MCW
GRADUATE SCHOOL

Academic Program Requirements

2025-2026

2025-26

4+1 Dual Degree Program

Degree Offered: Master of Public Health

Program Description

This program allows undergraduate students at partner schools to pursue graduate coursework online. Up to 15 credits of this graduate work may count towards both the undergraduate and graduate degrees. After earning the undergraduate degree, students continue as graduate students at MCW for approximately one additional year until they complete the Master of Public Health program. The curriculum focuses on public health practice and consists of four core courses, seven additional required courses, one elective course, a field placement experience, and a capstone project. Assignments require the application of theoretical concepts to practical situations through case analysis and experiential activities.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has specific requirements as defined by the undergraduate institution and MCW.

Credits Required to Graduate

42 credits

Required Courses

PUBH 18101 Foundations of Public Health. *3 credits.*
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 18155 Public Health Theory & Practice. *3 credits.*
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 credits.*
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 the 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 credits.*
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 credits.*
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 credits.*
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 credits.*
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 18223 Public Health Policy. *3 credits.*
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 credits.*
Recommended: 18203 Public Health Administration and 18209 Community Health Assessment and Improvement.
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 18260 Community Health Program Evaluation. *3 credits.*
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 credits.*
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.*
Prerequisites: 18165 Principles of Public Health Data and Epidemiology, 18203 Public Health Administration, 18204 Public Health Analytics, 18155 Public Health Theory and Practice; all required coursework in the Master of Public Health program besides 18280 Field Placement and 18297 MPH Capstone Project recommended.

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. *1-5 credits.*
Prerequisites: All required coursework in the Master of Public Health program besides 18297 MPH Capstone Project recommended.
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 18297 Capstone Project. *3 credits. Prerequisites: All other MPH coursework.*
The Capstone Project or Integrative Learning Experience 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.

Elective Courses

PUBH 18115 Health Promotion and Disease Prevention. *3 credits.*
Students will learn key concepts through readings, lectures, on-line discussions and written exercises. The latter will allow students to practice designing elements of an HP/DP plan for a population and health problem of their own choosing using each of the theoretical models and techniques presented in the course. This course is an elective in the MPH degree program, the Certificate in Community Health Assessment & Planning program, and the Certificate in Population Health Management program.

PUBH 18215 Infectious Diseases. *3 credits.*
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 18150 Public Health Law and Ethics. *3 credits.*
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 of 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 18232 Introduction to Population Health Management. *3 credits.*
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 credits*.
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.

2025-26

BASIC & TRANSLATIONAL SCIENCE

Degree Offered: Concentration

Program Description

The program builds on a strong foundation of core basic science knowledge and develops competencies associated with successful scientific innovation and research in a multidisciplinary collaborative learning environment. In this program, students are trained to think broadly about the clinical applications of the basic sciences and to carry out research bridging the gap between basic science and clinical practice. Students will come into graduate school through the Interdisciplinary Program in Biomedical Sciences (IDP), Neurosciences Doctoral Program, Physiology Graduate Program, Biomedical Engineering Program or Biophysics Graduate Program in Imaging.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Basic Science PhD seekers who are in good academic standing may express interest in the program near the end of the first year when a basic science advisor is chosen. If the advisor chosen is willing to help a student pursue the translation component, students can apply to the BTS Program.

Credits Required to Graduate

12 credits

Program Credit Requirements

Students will satisfy the PhD requirements of their Basic Science Department and those of the Translational Science portion of the program. Twelve advanced credits are required for the program. Four credits can overlap with existing program if they satisfy Clinical Research Professional Core Competencies. An Independent Study course has been created to allow for diverse experiences in Clinical & Translational work to count for credit.

Required Courses

BTSI 21150 Boundaries of Science and Medical Practice. *1 credit.*
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.*
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 credits per seminar, 4 credits total.*
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.

Notes

Program Components

- Apply after completion of first year PhD graduate courses
- Once accepted into the program, students are part of the PhD program in their selected Basic Science Department and part of the concentration in Basic and Translational Science Program.
- Complete Individual Development Plan based on Translational Research Competencies that you would like to develop
- Based on Individual Development Plan, identify a clinical/translational research mentor
- Work alongside BTS leadership, mentors, and fellow classmates to identify 12 credits of relevant work to develop Translational Research Competencies. These can include:
    - Relevant Coursework
    - Clinical Shadowing Experiences
    - Participation in National or Local Committees
    - Advocacy for Scientific Policy
    - Projects that Complement and Enhance the Translational Relevance of Dissertation Work
- Include one translationally relevant research aim in your dissertation proposal
- Develop mentor/mentee relationships with both basic and clinical healthcare professionals

2025-26

BIOCHEMISTRY

Degree Offered: Doctor of Philosophy

Program Description

As a member of the Biochemistry PhD program at MCW you will have the opportunity to investigate the biochemical basis of diseases such as cancer, neurodegeneration, heart failure, diabetes and others, using state-of-the-art facilities and instrumentation for structural biology, metabolism, signal transduction, and drug discovery.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Admission to the Biochemistry Graduate Program is through the Interdisciplinary Program in Biomedical Sciences (IDP), Neuroscience Doctoral Program (NDP), or Medical Scientist Training Program (MSTP). After completion of the first-year curriculum of that program, students who choose to complete their dissertation research project with faculty of the Biochemistry Graduate Program will have the opportunity to continue their graduate studies by selecting from among a wide range of courses that are offered within the Biochemistry Graduate Program as well as other programs at MCW. Courses to be taken are based on the student's interests in consultation with the student's dissertation advisor and committee.

Fields of Study

The following areas of research are available in the department:

- The identification and characterization of signaling pathways that prevent cells from completing cytokinesis with unresolved mitotic errors.
- Structure/function studies of kinases and other proteins that ensure faithful progression through cytokinesis.
- Machine learning to predict and understand biology, enabling drug discovery and personalized medicine
- Mass spectrometry-based multi-omics (proteomics, metabolomics, lipidomics)
- Cancer cell signaling in neurological and other malignancies.
- Regulation of chromatin structure and accessibility by the conformation and dynamics of nucleosomal histone tails. Additional levels of regulation by histone post-translational modifications (PTMs) and histone variants.
- Post-translational modification of lysine and cysteine residues controls protein function and exploiting these insights in the design of novel chemical probes
- Functional study of the nutrient-dependent O-GlcNAc signaling in pregnancy, early development, and metabolism.
- Pre- and Post-natal exposure to non-nutritive sweeteners: impact on development and metabolism
- Heme protein interactions with the actin cytoskeleton, mitochondria and RNA regulating proteins, how these change with cellular environment and the downstream effects.
- Redox and calcium signaling in the heart and disruptions contributing to atrial fibrillation.
- Diabetes, beta cell biology, inflammation innate immunity, cell signaling, cell fate decisions.
- Molecular mechanisms underlying the functioning of mannose 6-phosphate receptors

(MPRs) in mammalian cells.
- Molecular regulation of nutrient utilization in metabolic syndrome, atherosclerosis and inherited diseases of fat metabolism.
- Molecular mechanisms governing G protein-coupled receptor signaling and trafficking.
- Structural biochemistry of multi-protein machinery (RNA polymerases and associated factors) involved in gene transcription and RNA processing in the eukaryote.
- Oxidative stress, reactive oxygen/nitrogen species, cell membrane lipids, lipid peroxidation and mechanisms of oxidative apoptosis.
- The role of metabolic modifications such as acetylation. The role of topological stress in DNA. The role of accessory proteins in modulating histone DNA interactions.
- Structure-function relationship of enzymes and receptors using X-ray diffraction methods.
- Characterization of molecular mechanisms of protein dynamics and protein-protein interactions using solution NMR and other biophysical techniques.
- In vivo mechanisms controlling developmental and cardiovascular specific gene expression.
- Druggability of proteins involved in mitochondrial homeostasis in healthy and diseased cells to identify molecular mechanism and novel therapeutic routes.
- Mechanistic differences of Ras/Raf-induced growth inhibition vs. proliferation at molecular levels.
- Protease and protease inhibitors in the cornea. Structure-function of maspin and its effects on carcinoma and corneal cells.
- Structural biology of immunological signaling molecules and the use of NMR spectroscopy in structural proteomics

Credits Required to Graduate

60 credits minimum

Required Courses

BIOE 10222 Ethics and Integrity in Science. *1 credit.*
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. Bioethics 10222 is offered during the spring and summer terms only.

BIOE 10444 Research Ethics Discussion Series.
1 credit.
Prerequisite: 10222 Ethics and Integrity in Science.
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, 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. Bioethics 10444 is offered during the spring terms only.

BIOC 02207 Enzyme Kinetics and Receptor Binding. *1 credit.*
This course teaches 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 multisubstrate reactions, determination 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 reading and student-led discussions 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 six-week duration of the course each student will prepare a short report in which he or she describes the design and, if possible, execution of a series of kinetic or receptor binding studies that draw on the teachings of the course and are related to the work each proposes to carry out for a dissertation.

BIOC 02226 Biophysical Techniques in Biochemistry.
3 credits.
Prerequisite: 16268 Protein Chemistry: Principles
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.
Prerequisite: 16268 Protein Chemistry: Principles
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 3-D structure determination processes.

BIOC 02235 Biomolecular NMR: Protein Dynamics and Binding. *1 credit.*
Prerequisites: 16268 Protein Chemistry: Principles and enrollment in 02230 Biomolecular NMR: Structure and Molecular Recognition.
NMR spectroscopy is one of the most powerful tools of contemporary structural biology. Multiple NMR applications enable structural, thermodynamic, and kinetic analysis of proteins and nucleic acids under physiological conditions with site-specific resolution. The course "Biomolecular NMR: Protein Dynamics and Binding" discusses applications of NMR to protein dynamics, conformational transitions, and ligand binding. The topics include NMR line shape analysis and spin relaxation methods that are used to extract structural, thermodynamic, and kinetic parameters of conformational transitions and ligand binding in proteins. The course is directed to students who would like to utilize NMR spectroscopy as a part of the dissertation research.

BIOC 02240 Contemporary X-ray Crystallography.
1 credit.
Prerequisite: Completion of IDP course curriculum.
X-ray crystallography is the main method that is used to elucidate three-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 grasp the essence of macromolecular crystallography.

BIOC 02248 Structural Basis - Macromolecules. *1 credit.*
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 02276 Special Topics in Biochemistry. *1 credit.*
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 credits.*
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 02301 Seminar. *1 credit.*
Students are given practice in presenting and evaluating their research data. Solutions to research problems encountered are also discussed. Seminar is required beginning in the second semester and continues throughout each student's program.

BIOC 02399 Doctoral Dissertation. *9 credits.*
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.

INBS 16267 Protein Chemistry: Applications. *1 credit.*
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.*
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 16274 Metabolism. *1 credit.*
This new elective course will be mainly a didactic based course that will comprehensively review subjective important to metabolism. the topics covered will range from carbohydrate metabolism to oxidative phosphorylation to lipid and amino acid metabolism. 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 highlighted by focusing on landmark studies or recent developments from published research articles. Although there will be a specifically assigned textbook, students will be encouraged to read relevant chapters from Fundamentals of Biochemistry (Voet). 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.

Required Courses as Needed

BIOC 02002 Master's Thesis Continuation. *0 credits.*
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 credits.*
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 02299 Master's Thesis. *6-9 credits.*
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.

2025-26

BIOETHICS

Degree Offered: Master of Arts

Program Description

The Master of Arts in Bioethics Program provides advanced training in bioethics for professional, academics, and other interested individuals in health care, law, the humanities, and public policy who wish to become prepared for teaching, research, policy development, and/or clinical work in the field of bioethics. The program curriculum consists of a robust combination of theoretical and clinical course offerings that provide a strong foundational knowledge base upon which students develop the skills and understanding necessary to analyze and address the difficult and evolving ethical issues encountered in health care today.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has no additional specific requirements; however, interested individuals from all disciplines and backgrounds with a commitment to the field of bioethics are encouraged to apply.

Credits Required to Graduate

30 credits

Program Credit Requirements

The Master of Arts in Bioethics Program has three main components: (1) Required Courses, (2) Clinical Bioethics Experience, and (3) Master's Thesis or Final Paper.

The curriculum for the Master of Arts in Bioethics program requires completing a total of 30 credits. Students should aim to complete the required courses (10210, 10209, 10223) early in their program, as they provide the foundation for the electives and the comprehensive exam.

The remaining credits of the program are elective courses of the student's choosing and may include credits for the Master's Thesis, if a student chooses to write a thesis.

Once the core curriculum (10209, 10210, 10223) and elective credits combined reach a total minimum of 24 credits, each student will complete a written comprehensive examination. This exam is designed to challenge the student's ability to critically analyze selected bioethical issues in depth.

Clinical Bioethics Experience

The clinical bioethics experience requirement reflects the significance of clinical experience in medicine and/or biomedical research to the degree. The program acknowledges that many students, as health care professionals or researchers, may already have experience in clinical ethics or research ethics. Students can satisfy the clinical bioethics experience

requirement either through proven professional experience in clinical ethics or human subjects research ethics, or through taking a course on clinical ethics committees and ethics consultation.

Master's Thesis or Final Paper

Students choose to write either a traditional Master's Thesis or a Final Paper at the culmination of the program. Students choosing the Master's Thesis will earn six credits for their research and writing work. Students choosing the Final Paper must complete six additional course credits in lieu of the Master's Thesis credits in addition to writing a paper of publishable quality.

When all of the course credit requirements have been met, the Comprehensive Exam has been completed successfully, and the Master's thesis or final paper submitted, the Program will be completed by means of a successful oral defense of either the Master's thesis or the final paper.

Required Courses

BIOE 10209 Clinical Topics in Bioethics. *3 credits.*

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, and research ethics.

BIOE 10210 Philosophical Bioethics. *3 credits.*

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 10223 Law and Bioethics. *3 credits.*

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.

Required Courses as Needed

BIOE 10002 Master's Thesis Continuation. *0 credits.*

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.

BIOE 10231 Bioethics Consulting and Committees. *1 credit.*
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.

Elective Courses

BIOE 10200 Clinical Bioethics I. *3 credits.*
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. Enrollment limited.

BIOE 10203 Justice and Healthcare. *3 credits.*
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 credits.*
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 credits.*
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 credits.*
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. (Issued December 1, 2000.)

BIOE 10211 Ethics Beyond the Acute Care Hospital. *3 credits.*
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 10216 Race and Trust in Biomedical Research. *3 credits.*
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 credits.*
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 and Integrity in Science. *1 credit.*
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. Bioethics 10222 is offered in the spring and summer terms only.

BIOE 10225 Religion and Bioethics. *3 credits.*
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 Subjects Research Protections. *3 credits.*
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 credits.*
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 and Committees. *1 credit.*
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 Pediatric Ethics. *3 credits.*
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 and Human Reproduction. *3 credits.*
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 10275 Special Topics in Bioethics. *3 credits.*
This course focuses on topics of special interest in bioethics. Examples of topics include neuroethics, ethics at the end of life, ethical issues in mental health, and political issues in bioethics and public health.

BIOE 10295 Reading and Research. *1-3 credits.*
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 Master's Consultation. *1-2 credits.*
This course will familiarize and train students 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.*
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 credits.*
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.
Prerequisite: 10222 Ethics and Integrity in Science.
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, 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. Bioethics 10444 is offered in the spring term only.

2025-26

BIOINFORMATICS

Degree Offered: Master of Science in partnership with Marquette University

Program Description

This interdisciplinary program is jointly offered by Marquette University and Medical College of Wisconsin. The program prepares students for a multidisciplinary career in the biomedical sciences using mathematics, statistics, and computer science. It is designed to provide students quantitative tools for analyzing data and problems associated with molecular, cellular, physiological, and particularly, genetic systems. Students may select courses from a list of approved courses offered by the following departments at Marquette: Computer Science; Mathematical and Statistical Sciences; Biology; Biomedical Engineering; and Electrical and Computer Engineering. In addition, courses are offered by the Department of Physiology and the Division of Biostatistics at Medical College of Wisconsin. The program meets the needs of recent undergraduates seeking an advanced degree as well as employed professionals interested in opportunities for career advancement.

Students are admitted under the non-thesis option, but a thesis option is also offered. Students may pursue the degree on a full-time or part-time basis. Many courses are offered evenings.

Learn more here.

Contact information: gradschool@mcw.edu | (414) 955-8218

2025-26

BIOMEDICAL ENGINEERING

Degree Offered: Doctor of Philosophy in partnership with Marquette University

Program Description

Biomedical Engineering (BME) is an interdisciplinary field that is based on the application of engineering principles and experimental and analytical techniques to the development of biologics, materials, devices, implants, processes, and systems that advance biology and medicine and improve medical practice and health care.

The Doctor of Philosophy (PhD) degree in BME is a research degree that is intended to provide the graduate with the breadth and depth of knowledge in one area of specialization within BME, as well as the scientific research training needed for successful careers in academia, biomedical industry, or government. The research training process begins with the student working closely with his or her Dissertation Director and participating in his or her research program. Building on these experiences, the student begins to conduct independent research that eventually leads to an original contribution to the BME field.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Graduates of accredited colleges or universities with a Bachelor's or Master's degree in various engineering, physical science, or life science disciplines or equivalent are eligible for admission to the joint MU-MCW PhD Program in BME.

Students who do not have an engineering degree are admitted into the PhD program on a conditional status based on successful completion (grade of B or better) of a sequence of leveling courses. These courses will provide them with fundamental engineering principles and analytical skills needed for successful completion of the PhD degree in BME. See the Handbook of MU-MCW PhD Program in BME for details.

Credits Required to Graduate

60 credits minimum

Program Credit Requirements

Upon enrolling in the doctoral program in BME, a student selects his or her area of specialization. Faculty designs a curriculum and research program to address the specific goals of each student. Program includes course work in engineering, biology, mathematics, and medicine, all of which are integrated with research laboratory experience.

The Doctoral Qualifying Examination (DQE) consists of both written and oral components. Students entering the doctoral program with a master's degree are recommended to take the DQE at or before the completion of 15 graduate credits of didactic coursework. Students entering the doctoral program with a bachelor's degree are recommended to take the DQE at or before completion of 30 graduate credits of didactic coursework. The written portion of the DQE involves writing a dissertation proposal in the form of an NIH-styleF30/F31

fellowship grant proposal and the oral portion involves presentation and defense of the dissertation proposal, in which the Dissertation Committee members serve as examiners.

A minimum of 60 graduate credits are required to complete the PhD degree in BME. For someone entering with a BS degree, this constitutes 36 credits in didactic coursework, 9 credits in dissertation, and a minimum of 15 credits in reading and research. For those entering with an MS degree or with 18 graduate credits (see Transfer of Credits Policy), they are required to complete a minimum of 18 credits in didactic coursework, 9 credits in dissertation, and a minimum of 33 credits in reading and research. Pre-requisite courses for applicants who do not have a BME degree are not counted as graduate credits. Reading and Research credits can be earned by registering and attending a seminar series, workshop, conference, journal club, or simply carrying dissertation-related activities. A student can register for up to 9 credits of reading and research per semester during fall and spring semesters and up to 6 credits during the summer. Students should register for dissertation credits in the semester they intend to defend their dissertation.

Fields of Study

- Bioinstrumentation
- Biomechanics
- Biomedical Imaging
- Cellular and Molecular Engineering
- Computational Biology and Bioinformatics
- Rehabilitation Bioengineering

Required Courses

All doctoral students must complete courses that satisfy the following competencies:

BIOM 6953/*BIEN 6953. Seminar in Biomedical Engineering. *0 credits.*
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 BME graduate students.

