ROWAN-VIRTUA
Graduate School
of Biomedical Sciences

Course Descriptions

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Full time status:	**Fall/Spring Terms are 9 credits**	**Summer Term is 4 credits**
Part time status:	**Fall/Spring Terms are 5 credits**	**Summer Term is 2 credits**

Anatomical Sciences Program: MS (non-thesis); Certificate for students with a PhD

Course Descriptions

Required courses for the Certificate and the MS degree in Anatomical Sciences:

ANS 00501 CLINICALLY INTEGRATED HUMAN ANATOMY FALL 8 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. ROCCO CARSIA
PREREQUISITE: NO
SUGGESTED TEXTBOOKS:
Atlas of Human Anatomy, 7th Edition; Frank H. Netter, M.D.; Elsevier, 2019.
Grant's Atlas of Anatomy, 15th Edition; Anne M.R. Agur and Arthur F. Dalley; Walters Kluwer; 2021.
Clinically Oriented Anatomy, 8th Edition; Keith L. Moore, Arthur F. Dalley and Anne M.R. Agur; Walters Kluwer; 2018.
This course focuses on the study of the macroscopic structure and the 3-dimensional relationship of structures of the human body through dissection, supportive diagnostic imaging and other methods. In addition, the anatomical basis for certain body functions and diseases are taught and within the context of life-stage changes, stressing both adult and pediatric changes in anatomy. **This course is only open to students in the Anatomical Sciences program.**

ANS 00503 TEACHING PRACTICUM IN HUMAN ANATOMY DISSECTION I SUMMER 2 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. ROCCO CARSIA
PREREQUISITE: ANS 00501 ("C" grade or better)
REQUIRED TEXTBOOKS: As instructors in the medical curricula, ANS students in this practicum will be provided the required texts, atlases, and lab guides.
In this teaching practicum course, ANS students will be facilitating Synergistic Guided Learning (SGL)1 and SGL2 student physicians in their anatomy dissection experience. The anatomy focus of this practicum is mainly the SGL1 curriculum in their block, Integrated Musculoskeletal Anatomy (**IMA**), and two labs in the SGL2 curriculum in their **O**rgans/**S**ystems **A**natomy (**OSA**). The grading for this 2-credit course is Pass/Fail. **This course is only open to students in the Anatomical Sciences program.**

ANS 00504 HUMAN ANATOMY IN DIAGNOSTIC IMAGING FALL 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. ROCCO CARSIA
PREREQUISITE: ANS 00501 ("C" grade or better)
SUGGESTED TEXTBOOK: Weber, E.C., et al.: Netter's Concise Radiologic Anatomy, Update Edition 2, Elsevier, 2018.
This course takes a regional approach in human gross anatomy and focuses on the translation of anatomical structure into various diagnostic imaging modalities, mainly X-ray, computed tomography and magnetic resonance imaging. Where appropriate, surface ultrasonography is included. This course is particularly suited for students of the anatomical sciences. **This course is only open to students in the Anatomical Sciences program.**

ANS 00505 HUMAN DEVELOPMENTAL ANATOMY SPRING 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. ROCCO CARSIA
PREREQUISITE: ANS 00501 ("C" grade or better)
REQUIRED TEXTBOOK: Langman's Medical Embryology, 14th edition; Sadler, T. W.; Wolters Kluwer, 2019.
Unlike typical embryology courses, this course takes a regional approach like most courses in human gross anatomy and focuses on the morphogenic movements underlying the development of regional anatomy and the contained organs. Where appropriate, the principles and mechanisms of morphogenesis and dysmorphogenesis are brought into discussion without heavy reliance on an understanding of complex genetics and signaling pathways. The prominent clinical consequences of dysmorphogenesis, i.e., anomalies, syndromes, etc., are discussed with each topic. Thus, this course is particularly suited for students of the anatomical sciences. **This course is only open to students in the Anatomical Sciences program.**

CMB 00813 NEUROANATOMY: STRUCTURE AND FUNCTION OF THE VERTEBRATE NERVOUS SYSTEM FALL 2 Credits REQUIRED
COURSE DIRECTOR: DR. BENJAMIN ROOD
PREREQUISITE: NO
REQUIRED TEXTBOOK: Neuroanatomy: Text and Atlas, 5th Ed., McGraw Hill Education (Early 2020).
The goal of this course is to provide a broad but comprehensive overview of the structures and function of the vertebrate central nervous system. The purpose of this course is to provide students with the vocabulary and understanding of nervous system function needed to dive into the diverse and rich neuroscience literature whether it be examining brain circuits involved in behavior, understanding the pathology of various conditions and diseases, or perhaps placing their study of a specific biological mechanisms into a broader context for a grant proposal. The course will be broken into three sections. The first section will focus on the types of cells that make up brain structures and pathways and the structures involved in somatosensory and motor systems. The second section will cover cranial nerves and various sensory systems. The third section will cover integrative systems that regulate numerous systems involved in homeostasis, physiological response to stress, motivation, emotion, and learning and memory. Throughout much of the course hands-on exploration of brain structures through microscopy of stained tissue and dissection of preserved brain tissue (human and sheep) will augment and reinforce topics covered in lectures.

Additional Required courses for the MS degree in Anatomical Sciences:

ANS 00506 TEACHING PRACTICUM IN HUMAN ANATOMY DISSECTION II FALL 2 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. ROCCO CARSIA
PREREQUISITE: ANS 00501 ("C" grade or better)
REQUIRED TEXTBOOKS: As instructors in the medical curricula, ANS students in this practicum will be provided the required texts, atlases, and lab guides.
In this teaching practicum course, ANS students will be facilitating SGL1 and SGL2 student physicians in their anatomy dissection experience. The anatomy foci in these medical curricula are **H**ead and **N**eck **A**natomy associated with integrated neuroscience in the **B**rain and **B**ehavior block (**BBHNA**) and the **O**rgans/**S**ystems **A**natomy partitioned in the **o**rgans/**s**ystems blocks (**OSA**). The grading for this 2-credit course is Pass/Fail. **This course is only open to students in the Anatomical Sciences program.**

ANS 00507 TEACHING PRACTICUM IN HUMAN ANATOMY DISSECTION III SPRING 1 Credit REQUIRED COURSE
COURSE DIRECTOR: DR. ROCCO CARSIA
PREREQUISITE: ANS 00501 ("C" grade or better)
REQUIRED TEXTBOOKS: As instructors in the medical curricula, ANS students in this practicum will be provided the required texts, atlases, and lab guides.
In this teaching practicum course, ANS students will be facilitating SGL1 student physicians in their anatomy dissection experience. The anatomy focus in this medical curriculum is the **O**rgans/**S**ystems **A**natomy partitioned in the **o**rgans/**s**ystems blocks (**OSA**). The grading for this 1-credit course is Pass/Fail. **This course is only open to students in the Anatomical Sciences program.**

MBS 00503 SYSTEMS PHYSIOLOGY SPRING 3 Credits MS REQUIRED COURSE
COURSE DIRECTOR: DR. DEBORAH PODOLIN
PREREQUISITES: MBS 00501 & MBS 00502 OR ANS 00501 CIHA ("C" grade or better in each course)
RECOMMENDED TEXTBOOK: Berne & Levy Physiology, 6th Edition. B.M. Koeppen, and B.A. Stanton. Elsevier Healthsciences Division Publishing, 2008. ISBN: 0-323-04582-0
This course will focus on physiological systems of the human body, namely, the cardio-renal system and endocrinology. The course will be in the form of didactic lectures. Students will be evaluated on their performance on three examinations. At first the student will be introduced to basic physiological aspects of the cardiovascular system and how it interacts with the kidney. Integrated within the lectures, there will be discussion on diseases that may affect the heart and kidneys and pharmacological treatments for these disorders. In the endocrinology section, the student will be introduced to the actions of various hormones, which affect macro- and micronutrient metabolism. These series of lectures will provide the student with a

clear understanding of three complex physiological systems. In order to consolidate understanding of these systems, lectures will be supplemented with appropriate literature outside of texts.

