

# Biomedical Sciences (Medical) (BMSC)

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Course information contained within the Bulletin is accurate at the time of publication in June 2025 but is subject to change. For the most up-to-date course information, please refer to the Course Catalog.

## **BMSC 8001. Introduction to Biochemistry and Molecular Biology. 3 Credit Hours.**

Graduate level course that describes fundamentals of biochemistry and molecular biology. Topics include proteins, enzymes, ligand binding, energy metabolism, carbohydrate, lipid and amino acid metabolism, structure of RNA and DNA, chromosomes and genes, DNA replication and repair, RNA transcription, and protein translation, degradation, trafficking.

**Repeatability:** This course may not be repeated for additional credits.

## **BMSC 8002. Introduction to Cell Biology and Immunology. 3 Credit Hours.**

Graduate level course that describes fundamentals of cell biology and immunology. Topics include prokaryotic and eukaryotic cell biology, mitosis and meiosis, cell cycle control, membranes and membrane channels/transporters, cytoskeleton, cell differentiation, apoptosis, principles of immunology, antigens, cells of the immune system, humoral immune responses, autoimmunity, hypersensitivity and allergies, and host-pathogen interactions.

**Repeatability:** This course may not be repeated for additional credits.

## **BMSC 8003. Introduction to Molecular and Cell Biology. 3 Credit Hours.**

Graduate level course that describes fundamentals of molecular biology, genetics and cell biology. Topics include structure of DNA and RNA, chromosomes and genes, DNA replication and RNA, RNA transcription, protein translation, protein degradation and trafficking, prokaryotic and eukaryotic cell biology, mitosis and meiosis, cell cycle control, membranes and membrane channels/transporters, cytoskeleton, cell differentiation and apoptosis.

**Repeatability:** This course may not be repeated for additional credits.

## **BMSC 8101. Molecules to Cells. 6 Credit Hours.**

Graduate level course that describes fundamentals of biochemistry, molecular biology, cell biology and immunology. Biochemistry, molecular biology and cell biology will consider both prokaryotic and eukaryotic organisms. Immunology will include principles of immunology and host-pathogen interactions.

**Repeatability:** This course may not be repeated for additional credits.

## **BMSC 8102. Experimental Design and Biostatistics. 1 Credit Hour.**

This is a one-credit course designed to provide first year Biomedical Science graduate students basic information concerning experimental design and biostatistics. The emphasis of this course will be to provide practical information pertaining to the design of biomedical experiments and their analysis using a variety of statistical approaches.

**Repeatability:** This course may not be repeated for additional credits.

## **BMSC 8103. Scientific Integrity and Bioethics. 1 Credit Hour.**

This is a one-credit graduate course to provide Biomedical Science graduate students with instruction in ethical conduct of research.

**Repeatability:** This course may not be repeated for additional credits.

## **BMSC 8104. Introduction to Laboratory Research I. 1 Credit Hour.**

This is a one-credit graduate course to provide Biomedical Science graduate students with exposure to the research opportunities in the five Biomedical Science research clusters and to obtain supervised research experience in the laboratory.

**Repeatability:** This course may not be repeated for additional credits.

## **BMSC 8201. Organ Systems: Function, Dysfunction and Therapeutics. 4 Credit Hours.**

This graduate level course provides instruction in the physiological, pathophysiological and pharmacological aspects of various organ systems. Organ systems will include cardiovascular, pulmonary, renal, endocrine, musculoskeletal and neurological.

**Repeatability:** This course may not be repeated for additional credits.

## **BMSC 8202. Scientific Communications. 1 Credit Hour.**

This course will provide instruction in both written and oral scientific communications. Students will be guided in the preparation of power point presentations, abstracts and full manuscripts.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8203. Introduction to Bioinformatic Tools and Applications. 1 Credit Hour.**

This is a one-credit course to provide instruction in bioinformatic approaches to the conduct of biomedical research.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8204. Introduction to Laboratory Research II. 1 Credit Hour.**

This is a one-credit course to provide Biomedical Science graduate students with supervised research experiences within laboratories.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8205. Cell Structure & Function. 2 Credit Hours.**

The goal of this course is to learn the structure and function of basic tissues in the body. Emphasis will be on the study of the structure of different cell types in the body and how this relates to their function.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8206. Molecular, Cellular and Systems Signal Transduction. 2 Credit Hours.**

This course will discuss basic mechanisms of cell signaling in a variety of different cell types.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8207. Molecular Approaches to Research. 2 Credit Hours.**