Bioethics (2 credits required)
BIOE 10222 Ethics and Integrity in Science and Course. *1 credit.*
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. Bioethics 10222 is offered during the spring and summer terms only.

BIOE 10444 Research Ethics Discussion Series. *1 credit.*
Prerequisite: 10222 Ethics and Integrity in Science.
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, 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. Bioethics 10444 is offered during the spring terms only.

Biomedical Sciences (3 credits required)
This core course can cover: cellular and systems physiology, neurophysiology, intra- and intercellular signaling, genetics and developmental biology, pharmacology, cellular pathology and immunology, microbiology, molecular biology, biochemistry).

***BIOL 5102. Experimental Molecular Biology.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

BIOM 5700/*BIEN 5700. Systems Physiology. *3 credits.*
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.

***BIOL 5703. Exercise Physiology.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

BIOM 5720/*BIEN 5720 Cardiopulmonary Mechanics. *3 credits.*
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.

PHYS 08204 Graduate Human Physiology. *3 credits.*
This course provides the fundamental aspects of: 1) cell membrane transport, 2) smooth, skeletal, and cardiac contractile mechanisms and excitation-contraction coupling, 3) principles of synaptic transmission, neurotransmittors, and neuromodulators, 4) respiratory mechanics, gas exchange in the lung, and control of breathing, 5) cardiac electrophysiology, hemodynamics, nervous and humoral control of the heart and cardiac output, 6) renal tubular transport, glomerular filtration, and regulation of sodium and water balance, 7) neural and humoral control of gastrointestinal absorption and motility, and 8) endocrinology including pituitary, adrenal cortical, thyroid, pancreatic and male and female reproductive organs. Material will be covered primarily in lecture format by expert physiologists in each respective area.

INBS 16215 Foundations in Biomedical Sciences I. *3 credits.*
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, in-class discussions, and review sessions which are designed to promote class participation.

INBS 16216 Foundations in Biomedical Sciences II. *3 credits.*
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 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 credits.*
FBS III builds on the cell biology fundamentals introduced in the latter part of FBS I and II. This course starts with lectures on cell signaling and a discussion of a primary research article on the topic. 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. The third part of the course focuses on DNA homeostasis, genetic principals, the basis of stem cells and cancer.

INBS 16218 Foundations in Biomedical Science IV. *3 credits.*
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 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 is designed to incorporate current analytical methods, computational and statistical aspects of data analysis and clinical or practical impacts on human health and disease.

INBS 16271 Fundamentals of Neuroscience. *3.5 credits.*
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, seminars from prominent scientists (video archives), and written assignments. The purpose of this course is to introduce 1st year graduate students to the structure and function of the human nervous system.

NSCI 12221 Advanced Systems Neuroscience. *3 credits.*
Prerequisite: 16271 Fundamentals of Neuroscience or consent of the course director.
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 and Molecular Neurobiology. *3 credits.*
Prerequisite: 16271 Fundamentals of Neuroscience or consent of the course director.
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.

Biostatistical Methods (3 credits)

BIOS 04224 Biostatistical Computing. *3 credits.*
Prerequisites: Statistical Models and Methods I or concurrent registration
This course will cover the details of manipulating and transforming data required for statistical analysis. Topics include 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. How to use R packages and C/C++ codes in R will also be covered. The LaTeX document production system is also introduced.

BIOS 04231 Statistical Models and Methods I. *3 credits*.
Prerequisite: Three semesters of calculus and one semester of linear algebra
This course will cover statistical techniques for basic statistics. Topics include one-sample/two-sample tests, analyses for count data and contingency tables, basic nonparametric methods including sign, rank-sum and signed-rank tests, simple linear regression model and inference, checking model assumptions, model diagnostics, correlation analysis, one-way analysis of variance, Kruskal-Wallis one-way ANOVA, simple logistic regression, and weighted linear regression. SAS/R will be used throughout the course.

BIOS 04232 Statistical Models and Methods II. *3 credits.*
Prerequisite: Statistical Models and Methods I
This course will cover various regression models for independent and correlated data. Topics include multiple linear regression, model diagnostics, variable selection, influence/leverage, outliers, collinearity, transformation, GLM including logistic and Poisson regression, overdispersion, GEE, mixed models, and GLMM. SAS/R will be used throughout the course.

BIOS 04233 Introduction to Statistical and Machine Learning. *3 credits.*
Prerequisite: Statistical Models and Methods II
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, neural network, feature screening, graphical models, and quantile regression.

BIOS 04363 Advanced Statistics I. *3 credits.*
Prerequisites: Statistical Models and Methods II, Statistical Inference II
This course covers both the theoretical framework and practical aspects of statistical models. The course will cover likelihood inference, properties of likelihood, exponential

families and GLM, large sample properties of likelihood-based inference, likelihood-based regression models, GEE, conditional and marginal likelihood, asymptotics of penalized regression.

BIOS 04365 Linear Models I. *3 credits.*
Prerequisites: Statistical Inference II
This course will cover review of matrix algebra and vector spaces, multivariate normal distribution, quadratic forms, least squares estimation, ANOVA, testing contrasts, multiple comparison, lack-of-fit test, multiple regression models, and mixed models. Emphasis is on theory.

***MSCS 5720. Statistical Methods.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

***MSCS 5740. Biostatistical Methods and Models.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

Scientific and Technical Writing (2 credits)
INBS 16292 Writing a Scientific Paper. *1 credit.*
This course will present a step-by-step approach to putting together a scientific paper. Students will be divided into small groups, 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 credits.*
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 that will form the basis of their qualifying examination written report and a fellowship grant.

Leadership, Scientific Communication, and Teaching Skills (2 credits)
INBS 16290 Professional Development I. *1 credit.*
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 other's work.

INBS 16291 Professional Development II. *1 credit.*
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.

***GRAD 8961. Science Storytelling.** *1 credit.*
Course offered through Marquette University only. See the MU bulletin for more details.

Applied Mathematics (3 credits)
E.g., applied mathematical methods, fluid mechanics, finite element methods, biomedical signal processing, signals and systems, etc.

BIOM/*BIEN 5400 Transport Phenomena. *3 credits.*
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.

***BIEN 5410. Applied Finite Element Analysis.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

BIOM/*BIEN 5510 Image Processing for the Biomedical Sciences. *3 credits.*
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.

BIOM/*BIEN 6120 Introduction to the Finite Element Method. *3 credits.*
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.

BIOM/*BIEN 6200 Biomedical Signal Processing. *3 credits.*
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.

BIOM/*BIEN 6210 Advanced Biomedical Signal Processing. *3 credits.*
*Prerequisites: BIOM/*BIEN 6200 Biomedical Signal Processing.*
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.

BIOM 6500/*BIEN 6500 Mathematics of Medical Imaging. *3 credits.*
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.

BIOP 3240 Fourier Transformation. *3 credits.*
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.

***EECE 6010 Advanced Engineering Mathematics.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

***MEEN 5265 Intermediate Finite Element Method.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

***MEEN 6101 Advanced Engineering Analysis I.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

***MEEN 6102 Advanced Engineering Analysis II.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

***MEEN 6360 Computational Fluid Mechanics.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

***MEEN 6365 Computational Methods in Heat Transfer and Fluid Flow.** *3 credits*.
Course offered through Marquette University only. See the MU bulletin for more details.

Computational and Modeling Methods (3 credits)
E.g., numerical methods for solving mathematical models of physical and biological phenomena, regression analysis, data science and machine learning, biological network analysis, computer simulations of physiological systems, etc.

***BIEN 5410. Applied Finite Element Analysis.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

BIOM 5710/*BIEN 5710. Analysis of Physiological Models. *3 credits.*
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.

BIOM/*BIEN 6120 Introduction to the Finite Element Method. *3 credits.*
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.

BIOM 6620/*BIEN 6620. Modeling Rehabilitative Biosystems. *3 credits.*
Prerequisites: BIEN 5710 Analysis of Physiological Models and BIEN 5700 Systems of Physiology
Introduction to large-scale mathematical models of various physiological systems of interest in rehabilitation (e.g., cardiovascular, pulmonary, musculoskeletal, etc.). Discusses mathematical modeling, a widely used tool for testing hypothesis regarding the underlying mechanisms of complex systems such as physiological systems in health, disease, and recovery. For each, simulation is used to further our understanding of the adaptive processes of these systems in response to physiological/pathophysiological stresses and rehabilitative interventions.

***COSC 5610 Data Mining.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

***EECE 6820 Artificial Intelligence.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

***EECE 6822 Machine Learning.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

***EECE 6840 Neural Networks and Neural Computing.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

***MEEN 5270 Physical Systems Modeling.** *3 credits.*
Course offered through Marquette University only. See the MU bulletin for more details.

BIOM 35284. Computational Methods for Biomedical Research. *3 credits.*
This course focuses on modeling and computational 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 a complete step-by-step development of model assumptions, the resulting equations, and (when necessary) computer code.

BIOM 35285. Mathematical Biology. *3 credits.*
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.

Elective Courses

18 credits required. Courses intended to satisfy this requirement should be selected in consultation with the student's Dissertation Director. A minimum of three unique courses relevant to each specialization are offered within a three-year timespan. Additional specialization-specific courses may be chosen from special topics offerings, overlapping courses with other specializations and graduate courses offered through other departments at MU and MCW. PhD students and MSTP students in the Joint BME Department are also required to register for the BME Department seminar series for the duration of their study (BIEN 6953, which counts for 0 credit/semester of reading and research). For a given semester, students are expected to attend at least two thirds of the seminars

Notes

**Courses offered at Marquette University*
Please see Biomedical Engineering Handbook for additional information.

2025-26

BIOMEDICAL ENGINEERING

Degree Offered: Master of Engineering in partnership with Marquette University

Program Description

Upon enrolling in the Joint Marquette University/Medical College of Wisconsin Department's Master of Engineering (M.E.) program in biomedical engineering, a student selects one of five specializations and follows the curriculum designed for that specialization. The program includes course work in engineering, life sciences, mathematics, medicine, and healthcare technologies management, all of which will be integrated in a capstone comprehensive written exam.

Learn more here.

Contact information: gradschool@mcw.edu | (414) 955-8218

2025-26

BIOMEDICAL ENGINEERING

Degree Offered: Master of Science in partnership with Marquette University

Program Description

The MU-MCW biomedical engineering program is interdisciplinary in nature, involving the application of engineering and mathematics to the solution of problems related to medicine and biology. The faculty reflect this interdisciplinary nature in their courses and research. MU faculty are synergistically complemented by faculty from the MCW. The Department of Biomedical Engineering fosters collaborative interactions between the two institutions. Research can be characterized by the general areas of bioinstrumentation, biomechanics, biomedical imaging, cellular and molecular engineering, computational biology and bioinformatics, and rehabilitation bioengineering.

Learn more here.

Contact information: gradschool@mcw.edu | (414) 955-8218

2025-26

BIOPHYSICS

Degree Offered: Doctor of Philosophy

Program Description

The Biophysics Graduate Program encourages applications from students with strong backgrounds in chemistry, biology, biochemistry, biomedical engineering, physics, or mathematics and an enthusiasm for carrying out scientific research. The Program consists of two major areas—Molecular Biophysics and Magnetic Resonance Imaging. The faculty in the Molecular Biophysics section utilize biophysical techniques to study structural biology, free radicals in biology, and membrane protein systems. For example, current research includes studies on protein structure, functional dynamics, free radicals in biology, and magnetic resonance technology development. Students wishing to pursue this track should apply directly to the Biophysics Graduate Program or to the Interdisciplinary Program in Biomedical Sciences (IDP). The Magnetic Resonance Imaging section emphasizes research in the areas of cognitive neuroscience, signal processing, statistical analysis, image production, and hardware development. Students wishing to pursue this track should apply directly to the Biophysics Graduate Program or through the Neuroscience Doctoral Program (NDP). Applicants to this track are expected to have a high level of competence in physics and mathematics. Both tracks accept students from the Medical Scientist Training Program (MSTP).

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Students should have a strong foundation in quantitative, behavioral, and biological sciences

Fields of Study

- Protein structure and functional dynamics studies using site-directed spin labeling EPR spectroscopy.
- Structure-function relationships for membrane proteins; protein folding and dynamics; antibiotic peptides.
- Structure and function of protein-lipid assemblies relevant to human pathology.
- Structure and function of proteins embedded in cellular membranes using NMR spectroscopy.
- Molecular mechanisms of membrane protein function; role of protein conformational heterogeneity; GPCRs.
- Magnetic resonance (EPR, NMR, MRI) technology development.
- Molecular modeling and simulation integrating diverse experimental data
- Computational structural biology, molecular dynamics in mitochondrial processes
- Biological chemistry of nitric oxide and related species in physiology and pathology. Oxidative biology of sickle cell disease.
- Spin label studies on membrane dynamics and organization (raft- domain formation); spin label oximetry.
- Electron spin resonance studies of oxygen radicals and reactive nitrogen species in biological

systems; cardiovascular and neuro-degenerative pathologies (atherosclerosis, hypertension, ALS, Alzheimer's disease, etc.), free radicals in apoptosis and signal transduction, and chemotherapeutic drug-induced toxicity.

- Investigation of pathophysiological mechanisms enhancing free radical formation from nitric oxide synthase in vascular cells and their relation to the tetrahydrobiopterin pathway.
- Mapping of human brain language systems with magnetic resonance imaging (MRI).
- Development and employment of MRI techniques to diagnose and monitor injuries and diseases of the central nervous system.
- Mapping of activity in human brain visual systems with MRI.
- Characterization of brain cancer tumor cellularity and vascularity through diffusion and perfusion MRI; development of image processing techniques to help clinicians plan surgery and map out brain function for epilepsy.
- Functional MRI study of mechanism of anesthesia with respect to loss and return of consciousness as studied by electrophysiological and brain imaging methods, and of Alzheimer's disease and drugs of abuse.
- Address engineering challenges in diagnostic imaging to achieve higher sensitivity and specificity to the pathophysiology of various diseases, through of novel hardware and imaging protocols for MRI systems.
    - Metal artifact reduction methods for MRI; quantitative susceptibility mapping in MRI.
- Development of multiband or simultaneous multislice imaging technology.
- In vivo quantification of tissue perfusion using exogenous and endogenous contrast agents coupled with MRI.
- Development of MRI methods to assess brain tumor angiogenesis and invasion.

Credits Required to Graduate

60 credits minimum

Required Courses

BIOE 10222 Ethics and Integrity in Science. *1 credit.*
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. Bioethics 10222 is offered during the spring and summer terms only.

BIOE 10444 Research Ethics Discussion Series.
1 credit.
Prerequisite: 10222 Ethics and Integrity in Science.
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, 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. Bioethics 10444 is offered during the spring terms only.

Molecular Biophysics Track

After completing the first year IDP or MSTP curriculum, students will take the following required courses:

BIOP 03223 Electron Spin Resonance. *3 credits.*
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 Biophysical Techniques in Biochemistry. *3 credits.*
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 03290 Biophysics Journal Club. *1 credit.*
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 03298 Journal Club: EPR. *1 credit.*
EPR Journal Club introduces students to the various aspects of EPR via published studies in the scientific literature. Students present selected papers to the class, along with any introduction to the area of study, and the class critically discusses each 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 03295 Reading and Research. *1-9 credits.*
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.

BIOP 03300 Seminar. *1 credit.*
Weekly invited seminar speakers present their research on Molecular Biophysics and Magnetic Resonance Imaging topics.

BIOP 03399 Doctoral Dissertation. *1-9 credits.*
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.

Magnetic Resonance Imaging Track

After completing the first year NDP or MSTP curriculum, students will take these required courses:

BIOP 03230 Nuclear Magnetic Resonance. *3 credits.*
This course is designed as an introduction to NMR and nuclear MRI. Emphasis will be given to theory and application of modern MRI techniques.

BIOP 03239 Functional MRI Contrast Mechanisms and Applications. *3 credits.*
The use of MRI to evaluate tissue function will be described. The course will be dedicated to discussing functional MRI 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 03295 Reading and Research. *1-9 credits.*
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.

BIOP 03297 Journal Club: MRI. *1 credit.*
Selected papers in theory, practice, and applications of electron and NMR will be read and discussed.

BIOP 03300 Seminar. *1 credit.*
Weekly invited seminar speakers present their research on Molecular Biophysics and Magnetic Resonance Imaging topics.

BIOP 03399 Doctoral Dissertation. *1-9 credits.*
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.

Required Courses as Needed

BIOP 03002 Master's Thesis Continuation. *1-6 credits.*
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. *6-9 credits.*
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 03299 Master's Thesis. *1-6 credits.*
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

Elective Courses

Molecular Biophysics Track

This track is a component member of the IDP. After completing the first year IDP, students can take the following elective courses:

BIOP 03220 Introduction to Magnetic Resonance. *3 credits.*
The course provides basic knowledge for students who will continue to study ESR or nuclear magnetic resonance (NMR). The material covers MR 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 03233 Biomolecular NMR of Protein Assemblies: Theory and Applications. *1 credit.*
Solid-state NMR (ssNMR) is a unique technology to study the structure and dynamics of insoluble biomacromolecules in the rigid or semi-rigid forms, such as, membrane proteins, amyloid fibrils, sedimented proteins, and cellular extracts. The course starts with a brief introduction to solution and solid-state NMR spectroscopy with applications ranging from small molecules to macromolecular protein assemblies. We will then work on the NMR spin physics using product operator formalism and average Hamiltonian theory. Basic building blocks of ssNMR experiments consist of polarization transfer between different nuclei. These building blocks will be used to construct triple resonance multi-dimensional experiments for protein analysis. Recent methodological and technological advancements for pushing the limits of sensitivity and resolution will be summarized. Sample conditions and protein dynamics play a significant role in the selection of ssNMR experiments. Several examples from the protein ssNMR literature will be discussed to understand various aspects of sample preparation and NMR probe technology. Example data sets and NMR software (TOPSPIN) will be provided to get hands on experience on data processing.

BIOP 03245 Molecular Modeling and Simulations. *3 credits.*
This course will introduce 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 credits.*
Topics to be discussed include the nature of free radicals; radical initiation, propagation, and termination; free radical reactions of biological interest; and the role of free radicals in physiological and pathological processes.

BIOP 03260 Special Topics in Molecular Biophysics. *3 credits.*
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 03292 Molecular Dynamics Journal Club. *1 credit.*
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.

Magnetic Resonance Imaging Track

BIOP 03238 Magnetic Resonance Imaging. *3 credits.*
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 03240 Fourier Transforms. *3 credits.*
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 03296 NMR Journal Club. *1 credit.*
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.

2025-26

BIOSTATISTICS & DATA SCIENCE

Degree Offered: Master of Arts

Program Description

The Master of Arts program in Biostatistics and Data Science provides a learning experience focused on solid theoretical foundation and practical experience. Robust course offerings, active engagement in statistical consulting, and a capstone project create ample opportunities to develop essential analytical skills. Consulting projects ranging from the simplest statistical summaries to the most complex protocols and data collection schemes allow students to get experience of working with real data analysis projects from start to finish. This hands-on experience will enable students to synthesize the acquired knowledge and integrate various courses they have taken. In the process, students will create a portfolio which demonstrates competency in data analysis, statistical programming, consulting experience with non-statisticians, oral and written communication skills.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has specific requirements:

- Any graduate of an accredited college or university with an undergraduate degree in mathematics, statistics, or related field with strong preparation in mathematics is eligible for admission.
- Prior coursework in calculus (including integrals, such as Calculus II), probability and/or statistics, linear/matrix algebra, and computer programming experience.