MHP 00611 HISTOLOGY I: BASIC TISSUE TYPES SPRING 3 Credits MS REQUIRED COURSE
COURSE DIRECTOR: DR. CATHERINE NEARY
PREREQUISITES: MBS 00501 & MBS 00502 OR ANS 00501 CIHA ("C" grade or better in each course)
REQUIRED TEXTBOOKS: Histology and Cell Biology, Kierszenbaum, A.L., and Tres, L.L., 5th Ed., 2019, Elsevier Saunders *and* Di Fiore's Atlas of Histology with Functional Correlations, Eroschenko, V.P., 13th Ed., 2017, Lippincott Williams & Wilkins.
This course introduces students to the basic tissue types, as well as some of the common stains used to differentiate elements of tissue. In addition, students will learn to use a microscope and analyze photomicrographs critically. **This course is only open to students in the Histopathology and Anatomical Sciences programs.**

MHP 00613 HISTOLOGY III: ORGAN SYSTEMS SPRING 3 Credits MS REQUIRED COURSE
COURSE DIRECTOR: DR. CATHERINE NEARY
PREREQUISITES: MHP 00611 & MBS 00503
REQUIRED TEXTBOOK: Histology and Cell Biology, Kierszenbaum, A.L., & Tres, L.L., 5th Ed., 2019, Elsevier Saunders *and* Di Fiore's Atlas of Histology with Functional Correlations, Eroschenko, V.P., 13th Ed., 2017, Lippincott Williams & Wilkins.
In this course, students will apply their knowledge of tissue types to develop an understanding of organ structure and function. This will include information specific to commonly used animal models (e.g. rats, mice, rabbits). **This course is only open to students in the Histopathology and Anatomical Sciences programs.**

MHP 00616 TOPICS IN PATHOLOGY SPRING 2 Credits MS REQUIRED COURSE
COURSE DIRECTOR: DR. CATHERINE NEARY
PREREQ: MHP 00611 & MBS 00503
CO-REQUISITE: MHP 00613
RECOMMENDED TEXTBOOK: Histology and Cell Biology, Kierszenbaum, A.L., & Tres, L.L., 5th ed., 2019, Elsevier Saunders.
RECOMMENDED TEXTBOOK: Robbins Basic Pathology, Kumar, V., Abbas, A.K., & Aster, J.C., 10th ed., 2018, Elsevier, Inc.
This course will provide students exposure to the pathology of major organ systems. **This course is only open to students in the Histopathology and Anatomical Sciences programs.**

Biomedical Sciences Program: MBS (non-thesis); Certificate

Course Descriptions

MBS 00501 BIOCHEMISTRY AND MOLECULAR BIOLOGY FALL 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. JEFFERY POWERS
PREREQUISITE: NO
REQUIRED TEXTBOOK: ***Lippincott Illustrated Reviews: Biochemistry, 7th ed.*** **ISBN 9781496344496 (e-text available through library website)**
This course will cover fundamental topics in biochemistry and how they relate to human health and disease. This begins with the introduction of the biomolecules that are central to human metabolism at the cellular and organismal level. We then explore the bioenergetic and thermodynamic principles that govern this metabolism, as well as how the body uses enzymes to harness these properties. We then move onto the study of the biochemical pathways that underly human metabolism and how these pathways can be dysregulated in human disease.

MBS 00502 CELL BIOLOGY FALL 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. DANA ZAMBITO
PREREQUISITE: NO
REQUIRED TEXTBOOK: Essential Cell Biology, 6th Edition. B. Alberts, K. Hopkin A. Johnson, D. Morgan, K. Roberts, P. Walter, R. Heald. W.W. Norton & Co. Publishers, 2023. ISBN: 978-1-324-03341-7
This course is focused on biology and physiology of the cell and is organized around the central theme of homeostasis – how the cells adopt to various environmental changes while maintaining their internal constancy necessary for all tissues and organs to function. It is a course for both the basic scientists who seek general principles about cellular function, and the students preparing for health-related careers who wish to apply fundamental knowledge on cell biology to understand the molecular mechanisms of cellular dysfunction in human diseases.

MBS 00505 HUMAN GENETICS FALL 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. RONALD ELLIS
PREREQUISITE: NO
REQUIRED TEXTBOOK: Medical Genetics, 5th Edition. Lynn Jorde, John Carey and Michael Bamshad. Elsevier, 2015
This course will cover the key concepts in classical and molecular genetics, with a focus on their application to humans.

MBS 00610 MICROBIOLOGY FALL 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. MICHAEL HENRY
PREREQUISITE: NO
REQUIRED TEXTBOOK: Microbiology (an Introduction), 13th Edition. G. Tortora, B. Funke, C. Case, D. Weber, W. Bair, 2018. ISBN: 978-0-1346-0518-0
This is an introductory Microbiology course taken in the Fall Semester of the student's first or second year of graduate study. It strikes an appropriate balance between microbiological fundamentals and medical/research applications. It also provides a foundation in microbiology for those students planning to pursue advanced degrees. There are three sections to this course: I. Fundamentals of Microbiology. This section includes a brief history, methods used to observe microorganisms, and a study of microbial cell anatomy, metabolism, growth and genetics. II. A survey of the Microbial World, including classifications of Eukaryotes, Prokaryotes, Viruses, Viriods, and Prions. III. Interaction between the Microbe and host, including principle of disease and epidemiology, mechanisms of pathogenicity, innate and adaptive immunity, immunology and antimicrobial drugs. Although this course assumes no previous study of biology chemistry, a basic understanding of DNA, RNA, and proteins is recommended.

MBS 00503 SYSTEMS PHYSIOLOGY SPRING 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. DEBORAH PODOLIN
PREREQUISITES: MBS 00501 & MBS 00502 OR ANS 00501 CIHA ("C" grade or better in each course)
RECOMMENDED TEXTBOOK: Berne & Levy Physiology, 6th Edition. B.M. Koeppen, and B.A. Stanton. Elsevier Healthsciences Division Publishing, 2008. ISBN: 0-323-04582-0
This course will focus on physiological systems of the human body, namely, the cardio-renal system and endocrinology. The course will be in the form of didactic lectures. Students will be evaluated on their performance on three examinations. At first the student will be introduced to basic physiological aspects of the cardiovascular system and how it interacts with the kidney. Integrated within the lectures, there will be discussion on diseases that may affect the heart and kidneys and pharmacological treatments for these disorders. In the endocrinology section, the student will be introduced to the actions of various hormones, which affect macro- and micronutrient metabolism. These series of lectures will provide the student with a clear understanding of three complex physiological systems. In order to consolidate understanding of these systems, lectures will be supplemented with appropriate literature outside of texts.

MBS 00506 BIOMEDICAL ANATOMY SPRING 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. KATHARINE MILANI
PREREQUISITES: NO
REQUIRED TEXTBOOKS:
Human Anatomy by Saladin, 6th ed., McGraw Hill, ISBN: 978-1-260-39978-3
Atlas of Histology with Functional and Clinical Correlations by Cui, D. ISBN: 978-0-7817-9759-7.
Primal Pictures Anatomy & Physiology –available through the library website (https://rowanmed.libguides.com/gsbs/biomedical) * Firefox or Safari are the recommended browsers.
This course presents fundamentals of human gross anatomy with a focus on the microanatomy associated with each of the major organ systems. Sessions will incorporate lectures and interactive assignments that may utilize virtual histology. Students will use textbooks, virtual histology slides, and Primal Pictures assist in their study and comprehension of the material presented each week.

