Interdisciplinary Program in Biomedical Sciences (IDP)

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 take a core curriculum designed to provide a foundation in biochemistry, cell biology, genetics, molecular biology, physiology, signaling, laboratory techniques, and biostatistics.

Students will 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 five 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; 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 prepare and defend a proposal 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. Successful completion of this qualifying exam is a major step towards being admitted to 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 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.

**Degrees Offered**
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; Pharmacology and Toxicology; and Basic and Translational Science.**

**Program Admissions Requirements**
*In addition to the general Graduate School admission requirements, this program has additional specific requirements.* Applicants must have a bachelor’s degree from an accredited college or university. Successful applicants will show undergraduate achievement in science and mathematics courses and have prior research experience.

**Fields of Research**
Faculty participating in the Interdisciplinary Program in Biomedical Research have diverse research interests such as:
- Cancer Biology
- Cardiovascular Biology
- Cell Biology and Signaling
- Developmental Biology
- Drug Discovery
- Enzymology and Metabolism
- Free Radical Biology
- Gene Expressions and Epigenetics
- Inflammation and Immunology
- Microbial Infection and Pathogenesis
- Microbiome
- Molecular Genetics
- Molecular Pharmacology and Toxicology
- Neuroscience (Cellular and Molecular)
- Stem Cell Biology and Regenerative Medicine
- Structural Biology

**Required First-Year Curriculum**
16215, 16216, 16217, 16218. **Foundations in Biomedical Sciences I-IV**
Foundations in Biomedical Sciences (FBS) is broken into 4 course modules and represents the bulk of the didactic core coursework for first year IDP students. Each course module presents students with integrated and immersive cellular/molecular and systems/physiological level course material. This challenging, high-paced set of courses engage students in the major research interests and teaching philosophies
of the participating departments which helps prepare students with a strong foundation for their journey into their elective courses that will ultimately guide their PhD dissertation work.

16242. Techniques in Molecular and Cellular Biology
The objective for the Techniques course is to provide a theoretical and practical foundation underlying a number of the most common experimental techniques required for biomedical research. The information presented in this course will introduce procedures and experimental strategies that are commonly used in biomedical research projects and will facilitate students’ comprehension of the scientific literature even if they don’t use the techniques in their own research. The lecture materials present the theory behind each technique, the practical limitations of each technique, and the types of questions that each technique addresses, with emphasis on how each can be applied to generate new insight into biomedical research questions.

16290 & 16291. Professional Development 1 and 2
This course is taken in the fall and spring semesters of the first year and incorporates a multifaceted approach to introduce students to important elements of Professional Development. The course will incorporate lectures, active learning, and team-based approaches to such topics as preparing a laboratory notebook, scientific writing and reviewing, how to structure an effective hypothesis, research ethics, formulating an individual development plan, and presentation skills. Students will also participate in Responsible Conduct in Research training activities and engage in peer review discussions of the four laboratory rotation reports.

16210. IBR (Introduction to Biomedical Research)
This course reflects student’s participation in laboratory research rotations and their attendance at seminars and/or journal clubs.

16245. Statistics for Basic Sciences
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.

16265. Organ Systems Physiology
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.

16292 and 16xxx. Writing a Scientific Paper & Writing an Individual Fellowship
These courses span the summer of the first year and fall of the second year. The goal of these courses is to enhance specific skill sets related to scientific writing and presentation. These courses will focus on the processes important for the preparation of scientific manuscripts and an NIH F-type research proposal. These courses 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.

16273. Advanced Cell Biology (offered every other year)
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 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.

16266. Bacterial Diversity and the Microbiome (offered every other year)
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 based with chalk-talk style discussion sessions designed to promote discussion of the literature.

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

16xxx Cognitive Neuroscience (offered every other year)
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.

16271. Fundamentals of Neuroscience
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.

16272. Graduate Neuroanatomy
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.

16270. Integrated Microbiology and Immunology
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 second 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 will learn fundamental concepts in immunology and gain an appreciation of the basic properties of bacteria and virus structure, replication, and pathogenesis. In the final block of the course, students will integrate their knowledge of pathogens and the immune system.

16274. Metabolism (offered every other year)
This course will be mainly a didactic based course that will comprehensively review subjects 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 articles.

16267. Protein Chemistry-Applications
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.

16268. Protein Chemistry-Principles
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, the discussions will include methods learned in the first-year curriculum that might have been applied, but were not.

16275. Understanding Cell Signaling through Therapeutic Drugs
This course will present 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 will 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 will allow them to define how different signaling pathways are integrated. Lectures presented by the instructors will provide an in-depth overview of different signaling pathways, and manuscript discussions will promote additional advanced analysis that will creatively engage the students.
16xxx. Developmental and Stem Cell Biology (offered every other year)
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 will prepare and present a lecture on a developmental and stem cell biology topic directly relevant to each student’s own research interests. Students will also provide feedback to their peers in the form of brief critiques of individual presentations.