Credits Required to Graduate

31 credits

Program Credit Requirements

The curriculum consists of eight required biostatistics courses which have been identified as an essential knowledge base for all students in the program. Also required, is an Ethics and Integrity in Science course. The capstone project course can be taken throughout multiple semesters but at least 3 credit hours are required for graduation. The program allows for students to choose two or more elective courses which best reflect their personal interests. Students may pursue the degree on a full-time or part-time basis.

Required Courses

BIOE 10222 Ethics and Integrity in Science. *1 credit.*

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. Bioethics 10222 is offered during the spring and summer terms only.

BIOS 04221 Biomedical Applications and Consulting. *3 credits.*
Prerequisites: 04231/04232 Statistical Models and Methods I & II
Theory of consulting, communication and statistical techniques most often used in consulting and biomedical applications, practical experience in the real consulting setting and writing statistical reports.

BIOS 04224 Biostatistical Computing. *3 credits.*
Prerequisites: 04231 Statistical Models and Methods I or concurrent registration
This course will cover the details of manipulating and transforming data required for statistical analysis. Topics include 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. How to use R packages and C/C++ codes in R will also be covered. The LaTeX document production system is also introduced.

BIOS 04231 Statistical Models and Methods I. *3 credits.*
Prerequisite: Three semesters of calculus and one semester of linear algebra
This course will cover statistical techniques for basic statistics. Topics include one-sample/two-sample tests, analyses for count data and contingency tables, basic nonparametric methods including sign, rank-sum and signed-rank tests, simple linear regression model and inference, checking model assumptions, model diagnostics, correlation analysis, one-way analysis of variance, Kruskal-Wallis one-way ANOVA, simple logistic regression, and weighted linear regression. SAS/R will be used throughout the course.

BIOS 04232 Statistical Models and Methods II. *3 credits.*
Prerequisite: 04231 Statistical Models and Methods I
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 credits.*
Prerequisite: 04232 Statistical Models and Methods II
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, neural network, feature screening, graphical models, and quantile regression.

BIOS 24150 Bioinformatics in Omics Analysis. *3 credits.*
Prerequisites: 04231 Statistical Models and Methods I and Biostatistical Computing, or consent of instructor
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 credits.* or ****PH712 Probability and Statistical Interference**. *3 credits.*
Prerequisites: Calculus I and II
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. It focuses on the properties of random variables including distributions, expectations, and variability measures. Topics in inferential statistics covered in this course include estimation, hypotheses testing methods for categorical data tabulation and analysis. It also includes an overview of statistical techniques based on simulations and resampling. Key features of Bayesian analysis will be covered as well. After completion of the course, students should be well prepared for taking more advanced courses in statistics, both theoretical and applied.

BIOS 24297 Capstone Project. *1-3 credits.*
Prerequisites: 04232 Statistical Models and Methods II
The course is the culmination of the MA 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.

Elective Courses

BIOS 04214 Design and Analysis of Clinical Trials. *3 credits.*
Prerequisites: 04231 Statistical Models and Methods I or concurrent registration
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, Bayesian designs, and administrative issues in study design.

BIOS 04222 Statistical Consulting. *3 credits.*
Prerequisites: 04231/04232 Statistical Models and Methods I & II
This course is designed for students to gain experience in statistical consulting by working with the biostatistics faculty members on various consulting projects.

BIOS 04275 Applied Survival Analysis. *3 credits.*
Prerequisites: 04231 Statistical Models and Methods I
The following topics will be covered in this course: 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; Aalen's Additive hazards regression model; regression diagnostics.

BIOS 04285 Introduction to Bayesian Analysis. *3 credits.*
Prerequisites: 04231 Statistical Models and Methods I
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.

PUBH 18201 Principles of Public Health Data and Epidemiology. *3 credits.*
The Principles of Public Health Data and Epidemiology course examines the basic epidemiological concepts required by a health professional, including disease transmission and prevention; morbidity, vital statistics, and mortality; screening tests; the natural history of disease; clinical trials; cohort study designs; case control and cross-sectional study designs; measures and risks in populations; disease causation; and epidemiology as it relates to program evaluation and public policy.

Principles of Public Health Data and Epidemiology provides the student with an understanding of the distribution and determinants of health and disease in population groups. Epidemiology is considered the basic science of public health, and, as such, provides the foundation for many other courses in the MPH program; it is particular germane to Community Health Assessment and Environmental Health.

PUBH 18258 Advanced Epidemiological Methods. *3 credits.*
Epidemiologic Methods builds on introductory epidemiology courses by providing a more in depth understanding of fundamental epidemiologic principles presented in introductory epidemiologic courses such as study design and bias. In addition, Epidemiologic Methods emphasizes more advanced concepts needed in establishing causal relationships from observational data. It is particularly relevant to students who intend to conduct studies investigating the occurrence and determinants of diseases or who wish to be sophisticated consumers or critics of epidemiologic research conducted by others. The course emphasizes practical application of Epidemiologic Methods to real world problems.

PUCH 19150 Introduction to Epidemiology. *3 credits.*
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 19210 Health and Medical Geography. *3 credits.*
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? Students will become acquainted with theories and methods from health and medical geography through readings, discussion, Geographic Information Systems (GIS) laboratory exercises, and the completion of a focused course project. Throughout the semester we will use the concepts and techniques of the discipline of geography to

investigate a variety of health-related topics, and laboratory exercises will center on common health and medical geography research questions. Course projects will allow students to develop a deep understanding of the geographical nature of a health problem of their choosing and will incorporate both literature review and the analysis of geographical data.

PUCH 19229 Survey Research Methods. *3 credits.*
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.

CTSI 20151 Introduction to Epidemiology. *3 credits.*
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.

** denotes course is offered at UW-Milwaukee

2025-26

BIOSTATISTICS

Degree Offered: Doctor of Philosophy

Program Description

The PhD program in Biostatistics is designed for students having strong quantitative and computing skills with interest in applying cutting-edge biostatistical research techniques to biological and medical sciences. In this program, students will receive in-depth training on theoretical/methodological/collaborative research in biostatistics and the use of state-of-the-art software. The Division of Biostatistics is a highly collaborative unit and provides lots of opportunities to participate in numerous research projects within MCW and its affiliates.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Any graduate of an accredited college or university with an undergraduate degree in mathematics or closely related fields with strong preparation in mathematics is eligible for admission. Applicants are expected to have completed and performed well in courses in advanced calculus, linear/matrix algebra, and scientific programming. Those who haven't done so may be considered for admission to the program upon approval of the biostatistics admission committee, and if admitted, these requirements must be completed during the first year of study. In addition, the applicant must have strong interest in pursuing statistical research in biomedical sciences.

Fields of Study

- Survival and competing risks data analysis
- Big data analysis
- High dimensional data analysis
- Bayesian statistics and Bayesian machine learning
- Clinical trials
- Machine learning
- Statistical genetics
- Bioinformatics
- Personalized medicine, causal inference
- Image data analysis
- Missing data

Credits Required to Graduate

60 credits minimum

Required Courses

BIOE 10222 Ethics and Integrity in Science. *1 credit.*
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. Bioethics 10222 is offered during the spring and summer terms only.

BIOE 10444 Research Ethics Discussion Series. *1 credit.*
Prerequisite: 10222 Ethics and Integrity in Science.
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, 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. Bioethics 10444 is offered during the spring terms only.

BIOS 04214 Design and Analysis of Clinical Trials. *3 credits.*
Prerequisites: 04231 Statistical Models and Methods I or concurrent registration
This course covers topics in clinical trials including the clinical trial protocol; sources of bias in treatment evaluation; blinding; randomization; sample size and power calculation; phase I, phase II, phase III and hybrid trials; covariate adjustment; interim analysis; stochastic curtailment; safety monitoring; factorial and crossover designs.

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

BIOS 04221 Biomedical Applications and Consulting. *3 credits.*
Prerequisites: 04231 Statistical Models and Methods I
The course focuses on 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. *1 credit.*
Prerequisites: 04231/04231 Statistical Models and Methods I & II
This course is designed for students to gain experience in statistical consulting by working with the biostatistics faculty members on various consulting projects.

BIOS 04224 Biostatistical Computing. *3 credits.*
Prerequisites: 04231 Statistical Models and Methods I or concurrent registration
This course will cover the details of manipulating and transforming data required for graphical displays and/or statistical analysis. It will cover the techniques necessary to write R functions and SAS macros for developing new/modified data analysis methods. Students are expected to be somewhat facile in the use of computers before they take this course. UNIX/Linux and working with a cluster are also emphasized. SQL, C/C++ and LaTeX will be introduced as time permits.

BIOS 04231 Statistical Models and Methods I. *3 credits*.
Prerequisite: Three semesters of calculus and one semester of linear algebra
This course will cover statistical techniques for basic statistics. Topics include one-sample/two-sample tests, analyses for count data and contingency tables, basic nonparametric methods including sign/rank-sum/signed-rank tests, simple linear regression model and inference, one-way ANOVA, two-way ANOVA, Kruskal-Wallis one-way ANOVA. SAS/R will be used throughout the course.

BIOS 04232 Statistical Models and Methods II. *3 credits.*
Prerequisite: 04231 Statistical Models and Methods I
This course will cover various regression models for independent and correlated data. Topics include multiple linear regression, model diagnostics, variable selection, influence/leverage, outliers, collinearity, transformation, GLM including logistic and Poisson regression, overdispersion, GEE, mixed models, and GLMM. SAS/R will be used throughout the course.

BIOS 04233 Introduction to Statistical and Machine Learning. *3 credits.*
Prerequisite: 04232 Statistical Models and Methods II
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, random forests, and deep learning. 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, neural network, feature screening, graphical models, boosting, and quantile regression.

BIOS 04240: Biostatistics Inference I. *3 credits.*
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: Biostatistics Inference II. *3 credits*.
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 credits.*
Prerequisites: 04231 Statistical Models and Methods I
Parameters of interest in time-to-event studies; censoring and truncation; survival and competing risks outcomes; univariate estimation, including the Kaplan-Meier, Nelson-Aalen, and Aalen-Johansen estimators; tests comparing two or more samples, including the log rank test and Gray's test; semi-parametric regression, including the Cox proportional hazards, Aalen's additive, and Fine-Gray models; multi-state modeling; methods for high dimensional data analysis and machine learning may also be covered.

BIOS 04285 Introduction to Bayesian Analysis. *3 credits.*
Prerequisites: 04231 Statistical Models and Methods I
This course introduces basic concepts with computational tools for Bayesian statistical methods extolling the dynamism of the likelihood, prior, posterior and predictive distributions. Topics covered include one and two sample inference, regression models and comparison of several populations with normal, dichotomous and count data. An introduction to modern Bayesian software such as NIMBLE and Stan along with a basic understanding of Markov chain Monte Carlo (MCMC) via Gibbs sampling, Metropolis-Hastings, slice sampling and state-of-the-art techniques such as hybrid/Hamiltonian MCMC variants like No U-Turn Sampler (NUTS).

BIOS 04295 Reading and Research. *1-9 credit(s).*
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 04313 Advanced Statistical Computing. *3 credits.*
Prerequisites: 04232 Statistical Models and Methods II, Statistical Inference II, 04224 Biostatical Computing*
This is a course for performing sophisticated statistical simulation studies using computer. We will introduce some numerical algorithms which are useful for statistical modeling and data analysis. The topics include: random number generations, acceptance/rejection method, unconstrained/constrained likelihood optimizations, Kuhn-Tucker conditions, regularized regressions, the EM algorithm, numerical integration, Gaussian quadrature, Monte-Carlo method (importance sampling), Bootstrap, Permutation, Jackknife, Cross-validation.

BIOS 04363 Advanced Statistics I. *3 credits.*
*Prerequisites: 04232 Statistical Models and Methods II, Statistical Inference II**
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, and conditional, marginal likelihood, and asymptotics of penalized regression.

BIOS 04365 Linear Models I. *3 credits.*
*Prerequisites: Statistical Inference II**
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 credits.*
*Prerequisites: 04365 Linear Models I, Statistical Inference II**
This course will cover the fundamental concepts in population genetics and statistical models and methods on genetic linkage and association mapping studies. Topics include Mendelian inheritance, Hardy-Weinberg equilibrium, linkage disequilibrium, allele identity-by-descent (IBD), inbreeding and kinship coefficients, statistical models for quantitative traits, heritability, genetic variance components, linkage analysis, association analysis, case-control analysis, haplotype association analysis, adjust for familial relatedness and population structure, analysis of genetic rare variants, polygenic risk score analysis, LD score regression, statistical fine mapping.

BIOS 04385 Advanced Bayesian Analysis. *3.5 credits.*
Prerequisites: Introduction to Bayesian Analysis, Applied Survival Analysis
A combination of advanced Bayesian principles, tools and methods. Emphasis is on modern computations for parametric and nonparametric models with a deeper dive into NIMBLE/Stan and state-of-the-art sampling techniques, convergence diagnostics, goodness-of-fit, etc. Topics include Bayes factors, HPD regions, conjugate/non-informative priors, the generalized linear models, hierarchical/mixed models, multivariate data, restricted parameter spaces/time-to-event analysis with censored data, Dirichlet Process Mixtures, Gaussian Processes, Bayesian Additive Regression Trees (BART), advanced computational techniques like stochastic gradient descent and illustrative examples of Bayesian analyses for complex biomedical data.

BIOS 04386 Theory of Survival Analysis. *3 credits.*
*Prerequisites: 04275 Applied Survival Analysis, Statistical Inference II**
This course will provide students with a solid foundation in both classical and modern theory of survival analysis including mathematical theory of counting processes, martingales, and empirical processes; asymptotic properties for estimation of the survival, cumulative hazard, and cumulative incidence functions; extensions of k-sample nonparametric tests to survival data; sample size and power calculation; proportional hazards, additive hazards, and proportional subdistribution hazards regression models; multivariate survival analysis; methods for high dimensional data analysis and machine learning may also be covered.

BIOS 04399 Doctoral Dissertation. *1-9 credit(s).*
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 credits.*
Prerequisites: 04231 Statistical Models and Methods I and 04224 Biostatistical Computing, or consent of instructor.
The course aims to introduce modern statistical and computational methods in high-throughput 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).

*Taken at UW-Milwaukee

Required Courses as Needed

BIOS 04002 Master's Thesis Continuation. *0 credits*.
Prerequisite: 04299 Master's Thesis
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 credits*.
Prerequisite: 04339 Doctoral Dissertation
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 04299 Master's Thesis. *1-6 credits.*
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.

Elective Courses

A minimum of six credit hours of graduate-level electives in a non-statistical field such as biological/medical science, mathematics, and computer science is a requirement for a candidate seeking the PhD degree in Biostatistics.

2025-26
CELL & DEVELOPMENTAL BIOLOGY
Degree Offered: Doctor of Philosophy

MCW GRADUATE SCHOOL

Program Description
The graduate program in Cell and Developmental Biology (CDB) provides state of the art research training in cellular based experimental biology, including studies of organismal development, cell and organ homeostasis, and mechanisms of disease.
Specific areas of focus include regulation of cellular differentiation, the molecular basis of regeneration, how neurons sense their environment, the intricacies of signal transduction, and the mechanisms of disease pathology. The graduate program is hosted by the Department of Cell Biology, Neurobiology and Anatomy, but includes faculty mentors across multiple Departments and Centers of the Medical College of Wisconsin. Students enter CDB through one of several routes: Direct Admission, the Interdisciplinary Program in Biomedical Sciences (IDP), the Neuroscience Doctoral Program (NDP), or the Medical Scientist Training Program (MSTP). Successful completion of this program leads to a Doctor of Philosophy (PhD) degree. This is accomplished through a combination of coursework, seminars, journal clubs, and "hands-on" research in the laboratory of a faculty mentor. CDB graduates have outstanding track record of entering a wide variety of research-related careers including academic post-doctoral research fellowships, industry research scientist positions, employment with consulting firms, science writing positions, among other professions.

Admission Requirements
In addition to the general Graduate School admission requirements, this program has no additional specific requirements.

Entry to the Cell and Developmental Biology Graduate Program is through Direct Admission, Interdisciplinary Program in Biomedical Sciences (IDP), the Neuroscience Doctoral Program (NDP), or the Medical Scientist Training Program (MSTP). The
student is admitted after completion of the first-year curriculum or through the Medical Scientist Training Program following the second year of Medical School. The student elects to complete their dissertation work with faculty of the Cell and Developmental Biology Graduate Program. The student will then have the opportunity to continue graduate studies by selecting among a wide range of courses offered from the Graduate School as well as other programs affiliated with the Medical College.
Courses to be taken are based on the student's interests and consultation with the student's advisor.

Fields of Study
- Cellular and molecular mechanisms in developmental biology and neurobiology, which employ genetic approaches, including those in mice, zebrafish, stem cells, and invertebrate organisms.
- Development and diseases of the heart, liver, muscle, the nervous system, eye, and early embryo, among other tissues.
- Mechanisms of pain.
- Biology of vision.

- Mechanisms of cell signaling.
- Mechanisms of regeneration.
- Neuronal homeostasis and neurodegeneration.
- Molecular basis of drug interactions.
- Cancer biology.

Credits Required to Graduate

60 credits minimum

Program Credit Requirements

Nine credits coursework after the first-year semester is completed.

The curriculum consists of a core of courses required by the Graduate Entry Programs, plus additional courses selected by the student. In addition, Readings and Research is taken annually. Attendance at the departmental sponsored presentations is considered a major part of the educational experience.

Required Courses

BIOE 10222 Ethics and Integrity in Science. *1 credit.*
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. Bioethics 10222 is offered during the spring and summer terms only.

BIOE 10444 Research Ethics Discussion Series. *1 credit.*
Prerequisite: 10222 Ethics and Integrity in Science.
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, 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. Bioethics 10444 is offered during the spring terms only.

CDBI 31295 Reading and Research. *1-9 credit(s).*
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 31301 Seminars in Cellular Biology. *1 credit.*
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. *9 credits.*
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.

Required Courses as Needed

CDBI 31002 Master's Thesis Continuation. *0 credits.*
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 credits.*
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 31299 Master's Thesis. *1-6 credit(s).*
Students in the PhD 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.

Elective Courses

Electives are chosen by the student in concert with faculty advisor to best support area of interest and the student's thesis proposal. While there are no specific course requirements, CDB students often take several of the following:

NSCI 12221 Advanced Systems Neuroscience. *3 credits.*
Prerequisite: 12211 or consent of the course director.
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 and Molecular Neurobiology. *3 credits.*
Prerequisite: 12211 or consent of the course director.
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 16271 Fundamentals of Neuroscience. *3.5 credits.*
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, seminars from prominent scientists (video archives), and written assignments. The purpose of this course is to introduce 1st year graduate students to the structure and function of the human nervous system.

INBS 16273 Advanced Cell Biology. *3 credits.*
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 16276 Developmental and Stem Cell Biology. *3 credits.*
The offered course provides a detailed introduction to Developmental and Stem Cell Biology. The course uses a lecture-style format supplemented with paper discussions. The intent of the course is to provide a solid academic background in developmental biology to graduate students embarking upon research into cell differentiation and development.

CDBI 31154 Neurobiology of Pain. *1 credit.*
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 31207 Introduction to Neuroscience. *2 credits.*
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 31257 Biology of Vision. *3 credits.*
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 31298 Journal Club. *1 credit.*
Critical reviews of current research topics.

2025-26

CLINICAL BIOETHICS

Degree Offered: Certificate

Program Description

The Certificate in Clinical Bioethics program is designed to provide a foundational introduction to the philosophical, legal, and clinical foundations of health care ethics. Specifically designed to enhance the clinical practice of health care professionals or to provide a foundation for further study of bioethics for professionals and students in any discipline, the Certificate program is offered in an accessible online format available to individuals from across the nation and throughout the world.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has no additional specific requirements.