MBS 00603 IMMUNOLOGY SPRING 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. RENEE DEMAREST
PREREQUISITES: MBS 00501 & MBS 00502 ("C" grade or better in each course)
REQUIRED TEXTBOOK: The Immune System, Peter Parham, Fourth Edition, 2015. Garland Press
Students will learn the basic concepts of the immune response and its role in human health and disease. The underlying mechanisms that lead to immunosuppression, autoimmunity, and hypersensitivity will be explored. In addition, the role of the immune system in cancer development and treatment will be examined. An emphasis will be placed on applying the learned concepts to clinical case studies throughout the course.

MBS 00616 BIOMEDICAL DATA ANALYSIS SPRING 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. HRISTO HOUBAVIY
PREREQUISITE: NO
REQUIRED TEXTBOOK: The Analysis of Biological Data, 3rd edition. Michael C. Whitlock and Dolph Schluter. Freeman W. H. and Company, 2020. ISBN: 9781319226237
This course is intended to serve as a practical guide to analyzing biological and biomedical data. We will begin by introducing basic data representation concepts, followed by selected topics in introductory probability and statistics, which will provide the basis for the data analysis techniques introduced towards the end of the course. The latter include t-tests, ANOVA, correlation and regression as well as selected non-parametric methods. The emphasis of this course is on real-life biomedical data problem solving via worked out example cases in class sessions as well as via independent problem-solving homework assignments. While the focus is on practical applications, effective data analysis does require a basic understanding of the

principles on which data analysis tools are built. Therefore, the course will provide a fairly robust, albeit intuitive, introduction to basic probability and mathematical statistics. However, formal mathematical derivations will be avoided wherever possible and mathematical statistical concepts will be introduced only if complementary to the course's practical applications focus. Students are not expected to have a background in higher mathematics (i.e. calculus or linear algebra) nor any prior experience with probability, statistics and data analysis. Students enrolled in this course can expect to learn skills in analytical thinking and biological data analysis, both of which are an MCAT focal point.

MBS 00602 ANTIMICROBIAL DRUGS: MECHANISMS OF ACTION & RESISTANCE SPRING 3 Credits
COURSE DIRECTOR: DR. SERGEI BORUKHOV
PREREQUISITE: MICROBIOLOGY RECOMMENDED; COMPLEMENTS PRINCIPLES OF PHARMACOLOGY
REQUIRED TEXTBOOK: Principles of Pharmacology: The Pathophysiological Basis of Drug Therapy (4th Edition). D.E. Golan, A.H. Tashjian, E.J. Armstrong and A.W. Armstrong. Lippincott, Williams and Wilkins, 2016. ISBN/ISSN: 9781451191004
SUPPLEMENTAL TEXTBOOK: Microbiology (an Introduction), 11th Edition. G. Tortora, B. Funke, C. Case. Pearson Benjamin Cummings, 2013. (the same text used in Microbiology (MBS 00610).
This course covers the mechanisms of action, selectivity, and resistance to agents that are used to treat microbial infections, including bacterial, fungal, protozoal, helminthic, and viral infections. The course does not cover clinical aspects of Pharmacology but is focused on molecular mechanisms of action of antimicrobial agents. It is intended to complement the Principles of Pharmacology (MBS 00612) course which is more clinically oriented. There is no substantial overlap with other GSBS courses including Principles of Pharmacology and Microbiology. It is recommended that students complete Microbiology (MBS 00610) and Fundamentals of Biochemistry and Molecular Biology (MBS 00501) or comparable undergraduate courses prior to taking this course.

MBS 00606 ESSENTIAL NEUROSCIENCE FALL 3 Credits
COURSE DIRECTORS: DRS. PAOLA LEONE AND DAVID DEVILBISS
PREREQUISITE: NO
RECOMMENDED TEXTBOOK: Cognitive Neuroscience, Mary T. Banich & Rebecca J. Compton, ISBN: 1107158443, Cambridge University Press, 4th Edition (2018)
This course focuses on the basic molecular and biochemical aspects of neuronal physiology, emphasizing mechanisms that underlie the major classes of neurological disorders. Students will be provided with a fundamental understanding of the gross anatomy and general functions of the central nervous system at the cellular and molecular levels. The course will introduce essential concepts and facts on how neuronal cells communicate with each other, with examples of how neurotransmitter dysregulation and metabolic malfunction lead to the development of mental disorders. The course instructors are research scientists who have expertise in clinical neuroscience and translational research. There will be invited speakers who specialize in various neurological and psychiatric diseases with complex or heterogeneous etiology, including Alzheimer's Disease, Parkinson's Disease, White Matter Disease, Neuroinflammation and HIV-associated Neurorocognitive Disorders, Autism & Pharmacotherapy of Drug Addiction and Alcohol Abuse. The major goals of the course will be to introduce Master students to translational neuroscience and to the pivotal role that neuroscience plays in understanding and treatment of human brain diseases. Lectures will be supplemented with handouts, references and PowerPoint presentations.

MBS 00607 EXERCISE PHYSIOLOGY SUMMER 3 Credits
COURSE DIRECTOR: DR. JEFFERY POWERS
PREREQUISITE: MBS 00503 ("C" grade or better)
HIGHLY SUGGESTED TEXTBOOK: Exercise Physiology, 8th Edition. William McArdle, Frank Katch, Victor Katch. Lippincott, Williams & Wilkins, 2014
A major emphasis will be placed on examining the mechanisms underlying the body's response to acute and chronic exercise stress. The first portion of the course will include the fundamentals of bioenergetics and metabolism, measurement of work, power and energy expenditure, respiratory system, cardiovascular system, endocrine system, neuromuscular system, and the physiological adaptations of training. The latter part of the course will delve into selected topics in the field of exercise physiology such as obesity and weight loss, slowing age-related changes with exercise, ergogenic aids, overtraining and fatigue and gender differences in physiology and performance.

MBS 00609 MECHANISMS OF DISEASE FALL 3 Credits
COURSE DIRECTOR: DR. CATHERINE NEARY
PREREQUISITES: MBS 00501 & MBS 00502 ("C" grade or better in each course)
RECOMMENDED TEXT: Robbins Basic Pathology, 11th Edition. Kumar, V., Abbas, A.K., & Aster, J.C. Elsevier, 2022. ISBN: 978-0323790185
Advances in biochemical and genetic techniques have produced substantial information about altered cellular function in pathological conditions. This course is an introduction to the mechanisms by which disease processes develop on a cellular, tissue, and organ level, focusing on their impact on physiological functions and subsequent clinical manifestations. Each week, pathological conditions will be discussed in the context of the normal function of the relevant organ system as well as known cellular signaling pathways involved in the disease process.

MBS 00611 PATHOPHYSIOLOGY OF THE CARDIOVASCULAR SYSTEM FALL 3 Credits
COURSE DIRECTOR: DR. CARL HOCK
PREREQUISITE: MBS 00503 ("C" grade or better)
REQUIRED TEXTBOOK: Pathophysiology of Heart Disease, 6th Edition. L.S. Lilly. Lippincott, Williams & Wilkins Publishing, 2016. ISBN 978-1-4511-9275-9
Cardiovascular disease remains the number one killer in the United States. Despite the current successes in the treatment of acute myocardial infarction, the incidence of heart failure continues to increase as the population ages. This course will explore the underlying causes of heart disease and other cardiovascular diseases with an emphasis on normal physiology, pathophysiologic changes and current controversies. The course will cover selected topics of cardiovascular disease including: common cardiac arrhythmias, ischemic heart disease, acute coronary syndromes, atherosclerosis, hypertension, diseases of the peripheral vasculature and heart failure. The purpose of this course is to examine the underlying causes and the most current thinking as it relates to cardiovascular disease. The course will involve both lecture presentation and discussion of current literature.