The goal of the course is to give students an understanding of basic and novel molecular approaches to biomedical research. The following major issues are addressed: (i) what are the molecular approaches most frequently used in biomedical research; (ii) why a particular approach fits a specific question asked in the course of research, and how to select the most suitable approach; and (iii) what is the molecular basis of these experimental approaches, i.e. how and why the techniques used in the lab work. Areas of instruction will include methods for the study of DNA, RNA and protein, optical approaches, transgenic animals and other animal models of human disease and single-cell analysis using flow cytometry.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8401. Scientific Grant Writing. 1 Credit Hour.**

The overall purpose of this course is to provide training to Biomedical Science graduate students in the preparation of a successful grant application.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8500. Cancer Biology and Genetics Student Seminar and Journal Club. 1 Credit Hour.**

This course will require that the student participate in two separate activities: (i) attend and participate in the student seminar series of the Cancer Biology and Genetics cluster and present a literature based seminar on a topic within this field of study, and (ii) attend and participate in a specialized journal club in an area of interest. The course director will provide students with detailed course/grading policies, schedules, and a list of journal clubs.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 8502. Cancer Biology. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Cancer Biology and Genetics Cluster of the Biomedical Sciences Graduate Program. It is an interdisciplinary course taught by faculty from the School of Medicine and the Fox Chase Cancer Center. The goals of the course are 1) to provide students with a comprehensive background of cancer, from the patient to the transformed cell, 2) to provide a molecular understanding of the difference between normal and cancer cells and 3) to provide an understanding of the origins, treatments and prevention of cancer. Course syllabus will be provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8503. Genetics and Epigenetics. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Cancer Biology and Genetics Cluster of the Biomedical Sciences Graduate Program. The focus of this course is on Hereditary Mechanisms and Epigenetics. Mendelian diseases and complex phenotypes will be reviewed. The major focus will be on mechanisms of Epigenetic modifications and heritability, including its role in development and disease. Experimental approaches to epigenetics studies will be presented and papers from the literature will be the backbone of the course. Course syllabus will be provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8510. Special Topics in Cancer Biology and Genetics. 2 Credit Hours.**

This course is based on the breaking research findings in the area of Cancer Biology and Genetics and the interests of the faculty and students within this cluster. Topics will vary year to year. The course director will provide students with detailed course/grading policies, schedules and reading lists.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 8600. Infectious Disease and Immunity Student Seminar and Journal Club. 1 Credit Hour.**

This course will require that the student participate in two separate activities: (i) attend and participate in the student seminar series of the Infectious Disease and Immunity cluster and present a literature based seminar on a topic within this field of study, and (ii) attend and participate in a specialized journal club in an area of interest. The course director will provide students with detailed course/grading policies, schedules and a list of journal clubs.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 8602. The Biology of the Immune Response. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Infectious Disease and Immunity Cluster. The focus of this course is the study of the components of the immune system, their development and function, and their roles in various pathological processes. Readings are from the primary literature including landmark papers and recently published work. The successful completion of this course will allow the application of evidence based knowledge to the graduate student's own research project. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8603. Molecular Genetics of Human Viruses. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Infectious Disease and Immunity Cluster. This course aims to provide graduate students with the opportunity to gain knowledge of human viruses and viruses of zoonotic origins. The research methods used in medical virology relevant to elucidating viral replication and pathogenesis will be covered. In addition, the ways for which viruses are used in genetic engineering, cancer treatment and basic research will be discussed. The course covers materials from seminal papers and latest published work. The successful completion of this course will allow the application of evidence based knowledge to the graduate student's own research. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8604. Cellular and Molecular Basis of Host-Microbe Interactions. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Infectious Disease and Immunity Cluster. The focus of this course is to understand the cellular and molecular mechanisms of microbial pathogenesis and the host response to the pathogen. Selected model organisms will be used for in depth exploration of host-pathogen interactions. In addition, certain general strategies of microbial survival and penetration, and of host recognition and response to danger signals, will be covered. Lectures present evidence for current concepts and theories from the primary literature and review articles. Conference hours cover recent relevant research papers. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8610. Special Topics in Infectious Disease and Immunity. 2 Credit Hours.**

This course is based on the breaking research findings in the area of Infectious Disease and Immunity and the interests of the faculty and students within this cluster. Topics will vary year to year. The course director will provide students with detailed course/grading policies, schedules and reading lists.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 8700. Molecular and Cellular Biosciences Student Seminar and Journal Club. 1 Credit Hour.**