Credits Required to Graduate

12 credits

Program Credit Requirements

All courses of the Certificate program are delivered in an online format. The pedagogical capabilities of the online environment enhance the course discussions and allow for more individualized instructor feedback making the courses truly student-centered.

Students receive a Certificate in Clinical Bioethics from the Medical College of Wisconsin's Graduate School of Biomedical Sciences upon completion of all four courses. Graduate credits accumulated in this program may be applicable toward the Master of Arts degree at the Medical College of Wisconsin.

Required Courses

10209 Clinical Topics in Bioethics. *3 credits.*
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, and research ethics.

10210 Philosophical Bioethics. *3 credits.*
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.

10223 Law and Bioethics. *3 credits.*
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.

Elective Courses

For the elective course, students can choose one course from among the following selection of approved and offered courses, with the guidance of an advisor:

10203 Justice and Healthcare. *3 credits.*
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.

10207 Introduction to Research Ethics. *3 credits.*
This course provides students with a comprehensive introduction to the ethical issues involved in scientific, animal and human subject's 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. (Issued December 1, 2000.)

10233 Issues in Pediatric Ethics. *3 credits.*
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.

10234 Ethics and Human Reproduction. *3 credits.*
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.

10240 History and Meaning of Ethics and Professionalism in Medicine. *3 credits.*
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.

10275 Special Topics in Bioethics. *3 credits.*
This course focuses on topics of special interest in bioethics. Examples of topics include neuroethics, ethics at the end of life, ethical issues in mental health, and political issues in bioethics and public health.

2025-26

COMMUNITY HEALTH ASSESSMENT AND PLANNING

Degree Offered: Certificate

Program Description

This certificate is offered completely online, allowing working professionals the flexibility to fulfill their educational goals. The program focuses on individuals who have responsibility and accountability for the health of the populations they serve. This certificate will provide the training to competently assess, plan for improvement, and monitor the health of various populations. Coursework consists of two required courses and two elective courses for a total of 12 credits. All credits offered in the certificate program may be transferable to the Master of Public Health program within one year of certificate completion.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

One to two years of experience working in health care, worksite wellness, or public health strongly recommended.

Credits Required to Graduate

12 credits

Required Courses

PUBH 18209 Community Health Assessment and Improvement. *3 credits.*
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 18230 Community Health Program Planning. *3 credits.*
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.

Elective Courses

PUBH 18115 Health Promotion and Disease Prevention. *3 credits.*
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 18160 Racial and Ethnic Inequalities in Health. *3 credits.*
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 the 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 18223 Public Health Policy. *3 credits.*
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 18241 Health Communications. *3 credits.*
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 credits.*
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 credits.*
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.

2025-26

CLINICAL & TRANSLATIONAL SCIENCE

Degree Offered: Certificate

Program Description

This program is operated by the Clinical and Translational Science Institute (CTSI) of Southeast Wisconsin. The mission of the CTSI is to develop an integrated, shared home for clinical and translational research and to establish a borderless, collaborative, and investigator/ community/patient- friendly, research environment. The CTS Certificate degree program fits with the CTSI's strategic goals of providing quality education and training to cultivate the next generation of clinical and translational researchers.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has an additional specific requirement.

Potential students must apply by July 1st for Fall term enrollment.

Fields of Study

Certificate students will select from the four tracks and complete four classes, or 12 credits. The emphasis tracks include Translational Science, Population Science, Health Systems Science, and Community Based Science.

Translational Science

This track is focused on the foundational principles of the translational process. This "bench-to-bedside" process involves moving discoveries from their basic foundation to clinical settings. Discoveries of focus include diagnostics, therapeutics, medical procedures, and other interventions. Suggested electives for this program include Translational Genomics and Survey of Biomedical Engineering.

Population Science

There are a variety of factors that can influence health outcomes at a population level, and this track will focus on the relationship between these factors, health, and research. This program will focus on factors such as socioeconomic status, health disparities, social determinants of health, healthcare systems, environment, and policies. Suggested electives include Health Economics, Introduction to Statistics using Stata, Regression using Stata, and Health and Medical Geography.

Health System Science

The focus of this track is on principles and processes within the healthcare system. The topics of focus will include delivery of healthcare, how healthcare professionals work together, and improvements that can be made within the system to improve healthcare delivery. Suggested electives for this program include Health Economics, Health and Medical Geography, Dissemination and Implementation Science, and Qualitative and Mixed Methods.

Community Based Science
This track is focused on engaging the community in research being conducted near the end of the translational spectrum. Emphasis is placed on collaboration with community members and organizations to promote engagement in developing community-wide approaches to improve health for all. Suggested electives include Health Disparities, Health and Medical Geography, Dissemination and Implementation Science, and Qualitative and Mixed Methods.

Credits Required to Graduate
12 credits

Required Courses
CTSI 20101 Introduction to Clinical and Translational Science. *3 credits.*
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 20160 Foundations in Health Services Research. *3 credits.*
The course will provide the student with a broad understanding of health services research design and methodology, as well as provide the student with the opportunity to engage in a mentored, individualized, in-depth study experience. By the end of the course the student will be able to understand key theories that serve as the foundation of health services research and understand the process of developing a research idea and translating it into an R-series level NIH proposal. Coursework will include weekly reading of peer-reviewed manuscripts, one introductory textbook on health services research, and one introductory textbook on designing clinical research. Weekly classes will include discussion of reading and assignments are designed to allow practice of critically reading and planning health services research projects.

CTSI 20220 Clinical Statistics I. *3 credits.*
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.

Elective Courses

PUBH 18165 Principles of Public Health Data and Epidemiology. *3 credits.*
This 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. The course provides the foundation for many other courses in the MPH program.

PUBH 18209 Community Health Assessment and Improvement. *3 credits. Recommended: 18203 Public Health Administration*
This course covers the central concepts of community health assessment and improvement. Students will review public health concepts from a public health systems and practice perspective. The course will focus on public health essential services 1 and 2. Students will obtain an understanding of the public health system, community health assessment and the health improvement process using selected frameworks. The course will focus in-depth on learning about the Mobilizing for Action through Planning and Partnerships (MAPP) frameworks and application of selected components to course projects. In addition, this course will provide the foundation for future community health planning and evaluation courses by building on the content of the public health administration course using a public health practice perspective.

CTSI 20260 Introduction to Dissemination and Implementation Science. *3 credits. Emphasis Track suggested for: Population Science Track*
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 textbook 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.

PRME 42100 Introduction to Precision Medicine. *3 credits.*
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 42170 Medical Genetics, Undiagnosed, and Rare Diseases. *3 credits.*
Prerequisite: 42100 Introduction to Precision Medicine
Medical Genetics, Undiagnosed and Rare Diseases allows students examine the application of genomics to core clinical systems and applying that knowledge to personalized management of patients. Experts in their respective fields will guest lecture in several sessions.

2025-26

CLINICAL & TRANSLATIONAL SCIENCE

Degree Offered: Master of Science

Program Description

This program is operated by the Clinical and Translational Science Institute (CTSI) of Southeast Wisconsin. The mission of the CTSI is to develop an integrated, shared home for clinical and translational research and to establish a borderless, collaborative, and investigator/ community/patient- friendly, research environment. The CTS Master's and Certificate degree programs fit with the CTSI's strategic goals of providing quality education and training to cultivate the next generation of clinical and translational researchers.

The goal of the Master's in Clinical and Translational Science (MSCTS) degree is to train the next generation of health care professionals, clinical investigators, research scientists, and other individuals working in translational research sciences. The curriculum incorporates the full spectrum of the translational continuum (T0 through T5) and provides training and skills to position candidates to be successful in the growing field of Clinical and Translational Science. Topics covered include foundations of translational research, clinical statistics, epidemiology, ethics and safety, and study designs across the continuum. Candidates seeking a Master's degree will select from one of four emphasis tracks and complete a thesis.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has an additional specific requirement.

Potential students must apply by July 1st for Fall term enrollment.

Fields of Study

Candidates seeking a Master's degree will select from one of four emphasis tracks and complete a thesis. Certificate students will select from the same four tracks and complete 4 classes, or 12 credits. The emphasis tracks include Translational Science, Population Science, Health Systems Science, and Community Based Science.

Translational Science

This track is focused on the foundational principles of the translational process. This "bench-to-bedside" process involves moving discoveries from their basic foundation to clinical settings. Discoveries of focus include diagnostics, therapeutics, medical procedures, and other interventions. Suggested electives for this program include Translational Genomics and Survey of Biomedical Engineering.

Population Science

There are a variety of factors that can influence health outcomes at a population level, and this track will focus on the relationship between these factors, health, and research. This program will focus on factors such as socioeconomic status, health disparities, social determinants of health, healthcare systems, environment, and policies. Suggested electives

include Health Economics, Introduction to Statistics using Stata, Regression using Stata, and Health and Medical Geography.

Health System Science
The focus of this track is on principles and processes within the healthcare system. The topics of focus will include delivery of healthcare, how healthcare professionals work together, and improvements that can be made within the system to improve healthcare delivery. Suggested electives for this program include Health Economics, Health and Medical Geography, Dissemination and Implementation Science, and Qualitative and Mixed Methods.

Community Based Science
This track is focused on engaging the community in research being conducted near the end of the translational spectrum. Emphasis is placed on collaboration with community members and organizations to promote engagement in developing community-wide approaches to improve health for all. Suggested electives include Health Disparities, Health and Medical Geography, Dissemination and Implementation Science, and Qualitative and Mixed Methods.

Credits Required to Graduate
36 credits

Required Courses
BIOE 10226 Regulatory Issues in Human Subject Research Protections. *3 credits.*
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.

PUBH 18209 Community Health Assessment and Improvement. *3 credits. Recommended: 18203 Public Health Administration*
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.

CTSI 20101 Introduction to Clinical and Translational Science. *3 credits.*
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 18weeks.

CTSI 20151 Introduction to Epidemiology. *3 credits.*
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 credits.*
The course will provide the student with a broad understanding of health services research design and methodology, as well as provide the student with the opportunity to engage in a mentored, individualized, in-depth study experience. By the end of the course the student will be able to understand key theories that serve as the foundation of health services research and understand the process of developing a research idea and translating it into an R-series level NIH proposal. Coursework will include weekly reading of peer-reviewed manuscripts, one introductory textbook on health services research, and one introductory textbook on designing clinical research. Weekly classes will include discussion of reading and assignments are designed to allow practice of critically reading and planning health services research projects.

CTSI 20220 Clinical Statistics I. *3 credits.*
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 20299 Master's Thesis. *6-9 credits.*
6-9 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 credits.*
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 MS students will be required to take the course. First year Master's students will develop their research question, complete a thorough literature review of the topic of interest in the form of a systematic review, and begin to identify methods that will be used to answer their research question. While second year students will conduct the necessary steps to answer their research question, write their results and conclusions, and prepare an oral presentation of their thesis work to be presented before their colleagues at the end of the semester and during MCW student research day. All students will be expected to provide feedback to their classmates and will receive feedback from their peers and the course director. Each class period four students will present some aspect of their project and will receive feedback from peers and the course director.

Required Courses as Needed

CTSI 20002 Master's Thesis Continuation. *0 credits.*
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.

Elective Courses

HCTM 14200 Survey of Biomedical Engineering.
3 credits.
Emphasis Track(s) suggested for: Translational Science

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.

PUBH 18258 Advanced Epidemiological Methods. *3 credits.*
Prerequisites: 18201 Principles of Epidemiology or equivalent Department: Public Health
Emphasis Track(s) suggested for: Population Science, Health Systems Science
Epidemiologic Methods builds on introductory epidemiology courses by providing a more in depth understanding of fundamental epidemiologic principles presented in introductory epidemiologic courses such as study design and bias. In addition, Epidemiologic Methods emphasizes more advanced concepts needed in establishing causal relationships from observational data. It is particularly relevant to students who intend to conduct studies investigating the occurrence and determinants of diseases or who wish to be sophisticated consumers or critics of epidemiologic research conducted by others. The course emphasizes practical application of Epidemiologic Methods to real world problems.

PUCH 19210 Health and Medical Geography. *3 credits.*
Emphasis Track(s) suggested for: Population Science, Community Based Science
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 19225 Introduction to Statistical Analysis. *3 credits.*
Emphasis Track(s) suggested for: Population Science, Health Systems Science
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 credits.*
Emphasis Track(s) suggested for: Population Science, Health Systems Science
Prerequisites: 19225 Introduction to Statistical Analysis.
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 19230 Qualitative and Mixed Methods. *3 credits.*
Emphasis Track(s) suggested for: Community Based Science
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.

CTSI 20260 Introduction to Dissemination and Implementation Science. *3 credits.*
Emphasis Track(s) suggested for: Health Systems Science, Community Based Science
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 textbook 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 20265 Clinical Quality Improvement. *3 credits.*
In the spectrum of Clinical translational research an important but often overlooked component is the ability to implement and maximize the utilization of evidence-based practice. This involves skills in process improvement and change management that overlap with but extend beyond the traditional clinical research and development. This course would serve as an important complement to other aspects of translational research for those who interests are in the "real life" implementation of clinical research.

PRME 42100 Introduction to Precision Medicine. *3 credits.*
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 42150 Biomedical and Clinical Informatics and Data Science. *3 credits.*
This course provides an overview of the many types of informatics approaches and data science techniques that are used in the realm of medicine and clinical practice. Clinical informatics is a field of medicine focused on transforming health care by analyzing, designing, implementing, and evaluating information and communication systems that enhance individual and population health outcomes, improve patient care, and strengthen the clinician-patient relationship. Bioinformatics is the field focused on how to process high-throughput data for deriving knowledge from it.

PRME 42170 Medical Genetics, Undiagnosed, and Rare Diseases. *3 credits.*
Prerequisite: 42100 Introduction to Precision Medicine
Medical Genetics, Undiagnosed and Rare Diseases allows students examine the application of genomics to core clinical systems and applying that knowledge to personalized management of patients. Experts in their respective fields will guest lecture in several sessions.

2025-26

GENETIC COUNSELING

Degree Offered: Master of Science

Program Description

This program offers a Master of Science degree in Genetic Counseling, through the Medical College of Wisconsin Graduate School. The program is a full-time, day program with one cohort of 12 students beginning each fall term. The program offers a Milwaukee and Green Bay campus track. All 12 students will complete their first year together on the Milwaukee Campus. The two students matched to the Green Bay track will relocate to the Green Bay campus at the start of the fall term 2nd year. The duration is 21 months in length, consisting of four fall/spring terms with one intervening summer term session. The program curriculum consists of 56 term credits, including coursework, clinical practicums, and a research thesis. Students who successfully complete the program will be eligible for the American Board of Genetic Counseling (ABGC) certification examination.

The Genetic Counseling Master of Science Program at the Medical College of Wisconsin will prepare the next generation of genetic counselors to be diverse leaders at the forefront in the delivery of precision health.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Applicants must have a bachelor's degree. Although a specific major is not required, most applicants have a degree in a biological or social science (e.g., biology, genetics, biochemistry, sociology, social work).

A minimum undergraduate grade-point average (GPA) of 3.00 or a master's degree with a minimum cumulative GPA of 3.00 is required. If a student has an undergraduate GPA less than 3.0, coursework completed after graduation demonstrating a higher GPA will be considered.

Prerequisites listed below must be completed with a grade of C or better, prior to the program start date. Applications will still be considered with coursework pending. College credit for high school Advanced Placement courses do not satisfy the requirement.

Prerequisite course work includes one term each of the following:

- Genetics
- Statistics
- Biochemistry
- Social Science
- Medical Terminology, Human Anatomy or Human Physiology (does not need to be taken in advance). If you match with MCW, you can take the course in the summer before matriculation. Taking an online medical terminology course for certificate completion is acceptable for this prerequisite. An example of a self-paced course is through Rice University.

An applicant must complete courses in biochemistry, statistics, genetics, and a social science (such as psychology, sociology, women's studies, philosophy, ethnic studies, etc Additionally, starting in the 2025 admissions cycle applicants will be required to complete coursework in medical terminology, anatomy or physiology to ensure they are best prepared for the advanced level of learning occurring in the classrooms and practicum sites. We encourage students to take as many courses as possible relevant to genetic counseling to strengthen their application. All required courses should be taken prior to applying as it is difficult to evaluate courses "in progress" at the time of application.

For additional information pertaining to the admissions process and requirements, we encourage you to check out the MSGC Program Website

Credits Required to Graduate

56 credits

Required Courses

GECO 40110 Bioethics in Precision Medicine. *3 credits.*
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 as they manifest in a variety of clinical, biomedical, and health policy context.

GECO 40130 Prenatal Genetics. *3 credits.*
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 credits.*
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.

GECO 40145 Medical Genomics. *3 credits.*
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 and Practice. *2 credits.*
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 be encouraged to explore their own values and biases. Development and adaptation of oral and written communication skills to various audiences will be applied through course assignments and case-based learning. Students will be introduced to professional issues such as credentialing, professional development and lifelong learning.

GECO 40155 Genetic Counseling II: Theory and Practice. *2 credits.*
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. Through standardized patients and in class role play, students will learn to recognize psychosocial aspects of the genetic counseling session and apply their counseling skills. Students will engage in course activities to further develop their communication abilities (oral and written), apply advanced risk assessment, and examine professional boundaries. Students will have the opportunity to enhance personal skill development through the giving and receiving of feedback with peers and supervisors.

GECO 40156 Genetic Counseling III: Psychosocial Issues. *2 credits.*
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, 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 family 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 credits.*
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 credits.*
This course is designed to build a foundation to help students formulate and execute their research thesis topics. Students will learn about a variety of research methodologies, including quantitative and qualitative approaches. As part of this course, students will gain experience identifying and critically reviewing scientific literature and get exposure to the use of informatics tools. They will learn to evaluate research hypotheses and identify various aspects of the research process, including 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 credits.*
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, 40295, 40296, 40297, 40298 Clinical Practicum I-V. *3 credits.*
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. Students are required to complete five practicums with the program. There are 4 clinical specialty placements and 1 elective rotation. The core clinical placements are in pediatrics, prenatal, oncology, and other adult specialty. Throughout the practicum, students will apply their knowledge in a supervised setting and will participate in clinical cases. Each practicum will consist of 16 total days with the goal to have 2-3 prepped cases per day or 4-6 total prepped cases per week under the supervision of a certified genetic counselor in a specific area of practice. Students may begin to document participatory cases in their logbook in these practicums. Students will be expected to progress from beginning level of proficiency to intermediate and advanced levels in as many domains as possible within the practiced-based competencies as defined by the Accreditation Counseling for Genetic Counseling. 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. Students will establish goals for each rotation and expectations alongside their 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 credits.*
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 audiences. Students will also learn about how genetic testing has changed over time and how genetics professionals adapt to those changes. Finally, students will be encouraged to explore the

different ways genetic counselors are involved in the testing process through interviews, field trips, and other experiences.

GECO 40299 Genetic Counseling Research Thesis. *1-3 credits.*
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 write-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 Research 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.*
This course promotes lifelong education for the profession of genetic counselling through exposure to interdisciplinary events and engagement in community activities. 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

2025-26

GLOBAL HEALTH EQUITY

Degree Offered: Master of Science

Program Description

The Master of Science in Global Health Equity program at the Medical College of Wisconsin was created to meet the growing demand of global health professionals. Our small cohorts make it possible for local and intentional mentoring from faculty who have a wide range of global health experience. Students will conduct a global health project with one of our local or international partners. Our flexible, interactive program allows students to choose from a variety of elective courses to gain expertise in areas they are most interested in. Full-time and part-time study are allowed.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Students should have a strong foundation in quantitative, behavioral, and biological sciences

Credits Required to Graduate

36 credits

Required Courses

GLHE 29219 Introduction to Global Health Equity. *3 credits.*
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 credits.*
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 29230 Epidemiologic Research Methods in Global Health Equity. *2 credits.*
This course was developed specifically for the Master of Science in Global Health Equity Students. This course will tie the application of Epidemiology to Global Health and develop student's knowledge and skills in developing a research question, conducting literature reviews, analyzing data and succinctly communicating a research project in written and oral formats. This will be a required course for MS GHE students and will be a foundational base for future course work as well as the student's final thesis work project and paper.