MBS 00612 PRINCIPLES OF PHARMACOLOGY SPRING 3 Credits
COURSE DIRECTORS: DRS. BERND SPUR AND KINGSLEY YIN
PREREQUISITE: NO
REQUIRED TEXTBOOK: Basic and Clinical Pharmacology, 13th Edition. B.G. Katsung. McGraw-Hill Publishing, 2015.
The modern discipline of pharmacology involves understanding how medications are used in the prevention, diagnosis and treatment of human diseases. The emphasis of this course is on mechanisms of drug action, therapeutic applications, adverse effects, contraindications and drug interactions. The overall mission of the course will be to introduce students to the basic principles of pharmacology and to familiarize them with classes of drugs and examples of specific drugs used frequently in the clinical setting.

MBS 00613 MBS INDEPENDENT STUDY FALL/SPRING/SUMMER 2 Credits
COURSE DIRECTOR: DR. KATHARINE MILANI
PREREQUISITE: PERMISSION BY COURSE DIRECTOR
This course introduces students to biomedical research by preparing a review of published scholarly literature on a topic of their own interest. With the guidance of a faculty advisor, students will identify a suitable topic and develop the skills of literature research, writing, revision, and oral presentation. Students will prepare an essay of at least 4000 words that presents the current understanding of the topic aimed at an audience of professionals. The student will also prepare an oral presentation which will be delivered at the end of semester.
Eligibility:
Matriculated students in the MBS program who have completed 9 or more course credits are eligible to register for Independent Study. Only one Independent Study course may count toward the Certificate in Biomedical Sciences or Masters in Biomedical Sciences degree.

MBS 00617 IMMUNOHEMATOLOGY SPRING/SUMMER 4 Credits
COURSE DIRECTOR: DR. RENEE DEMAREST
PREREQUISITE/CO-REQUISITE: Immunology (MBS 00603) or equivalent course and requires permission of program director and course director.
REQUIRED TEXT: Harmening, D. Modern Blood Banking and Transfusion Practices. F.A.Davis, 7th. ed. ISBN-13: 978-0-8036-6888-1

RECOMMENDED TEXT: Standards for Blood Banks and Transfusion Services, AABB, 32nd ed. ISBN-10: 1563953676; ISBN-13: 978-1563953675
Students successfully completing this course will have an understanding of antigen-antibody reactions and the basics of transfusion therapy, including being able to perform pre-transfusion testing. Students will also understand the pathogenesis and clinical manifestations of blood disorders. ***Enrollment is limited.**

MBS 00680 LABORATORY RESEARCH (A) – MBS FALL/SPRING/SUMMER 2 Credits
MBS 00681 LABORATORY RESEARCH (B) – MBS FALL/SPRING/SUMMER 2 Credits
COURSE DIRECTOR: DR. KATHARINE MILANI
PREREQUISITE: PERMISSION BY FACULTY/INVESTIGATOR
PREREQUISITE: MBS 00680 MUST BE TAKEN BEFORE MBS 00681
Laboratory Research introduces students to biomedical research as it is carried out in one of the school's basic science laboratories. Students work on a project under the guidance of a faculty advisor and their research team. The student is expected to spend 8 to 10 hours per week in the lab for the semester. The student prepares a short report presenting their topic, summarizing their work, and recording their results.
Eligibility: Matriculated students in the MBS program who have completed 9 or more course credits and are in good academic standing are eligible to register for Laboratory Research. A student may continue their research project with the same faculty advisor for a second semester. The first semester is graded on the standard scale and the second semester is satisfactory/unsatisfactory only.

Histopathology Program: MS (non-thesis)

Course Descriptions

MBS 00501 BIOCHEMISTRY AND MOLECULAR BIOLOGY FALL 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. JEFFERY POWERS
PREREQUISITE: NO
REQUIRED TEXTBOOK: *Lippincott Illustrated Reviews: Biochemistry, 7th ed.* ISBN 9781496344496 (e-text available through library website)
This course will cover fundamental topics in biochemistry and how they relate to human health and disease. This begins with the introduction of the biomolecules that are central to human metabolism at the cellular and organismal level. We then explore the bioenergetic and thermodynamic principles that govern this metabolism, as well as how the body uses enzymes to harness these properties. We then move onto the study of the biochemical pathways that underly human metabolism and how these pathways can be dysregulated in human disease.

MBS 00502 CELL BIOLOGY FALL 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. DANA ZAMBITO
PREREQUISITE: NO
REQUIRED TEXTBOOK: Essential Cell Biology, 6th Edition. B. Alberts, K. Hopkin A. Johnson, D. Morgan, K. Roberts, P. Walter, R. Heald. W.W. Norton & Co. Publishers, 2023. ISBN: 978-1-324-03341-7
This course is focused on biology and physiology of the cell and is organized around the central theme of homeostasis – how the cells adopt to various environmental changes while maintaining their internal constancy necessary for all tissues and organs to function. It is a course for both the basic scientists who seek general principles about cellular function, and the students preparing for health-related careers who wish to apply fundamental knowledge on cell biology to understand the molecular mechanisms of cellular dysfunction in human diseases.

MBS 00503 SYSTEMS PHYSIOLOGY SPRING 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. DEBORAH PODOLIN
PREREQUISITES: MBS 00501 & MBS 00502 OR ANS 00501 CIHA ("C" grade or better in each course)
RECOMMENDED TEXTBOOK: Berne & Levy Physiology, 6th Edition, B.M. Koeppen, and B.A. Stanton. Elsevier Healthsciences Division Publishing, 2008. ISBN: 0-323-04582-0
This course will focus on physiological systems of the human body, namely, the cardio-renal system and endocrinology. The course will be in the form of didactic lectures. Students will be evaluated on their performance on three examinations. At first the student will be introduced to basic physiological aspects of the cardiovascular system and how it interacts with the kidney. Integrated within the lectures, there will be discussion on diseases that may affect the heart and kidneys and pharmacological treatments for these disorders. In the endocrinology section, the student will be introduced to the actions of various hormones, which affect macro- and micronutrient metabolism. These series of lectures will provide the student with a clear understanding of three complex physiological systems. In order to consolidate understanding of these systems, lectures will be supplemented with appropriate literature outside of texts.

MBS 00609 MECHANISMS OF DISEASE FALL 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. CATHERINE NEARY
PREREQUISITES: MBS 00501 & MBS 00502 ("C" grade or better in each course)
RECOMMENDED TEXT: Robbins Basic Pathology, 11th Edition. Kumar, V., Abbas, A.K., & Aster, J.C. Elsevier, 2022. ISBN: 978-0323790185
Advances in biochemical and genetic techniques have produced substantial information about altered cellular function in pathological conditions. This course is an introduction to the mechanisms by which disease processes develop on a cellular, tissue, and organ level, focusing on their impact on physiological functions and subsequent clinical manifestations. Each

week, pathological conditions will be discussed in the context of the normal function of the relevant organ system as well as known cellular signaling pathways involved in the disease process.

