
Survey Research Methods is a graduate-level, 3-credit hour course that introduces students to the broad concepts of survey design, conduct, and analysis. Students will gain a detailed and comprehensive understanding of questionnaire design, sampling, data collection, survey nonresponse, and analysis of survey data. The course will include lectures, reading assignments, class discussions, individual and group presentations, and exams.

PUCH 19230 Qualitative and Mixed Methods
3 Credit Hours
Qualitative and mixed methods can be highly useful in the conduct of community-based population health research. This course will provide introductory classroom and field-based learning experience in qualitative and mixed methods research. Students will receive training in the design, implementation, analysis, and synthesis or qualitative and mixed methods. Emphasis will be given to the appropriate uses of commonly-used methods in community-based health research. Course participation will provide students with the basic foundation necessary to develop a research study using qualitative or mixed method designs. This course is for graduate students in the doctoral degree program for Public and Community Health.

PUCH 19232 Qualitative Data Analysis
3 Credit Hours
This course will introduce students to the analysis of qualitative data in public health research The aim of the course is to explore the process of transforming various types of qualitative data interview transcripts field notes and other texts into analyses and interpretations We will introduce students to various analytic approaches explore their use and guide students in applying them to data The course will explore both theoretical and practical dimensions of qualitative data analysis including identifying themes developing and using codebooks making systematic comparisons and building and testing models Approaches to qualitative data analysis will include grounded theory and content analysis Students will also be introduced to the use of computer software for coding and managing qualitative data The course will emphasize the connection between theory and methodology with particular attention to the relationship between the research question study design data sources analytic approach and interpretation of results

PUCH 19234 Introduction to Grant Writing
2 Credit Hours
Grant writing is an essential skill for those preparing to become independent research investigators. This course offers an overview of the tools, processes, and strategies involved in preparing a successful National Institutes of Health (NIH) funding proposal. Students will critically examine funding applications and gain practical, hands-on experience in developing the key components of a research proposal.

PUCH 19235 Data Management and Use for Public and Community Health
3 Credit Hours
Understanding approaches to working with data provides critical skills to support public and community health research and practice. This course is intended to give students background on data management for quantitative and qualitative data, including both primary and secondary data sources, and working with large datasets. Students will work hands-on with data in various formats and will also learn fundamental skills in data management, working with databases, data quality, data documentation, and related topics.

PUCH 19250 Human Health Risk Assessment and Environmental Health Literacy
3 Credit Hours
The course will provide a foundation in Human Health Risk Assessment (HHRA) as it is described by United States Health Agencies: The National Research Council, the Agency for Toxic Substances for Disease Registry, and the Environmental Protection Agency. This foundation will then contextualize the emerging field of Environmental Health Literacy (EHL), which is a hybrid of Risk Assessment and Health Communication. EHL thusly draws from well-established methodologies and theories to tackle difficult issues in translational science. Students will gain a detailed comprehension of the historical development of environmental science and how this set of disciplines have integrated with health science. The course will begin with a primer on the philosophical foundations of environmental science by considering late 19th and early 20th century thinkers with accompanied readings. Next, the course will review basic principles of Risk Assessment (with a focus on Human Health Risk Assessment) from the perspective of addressing federal policy. This will lead into some case studies to illustrate the contribution of scientific research to the policy-oriented topic of Risk Assessment. Finally, students will obtain an overview of environmental policy and participate in discussions and assignments that elucidate this important interface between science and society. Students will be evaluated via a midterm exam (20%), a final exam (20%), participation in discussion and organized class debate-styled actives (20%), an oral presentation (20%), and a written essay (20%).

PUCH 19260 Implementation Research Methods
3 Credit Hours
This course provides an introduction to the field of implementation science, which is the systematic study of methods to promote the uptake of research findings into practice and to improve the implementation of evidence-based interventions. The course will cover the following topics: (1) What is implementation science and why is it important? (2) Theoretical frameworks and models for implementation; (3) Implementation research methods and designs; (4) Evaluation of implementation interventions and reporting; (5) Scale-up and de-implementation; and (6) Implementation science and health equity. The course will include a combination of lectures, discussions, and in-class assignments. Students will also be responsible for crafting and presenting a research proposal using implementation research methods as the final project.

PUCH 19280 Advanced Program Evaluation for Public Health
3 Credit Hours
This course is designed to introduce advanced graduate students in public health to a variety of approaches to program evaluation. Students will develop a range of skills that are required to both design and implement an evaluation. The emphasis will be on quantitative skills, but qualitative skills will be addressed. The focus is mainly on the evaluation of programs, and policy evaluation in the public health sector. Exercises will be cumulative and build toward a final evaluation proposal.

PUCH 19290 Critical and Analytical Writing
3 Credit Hours
Critical and Analytical Writing provides hands-on training, practice, and feedback in the construction of clear, well-written documents and arguments. With a focus on critical

analysis and rhetorical situations, the successful student will be able to effectively write to any audience. Interactive sessions and structured assignments highlight the importance of developing these skills you will use throughout your professional life.

PUCH 19295 Reading and Research
1-9 Credit Hours
The course of study for Reading and Research is designed by each student with his/her advisor to focus on readings in literature in the student's field, to build bibliographic resources for the dissertation, and to conduct supervised, independent research.

PUCH 19301 Doctoral Seminar in Public and Community Health
1 Credit Hours
This is a weekly seminar for students enrolled in the PhD Program in Public and Community Health. The seminar will consist of several types of activities: 1) presentations on content areas by faculty, community organizations, and community and academic partners in collaboration, 2) sessions focused on issues of professional development, 3) sessions focused on specific research skills or methods, 4) student presentations, and 5) program-specific sessions. A total of 7 semester hours of this course is required for graduation.

PUCH 19399 Doctoral Dissertation
1-9 Credit Hours
This course is required for the completion of the PhD degree. The PhD candidate must submit a dissertation based on original research of a high scholarly standard that makes a significant contribution to knowledge in their chosen field.