GLHE 29236 Digital Storytelling for Public Health. *1 credit.*
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 29239 Ethics and Global Health. *3 credits.*
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 challenge 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 29279 Internship Preparation: Cultural and Ethical Global Engagement. *1 credit.*
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 29290 Global Health Equity Internship. *2 credits.*
Prerequisite: 29279 Internship Preparation: Cultural and Ethical Global Engagement.
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 29299 Thesis Work. *1-6 credits.*
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 will engage in research or a community engagement project. Students are encouraged to choose a thesis placement that aligns with their career interests. Global and local placements are available with MCW's established partners.

Required Courses as Needed

GLHE 29002 Thesis Work Continuation. *0 credits.*
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.

Elective Courses

GLHE 29100 Community Health Needs Assessment. *2 credits.*
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.

GLHE 29110 Introduction to Chronic Diseases in Global Health. *2 credits.*
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, and utilization of the expertise of identified global health professional and groups with similar interests.

GLHE 29150 Global Environmental Health. *3 credits.*
Global Environmental Health will examine environmental problems that manifest at a global scale, with implications for human health and health equity. This course provides (1) a survey of major global environmental issues impacting human health, and (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, 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.

GLHE 29160 Infectious Disease Epidemiology. *2 credits.*
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 credits.*
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 29235 Fragile Lives: Understanding Vulnerability in Old Age. *2 credits.*
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 29237 Researching, Analyzing and Profiling Global Health TIPS1. *2 credits.*
This course grows students' awareness of and engagement with significant, urgent, and uncertain global healthcare (HC) issues and policies, with an emphasis on their equity considerations and outcomes. This course provides data and evidence-driven "real-world" contexts and applications. Students will examine subject matter areas that their research has the highest potential of producing valued guests (i.e., analyzing data and translating evidence and science into policy) for stakeholders, especially HC organizational leaders, practitioners, and policymakers. Practical knowledge will be developed in conducting issues research and policy analysis, shaping different briefs and communicating findings for leadership audiences, developing partnerships, promoting, and implementing evidence-based interventions. Lastly, it aims to connect how students can help move data and evidence-based insights about problems toward desired actions and improvement of health and medical practices.

GLHE 29238 Global Health Initiatives. *2 credits.*
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. 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 29240 Multicultural Mental Health Guidelines in Native American Populations. *3 credits.* 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 29245 Health and Forced Migration. *2 credits.*
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, specific 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 population health.

GLHE 29250 How to Build Health Research Partnerships with Native American Communities. *2 credits.*
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 standard 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 Methods. *3 credits.*
This course is an applied, project-focused, "real-world" overview for individuals in healthcare consulting. 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. This course provides you with an introduction to a range of established and emerging consultancy practices such as design thinking, open innovation and sourcing, stakeholder journey mapping, and agile methodology.

GLHE 29280 Career Development. *1 credit.*
The goal of the Career Development course is to increase your skills and readiness for the next step in your professional development, whether that is medical school, other professional degree programs, or a career after graduation. To achieve this goal, you will be working with your 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 29295 Readings and Research. *1-2 credits.*
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 student 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 29325 Global Maternal and Child Health. *2 credits.*
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.

Electives offered at Marquette University:
5461 Comparative Health Politics and Policy. *3 credits.*
7150 Outbreaks, Epidemics and Pandemics. *3 credits.*
7931 Politics of US Health Care. *3 credits.*

2025-26

HEALTHCARE TECHNOLOGIES MANAGEMENT

Degree Offered: Master of Science in partnership with Marquette University

Program Description

The Healthcare Technologies Management program is a collaborative effort between Marquette University and the Medical College of Wisconsin that combines management, technology, and health care. The objective of the program is to educate professionals capable of managing the design, development, commercialization and regulatory compliance of diagnostic and therapeutic medical devices, and the implementation, utilization, and assessment of hospital-based healthcare technologies.

Learn more here.

The Healthcare Technologies Management program is not currently accepting new students.

Contact information: gradschool@mcw.edu | (414) 955-8218

2025-26

INTERDISCIPLINARY PROGRAM IN BIOMEDICAL SCIENCES

MCW GRADUATE SCHOOL

Program Description

The Interdisciplinary Program in Biomedical Sciences (IDP) is committed to providing a broad and integrated education in biomedical science. This education is designed to serve the students well as they move on to pursue specialized research projects. During the first year, students enroll in a core curriculum designed to provide a foundation in biochemistry, cell biology, genetics, immunology, microbiology, pharmacology, physiology, signaling, laboratory techniques, and biostatistics. Students also take 4-6 credits of elective courses and manuscript and grant writing courses to better prepare them for their chosen field of interest. Finally, two professional development courses provide students the opportunity to gain experience in various professional scientific skills.

Students also explore their individual research interests through four laboratory rotations that emphasize experimental design and integration into a research team. Students are encouraged to take advantage of the diversity of opportunities in the six participating programs. Once a student selects a dissertation advisor, they become affiliated with one of the following graduate programs: Biochemistry; Biophysics; Cell and Developmental Biology; Microbiology and Immunology; Pharmacology and Toxicology; or Physiology. In addition, students may also pursue a clinical focus if admitted into the Basic and Translational Science Program. Additional information about individual departmental programs is given elsewhere in this publication.

During their second year of studies, students take a course in writing an NIH-style fellowship and prepare a proposal based on their own research that provides them with valuable experience in mastering a significant and innovative scientific problem, formulating a suitable hypothesis, and drafting a well rationalized and rigorous experimental plan with which to test it. This proposal is defended as part of their qualifying exam for candidacy for a PhD degree in one of the participating departments.

During their second semester and in subsequent years, students are also expected to successfully complete several advanced courses selected with the guidance of their dissertation mentor, dissertation committee, and the Graduate Program Director of their affiliated program. Throughout their graduate careers, students formally in the Interdisciplinary Program continue to meet as a group to share ideas, insights, and research accomplishments with each other and faculty.

IDP prepares students for advanced study in one of the following PhD degree- granting programs: Biochemistry, Biophysics, Cell and Developmental Biology, Microbiology and Immunology, Pharmacology and Toxicology and Physiology.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Successful applicants will show undergraduate achievement in science and mathematics courses and have prior research experience.

Fields of Study

Faculty participating in the Interdisciplinary Program in Biomedical Research have diverse research interests such as:

- Cancer Biology
- Cardiovascular Biology
- Cell Biology & Signaling
- Developmental Biology
- Drug Discovery
- Enzymology & Metabolism
- Free Radical Biology
- Gene Expressions and epigenetics
- Inflammation & Immunology
- Microbial Infection & Pathogenesis
- Microbiome
- Molecular Genetics
- Molecular Pharmacology & Toxicology
- Neuroscience (Cellular and Molecular)
- Physiological Sciences
- Stem Cell Biology & Regenerative Medicine
- Structural Biology
- Technology Development

Required Courses

BIOE 10222 Foundations Ethics and Integrity in Science. *1 credit.*
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.

INBS 16211,16212, 16213, 16214 Introduction to Biomedical Research I-IV. *1 credit each.* These courses reflect student participation in laboratory research rotations, overall professionalism, timely completion of written reports, and attendance at required events.

INBS 16215 Foundations in Biomedical Sciences I. *3 credits.*
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, in-class discussions, and review sessions which are designed to promote class participation.

INBS 16216 Foundations in Biomedical Sciences II. *3 credits.*

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 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 credits.*

FBS III builds on the cell biology fundamentals introduced in the latter part of FBS I and II. This course starts with lectures on cell signaling and a discussion of a primary research article on the topic. 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. The third part of the course focuses on DNA homeostasis, genetic principals, the basis of stem cells and cancer.

INBS 16218 Foundations in Biomedical Science IV. *3 credits.*

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 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 is 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 and Cellular Biology. *2 credits.*

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.

INBS 16245 Statistics for Basic Sciences. *1 credit.*

This course is designed to provide graduate students working in the research laboratory or studying the experimental sciences with fundamental knowledge in biostatistics. 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 the study. Emphasis is placed on understanding concepts as well as learning

to apply the covered statistical techniques. Students also learn how to read, interpret, and critically evaluate statistical concepts in the literature.

INBS 16290 Professional Development I. *1 credit.*
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 other's work.

INBS 16291 Professional Development II. *1 credit.*
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.*
This course will present a step-by-step approach to putting together a scientific paper. Students will be divided into small groups, 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 credits.*
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 that will form the basis of their qualifying examination written report and a fellowship grant.

Elective Courses

INBS 16265 Introduction to Organ Systems Physiology. *2 credits.*
Introduction to 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 Cells, Muscle, Cardiovascular, Pulmonary, Renal, GI, Endocrine, and Reproduction. It also introduces students to animal models in physiological research appropriate for the topic at hand.

INBS 16266 Bacterial Diversity and the Microbiome. *1 credit.*
This interdisciplinary course provides 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 is also highlighted. The course will be paper based with chalk-talk style discussion sessions designed to promote discussion of the literature.

INBS 16267 Protein Chemistry: Applications. *1 credit.*
Suitable for all students interested in developing critical thinking skills through literature examples of protein activity and its regulation. Students and instructors discuss literature that illustrates the in vitro reconstitutions, proteins structure/activity, and methods and logic of experimental design including critical control experiments. In addition, discussions include methods learned in the first-year curriculum that might have been applied but were not. From these analyses, students hone their critical thinking and communication skills.

INBS 16268 Protein Chemistry: Principles. *1 credit.*
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 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 emphasizes literature examples and expect students to learn these principles by working through problem sets provided by instructors. Students are 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, discussions include methods learned in the first-year curriculum that might have been applied but were not.

INBS 16269 Basic Immunology. *1 credit.*
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 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 integrate their knowledge of the immune system and apply it to disease.

INBS 16270 Integrated Microbiology and Immunology. *3 credits.*
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 first year 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 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 integrate their knowledge of pathogens and the immune system.

INBS 16271 Fundamentals of Neuroscience. *3.5 credits.*
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, seminars from prominent scientists (video archives), and written assignments. The purpose of this course is to introduce 1st year graduate students to the structure and function of the human nervous system.

INBS 16272 Graduate Neuroanatomy. *0.5 credit.*
Graduate Neuroanatomy is a lab-based course intended to accompany MCW course 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 credits.*
Advanced Cell Biology is an upper level, 3-credit hour cell biology elective course that focuses on a variety of advanced topics in contemporary Cell Biology. Students gain an in depth understanding of specific selected topics through the use of a variety of resources including 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 are minimized.

INBS 16274 Metabolism. *1 credit.*
This course is mainly a didactic based course that comprehensively reviews subjects important to metabolism. The topics covered range from carbohydrate metabolism to oxidative phosphorylation to lipid and amino acid metabolism. There is 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 is not necessarily comprehensive, but there may be a few aspects of each topic that are highlighted by focusing on landmark studies or recent developments from published articles. In addition, the discussions include methods learned in the first-year curriculum that might have been applied but were not.

INBS 16275 Understanding Cell Signaling through Therapeutic Drugs. *2 credits.*
This course presents advanced concepts in cellular signaling by analyzing the molecular mechanisms 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 were removed from the market due to unanticipated toxicity or limited effectiveness. The lectures provide an advanced analysis of the molecular responses that led to the success or failure of these drugs, encouraging students to develop sophisticated analytical skills that allow them to define how different signaling pathways are

integrated. Lectures presented by instructors provide an in-depth overview of different signaling pathways, and manuscript discussions promote additional advanced analysis that creatively engages the students.

INBS 16276 Developmental and Stem Cell Biology. *3 credits.*
This 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 prepare and present a lecture on a developmental and stem cell biology topic directly relevant to each student's own research interests. Students also provide feedback to their pers in the form of brief critiques of individual presentations.

INBS 16278 Functional Genomics. *3 credits.*
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.

2025-26

MD/MPH

Degree Offered: Medical Doctor/Master of Public Health

Program Description

This online program gives students who have been accepted to the Medical School at MCW the opportunity to complete the MD and MPH degrees in five years. Combining medical and public health education provides students with interdisciplinary skills needed to serve as leaders to address population-level issues that impact health at local, national, and global levels. With a focus on public health practice, students will find great value in working with others in the community to prevent disease and improve health. Those graduating with the MD/MPH are uniquely prepared for a wide array of careers addressing the health of individuals and populations.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional requirements.

M1 course grades will also be used in the MPH acceptance decision

Prospective students must apply to both the MCW Medical and Graduate Schools. Students must apply first to the Medical School, be accepted, and matriculate at the MCW Milwaukee campus. Application to the Graduate School occurs in the spring of the M1 year. Enrollment is contingent upon:

1. Achieving a grade of Pass, Satisfactory, or better in all courses during their M1 year
2. Completing all courses without withdrawing from any courses
3. Approval by the Academic Standing and Professionalism Committee
4. Earning satisfactory pathway grades and satisfying all pathway deadlines in a timely manner

Credits Required to Graduate

42 credits

Required Courses

PUBH 18155 Public Health Theory & Practice. *3 credits.*
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 credits.*
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 the 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 credits.*
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 credits.*
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 credits.*
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 credits.*
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 18223 Public Health Policy. *3 credits.*
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 credits.*
Recommended: 18203 Public Health Administration and 18209 Community Health Assessment and Improvement.
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 18260 Community Health Program Evaluation. *3 credits.*
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 credits.*
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.*
Prerequisites: 18165 Principles of Public Health Data and Epidemiology, 18203 Public Health Administration, 18204 Public Health Analytics, 18155 Public Health Theory and Practice; all required coursework in the Master of Public Health program besides 18280 Field Placement and 18297 MPH Capstone Project recommended.
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. *1-5 credits.*
Prerequisites: All required coursework in the Master of Public Health program besides 18297 MPH Capstone Project recommended.
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 18297 Capstone Project. *3 credits.*
Prerequisites: All other MPH coursework.
The Capstone Project or Integrative Learning Experience 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.

Elective Courses

PUBH 18115 Health Promotion and Disease Prevention. *3 credits.*
Students will learn key concepts through readings, lectures, on-line discussions and written exercises. The latter will allow students to practice designing elements of an HP/DP plan for a population and health problem of their own choosing using each of the theoretical models and techniques presented in the course. This course is an elective in the MPH degree program, the Certificate in Community Health Assessment & Planning program, and the Certificate in Population Health Management program.

PUBH 18150 Public Health Law and Ethics. *3 credits.*
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 of 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 18215 Infectious Diseases. *3 credits.*
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 18232 Introduction to Population Health Management. *3 credits.*
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 credits.*
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 18295 Reading and Research. *1-3 credit(s).*
An independent study course, under public health faculty guidance, to pursue reading and research in an area of specific student interest.

2025-26

CLINICAL AND TRANSLATIONAL SCIENCE

Degree Offered: Doctor of Medicine/Master of Science Dual Degree

Program Description

This program is operated by the Clinical and Translational Science Institute (CTSI) of Southeast Wisconsin. The mission of the CTSI is to develop an integrated, shared home for clinical and translational research and to establish a borderless, collaborative, and investigator/ community/patient- friendly, research environment. The CTS MD/MS dual degree program fit with the CTSI's strategic goals of providing quality education and training to cultivate the next generation of clinical and translational researchers.

The MD/MS in Clinical and Translational Science Program is designed for students who wish to pursue a medical career with a research focus. During the first two years of the dual degree program, students complete the basic science coursework for the MD degree. In addition, dual degree students take some coursework to meet the requirements for the MS degree. MS degree coursework emphasizes clinical study design, biostatistics, and research methods, and provides students with an opportunity to conduct a mentored research project. Some coursework meets the requirements for both degrees. Students engage in their research projects during the summer between the first and second years of study and subsequent research electives during the third and fourth years of medical school.

Upon entering the dual degree program, students have a designated faculty advisor who will provide guidance in the program and assist them in identifying an area of research that is of interest to them. During the first year of the program, students will have the opportunity to explore a wide range of research options and to identify a research mentor with whom they will work.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

To enroll in the MD/MS program, applicants must first be admitted to the Doctor of Medicine program.

Fields of Study

MS degree coursework emphasizes clinical study design, biostatistics, and research methods, and provides students with an opportunity to conduct a mentored research project.

Credits Required to Graduate

36 credits

Program Credit Requirements

The MD/MS in Clinical and Translational Science consists of 36 credit hours. 27 credits are from required courses, 9 credits are from thesis hours. The program is designed to be completed in four (4) academic years.

Required Courses

BIOE 10226 Regulatory Issues in Human Subject Research Protections. *3 credits.*
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.

PUBH 18209 Community Health Assessment and Improvement. *3 credits. Recommended: 18203 Public Health Administration*
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.

CTSI 20101 Introduction to Clinical and Translational Science. *3 credits.*
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 credits.*
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 credits.*
The course will provide the student with a broad understanding of health services research design and methodology, as well as provide the student with the opportunity to engage in a mentored, individualized, in-depth study experience. By the end of the course the student will be able to understand key theories that serve as the foundation of health services research and understand the process of developing a research idea and translating it into an R-series level NIH proposal. Coursework will include weekly reading of peer-reviewed manuscripts, one introductory textbook on health services research, and one introductory textbook on designing clinical research. Weekly classes will include discussion of reading and assignments are designed to allow practice of critically reading and planning health services research projects.

CTSI 20220 Clinical Statistics I. *3 credits.*
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 20260 Introduction to Dissemination and Implementation Science. *3 credits.*
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 textbook 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 credits.*
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 by the last day of this course are comprised of a two-page literature review, a one-page abstract of their research project progress thus far, along with a scientific poster as it currently stands. Both the abstract and poster will also be submitted at the medical school SAMS poster day during the Fall term. Students will meet with their research mentor on a predetermined regular basis over the course of 9 weeks during the summer.

20299 Master's Thesis. *3 credits.*
A total of 6 master's thesis credits is 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 credits,*
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 MS students will be required to take the course. First year Master's students will develop their research question, complete a thorough literature review of the topic of interest in the form of a systematic review, and begin to identify methods that will be used to answer their research question. While second year students will conduct the necessary steps to answer their research question, write their results and conclusions, and prepare an oral presentation of their thesis work to be presented before their colleagues at the end of the semester and during MCW student research day. All students will be expected to provide feedback to their classmates and will receive feedback from their peers and the course director. Each class period four students will present some aspect of their project and will receive feedback from peers and the course director.

PRME 42100 Introduction to Precision Medicine. *3 credits.*
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 42170 Medical Genetics, Undiagnosed, and Rare Diseases. *3 credits.*
Prerequisite: 42100 Introduction to Precision Medicine
Medical Genetics, Undiagnosed and Rare Diseases allows students examine the application of genomics to core clinical systems and applying that knowledge to personalized management of patients. Experts in their respective fields will guest lecture in several sessions.

Required Courses as Needed

CTSI 20002 Master's Thesis Continuation. *0 credits.*
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.

2025-26

MICROBIOLOGY & IMMUNOLOGY

Degree Offered: Doctor of Philosophy

Program Description

The Graduate Program in Microbiology & Immunology (M&I) seeks to teach and train the next generation of research scientists in the molecular and cellular biology of bacterial pathogens, virus/host interactions, the innate and adaptive immune responses, animal and cellular model systems of infection and immunity, the microbiome, and the molecular mechanisms of gene expression, signal transduction, cell proliferation and cancer biology. It is the goal of the faculty and students to utilize classic and cutting-edge methodologies and technologies to conduct interdisciplinary research that will solve problems that are of significant biomedical importance.