MHP 00610 BASIC LABORATORY TECHNIQUES – BIOLOGY SPRING 3 Credits REQUIRED COURSE
COURSE DIRECTORS: DRS. RENEE DEMAREST AND CATHERINE NEARY
PREREQUISITES: MBS 00501 & MBS 00502 ("C" grade or better in each course)
REQUIRED TEXTBOOK: At the Bench: A Laboratory Navigator, Barker K. 2nd Ed., 2004, Cold Spring Harbor Laboratory Press.
RECOMMENDED TEXTBOOK: Principles and Techniques of Biochemistry and Molecular Biology, Wilson, K. and Walker, J. 7th Ed., 2010, Cambridge University Press.
This course will teach students basic techniques used in a modern biomedical laboratory, to prepare them to integrate these techniques into more advanced processes they will use later. **This course is only open to students in the Masters in Histopathology program.**

MHP 00611 HISTOLOGY I: BASIC TISSUE TYPES SPRING 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. CATHERINE NEARY
PREREQUISITES: MBS 00501 & MBS 00502 OR ANS 00501 CIHA ("C" grade or better in each course)
REQUIRED TEXTBOOKS: Histology and Cell Biology, Kierszenbaum, A.L., and Tres, L.L., 5th Ed., 2019, Elsevier Saunders *and* Di Fiore's Atlas of Histology with Functional Correlations, Eroschenko, V.P., 13th Ed., 2017, Lippincott Williams & Wilkins.
This course introduces students to the basic tissue types, as well as some of the common stains used to differentiate elements of tissue. In addition, students will learn to use a microscope and analyze photomicrographs critically. **This course is only open to students in the Histopathology and Anatomical Sciences programs.**

MHP 00612 HISTOLOGY II: TECHNIQUES SUMMER 4 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. RENEE DEMAREST
PREREQUISITES: MHP 00610 & MHP 00611 ("C" grade or better in each course)
REQUIRED TEXTBOOK: Histological and Histochemical Methods: Theory and Practice, Kiernan, J., 5th Ed., 2015, Scion Publishing Ltd.
This lab-intensive course builds upon the theory learned in Histology I: Basic Tissue Types. Students will be trained in histological techniques in a hands-on setting, in order to develop the critical skills required to become a histotechnologist. Students will learn to section various animal tissue utilizing a microtome and cryostat, and perform basic staining procedures. **This course is only open to students in the Masters in Histopathology program.**

MHP 00613 HISTOLOGY III: ORGAN SYSTEMS SPRING 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. CATHERINE NEARY
PREREQUISITES: MHP 00611 & MBS 00503
REQUIRED TEXTBOOK: Histology and Cell Biology, Kierszenbaum, A.L., & Tres, L.L., 5th Ed., 2019, Elsevier Saunders *and* Di Fiore's Atlas of Histology with Functional Correlations, Eroschenko, V.P., 13th Ed., 2017, Lippincott Williams & Wilkins.
In this course, students will apply their knowledge of tissue types to develop an understanding of organ structure and function. This will include information specific to commonly used animal models (e.g. rats, mice, rabbits). **This course is only open to students in the Histopathology and Anatomical Sciences programs.**

MHP 00614 BASIC LABORATORY ANIMAL TECHNIQUES FALL 4 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. RENEE DEMAREST
PREREQUISITES: MHP 00610, MHP 00611 & MHP 00612
REQUIRED TEXTBOOK: No required text – learning materials will be provided.

This basic animal techniques course will teach students basic mouse colony management and preclinical research techniques. This course is lab intensive. Students will receive one-on-one instruction for each of the indicated skills listed in the syllabus. This format allows students to develop the ability to perform basic mouse colony management, tissue collection and processing, and molecular and histological analysis of primary tissue. **This course is only open to students in the Masters in Histopathology program.**

MHP 00615 ADVANCED LABORATORY ANIMAL TECHNIQUES SPRING 4 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. RENEE DEMAREST
PREREQUISITES: MHP 00610, MHP 00611, MHP 00612 & MHP 00614
REQUIRED TEXTBOOK: No required text – learning materials will be provided.
This advanced animal techniques course will reinforce what students learned about basic mouse colony management and teach students advanced preclinical research techniques. This course is lab intensive. Students will receive one-on-one instruction for each of the indicated skills listed in the syllabus. This format allows students to develop advanced animal research skills, including the ability to perform various surgical procedures and familiarity with a variety of mouse models of disease. **This course is only open to students in the Masters in Histopathology program.**

MHP 00616 TOPICS IN PATHOLOGY SPRING 2 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. CATHERINE NEARY
PREREQ: MHP 00611 & MBS 00503
CO-REQUISITE: MHP 00613
RECOMMENDED TEXTBOOK: Histology and Cell Biology, Kierszenbaum, A.L., & Tres, L.L., 5th ed., 2019, Elsevier Saunders.
RECOMMENDED TEXTBOOK: Robbins Basic Pathology, Kumar, V., Abbas, A.K., & Aster, J.C., 10th ed., 2018, Elsevier, Inc.
This course will provide students exposure to the pathology of major organ systems. **This course is only open to students in the Histopathology and Anatomical Sciences programs.**

MHP 00650 HISTOPATHOLOGY INTERNSHIP FALL/SPRING 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. RENEE DEMAREST
PREREQUISITES: NO
Students will perform internships at affiliate sites throughout the semester in order to build upon their basic histological techniques in various histology lab settings. The grading for this 3 credit course is Pass/Fail.

CMB 00910 RESPONSIBLE CONDUCT IN RESEARCH FALL 0 Credits REQUIRED COURSE
COURSE DIRECTOR: DRS. CATHERINE NEARY AND DAVID DEVILBISS
PREREQUISITES: NO
Responsible Conduct in Research training presents a series of 8 one-hour sessions whereby faculty, postdoctoral fellows, and students discuss professional standards of science. Participating individuals are enlightened as to why adherence to these standards is essential for continued scientific progress. Case studies along with open dialog between attendees provides the backdrop for discussion on issues that may arise in the laboratory setting. The grading for this zero (0) credit course is Satisfactory/Unsatisfactory. All PhD and research-based MS students must earn a grade of Satisfactory to fulfill degree requirements.

MHP 00640 HISTOPATHOLOGY INDEPENDENT STUDY FALL/SPRING/SUMMER 3 Credits ELECTIVE
COURSE DIRECTORS: DRS. RENEE DEMAREST AND CATHERINE NEARY
PREREQUISITES: NO
This course introduces students to the use of histopathology techniques in research by preparing a review of published scholarly literature on a topic of their own interest. With the guidance of a faculty advisor, students will identify a suitable topic and develop the skills of literature research, writing, revision, and oral presentation. Students will prepare an essay of at

least 6,000 words that presents the current understanding of the topic aimed at an audience of professionals. The student will also prepare an oral presentation which will be delivered at the end of the semester.

Molecular Cell Biology and Neuroscience (MCBN) Program: PhD; DO-PhD; MS (thesis only)

Course Descriptions

CMB 00703 MCBN FOUNDATIONS I FALL 4 Credits FOUNDATION COURSE
COURSE DIRECTORS: DRS. DANIEL CHANDLER & BRIAN WEISER
PREREQUISITE: NO
REQUIRED TEXTBOOK: NO
MCBN Foundations is designed as a two-semester course sequence. MCBN Foundations provides a broad overview of content areas within biomedical science and biological systems, especially those that are relevant to active research laboratories within the graduate school. Course content will be delivered in modules (four per semester), led and taught by faculty experts within each content area. Each module has a Module Director who is responsible for leading and grading each module with oversight by the Course Director(s). Each module is organized to include lectures, a discussion on research methods relevant to the module's content area, a discussion of primary literature that integrates the lecture and methodology content, and an exam.

CMB 00704 MCBN FOUNDATIONS II SPRING 4 Credits FOUNDATION COURSE
COURSE DIRECTORS: DRS. DANIEL CHANDLER & BRIAN WEISER
PREREQUISITE: PASS MCBN FOUNDATIONS I (CMB 00703) OR COURSE DIRECTOR APPROVAL
REQUIRED TEXTBOOK: NO
MCBN Foundations is designed as a two-semester course sequence. MCBN Foundations provides a broad overview of content areas within biomedical science and biological systems, especially those that are relevant to active research laboratories within the graduate school. Course content will be delivered in modules (four per semester), led and taught by faculty experts within each content area. Each module has a Module Director who is responsible for leading and grading each module with oversight by the Course Director(s). Each module is organized to include lectures, a discussion on research methods relevant to the module's content area, a discussion of primary literature that integrates the lecture and methodology content, and an exam.