Through participation in a variety of departmental activities, M&I graduate students receive a broad education and training base that encompasses various aspects of biomedical science including those centered in the fields of bacteriology, immunology, virology, molecular biology, microbe-host interactions, genetics/gene expression and cancer biology. Our students develop essential technical skills and/or capabilities that allow them to conduct independent research, and effectively communicate scientific accomplishments in both written and oral forms. In general, M&I faculty seek to promote accomplishment of these objectives by providing a stimulating work and learning environment in which scientific curiosity is encouraged, scientific questions of significance are investigated, rigorous experimental approaches to problems are designed and executed, data are critically interpreted, and sound and cogent concepts are developed. The M&I Graduate Program assesses accomplishment of these objectives through several mechanisms including didactic course requirements, required annual research in progress (RIP) scientific presentations, semi-annual meetings with dissertation committee members coupled with submission of committee report forms, and dissertation-specific qualifying examination. The ultimate goal of the M&I Graduate Program is to produce well-rounded scientists that possess the necessary maturity, experience, and knowledge base to become independent leaders in the biomedical sciences within academia, industry, government, or other health-related career venues. These goals are consistent with the mission of the MCW Graduate School and of the Medical College of Wisconsin as a whole.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Students enter the graduate program in the Department of Microbiology and Immunology through the Interdisciplinary Program in Biomedical Sciences (IDP), the Neuroscience Doctoral Program (NDP), the Medical Scientist Training Program (MSTP), or by direct entry into the Microbiology and Immunology Graduate Program. Students who choose a mentor in the Department of Microbiology and Immunology will enter the Microbiology and Immunology Graduate Program upon start of their

thesis research with the selected dissertation mentor.

Fields of Study

The following areas of research in the Department of Microbiology and Immunology offer excellent opportunities for graduate dissertation projects:

Molecular Biology of Bacterial Pathogenesis

- Characterization of the molecular properties of bacterial exotoxins, with the goals of defining their mode of action and how toxins modify host cell physiology
- Identification of host and bacterial proteins involved in attachment of Borrelia burgdorferi and Leptospira interrogans to human cells, and the consequences of these interactions for the host
- Investigation of the secretion and function of bacterial virulence factors encoded by Pseudomonas aeruginosa and other opportunistic infections
- Investigation of genetic, biochemical, and signaling pathways required for antimicrobial resistance and gut colonization by enterococci
- Studies of the phasevarion regulatory system in the pathogenesis of Haemophilus influenzae, Moraxella catharrhalis, Helicobacter pylori and Neisseria species
- Investigation of host defenses in the cytosol and how professional cytosolic pathogens like *Listeria monocytogenes* evade them

The Microbiome

- Role of xenobiotics in disrupting gut microbiota and consequences on metabolism
- Importance of bacteriophage in regulating composition of gut microbiota
- Role of xenobiotics in disrupting the gut microbiota/metabolism, two-component signaling, and predatory-prey interactions
- Role of the mosquito microbiome in shaping immune responses to malaria infection

Molecular Genetics of Human Viruses

- Investigation of the molecular mechanisms employed by human herpesviruses to escape detection by the immune system
- Characterization of interactions between cancer-associated gammaherpesviruses and host systems that either promote or restrict lytic and chronic gammaherpesvirus infection,
- Investigation of proteins involved in establishing a permissive environment for herpesvirus replication using mass spectrometry

Cellular and Molecular Analysis of the Immune Response

- Autoimmunity. Investigation into roles of T cells and B cells and mechanisms of central and peripheral tolerance in autoimmune disorders including type 1 diabetes, multiple sclerosis, arthritis, and colitis
- Oncology. Investigation of tumor microenvironment and immune response against solid and liquid tumors; mechanistic studies of immunity, anti-tumor evasion and tolerance in anti-tumor response
- Cellular therapy. Allogeneic hematopoietic cell transplantation (Allo-HCT), studies of allogeneic T- and B-cell mediated graft-versus-host (GVH) and graft-versus-leukemia/lymphoma (GVL) responses. Adoptive T-cell Therapy (ACT) including chimeric antigen receptor (CAR) T-cell therapy. Investigations of T-cell activation, differentiation, persistence, and migration in the context of immunotherapy against cancer

- Inflammation. Basic mechanisms of immune regulation and inflammation; structure-function studies of adhesion molecules and integrins; immunobiology investigations of Chemokines,cytokines and their receptors
- Host Defense. Studies of MHC, antigen presentation, innate and adaptive immune responses to bacterial and viral infections, autoimmune diseases, and cancer
- Immune Metabolism and Molecular Immunology. Seahorse energy metabolism, metabolomic, proteomic, single cell sequencing, and ATAC sequencing analyses of immune system in health and disease

Molecular Mechanisms of Gene Expression

- Studies of the mechanisms and consequences of signal transduction: endothelin-mediated signaling through small GTPases, cycloxygenase-2, and the prevention of apoptosis.
- Study of two-component signal transduction networks in bacteria
- Studies of mosquito non-coding genetic variation in transcriptional enhancers and differential malaria susceptibility

Credits Required to Graduate

60 credits minimum

Program Credit Requirements

Students entering from the IDP and NDP, or who directly enter into the Microbiology and Immunology Graduate Program, are required to take 9 credits of advance coursework as a minimum. MSTP students are required to take 6 credits of advanced coursework at a minimum.

All students must also complete 16242 Techniques in Molecular and Cellular Biology, 25301 Research in Progress Course (taken during the Fall and Spring semester of third year in graduate school), and 25302 Scientific Communication course (taken during the Spring semester of second year in graduate school). In addition to courses above, students entering directly into the Microbiology and Immunology Graduate Program are also required to complete 16293 Writing an Individual Fellowship. Furthermore, students entering from the IDP or NDP need to complete 16270 Integrated Microbiology and Immunology (the entire course, or two 1-credit hour blocks, as advised by the thesis mentor), 16292 Writing a Scientific Paper, and 16293 Writing an Individual Fellowship.

Required Courses

10222 Ethics and Integrity in Science. *1 credit.*
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. Bioethics 10222 is offered during the spring and summer terms only.

10444 Research Ethics Discussion Series. *1 credit.*
Prerequisite: 10222 Ethics and Integrity in Science.
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, 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. Bioethics 10444 is offered during the spring terms only.

16242 Techniques in Molecular and Cellular Biology. *2 credits.*
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 use 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.

16270 Integrated Microbiology and Immunology. *3 credits.*
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 first year 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 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 integrate their knowledge of pathogens and the immune system. Required for IDP and NDP students.

16292 Writing a Scientific Paper. *1 credit.*
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.

16293 Writing an Individual Fellowship. *2 credits.*
Prerequisite: 16292 Writing a Scientific Paper
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).

25295 Reading and Research. *1-9 credit(s).*
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.

25301 Research in Progress Course. *1 credit.*
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.

25302 Scientific Communication. *1 credit.*
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.

25399 Doctoral Dissertation. *9 credits.*
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.

Required Courses as Needed

25002 Master's Thesis Continuation. *0 credits.*
Prerequisite: 25299 Master's Thesis
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.

25003 Doctoral Dissertation Continuation. *0 credits.*
Prerequisite: 25399 Doctoral Dissertation
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.

25299 Master's Thesis. *6-9 credits.*
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.

Elective Courses

16217 Foundations in Biomedical Sciences III. *3 credits.*
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, the basis of stem cells and cancer. Exam 3 closes out the Fall semester.

25230 Current Topics in Microbiology and Immunology. *2 credits.*
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.

25251 Advanced Molecular Genetics. *3 credits.*
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.

25259 Mucosal Immunity. *1 credit.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
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.

25260 Mucosal Pathogenesis. *1 credit.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
Mucosal Pathogenesis is an upper-level, one-credit hour Microbiology course that focuses on the interactions of microbial pathogens with cells of the mucosal epithelium. Students gain a detailed and comprehensive understanding of specific infectious microbial pathogens, and the mechanisms utilized by the 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.

25261 Bacterial Toxin-Mucosal Cell Interactions. *1 credit.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
Bacterial Toxin-Mucosal Cell Interactions is a one-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 includes formal lectures and paper discussions.

25262 Tumor Immunology. *1 credit.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
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.

25263 Signaling in the Immune System. *1 credit.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
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.

25265 Immunological Tolerance. *1 credit.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
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 select 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 meet twice weekly for 6 weeks.

25266 Clinical Immunology. *1 credit.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
Clinical Immunology is an upper-level, one-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 the recent literature.

25267 Bacterial Diversity and the Microbiome. *1 credit.*
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.

25269 Advanced Bacterial Physiology. *1 credit.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
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 mechanism's 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 the 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.

25271 Membranes and Organelles. *1 credit.*
Prerequisites: 16216 Foundations in Biomedical Sciences II.
Membranes and Organelles is an upper-level, one-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%).

25272 Innate and Adaptive Immunity *2 credits.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
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.

25273 Advanced Immunology. *1 credit.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
Immunology is currently enjoying a golden age, and breakthroughs in immunology research have transformed our understanding of many areas of biomedical science. This rapidly evolving landscape is also giving rise to novel immune-based therapeutic approaches to prevent and cure many diseases such as autoimmunity, cancer, and infectious diseases. 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.

The objective for this course is to provide a comprehensive understanding of the experimental basis of the fundamental principles of immunology. This course is designed for second year graduate students and is intended to enhance the interpretation of experimental data and experimental design in the field of immunology. Emphasis will be placed on current knowledge of the immune system and how to read and critically analyze the primary literature. Topics to be discussed include Innate Immunity and Antigen Recognition, Immune Signaling and Development, Immune Responses and Diseases of the Immune System.

25275 Advanced Bacterial Genetics. *1 credit.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
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.

25276 Basic Bacteriology. *1 credit.*
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.

25277 Basic Virology. *1 credit.*
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 study to pathogens.

25280 Classical Papers in Microbiology and Immunology. *1 credit.*
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 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.

25285 One Health Perspectives on Infectious Agents. *2 credits.*
Prerequisites: 16270 Integrated Microbiology and Immunology.
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 in 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.

25289 Career Internships in the Biomedical Sciences. *0 credits.*
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.

25298 Immunology Journal Club. *1 credit.*
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.

2025-26

MEDICAL PHYSIOLOGY

Degree Offered: Master of Medical Physiology

Program Description

The Master's in Medical Physiology Program at MCW is a one-year special Master's program designed to help college graduates strengthen their academic credentials for medical school and other health professional programs. Our program includes MCW School of Medicine courses and exams, providing students with experience comparable to MCW medical students. Our program also includes MCAT preparation and conditional admissions interviews to the MCW School of Medicine and MCW School of Pharmacy. We maintain a small cohort size to ensure each student receives the personalized academic advising and career development they need to succeed. Graduates of this program have a solid foundation for medical school, other health professional or biomedical research programs, and jobs in academia, industry, or government positions, as supported by our strong placement data.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

This program requires applicants submit standardized test scores with their applications. MCAT scores are preferred, but other health professional school test scores (e.g., GRE, DAT, or PA-CAT) can be used if MCAT scores are not available.

Credits Required to Graduate

32.5 credits

Required Courses

MMPY 41100 Foundations of Medicine. *6 credits.*
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 credits.*
The Hematology/Immunology block is designed to teach medical students the biochemical, genetic, and physiological etiology of hematological and immunological pathologies and physiological responses to infection. This course will be anchored in 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. This 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 credits.*
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 credits.*
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. *0.5 credits.*
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, & Wellbeing. *2 credits.*
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 credits.*
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 credits.*
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.

PHYS 08275 Special Problems in Physiology. *1 credit.*
Readings and/or research under direction of a faculty member in a specialized field of physiology. Under specific circumstances, may be substituted for formal courses.

BIOE 10222 Ethics and Integrity in Science Course. *1 credit.*
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. Bioethics 10222 is offered during the spring and summer terms only.

INBS 16265 Organ Systems Physiology. *2 credits.*
Introduction to 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 Cells, 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.

PHYS 08295 Reading and Research. *1-9 credits (elective)*.
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.

INBS 16271 Fundamentals in Neuroscience. *3.5 credits (elective)*.
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, seminars from prominent scientists (video archives), and written assignments. The purpose of this course is to introduce 1st year graduate students to the structure and function of the human nervous system.

INBS 16278 Functional Genomics. *3 credits (elective)*.
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.

2025-26

NEUROSCIENCE DOCTORAL PROGRAM

MCW GRADUATE SCHOOL

Program Description

Neuroscience is a dynamic, rapidly growing field devoted to study of the central and peripheral nervous systems in health and disease. During the past three decades, a group of eminent scientists with research interests in many areas of neuroscience has been assembled in the basic science and clinical departments of the Medical College of Wisconsin. These individuals, who have an impressive record of pre-and post-doctoral training, research, and extramural funding in the neurosciences, form the core faculty for this training program. The research areas of the neuroscience faculty include functional imaging, electrophysiological, biochemical, cellular, and molecular approaches to questions of fundamental and clinical importance.

The Neuroscience Doctoral Program (NDP) is committed to providing a specialized education in neuroscience ranging across molecular and cellular mechanisms, systems neuroscience, and brain imaging. This education is designed to serve the students well as they move on to pursue specialized research projects. During the first year, students take a core curriculum designed to provide a foundation in neuroscience as well as biochemistry, cell biology, genetics, molecular biology, physiology, signaling, laboratory techniques, and biostatistics. Students also take 4-6 credits of elective courses and a summer course on general writing to help with the qualifying exam and professional development.

A novel aspect of the NDP is that students will be provided with a hands-on Techniques in Neuroscience program, an immersive 6-week program designed to create an on-ramp for new students to the major techniques and skills they will need for their careers in Neuroscience. Through hands-on, interactive sessions, first-year NDP students will be introduced to 1) Molecular techniques in neuroscience, 2) Microscopy and image analysis, 3) Electrophysiology in the neurosciences, 4) Animal behavioral models for neuroscientific investigation, 5) Basics of Python for data analysis, and 6) Introduction to Human Subjects Research. This program also offers several opportunities for students to engage directly with NDP faculty instructors. Opportunities include social events, conversation-focused seminars, and shadow opportunities. These relationship-building events were designed to facilitate students' transition into their lab rotations by allowing them to familiarize themselves with potential research programs and build connections with faculty members crucial to their doctoral training. It also provides a platform for increased visibility of NDP faculty and opportunities for faculty members to interact with potential future trainees. Students will shadow a minimum of 9 faculty instructors to assist in choosing laboratories for first-year rotations.

Students will then explore their individual research interests through 3-4 laboratory rotations that emphasize experimental design and integration into a research team. Students are encouraged to take advantage of the diversity of neuroscience research opportunities in the participating departments. Once a student selects a dissertation advisor at the end of their first year, they will become affiliated with one of the following graduate programs: Biochemistry; Biophysics; Cell and Developmental Biology;

Physiology; Microbiology and Immunology; or Pharmacology and Toxicology. In addition, students may also pursue a clinical focus if admitted into the Basic and Translational Science Program. Additional information about individual departmental programs is given elsewhere in this publication.

During the second year of their studies, students will take a course in writing an NIH-style fellowship and prepare and defend a proposal based on their own research that will provide them with valuable experience in mastering a scientific problem, formulating a suitable hypothesis, and drafting a feasible and productive experimental scheme with which to test it. The qualifying exam for NDP students will be administered by the graduate program that their thesis laboratory is affiliated with (e.g., Biochemistry; Biophysics; Cell and Developmental Biology; Physiology; Microbiology and Immunology; or Pharmacology and Toxicology*)*. Successful completion of this qualifying exam is a major step towards being admitted to candidacy for a PhD degree in the thesis department. During their second semester and in subsequent years, students are also expected to successfully complete a number of advanced courses selected with the guidance of their dissertation mentor, dissertation committee, and the Graduate Program Director of their affiliated department. Upper-level students will focus on the development of their research skills, performance of their doctoral research, and completion of their dissertation.

Once affiliated with a particular laboratory and department, students can expect attentive personal mentoring by their dissertation advisor. Throughout their graduate careers, students in the Interdisciplinary Program continue to meet as a group to share ideas, insights, and research accomplishments with each other and with the faculty.

This program prepares students for advanced study in one of the following PhD degree-granting programs: Biochemistry; Biophysics; Cell and Developmental Biology; Microbiology and Immunology; Physiology; and Pharmacology and Toxicology.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Successful applicants will show undergraduate achievement in science and mathematics courses and have prior research experience.

Fields of Study

Faculty participating in the Neuroscience Doctoral Program have diverse research interests such as:

- Neurodegeneration and Neurotrauma

Neurodegenerative diseases including ALS, Parkinson's disease, Alzheimer's disease, and Spinal Cord Injury are studied using stem cells, animal models, and human tissues.

- Neuroimaging, Tissue to Brain

State of the art brain imaging and biomedical engineering technologies are used to study language, vision, hearing, motor control, learning and memory, and brain associated cancers.

- Cellular and Synaptic Communication

Neuronal communication and receptor-ligand binding at the cellular and structural levels are studied using cutting edge genetic, electrophysiological, and computational tools to

dissect mechanisms of development, signaling, and disease associated with vison, learning and memory, and addiction.

- Function of Neural Systems in Normal and Disease states

Sleep disruption, breathing, chronic stress, reward and drug abuse systems, hearing, touch and temperature sensation and chronic pain are studied using diverse model systems and approaches.

Required Courses

INBS 16211,16212, 16213, 16214 Introduction to Biomedical Research I-IV. *1 credit each.* These courses reflect student participation in laboratory research rotations, overall professionalism, timely completion of written reports, and attendance at required events.

INBS 16215 Foundations in Biomedical Sciences I. *3 credits.*
This is 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 credits.*
An interdisciplinary course that provides students with a foundation in the areas of gene expression, and basic and contemporary issues in cell biology. The material is primarily presented in lecture format, but a significant number of paper discussion sessions are also included.

INBS 16217 Foundations in Biomedical Sciences III. *3 credits.*
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, the basis of stem cells and cancer. Exam 3 closes out the Fall semester.

INBS 16218 Foundations in Biomedical Science IV. *3 credits.*
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 credits.*
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 use 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.*
This course is designed to provide graduate students working in the research laboratory or studying the experimental sciences with fundamental knowledge in biostatistics. It will focus 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 the study. Emphasis will be placed on understanding concepts as well as learning to apply the covered statistical techniques. Students will also learn how to read, interpret, and critically evaluate statistical concepts in the literature.

INBS 16271 Fundamentals of Neuroscience. *3.5 credits.*
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, seminars from prominent scientists (video archives), and written assignments. The purpose of this course is to introduce 1st year graduate students to the structure and function of the human nervous system.

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

INBS 16290 Professional Development I. *1 credit.*
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 other's work.

INBS 16291 Professional Development II. *1 credit.*
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.*
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 credits.*
Prerequisite: 16292 Writing a Scientific Paper
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).

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

Elective Courses

NSCI 12221 Advanced Systems Neuroscience. *3 credits.*
Prerequisite: 16271 Fundamentals of Neuroscience or consent of the course director.
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 and Molecular Neurobiology. *3 credits.*
Prerequisite: 16271 Fundamentals of Neuroscience or consent of the course director.
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 12277 Cognitive Neuroscience. *2 credits.*

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 two relevant landmark papers, sometimes 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. There are a number of courses offered by other departments at the Medical College of Wisconsin that can be taken by students in the Neuroscience Doctoral Program depending upon their research interests. The goal is to provide each student with the basics of modern neuroscience and then allow them to customize a program of course work that best meets their needs.