CMB 00812 QUANTITATIVE METHODS FALL 2 Credits SKILL COURSE
COURSE DIRECTOR: DR. JESSICA LOWETH
PREREQUISITE: NO
This course addresses the fundamentals of statistics and other quantitative methods for researchers in biomedical sciences. It covers the basics of probability, distributions, power analysis, sampling from populations, comparisons between populations, statistical significance, regressions, curve fitting, and graphing data. Students will also become acquainted with basic bioinformatics analysis and their quantitative aspects. Each of six topics will be taught in two sessions: first, a lecture session, and second, a problem-solving session. The course is intended to impart practical skills and resource building so students can expand their knowledge in their laboratories and with their own data sets. This course is required for all second-year CMB doctoral and masters students.

CMB 00803 SCIENTIFIC WRITING SPRING 2 Credits SKILL COURSE
COURSE DIRECTORS: DRS. NATALIA SHCHERBIK AND JESSICA LOWETH
PREREQUISITE: NO
REQUIRED TEXTBOOK: How to Write and Publish a Scientific Paper, 8th Edition. Barbara Gastel and Robert A. Day. Greenwood, 2016. ISBN: 978-1-4408-4280-1 (paperback). ISBN: 978-1-4408-4262-7 (hardcover). EISBN: 978-1-4408-4263-4
This course presents the fundamental principles of scientific writing. Topics include components of a research paper, elements of a grant proposal, posters and power point presentations. Students will write an Abstract of a research paper and a Specific Aims page of a grant proposal. Students will also complete frequent short homework assignments, deliver an oral presentation, and critique/edit each other's work. This course is required for all first-year CMB doctoral and masters students.

CMB 00805 CELL CULTURE AND STEM CELLS FALL 2 Credits FOCUS COURSE
COURSE DIRECTORS: DRS. HRISTO HOUBAVIY AND DIMITRI PESTOV
PREREQUISITE: NO
RECOMMENDED TEXTBOOK: Essentials of Stem Cell Biology, 3rd Edition. Lanza, R. and Atala, A. Academic Press, 2013. ISBN-13: 978-0124095038
RECOMMENDED TEXTBOOK: Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications, 6th Edition. R. Ian Freshney. Wiley-Blackwell, 2010. ISBN: 978-0-470-52812-9
This course will introduce the student to major theories and methods of analysis of cellular-level functions and behaviors that underlie normal development in multicellular organisms and pathologies such as cancer and tissue aging. The first part of the course focuses on the design and interpretation of experiments in mammalian cell culture, with a particular emphasis on the validity of cell culture models for studying biological processes in vivo. The second part covers the fundamentals of stem cell biology, transgenic technologies and emerging therapeutic applications of stem cells.

CMB 00810 BIOMOLECULAR INTERACTIONS FALL 2 Credits FOCUS COURSE
COURSE DIRECTOR: DR. SERGEI BORUKHOV
PREREQUISITE: NO
REQUIRED TEXTBOOK: Protein-protein interactions, Second Edition. (2005) *E.A. Golemis and P.D. Adams*. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY (ISBN: 0-87969-722-9)
This course will introduce students to a wide range of experimental approaches including the cutting edge biochemical, immunological, biophysical, genetic and computational methods that are currently used to detect, visualize and characterize protein-protein and protein-nucleic acid interactions in biomedical research and molecular diagnostics applications. The course instructors are research scientists, who have hands-on knowledge and expertise in various methods and techniques to study biomolecular interactions. This course is aimed to be highly interactive with the purpose of developing a student's analytical skills.

CMB 00813 NEUROANATOMY: STRUCTURE AND FUNCTION OF THE VERTEBRATE NERVOUS SYSTEM FALL 2 Credits FOCUS COURSE
COURSE DIRECTOR: DR. BENJAMIN ROOD
PREREQUISITE: NO
REQUIRED TEXTBOOK: Neuroanatomy: Text and Atlas, 5th Ed., McGraw Hill Education (Early 2020).
The goal of this course is to provide a broad but comprehensive overview of the structures and function of the vertebrate central nervous system. The purpose of this course is to provide students with the vocabulary and understanding of nervous system function needed to dive into the diverse and rich neuroscience literature whether it be examining brain circuits involved in behavior, understanding the pathology of various conditions and diseases, or perhaps placing their study of a specific biological mechanisms into a broader context for a grant proposal. The course will be broken into three sections. The first section will focus on the types of cells that make up brain structures and pathways and the structures involved in somatosensory and motor systems. The second section will cover cranial nerves and various sensory systems. The third section will cover integrative systems that regulate numerous systems involved in homeostasis, physiological response to stress, motivation, emotion, and learning and memory. Throughout much of the course hands-on exploration of brain structures through microscopy of stained tissue and dissection of preserved brain tissue (human and sheep) will augment and reinforce topics covered in lectures.

CMB 00814 NEUROPHYSIOLOGY FALL 2 Credits FOCUS COURSE
COURSE DIRECTOR: DR. DANIEL CHANDLER
PREREQUISITE: NO
REQUIRED TEXTBOOK: C. Hammond. (2015). Cellular and Molecular Neurophysiology, 4nd Edition.
SUGGESTED SUPPLEMENTARY TEXTBOOK: Kandel, ER, Schwartz JH, Jessell TM, Siegelbaum SA, Hudspeth AJ. (2013) Principles of Neural Science, 5th edition. Appleton and Lange, Norwalk, CT

This course provides a basic foundation in neurophysiology for research-oriented graduate students. Topics are presented by members of the Department of Cell Biology and Neuroscience in lecture format. The assigned text is Cellular and Molecular Neurophysiology, 4th edition by Constance Hammond. Through readings, lectures, and discussion students will develop a basic knowledge the electrochemical properties cellular communication within the nervous system.

CMB 00806 GRADUATE GENETICS SPRING 2 Credits FOCUS COURSE
COURSE DIRECTOR: DR. RONALD ELLIS
PREREQUISITE: NO
RECOMMENDED TEXTBOOK: Introduction to Genetic Analysis, 10th Edition or earlier. AJF Griffiths, SR Wessler, SB Carroll, and J Doebley . W.H. Freeman and Company Publishing, 2010. ISBN: 978-1-4292-2943-2
This course covers advanced topics in genetic analysis and genetic methods. Our focus will be on the techniques and logic common to all research subjects, from viruses to humans. Previous exposure to Genetics is helpful but not required. Students must attend lectures, read the textbook, solve problems and read papers before each class.

MBS 00603 IMMUNOLOGY SPRING 3 Credits FOCUS COURSE
COURSE DIRECTOR: DR. RENEE DEMAREST
PREREQUISITES: MBS 00501 & MBS 00502 ("C" grade or better in each course) or by Permission of Course Director
REQUIRED TEXTBOOK: The Immune System, Peter Parham, Fourth Edition, 2015. Garland Press
Students will learn the basic concepts of the immune response and its role in human health and disease. The underlying mechanisms that lead to immunosuppression, autoimmunity, and hypersensitivity will be explored. In addition, the role of the immune system in cancer development and treatment will be examined. An emphasis will be placed on applying the learned concepts to clinical case studies throughout the course.

CMB 00815 NEUROPHARMACOLOGY & BEHAVIOR SPRING 2 Credits FOCUS COURSE
COURSE DIRECTORS: DRS. DANIEL MANVICH AND RACHEL NAVARRA
PREREQUISITE: NO
REQUIRED TEXTBOOK: Nestler EJ, Hyman SE, Holtzman DM, Malenka RC (2015). Molecular Neuropharmacology: A Foundation for Clinical Neuroscience, Third Edition. The McGraw-Hill Companies, Inc. Note: An online version of this textbook is available free-of-charge to students via Rowan University's subscription to AccessNeurology (https://neurology.mhmedical.com/).
RECOMMENDED SUPPLEMENTARY TEXTBOOK: Iversen LL, Iversen SD, Bloom FE, Roth RH (2008) Introduction to Neuropsychopharmacology, First Edition. Oxford University Press.
RECOMMENDED SUPPLEMENTARY TEXTBOOK: Cooper JR, Bloom FE, Roth RH (2003) The Biochemical Basis of Neuropharmacology, Eighth Edition. Oxford University Press.
The course will begin with a basic overview of neuronal function and neurotransmission, with specific emphasis placed on describing how transmission of major neurotransmitters and neuropeptides may be affected by exogenous drugs. This will be followed by an introduction to fundamental concepts in pharmacology including but not limited to pharmacodynamics, pharmacokinetics, receptor theory, and dose-response relationships. With this framework in place, the remainder of the course will describe the neuropharmacological mechanisms of action of various drug classes and how they alter brain function and behavior in preclinical models of disease and/or produce therapeutic benefit in human pathologies. Examples of drug classes to be discussed include but are not limited to: treatments for neurodegenerative diseases (e.g. Parkinson's disease, Alzheimer's disease); wakefulness-promoting and sleep-promoting drugs; opioid and non-opioid treatments for pain; affective disorders (e.g. anxiety, depression); antipsychotics; drugs of abuse (e.g. psychostimulants, opioids, alcohol, etc.).

CMB 00816 RESEARCH TOPICS IN NEUROBIOLOGY SPRING 2 Credits FOCUS COURSE
COURSE DIRECTOR: DR. JESSICA LOWETH
PREREQUISITE: NO
REQUIRED TEXTBOOK: NO
This course covers critical topics in neurobiology, with a focus on primary literature review, as learning how to effectively read and interpret scientific papers is a key skill for scientists. The first module will cover seminal findings in neuroscience and the impact each of these discoveries had on the field. The first lecture in this module will focus on the discovery of neurogenesis in the adult brain while others will cover crossmodal plasticity, long-term potentiation, the role of the prefrontal cortex in working memory, the role of dopamine in reward and epigenetics. Module two will cover cells and neuronal circuits while module three will cover motivated and cognitive behaviors. Highlighted techniques discussed (via review of review of primary literature) will include (but are not limited to): chemogenetics, optogenetics, *in vivo* calcium imaging, and *in vivo* and *ex vivo* physiology.

CMB 00901 LABORATORY ROTATION A – MCBN FALL 2 Credits REQUIRED COURSE
CMB 00902 LABORATORY ROTATION B – MCBN FALL 2 Credits REQUIRED COURSE
CMB 00903 LABORATORY ROTATION C – MCBN SPRING/FALL 2 Credits REQUIRED COURSE (Fall for DO/PhD students only)
CMB 00904 LABORATORY ROTATION D – MCBN SPRING 2 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. DIMITRI PESTOV
PREREQ: PERMISSION BY FACULTY/INVESTIGATOR
During the first year in the program, GSBS students perform research rotations in the laboratories of GSBS faculty members. Laboratory rotations are essential components of a student's education in the Molecular Cell Biology and Neuroscience (MCBN) program. These experiences introduce students to specific areas of cell biology, molecular biology, and neuroscience, expose students to specialized techniques, and familiarize students with specific projects in the program in anticipation of choosing a research advisor. Students will be evaluated on their attendance, motivation and interest within the lab as well as their attendance and participation at lab meetings. Students are responsible for learning new techniques, asking questions and working semi-independently by the end of each lab rotation. Each lab rotation will consist of 7 weeks. All MCBN students are required to complete three rotations in different laboratories. The fourth rotation may be in a new laboratory or the laboratory of the mutually agreed upon thesis mentor in the Spring semester. Exposure to different laboratories allows students to become acquainted with potential advisors for a thesis while exploring diverse scientific areas and learning new experimental approaches. DO/PhD students are expected to perform 1 or 2 Summer Medical Research Fellowships (SMRF) while still being a 1st or 2nd year DO student prior to officially enrolling in the PhD program.

CMB 00910 RESPONSIBLE CONDUCT IN RESEARCH FALL 0 Credits REQUIRED COURSE
COURSE DIRECTOR: DRS. CATHERINE NEARY AND DAVID DEVILBISS
PREREQUISITE: NO
Responsible Conduct in Research training presents a series of 8 one-hour sessions whereby faculty, postdoctoral fellows, and students discuss professional standards of science. Participating individuals are enlightened as to why adherence to these standards is essential for continued scientific progress. Case studies along with open dialog between attendees provides the backdrop for discussion on issues that may arise in the laboratory setting. The grading for this zero (0) credit course is Satisfactory/Unsatisfactory. All PhD and research-based MS students must earn a grade of Satisfactory to fulfill degree requirements.

CMB 00690 THESIS RESEARCH – MS MCBN SUMMER 7 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. MIKHAIL ANIKIN
The Mentor or Mentor-of-Record is responsible for grading this Satisfactory/Unsatisfactory graded course, which must be laboratory (not library) based and must be hypothesis driven. A student can enroll in this course just once. However, please note that the research thesis is done over two or more semesters. The conclusion of the research is based on proving the hypothesis. The student must publicly defend his/her thesis. The grading for this course is Satisfactory/Unsatisfactory, which does not affect the grade point average.

CMB 00699 MS THESIS CONTINUATION FALL/SPRING (Summer, if necessary) 1-9 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. MIKHAIL ANIKIN
After completing the number of thesis credits as defined by the MS program requirements and completing required coursework, students may register for Master of Science Thesis Continuation during each subsequent semester of thesis phase. Master of Science Thesis Continuation will carry a variable credit weight of 1-9 credits. The student's mentor will be responsible for certifying that a student is working on his/her thesis on a part-time or full-time basis commensurate with the number of credits they are registered for in a semester. Students will be charged the Master of Science Thesis Continuation fee of $200 per semester for thesis continuation regardless of the number of thesis credits for which they are registered. The maximum number of semesters that a student can register for thesis research and thesis continuation is four (2 years). The grading for this course is Satisfactory/Unsatisfactory, which does not affect the grade point average.

CMB 00920 ADVANCED GRADUATE RESEARCH FALL/SPRING 5 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. DANIEL MANVICH
To enroll in this course, students must have selected a permanent research advisor and laboratory in which to perform their dissertation research but should not yet have progressed to Ph.D. candidacy. The overall objectives for the course are 1) to successfully prepare for the Qualifying Examination, and 2) for the student to receive appropriate feedback from the mentor regarding their performance in the laboratory and their progress in Qualifying Examination preparations.
Eligibility:
To enroll in this course, students must have selected a permanent research advisor and laboratory in which to perform their dissertation research but should not yet have progressed to Ph.D. candidacy.

CMB 00925 SUMMER RESEARCH IN MCBN SUMMER 4 Credits REQUIRED COURSE
COURSE DIRECTOR: DOCTORAL STUDENT'S MENTOR
Each course will be directed by a doctoral student's mentor and its content will reflect his/her research interests. The goal is to have the student gain experience in a research laboratory and gain insight into the creative research process. Satisfactory/Unsatisfactory graded course.

CMB 00990 SUMMER THESIS RESEARCH/PhD SUMMER 4 Credits REQUIRED COURSE
COURSE DIRECTOR: DOCTORAL STUDENT'S MENTOR
This course is based on the laboratory research that each doctoral student performs as they work toward their thesis defense. The chair of each student's thesis research committee has the responsibility of ensuring that the course goals are met for that student. The summer semester will not require any formal update to the committee. As this course recurs every summer semester for qualified doctoral candidates, the course is considered completed when the student successfully defends her/his thesis. It is a Satisfactory/Unsatisfactory graded course.

CMB 00999 THESIS RESEARCH/PhD FALL/SPRING 9 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. MIKHAIL ANIKIN
This course is based on the laboratory research that each doctoral student performs as they work toward their thesis defense. The chair of each student's thesis advisory committee has the responsibility of ensuring that the course goals are met for that student. The course requires that the student formally present their research progress and plan for future work and receive critical feedback from committee members. The presentation will be either a written report or an oral presentation, alternating these formats each fall and spring semester. The students will receive detailed feedback in the form of a written review and discussion with all committee members. The student is expected to take advantage of the feedback and present again the next fall or spring semester what steps were taken in response. As this course recurs every fall and spring semester for qualified doctoral candidates, the course is considered completed when the student successfully defends her/his thesis. It is a Satisfactory/Unsatisfactory graded course.