2025-26

NEUROETHICS

Degree Offered: Certificate

Program Description

The Certificate in Neuroethics program training valuable to both clinicians and researchers; as the ever-advancing fields of neuroscience and neurotechnology posit new challenges, there is an increased demand for thoughtful consideration by individuals with a strong foundation in brain science as well as an expertise in ethical analysis and policy development. The Certificate in Neuroethics program is offered in an accessible online format available to individuals from across the nation.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Criteria for admission includes academic training and professional experience in a relevant area; commitment to the field of neuroethics; and promise in the program's academic areas.

Credits Required to Graduate

12 credits

Program Credit Requirements

Students in the Certificate program are required to complete a total of four three-credit online courses. All four of the courses are required.

These required courses provide students with the necessary legal, philosophical, and clinical perspectives necessary and valuable to researchers and clinicians interested in neuroethics.

Two of the courses will be offered in the fall semester, and the other two will be offered in the spring semester. Enrolled students have the choice to take one class per semester and finish the certificate in four semesters or take two classes per semester and finish in two semesters.

The technical requirements are minimal, i.e., ability to use a Web-browser and email. Class discussions and additional work are conducted primarily in non-real time, so students can participate at their convenience during each week. The pedagogical capabilities of the online environment enhance the class discussions and allow for individualized instructor feedback, which empowers the learners and makes the courses truly student-centered.

Required Courses

10210 Philosophical Bioethics. *3 credits.*

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.

10223 Law and Bioethics. *3 credits.*
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.

10245 Philosophical Neuroethics. *3 credits.*
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, ethical issues arising from advances in neuroscience/ neurotechnologies in the broader social milieu.

10248 Clinical Neuroethics. *3 credits.*
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.

2025-26
PHARMACOLOGY & TOXICOLOGY
Degree Offered: Doctor of Philosophy

MCW GRADUATE SCHOOL

Program Description

The Pharmacology & Toxicology Doctoral program provides diverse research opportunities in the areas of cardiovascular, cancer, and neurosciences. An emphasis is placed on cellular and molecular pharmacology/toxicology and signal transduction. The primary objective of our program is to provide students with an academic background, professional skills, and expertise in state-of-the-art scientific approaches needed to investigate and solve the important biological problems that will be the focus of research in the decades to come. Our graduate degree program is multidisciplinary in nature and has strong associations with researchers in other basic science and clinical departments.

There are three major components to the program: graduate level coursework, successful completion of a combined written and oral qualifying exam, and the completion of a novel, publishable research project.

The coursework requirements of the doctoral program are flexible and tailored to the needs of individual students as much as possible. However, emphasis is placed on instruction in the areas of basic pharmacological principles, mechanism of drug action, signal transduction, and pharmacological techniques.

After completion of the initial coursework, students take a qualifying examination. The qualifying examination is designed to ensure a solid biomedical knowledge base has been established and consists of writing and defending a research proposal. The exam typically takes place in the second year of the doctoral program.

After a student has successfully passed his or her qualifying examination and completed the basic coursework, his or her time is spent engaged in a cutting-edge research project in the laboratory of a member of the department's graduate faculty. The final requirement of the program is for the student to write and defend a dissertation describing their research project.

Admission Requirements

In addition to the general Graduate School admission requirements, this program requires students to have a specific interest in pharmacology. This interest should be described in the personal statement section of the application.

Entry to the Pharmacology & Toxicology Graduate Program is through Direct Admission, Interdisciplinary Program in Biomedical Sciences (IDP), the Neuroscience Doctoral Program (NDP), or the Medical Scientist Training Program (MSTP). The student is admitted after completion of the first-year curriculum or through the Medical Scientist Training Program following the second year of Medical School. The student elects to complete their dissertation work with faculty of the Pharmacology & Toxicology Graduate Program. The student will then have the opportunity to continue graduate studies by selecting among a

wide range of courses offered from the Graduate School as well as other programs affiliated with the Medical College. Courses to be taken are based on the student's interests and consultation with the student's advisor.

Fields of Study

Research opportunities in the department are available in four general areas:

Cardiovascular Pharmacology

- Cellular pharmacology of vascular smooth muscle and endothelium
- Molecular biology of cell adhesion molecules and other inflammatory mediators
- Mechanisms of action of anti-hypertensive and anti-ischemic drugs
- Therapeutic development for the treatment of cardiovascular disease

Cancer Biology

- Study of cellular signaling pathways that promote malignancy and metastasis
- Identification of genes and genetic mutations that increase susceptibility to cancer
- Therapeutic development for the treatment of cancer

Neuropharmacology

- Biochemical and molecular mechanisms of action of centrally acting neurotransmitters and drugs
- Signal transduction mechanisms involving receptors, ion channels and protein trafficking
- Biochemical mechanisms and behavioral effects of drugs of abuse
- Therapeutic development for the treatment of neurological and psychiatric diseases

Structural Biology and Signaling

- Fundamentals of structural biology, molecular biology, and biochemistry are applied to mechanisms of drug action
- Ongoing projects include studies of the structures of drug targets and the effects of drugs on signal transduction processes, including receptors and intracellular signaling molecules

Credits Required to Graduate

60 credits minimum

Program Credit Requirements

All students who enter the program must take 10222 Ethics and Integrity in Science, 10444 Research Ethics Discussion series, and the 07301 Seminar course offered by the Pharmacology & Toxicology Doctoral program. In addition, eight additional credits of advanced elective coursework are required; 6 of these credits must be from elective courses offered from the Pharmacology & Toxicology Doctoral program listed below (up to 3 credits can be of graduate level courses offered from any program at MCW). All students entering directly into the Pharmacology & Toxicology program are required to complete the IDP curriculum during their 1st year. Alternatively, the program director may waive these requirements.

Required Courses

10222 Ethics and Integrity in Science Course. *1 credit.*
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. Bioethics 10222 is offered during the spring and summer terms only.

10444 Research Ethics Discussion Series. *1 credit. Prerequisite: 10222 Ethics and Integrity in Science.*
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. Bioethics 10444 is offered during the spring terms only.

PHTX 07301 Seminar. 1 *credit*.
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. Variable 1-9 credits. 9 total credits required.
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.

INBS 16211,16212, 16213, 16214 Introduction to Biomedical Research I-IV. *1 credit each.* This course reflects student's participation in laboratory research rotations and their attendance at seminars and/or journal clubs.

INBS 16215 Foundations in Biomedical Sciences I. *3 credits.*
This course is 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 credits.*
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 credits.*
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, the basis of stem cells and cancer. Exam 3 closes out the Fall semester.

INBS 16218 Foundations in Biomedical Science IV. *3 credits.*
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 and Cellular Biology. *2 credits.*
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 use 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.*
This course is designed to provide graduate students working in the research laboratory or studying the experimental sciences with fundamental knowledge in biostatistics. 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 the study. Emphasis is placed on understanding concepts as well as learning to apply the covered statistical techniques. Students also learn how to read, interpret, and critically evaluate statistical concepts in the literature.

INBS 16290 Professional Development I. *1 credit.*
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 other's work.

INBS 16291 Professional Development II. *1 credit.*
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.*
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 credits.*
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).

PHTX 07295 Reading and Research. *1-9 variable credits.*
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.

Required Courses as Needed

PHTX 07002 Master's Thesis Continuation. *0 credits.*
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 credits.*
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 07299 Master's Thesis. *1-6 variable credits. 6 credits required.*
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.

Elective Courses

At least 8 credits of electives are required for graduation. One 2-3 credit course can be taken from any program. Two 2-3 credit Pharmacology courses must be from the from the list below. 1 credit courses do not count towards the 8 credit requirement.

PHTX 07225 Ion Channels and Signal Transduction. *3 credits.*
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 credits.*
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 Discover and Development. 3 credits. Current Concepts of Cancer Biology. *3 credits.*
Modern Drug Discovery & 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 the fundamental concepts of therapeutic target identification and drug design, drug screening, preclinical testing, pharmaceutical optimization, human clinical trials, and drug commercialization.

PHTX 07250 Current Topics in Cancer Pharmacology. *1 credit.*
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.*
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.*
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.*
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 Professional Development in Pharmacology. *1 credit.*
This course supports graduate student professional development through experiential learning, and includes portfolio building, learning how to engage community partners and policy-makers, 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.

2025-26

PHYSIOLOGY

Degree Offered: Doctor of Philosophy

MCW GRADUATE SCHOOL

Program Description

The Physiology program at MCW features research leaders with strong programs in cardiovascular, renal, metabolic, and respiratory physiology, and utilize genetics, genetically manipulated model systems, functional genomics, proteomics, bioinformatics, computational biology, and a growing strength in neuroscience. Didactic coursework covers a broad interdisciplinary foundation complemented with several integrative systems physiology courses. Trainees develop critical thinking skills and other professional skills through performance of cutting-edge research to prepare the next generation of scientists in the Physiological Sciences.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Students with a major in the Biological or Physical Sciences who have demonstrated above- average scholastic ability are eligible to apply. Preferred undergraduate course work should include Biology (8 credits), General Chemistry (8 credits), Organic chemistry (8 credits), Physics (8 credits), Algebra (3-4 credits), and Calculus (3-4 credits).

Fields of Study

There are six general areas of Physiology in which students may conduct research. Both human and animal models are studied.

Circulatory

- Overall control of the cardiovascular system with emphasis on the neurohumoral control of arterial pressure and the interactions of the renal body fluid volume system.
- Ongoing projects relate to the role of circulatory smooth muscle in hypertension.
- Projects related to regeneration of the heart and vasculature

Endocrinology

- Renin-angiotensin-aldosterone system, vasopressin, and prostaglandin with emphasis on the role of these systems on the control of body fluids, electrolytes, arterial pressure regulation and basal metabolic rate determination in the context of obesity.
- Role of environmental exposure on endocrine systems

Renal and Excretory

- The importance of autocrine, paracrine, and hormonal factors in the regulation of renal tubular and vascular function.
- Elucidation of the factors important in the development of renal failure and hypertensive disease.
- Neural mechanisms regulating bladder function and bladder pain

Respiratory

- The role of the carotid chemoreceptors and medullary, pontine, and cerebellar nuclei in the control of breathing.
- Specific emphasis is on respiratory rhythm and pattern generation and chemosensitivity.
- Studies are targeted to gain insight into Sleep Disordered Breathing, the Sudden Unexpected Death in Epilepsy, and Central Congenital Hypoventilation Syndrome.

Genetics

- Identification and characterization of gene(s) involved in the development of complex disorders in humans and rat models.
- CRISPR/Cas9 gene editing in cells, including inducible pluripotent stem cells, and whole animal models

Molecular and Cell Biology

- Cell signaling in renal, respiratory, and cardiovascular diseases
- DNA binding proteins and their role in health and models of disease
- Development of novel gene editing strategies

Credits Required to Graduate

60 credits minimum

Program Credit Requirements

The emphasis of our PhD program is to provide training in molecular and physiology and/or whole-animal integrative Physiology complemented by training in cellular and molecular Physiology. To achieve this objective, all PhD students are required to complete a sequence of required courses in addition to any elective courses.

For a complete listing of all courses and their timing of enrollment throughout the Physiology PhD program, see the Physiology Student and Faculty Handbook (requests sent to Matt Hodges, PhD (mhodges@mcw.edu). The requirements are summarized below:

Year 1

Fall 2021			Spring 2022		Summer 2022
FBS1 (3cr)	FBS2 (3cr)	FBS3 (3cr)	FBS4 (3cr)	Intro to Organ Systems (2cr)	Ethics (1 cr)
			Statistics	Elective/Functional Genomics (3cr)	Scientific Writing (1cr)
Techniques in Molecular and Cell Biol (1cr)				Professional Development (1cr)	
Rotation 1	Rotation 2	Rotation 3	Rotation 4	Join lab (Feb)	

Year 2

Fall 2022	Spring 2023	Summer 2023
Advanced Human Physiology (3cr)	Electives with permission	Seminar (1 cr)
Writing an Individual Fellowship (1cr)	Special Topics (1cr)	
Qualifying Exam (Dec)	Full-time physiological research	

All students enter through the Interdisciplinary Doctoral Program (IDP), Neuroscience Doctoral Program (NDP), and/or the Medical Scientist Training Program (MSTP). In addition to the course requirements of these programs, there are additional required courses in the Physiology program (highlighted in yellow above). For those entering through IDP and NDP, one additional course must be completed in Spring of Year 1

(Organ Systems Physiology). Students are then required to also enroll in the Seminar course in the Summer semester. Additional required courses in the Physiology program prior to the Qualifying Exam include a grant writing course and Advanced Human Physiology (see descriptions below), which should be completed in the Fall semester of Year 2. Additional required courses that may be completed before or after completion of the Qualifying Exam include Functional Genomics [Spring Offering], Seminar (each Summer semester beginning in Year 2), and Special Problems in Physiology (each Spring semester beginning in Year 2).

Advanced Physiology: This 3-credit course provides the foundation for physiological concepts and integrative thinking and covers 4 major physiological systems: 1) endocrinology and reproduction, 2) cardiovascular physiology, 3) respiratory physiology, 4) renal physiology. Material will be covered by completing assigned pre-work (recorded lectures and primary literature) which are complemented by in-person condensed review sessions/lectures and presentation of classical and cutting-edge research publications within each discipline.

Students complete a written and oral Qualifying Examination after completing courses in the Fall of the second year in the program. This examination is administered by the Physiology Program Faculty. The written component is a grant-style proposal on a topic chosen by the student, and it usually is derived from didactic course materials, work conducted in laboratory rotations, and/or research that potentially will become part of the student's dissertation. The proposal and performance in the oral component of the Qualifying Exam will be evaluated by the examination committee and if acceptable the student will reach advanced degree status.

In each spring semester following the Qualifying Exam, physiology students enroll in Special Problems in Physiology course which is a journal club discussion of manuscripts. Another requirement of all MCW PhD programs is to fulfill two credits in Bioethics by completing Courses on Ethics and Integrity in Science and Research Ethics Discussion Series which are usually completed in the first two years. Students may choose to enroll in elective courses to complement their academic and research interests. Graduate students in other programs may choose to also enroll in this physiology course. Physiology students can also enroll in courses taught by other basic science departments. The student and their advisor choose elective courses that best meet the students career needs. Course selection can be specific to Physiology (see below) or from other MCW departments or other institutions in Milwaukee.

Required Courses Offered by Physiology

PHYS 08205 Advanced Physiology. *3 credits.*
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.

PHYS 08208 Current Topics in Physiology. *1 credit*.
The course is designed to give enrolled students a window into current advances and techniques in modern physiological research. Students will be required to attend and be graded upon attendance at weekly lectures/seminars sponsored by the Dept. of Physiology and their evaluations of each presentation. This course is offered in Fall and Spring semesters. But is only required beginning in the second year of graduate school until the final semester of their thesis work.

PHYS 08275 Special Problems in Physiology. *1 credit.*
Readings and/or research under direction of a faculty member in a specialized field of physiology. Under specific circumstances, may be substituted for formal courses.

PHYS 08295 Reading and Research. *1-9 credit(s)*.
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 08301 Graduate Student Seminar. *1 credit.*
This course is designed to provide Physiology Graduate students the opportunity to gain experience in presenting their scientific work as part of either the IDP student symposium or the Department of Physiology Seminar series, to gain useful scientific feedback from the audience during and upon the completion of their presentation, and to gain experience in participating in discussion during the presentations of their peers. It is taken each summer during Graduate School.

PHYS 08399 Doctoral Dissertation. *9 credits*.
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.

Required Courses Offered by IDP and others

BIOE 10222 Ethics and Integrity in Science. *1 credit.*
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. Bioethics 10222 is offered during the spring and summer terms only.

BIOE 10444 Research Ethics Discussion Series.
1 credit. Prerequisite: 10222 Ethics and Integrity in Science.
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, 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. Bioethics 10444 is offered during the spring terms only.

INBS 16215 Foundations in Biomedical Sciences I. *3 credits.*
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 credits.*
An interdisciplinary course that provides students with a foundation in the areas of gene expression, and basic and contemporary issues in cell biology. The material is primarily presented in lecture format, but a significant number of paper discussion sessions are also included.

INBS 16217 Foundations in Biomedical Sciences III. *3 credits.*
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, the basis of stem cells and cancer. Exam 3 closes out the Fall semester.

INBS 16218 Foundations in Biomedical Science IV. *3 credits.*
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 & Cellular Biology. *2 credits.*
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 use 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 16265 Organ Systems Physiology. *2 credits.*
Introduction to 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 Cells, 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 first year first semester Graduate School (FBS) course that runs from August-February.

INBS 16278 Functional Genomics. *3 credits.*
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 16278 Functional Genomics. *3 credits.*
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.*
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 other's work.

INBS 16291 Professional Development II. *1 credit.*
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 other's work.

INBS 16292 Writing a Scientific Paper. 1 credit.
This course is offered in the Summer between years 1 and 2. The goal is to enhance specific skill sets related to scientific writing and presentation. The course will focus on the processes important for the preparation of scientific manuscripts and an NIH F-type research proposal. This course will include didactic components, and will require students to work individually, or in small groups. Students will also engage in peer review activities to improve interpersonal, professionalism, and leadership skills.

Required Courses as Needed

PHYS 08002 Master's Thesis Continuation. *0 credits.*
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 credits.*
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 08299 Master's Thesis. *1-9 credit(s)*.
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.

Elective Courses in Physiology

PHYS 08270 Current Concepts in Cardiovascular Biology. *3 credits*.
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 CVCs Signature Programs and Affinity Groups. Unique features of the course include the integration of basic and clinical research intentional pairing of pre-doctoral students with post-doctoral fellows' presentations by students and fellows on selected topics and a section on Current Topics in Cardiovascular Sciences such as racial inequity COVID19 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.

Notes

Summary of explicit expectations and timelines for trainees
Students are expected to: 1) complete four 6-week research rotations, 2) choose a laboratory for their PhD research by March of the first year in graduate school, 3) complete the core didactic IDP and Physiology course curriculum by the end of the second year in graduate school, 4) fulfill the requirements for the PhD Qualifying Examination by the end of the second year in graduate school, 5) form an approved

dissertation committee before the start of the Fall semester in Year 2, 6) provide an approved dissertation outline within 6 months after completing the Qualifying Exam, 7) attend and present research at regional or national meetings each year beginning at the end of the second year in graduate school, 8) complete the PhD within 5 years after matriculation, and 9) publish two (2) or more peer-reviewed, first-authored manuscripts with a minimum of at least one accepted at the time of graduation.

2025-26
POPULATION HEALTH MANAGEMENT
Degree Offered: Certificate

Program Description
This certificate is offered completely online, allowing working professionals the flexibility to fulfill their educational goals. Through innovative online learning technologies promoting communication with faculty and fellow students, this program prepares individuals with the knowledge and skills to apply and achieve the concept of the "quadruple aim" of improved population health outcomes, better patient, and provider experiences, and reduced per person costs. Coursework consists of two required courses and two elective courses for a total of 12 credits. All credits offered in the certificate program may be transferable to the Master of Public Health program within one year of certificate completion. Experience working in a health care system, health plan, employer benefit plan, or public health department recommended.

Admission Requirements
In addition to the general Graduate School admission requirements, this program has no additional specific requirements.

Credits Required to Graduate
12 credits

Required Courses
PUBH 18232 Introduction to Population Health Management. *3 credits.*
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.