Molecular Pathology and Immunology Program: MS (thesis)

Course Descriptions

MBS 00501 BIOCHEMISTRY AND MOLECULAR BIOLOGY FALL 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. JEFFERY POWERS
PREREQUISITE: NO
REQUIRED TEXTBOOK: ***Lippincott Illustrated Reviews: Biochemistry, 7th ed.*** **ISBN 9781496344496 (e-text available through library website)**
This course will cover fundamental topics in biochemistry and how they relate to human health and disease. This begins with the introduction of the biomolecules that are central to human metabolism at the cellular and organismal level. We then explore the bioenergetic and thermodynamic principles that govern this metabolism, as well as how the body uses enzymes to harness these properties. We then move onto the study of the biochemical pathways that underly human metabolism and how these pathways can be dysregulated in human disease.

MBS 00502 CELL BIOLOGY FALL 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. DANA ZAMBITO
PREREQUISITE: NO
REQUIRED TEXTBOOK: Essential Cell Biology, 6th Edition. B. Alberts, K. Hopkin A. Johnson, D. Morgan, K. Roberts, P. Walter, R. Heald. W.W. Norton & Co. Publishers, 2023. ISBN: 978-1-324-03341-7
This course is focused on biology and physiology of the cell and is organized around the central theme of homeostasis – how the cells adopt to various environmental changes while maintaining their internal constancy necessary for all tissues and organs to function. It is a course for both the basic scientists who seek general principles about cellular function, and the students preparing for health-related careers who wish to apply fundamental knowledge on cell biology to understand the molecular mechanisms of cellular dysfunction in human diseases.

MPI 00503 MOL PATH & IMMUNO SEMINAR FALL/SPRING 2 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. JOSEPH NICKELS
PREREQUISITES: NO
GENESIS BIOTECHNOLOGY GROUP FACILITY: Galaxy Building, North One Conference Room
All MSMPI students are required to attend both of the Genesis Biotechnology Group (GBG) Seminar Series during their first year. The *Basic Research Seminar Series* is a weekly meeting that includes the presentation and discussion of scientific data from individual members of GBG's basic research groups. These seminars will serve two functions: the critical analysis and proper planning of experiments and the opportunity to become familiarized with the various research projects and multiple scientific disciplines offered within GBG. This exposure will aid the students in their selection of laboratory rotations during the current semester. Held on a monthly basis, the *Distinguished Lecturer Seminar Series* provides students the unique opportunity to learn about various scientific disciplines from invited speakers who are experts in their fields. Both seminar series are held on the GBG campus. Within this course, students are expected to participate in the scientific discussion, are invited to ask questions of the presenters, and are required to submit written summaries, supplemented with information and references from relevant published articles, for each presentation.

MBS 00603 IMMUNOLOGY SPRING 3 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. RENEE DEMAREST
PREREQUISITES: MBS 00501 & MBS 00502 ("C" grade or better in each course)
REQUIRED TEXTBOOK: The Immune System, Peter Parham, Fourth Edition, 2015. Garland Press

Students will learn the basic concepts of the immune response and its role in human health and disease. The underlying mechanisms that lead to immunosuppression, autoimmunity, and hypersensitivity will be explored. In addition, the role of the immune system in cancer development and treatment will be examined. An emphasis will be placed on applying the learned concepts to clinical case studies throughout the course.

MPI 00680 MOL PATH & IMMUNO LAB ROTATION I (7 weeks each) FALL 1 Credit REQUIRED COURSE
MPI 00681 MOL PATH & IMMUNO LAB ROTATION II (7 weeks each) FALL 1 Credit REQUIRED COURSE
MPI 00682 MOL PATH & IMMUNO LAB ROTATION III (7 weeks each) SPRING 1 Credit Optional Elective Course
COURSE DIRECTORS: GENESIS BIOTECHNOLOGY GROUP GSBS FACULTY MENTOR
PREREQUISITE: PERMISSION BY FACULTY/INVESTIGATOR
Laboratory rotations are essential components of a student's education in the Molecular Pathology and Immunology Program. These experiences introduce students to specific areas of molecular pathology and immunology; expose students to specialized techniques, and familiarize students with specific projects in the program in anticipation of choosing a research advisor. Students will be evaluated on their attendance, motivation and interest within the lab as well as their attendance and participation at lab meetings. Students are responsible for learning new techniques, asking questions and working semi-independently by the end of each lab rotation. Students are encouraged to select their laboratory rotations so as to acquire diverse research experiences. A Molecular Pathology and Immunology Program student needs to complete two laboratory rotations prior to the selection of a thesis advisor. The length of each laboratory rotation is 7 weeks and each must be completed within the fall semester of the student's first year. Hence, by the end of the fall semester, the student will know which lab they will do their research in for their thesis. There is also an optional spring semester lab rotation, if needed.

CMB 00910 RESPONSIBLE CONDUCT IN RESEARCH FALL 0 Credits REQUIRED COURSE
COURSE DIRECTOR: DR. JOSEPH NICKELS
PREREQUISITES: NO
Responsible Conduct in Research training presents a series of 10 one-hour sessions whereby faculty, postdoctoral fellows, and students discuss professional standards of science. Participating individuals are enlightened as to why adherence to these standards is essential for continued scientific progress. Case studies along with open dialog between attendees provides the backdrop for discussion on issues that may arise in the laboratory setting. The grading for this zero (0) credit course is Satisfactory/Unsatisfactory. All MSMPI students must earn a grade of Satisfactory to fulfill degree requirements.

MPI 00685 MOL PATH & IMMUNO RESEARCH I SPRING 1 Credit REQUIRED COURSE
MPI 00686 MOL PATH & IMMUNO RESEARCH II SUMMER 2 Credits REQUIRED COURSE
COURSE DIRECTOR: GENESIS BIOTECHNOLOGY GROUP GSBS FACULTY MENTOR
Each course will be directed by a masters student's Mentor who is a member of the GSBS Faculty at Genesis Biotechnology Group and its content will reflect his/her research interests. The goal is to have the student gain experience in a research laboratory and gain insight into the creative research process.

MPI 00690 THESIS RESEARCH – MSMPI FALL 7 Credits REQUIRED COURSE
The Mentor or Mentor-of-Record is responsible for grading this Satisfactory/Unsatisfactory graded course, which must be laboratory (not library) based and must be hypothesis driven. A student can enroll in this course just once. However, please note that the research thesis is done over two or more semesters. The conclusion of the research is based on testing the hypothesis but not necessarily on proving the hypothesis (unlike a doctoral or masters thesis in the Molecular Cell Biology and Neuroscience program). The student must publically defend his/her thesis. The grading for this course is Satisfactory/Unsatisfactory, which does not affect the grade point average.

MPI 00699 MS THESIS CONTINUATION FALL/SPRING/SUMMER 1-9 Credits
After completing the number of thesis credits as defined by the MS program requirements and completing required coursework, students may register for Master of Science Thesis Continuation during each subsequent semester of thesis phase. Master of Science Thesis Continuation will carry a variable credit weight of 1-9 credits (5 credits are part-time status; 9 credits are full-time status). The student's mentor will be responsible for certifying that a student is working on his/her thesis on a part-time or full-time basis commensurate with the

number of credits they are registered for in a semester. Students will be charged the Master of Science Thesis Continuation fee of $200 per semester for thesis continuation regardless of the number of thesis credits for which they are registered. The maximum number of semesters that a student can register for thesis research and thesis continuation is four (2 years). The grading for this course is Satisfactory/Unsatisfactory, which does not affect the grade point average.