Elective Courses
PUBH 18101 Foundations of Public Health. *3 credits.*
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 credits.*
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 credits.*
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 of 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 & Practice. *3 credits.*
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 credits.*
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 the 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 credits***.**
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 18204 Public Health Analytics. *3 credits.*
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 credits.*
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 credits.*
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 credits.*
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 credits.*
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 18241 Health Communications. *3 credits.*
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 credits.*
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 credits.*
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.

2025-26

PRECISION MEDICINE

Degree Offered: Master of Science

Program Description

The Precision Medicine Education program based in the Medical College of Wisconsin Institute for Health & Equity in partnership with the Mellowes Center for Precision Medicine and Genomic Medicine offers online coursework toward a 30- credit Master of Science in Precision Medicine (PM) degree. Participants in the program will advance their knowledge, skills, practices, and competencies in PM. Learners may also enroll in courses as non-degree- seeking students.

Admission Requirements

Graduate School admission requirements.

All applicants will be required to submit their clinical or medical license as part of the application process.

Credits Required to Graduate

30 credits

Required Courses

PRME 42100 Introduction to Precision Medicine. *3 credits.*
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 42283 Precision Medicine Research Plan.
3 credits.
Prerequisite: 42100 Introduction to Precision Medicine
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 two faculty advisors.

PRME 42299 Precision Medicine Master's Thesis.
3 credits.
Prerequisite: 42100 Introduction to Precision Medicine
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 two faculty advisors.

Required Courses as Needed

PRME 42002 Master's Thesis Continuation. *0 credits.*
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.

Elective Courses

Students must pick seven PM elective courses.

PRME 42145 Omics Technology in Precision Medicine. *3 credits.*
Prerequisite: 42100 Introduction to Precision Medicine
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 credits.
Prerequisite: 42100 Introduction to Precision Medicine
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. Entry level visualization of bioinformatics will be covered as it relates to Epigenomics. No prior bioinformatic knowledge is necessary to enroll for course.

PRME 42170 Medical Genetics, Undiagnosed, and Rare Diseases.
3 credits.
Prerequisite: 42100 Introduction to Precision Medicine
Medical Genetics, Undiagnosed and Rare Diseases allows students examine the application of genomics to core clinical systems and applying that knowledge to personalized management of patients. Experts in their respective fields will guest lecture in several sessions.

PRME 42175 Pharmacogenomics for Precision Medicine.
3 credits.
Prerequisite: 42100 Introduction to Precision Medicine
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 credits.*
Prerequisite: 42100 Introduction to Precision Medicine
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.

Elective offered by the MCW IDP Program:
INBS 16270 Integrated Microbiology and Immunology. *3 credits.*
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 first year 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 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 integrate their knowledge of pathogens and the immune system.

Elective offered by the MCW MSGC Program:
CTSI 20241 Translational Genomics. *3 credits.*
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.

GECO 40110 Bioethics in Precision Medicine. *3 credits.*
Prerequisite: 42100 Introduction to Precision Medicine
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 as they manifest in a variety of clinical, biomedical, and health policy contexts.

Electives offered by the MCW MPH Program:
PUBH 18223 Public Health Policy. 3 credits
Prerequisite: 42100 Introduction to Precision Medicine
This introductory course will prepare students to know and understand the fundamentals of public health policymaking from the perspective of diverse

stakeholders. Throughout the course, students will engage in critical and creative thinking to judge the validity of information and to use defensible and persuasive information to reach new insights in the field of public health policy. Students will be challenged to analyze complex public health policies in areas such as health care reform, health equity, access to care, chronic disease and injury, and global health. This course will assist students in developing the skills necessary to understand and apply diverse sources of information in policy development and the advocacy to implement public health policy.

PUBH 18232 Introduction to Population Health Management. *3 credits*
Prerequisite: 42100 Introduction to Precision Medicine
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.

Electives offered through MCW/Marquette University:
BIIN 6931 Topics in Bioinformatics. *3 credits*
Prerequisite: 42100 Introduction to Precision Medicine
Topics vary. Students may enroll more than once as the subject matter changes.

BIIN 17150 Bioinformatics of Systems Biology. *3 credits*
Prerequisite: 42100 Introduction to Precision Medicine
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.

Electives offered through UW-Milwaukee:
HCA-700 Introduction to Health Care Informatics. *3 credits*
Prerequisite: 42100 Introduction to Precision Medicine
An introduction to the history, theory, applications, and organizational context of health informatics.

Search Classes (uwm.edu)

2025-26

PRECISION MEDICINE

Degree Offered: Certificate

Program Description

The Precision Medicine Education program based in the Medical College of Wisconsin Institute for Health & Equity offers a hybrid of online and in-person coursework toward a 12-credit Graduate Certificate in Precision Medicine (PM). Participants in the program will advance their knowledge, skills, practices, and competencies in PM. Learners may also enroll in courses as non-degree seeking students.

Admission Requirements

Graduate School admission requirements.

Credits Required to Graduate

12 credits

Required Courses

PRME 42100 Introduction to Precision Medicine. *3 credits.*

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.

Elective Courses

Students must pick three of these courses.

PRME 42145 Omics Technology in Precision Medicine. *3 credits.*

Prerequisite: 42100 Introduction to Precision Medicine

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 credits.

Prerequisite: 42100 Introduction to Precision Medicine

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. Entry level visualization of bioinformatics will be covered as it relates to Epigenomics. No prior bioinformatic knowledge is necessary to enroll for course.

PRME 42170 Medical Genetics, Undiagnosed, and Rare Diseases. *3 credits. Prerequisite: 42100 Introduction to Precision Medicine*
Medical Genetics, Undiagnosed and Rare Diseases allows students examine the application of genomics to core clinical systems and applying that knowledge to personalized management of patients. Experts in their respective fields will guest lecture in several sessions.

PRME 42175 Pharmacogenomics for Precision Medicine. *3 credits. Prerequisite: 42100 Introduction to Precision Medicine*
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 credits.*
Prerequisite: 42100 Introduction to Precision Medicine
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.

<u>Elective offered by the MCW IDP Program:</u>
INBS 16270 Integrated Microbiology and Immunology. *3 credits.*
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 first year 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 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 integrate their knowledge of pathogens and the immune system.

<u>Elective offered by the MCW MSGC Program:</u>
CTSI 20241 Translational Genomics. *3 credits.*
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.

GECO 40110 Bioethics in Precision Medicine. *3 credits.*
Prerequisite: 42100 Introduction to Precision Medicine
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 as they manifest in a variety of clinical, biomedical, and health policy contexts.

Electives offered by the MCW MPH Program:
PUBH 18223 Public Health Policy. 3 credits
Prerequisite: 42100 Introduction to Precision Medicine
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 18232 Introduction to Population Health Management. *3 credits*
Prerequisite: 42100 Introduction to Precision Medicine
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.

Electives offered through MCW/Marquette University:
BIIN 6931 Topics in Bioinformatics. *3 credits*
Prerequisite: 42100 Introduction to Precision Medicine
Topics vary. Students may enroll more than once as the subject matter changes.

BIIN 17150 Bioinformatics of Systems Biology. *3 credits*
Prerequisite: 42100 Introduction to Precision Medicine
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.

Electives offered through UW-Milwaukee:

HCA-700 Introduction to Health Care Informatics. *3 credits*

Prerequisite: 42100 Introduction to Precision Medicine

An introduction to the history, theory, applications, and organizational context of health informatics.

Search Classes (uwm.edu)

2025-26
PUBLIC & COMMUNITY HEALTH
Degree Offered: Doctor of Philosophy

MCW GRADUATE SCHOOL

Program Description
The purpose of this PhD Program is to transform the research paradigm in public and community health by educating a new generation of innovative researchers who will integrate the rigors of the traditional public health sciences with the essential components of community health improvement through participation and partnership.

Admission Requirements
In addition to the general Graduate School admission requirements, this program has additional specific requirements.

If the undergraduate degree is not in public health, then applicants are required to have six credits of psychology, sociology, or anthropology, three credits of anatomy, physiology, or biology, three credits of statistics and three credits of research methods. Research or professional experience relevant to public and community health is required; graduate degrees (MA, MPH, MS etc.) are not required for admission consideration.

Fields of Study
Students will discover and participate in innovative research conducted by faculty at the Medical College of Wisconsin.

PhD students have the opportunity to learn from these nationally recognized leaders in public and community health utilizing interdisciplinary approaches to complex public health issues.

Credits Required to Graduate
60 credits minimum

Program Credit Requirements
Full-Time

The program is designed for a four-year, full-time commitment. All full-time students in the program are required to be enrolled in a minimum of 9 credits in the fall and spring semesters and 6 credits in the summer. The student is responsible for maintaining full-time enrollment. Full-time students must complete the required coursework and need a minimum of 60 credits to graduate. Students must maintain a full-time credit load each semester to be eligible to receive a stipend.
*The program director may waive program requirements in exceptional circumstances.

Part-Time

It is recommended that all part-time students in the program be enrolled in 1-8 credits in the fall and spring semesters and 1-5 credits in the summer. The student is responsible for maintaining part-time enrollment. Part-time students must complete the required coursework and need a minimum of 60 credits to graduate.
*The program director may waive program requirements in exceptional circumstances.

Required Courses

BIOE 10222 Ethics and Integrity in Science. *1 credit.*
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. Bioethics 10222 is offered during the spring and summer terms only.

BIOE 10444 Research Ethics Discussion Series. *1 credit. Prerequisite: 10222 Ethics and Integrity in Science.*
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, 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. Bioethics 10444 is offered during the spring terms only.

PUCH 19150 Introduction to Epidemiology. *3 credits.*
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 19201 Community Health Improvement I: Foundations of Public and Community Health. *3 credits.*
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: Health Disparities and Underlying Determinants of Health. *3 credits.*
Prerequisite: 19201 Community Health Improvement I: Foundations of Public and Community Health.
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: Principles and Practices of Community-Academic Partnerships. *3 credits.*
Prerequisite: 19201 Community Health Improvement I: Foundations of Public and Community Health.
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: Translating Community Health Improvement into Policy. *3 credits.*
Prerequisite: 19201 Community Health Improvement I: Foundations of Public and Community Health.
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 19225 Introduction to Statistical Analysis. *3 credits.*
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 credits.*
Prerequisite: 19225 Introduction to Statistical Analysis.
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 19230 Qualitative and Mixed Methods. *3 credits.*
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 credits.*
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 19295 Reading and Research. *1-9 credits.*
Approval from Program Director and/or student's advisor required. 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. Full-time students enrolled over four years will take an estimated 38-41 credit,

PUCH 19301 Seminar. *1 credit.*
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 are required for graduation.

PUCH 19399 Doctoral Dissertation. *9 credits.*
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 the field of public and community health. Each student is encouraged to draft one or more papers for publication in a peer-reviewed journal describing results of the research.

Required Courses as Needed

PUCH 19003 Doctoral Dissertation Continuation. *0 credits.*
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.

Elective Courses

Three elective courses at 3 credits each.

PUCH 19210 Health and Medical Geography. *3 credits.*
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? Students will become acquainted with theories and methods from health and medical geography through readings, discussion, Geographic Information Systems (GIS) laboratory exercises, and the completion of a focused course project. Throughout the semester we will use the concepts and techniques of the discipline of geography to investigate a variety of health-related topics, and laboratory exercises will center on common health and medical geography research questions. Course projects will allow students to develop a deep understanding of the geographical nature of a health problem of their choosing and will incorporate both literature review and the analysis of geographicaldata.

PUCH 19229 Survey Research Methods. *3 credits.*
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 19235 Data Management and Use for Public and Community Health. *3 credits.*
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 credits.*
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 credits.*
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 credits.*
Prerequisite: 19225 Introduction to Statistical Analysis and 19226 Applied Regression Analysis.
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, 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 credits.*
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 write effectively to any audience. Interactive sessions and structured assignments highlight the importance of developing these skills you will use throughout your professional life.

Beyond electives offered at MCW, students may complete electives available at MU, or UWM. To ensure rigor and relevancy, the choice of electives is contingent upon approval by the student's major advisor and faculty teaching the courses. Courses must be at the graduate level.

2025-26

PUBLIC HEALTH

Degree Offered: Doctor of Public Health

Program Description

This is the first online DrPH program in Wisconsin designed to prepare experienced public health practitioners with the competencies needed to lead community health improvement efforts. The program is a cohort model in that the students will work together over the course of three years. This will enable the students to work on problems together, and to challenge one another in an environment built on trust. Forty-six credits encompass applied course work culminating with successful defense of the dissertation. The curriculum is a "hybrid" in that synchronous and asynchronous online learning will occur in addition to three summer visits for on-campus learning. Training will be self-directed, faculty and dissertation advisor guided, and cohort influenced. Academic relationships and community partnerships developed through this program will support success in the short term and over the course of a career.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

A master's degree from an accredited school or program in public health, a master's degree in a related field, a doctoral degree, or a professional degree (e.g., MD, JD, PharmD). Students without a master's degree in public health from an accredited school of public health or program will be required to complete an online core public health course prior to the start of the first semester of the program.

At least three years of post-graduate experience in public health, healthcare, or a related field with management or leadership responsibilities is required.

Students must commit to attend three onsite summer visits and participate in synchronous sessions at designated times.

Credits Required to Graduate

46 credits

Required Courses

28106 Introduction to Community Engagement. *3 credits.*
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).

28150 Research Theory. *3 credits.*
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.

28151 Data Collection and Analysis. *3 credits.*
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.

28152 Executive and Organizational Leadership. *3 credits.*
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.

28153 Executive Communication in Public Health. *3 credits.*
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.

28160 Public Health Research Study & Design. *3 credits.*
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.

28170 Public Health Applied Research. *3 credits.*
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.

28201 Public Health Practice I: Building a Foundation for Public Health. *3 credits***.**
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.

28202 Public Health Practice II: Building Community Partnerships and Coalitions. *3 credits.*
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.

28203 Public Health Practice III: Strategies to Eliminate Health Disparities. *3 credits.*
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 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.

28301 Doctoral Seminar. *1 credit.*
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.

28390 Dissertation Preparation. *1-9 credits.*
Prerequisite: All required DrPH courses.
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.

28399 Doctoral Dissertation. *1credit.*
Prerequisite: All required DrPH courses.
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.

Applied Practice Experience. *0 credits.*
DrPH students are required to engage in an applied practice experience in which they are responsible for completion of at least one project that is meaningful for an organization and to advanced public health practice. Relevant organizations may include governmental, non-governmental, non-profit, industrial, and for-profit settings. The applied practice experience may be completed within a student's own work setting. The deliverable must contain a reflective component that includes the student's expression of personal and/or professional

reactions to the applied practice experience. The student will develop a plan under the guidance of the program staff, director, and faculty advisor.

Required Courses as Needed

28003 Doctoral Dissertation Continuation. *0 credits.*
This course is available for students to take only after completing the required 10 credits of doctoral dissertation if additional time is needed to continue dissertation work.

2025-26

PUBLIC HEALTH

Degree Offered: Certificate

Program Description

This completely online program is designed for individuals interested in pursuing or further developing a career in public health. Coursework consists of four major disciplines of public health (12 credits). All credits offered in the certificate program may be transferable to the Master of Public Health program within one year of certificate completion.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has no additional specific requirements.

Credits Required to Graduate

12 credits

Required Courses

PUBH 18155 Public Health Theory & Practice. *3 credits.*
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 18165 Principles of Public Health Data and Epidemiology. *3 credits.*
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 credits.*
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 credits.*
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.

2025-26

PUBLIC HEALTH

Degree Offered: Master of Public Health

Program Description

This program allows students the flexibility to pursue graduate coursework online. It provides active learning opportunities through online technologies and interactive methods. Students may choose full or part-time study but should plan to complete the program within 5 years. The curriculum focuses on public health practice and consists of four core courses, six additional required courses, two elective courses, a field placement experience, and a capstone project. Assignments require the application of theoretical concepts to practical situations through case analysis and experiential activities.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has no additional specific requirements.

Credits Required to Graduate

42 credits

Required Courses

PUBH 18155 Public Health Theory & Practice. *3 credits.*
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 credits.*
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 the 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 credits.*
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 credits.*
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 credits.*
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.is a required course for students matriculated in the Master of Public Health or Certificate in Public Health programs. The overall goal of the course is to provide the students with an opportunity to 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.

PUBH 18209 Community Health Assessment and Improvement. *3 credits.*
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 18223 Public Health Policy. *3 credits.*
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 credits.*
Recommended: 18203 Public Health Administration and 18209 Community Health Assessment and Improvement.

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 18260 Community Health Program Evaluation. *3 credits.*
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 credits.*
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.*
Prerequisites: 18165 Principles of Public Health Data and Epidemiology, 18203 Public Health Administration, 18204 Public Health Analytics, 18155 Public Health Theory and Practice; all required coursework in the Master of Public Health program besides 18280 Field Placement and 18297 MPH Capstone Project recommended.

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. *1-5 credits.*
Prerequisites: All required coursework in the Master of Public Health program besides 18297 MPH Capstone Project recommended.
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 18297 Capstone Project. *3 credits.*
Prerequisites: All other MPH coursework.
The Capstone Project or Integrative Learning Experience 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.

Elective Courses

PUBH 18101 Foundations of Public Health. *3 credits.*
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 credits.*
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 credits.*
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 of 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 18215 Infectious Diseases. *3 credits.*
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 18232 Introduction to Population Health Management. *3 credits.*
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 credits.*
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 18295 Reading and Research. *1-3 credit(s).*
An independent study course, under public health faculty guidance, to pursue reading and research in an area of specific student interest.

2025-26

REGULATORY SCIENCE FOR FACILITATING ETHICAL RESEARCH

Degree Offered: Certificate

Program Description

This certificate is designed to explore advanced topics in human subjects' protections relevant to IRB work in the area of ethics, regulations, current topics, and IRB member skills and professionalism. Graduates of this certificate program will be able to specialize in IRB work and research, akin to recent developments in quality improvement, in which faculty and staff have undertaken specialization in their field. Upon completion of this program, graduates will be ready to conduct their own research to advance the field of regulatory science in addition to being better equipped to serve as senior IRB members, perhaps eventually moving into leadership roles. The certificate will enroll a cohort of new students every other year, as the bioethics-based courses will only be offered every other year.

Admission Requirements

In addition to the general Graduate School admission requirements, this program has additional specific requirements.

Criteria for admission include a minimum of 2 years professional experience as a member of an IRB; college and, if applicable, graduate, or professional school grades; commitment to the field of research ethics; and promise in the program's academic areas.

Credits Required to Graduate

12 credits

Program Credit Requirements

The certificate will enroll a cohort of new students every other year, as the bioethics-based courses will only be offered every other year. Therefore, students will take one course per semester to complete the program.

All the courses of the certificate program are offered online. The technical requirements are minimal, i.e., ability to use a web-browser and email. Class discussions and case analyses are conducted primarily in non-real time, so students can participate at their convenience during each week. However, students are paced on a week-to-week basis just as in a campus course. Moreover, the pedagogical capabilities of the online environment enhance the class discussions and allow for individualized instructor feedback, which empowers the learners and makes the courses truly student-centered.

Participants receive a Certificate of Regulatory Science for Facilitating Ethical Research from the Medical College of Wisconsin's Graduate School of Biomedical Sciences upon completion of the four courses. Each course is also worth graduate credit which may be applicable to the Bioethics MA degree.

Required Courses

10207 Introduction to Research Ethics. *3 credits.*
This course provides students with a comprehensive introduction to the ethical issues involved in scientific, animal and human subject's 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. (Issued December 1, 2000.)

10226 Regulatory Issues in Human Subject Research Protections. *3 credits.*
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.

10228 Current Topics in Research Ethics. *3 credits.*
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 subject's 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.

20262 Mastering Human Subjects Protections: Meetings, Members, and Processes. *3 credits.*
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.