This course will require that the student participate in two separate activities: (i) attend and participate in the student seminar series of the Molecular and Cellular Biosciences cluster and present a literature based seminar on a topic within this field of study, and (ii) attend and participate in a specialized journal club in an area of interest. The course director will provide students with detailed course/grading policies, schedules and a list of journal clubs.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 8702. Enzymes and Proteins. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Molecular and Cellular Biosciences Cluster. The overall goal of this course is to enable students to understand protein structural and catalytic aspects of contemporary biochemistry. The student who completes this course will be able to engage in dialog about protein structure and function. The student will be able to understand, visualize, reshape, present and discuss data from original sources. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8703. RNA and its Role in Gene Expression. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Molecular and Cellular Biosciences Cluster. The focus of this course is on the study of RNA and its multiple roles in gene expression. The structure, synthesis, processing and function including protein translation of both classic RNA molecules (mRNA, tRNA and rRNA) and nontraditional RNA molecules (such as miRNAs, long noncoding RNAs, RNAs with enzymatic activity) are discussed. Both single molecule based approaches and genomic approaches are discussed. Readings are from the primary literature including landmark papers and recently published work. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8704. Molecular Physiology of Ion Signaling. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Molecular and Cellular Biosciences Cluster. The overall focus of this course is on ion channels and their function in biological systems. Part 1 of the course focuses on ion balance, channel classes and channel structures. Part 2 focuses on the biological impact of ionic control of cytosolic  $\text{Ca}^{2+}$  concentration. Part 3 focuses on the impact of these changes on physiology and disease in multiple organ systems. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8705. Biophysical Approaches to Research. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Molecular and Cellular Biosciences Cluster. Students will learn to appreciate how biophysical principles can be used to understand and measure properties of biomolecules and cells. The areas covered in the course emphasize how to generate, analyze and interpret quantitative information about biological molecules or systems. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8706. Structure and Dynamics of Biomolecules and Assemblies. 2 Credit Hours.**

This is an advanced topics course offered for students in the second year of study in the Biomedical Sciences Graduate Program. The course will focus on understanding structure and behavior of biomolecules and assemblies, including the chemical basis for molecular interactions and techniques for studying macromolecular structure.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8710. Special Topics in Molecular and Cellular Biosciences. 2 Credit Hours.**

This course is based on the breaking research findings in the area of Molecular and Cellular Biosciences and the interests of the faculty and students within this cluster. Topics will vary year to year. The course director will provide students with detailed course/grading policies, schedules and reading lists.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 8800. Neuroscience Student Seminar and Journal Club. 1 Credit Hour.**

This course will require that the student participate in two separate activities: (i) attend and participate in the student seminar series of the Neuroscience cluster and present a literature based seminar on a topic within this field of study, and (ii) attend and participate in a specialized journal club in an area of interest. The course director will provide students with detailed course/grading policies, schedules and a list of journal clubs.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 8802. Essentials of Neuroscience. 2 Credit Hours.**

This is a REQUIRED Cluster-based Advanced Course offered by the Neuroscience Cluster of the Biomedical Sciences Graduate Program. This course is open to all graduate students in all disciplines with an interest in learning basic neuroscience. This course focuses on the basic neurophysiological and neuroanatomical aspects of the organization of the nervous system. Neuroanatomical structures and their function will be covered using a system based approach. Sensory, motor and special sensory systems will be included. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8803. Molecular and Cellular Neuroscience. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Neuroscience Cluster. The overall goal of this course is to provide an integrated approach to the understanding of the structure and function of neurons and glia. Topics include the cellular structure of neurons and glia, molecular mechanisms for neural transmission and plasticity, new concepts on neurogenesis and cell fate decisions, signaling pathways for neuronal polarization and neuritogenesis, molecular biology and function of glia, neuron-glia interactions, glial cell pathophysiology, neuroinflammation and the role of glia in the development and progression of various neurological disorders and diseases. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8804. Neuropharmacology. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Neuroscience Cluster. The overall goal of this course is to provide the basic aspects of neuropharmacology by investigating mechanism by which drugs influence and/or modulate different neural system activities and functions. The molecular, cellular and biochemistry characteristics of several classes of drugs with implications for human pathologies will be discussed. Four areas of emphasis will include: structure and function of the nervous system, neurotransmitters and neuromodulators, neuroinflammation and neurodegeneration. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8805. Pharmacology of Drugs of Abuse. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Neuroscience Cluster. The focus of this course is on the pharmacology of drugs of abuse. Topics include historical perspectives of drug abuse, cellular responses to acute and chronic exposure to drugs of abuse, effects of drugs of abuse on the immune system, and medical treatment of drug dependence. Specific drug classes that are covered include opioids, cocaine, amphetamines, spice and bath salts, club drugs, LSD and PCP, alcohol, caffeine, nicotine, benzodiazepines and sedatives, and cannabinoids. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8806. Translational Science of Nervous System Diseases. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Neuroscience Cluster. Students will gain knowledge of translational science regarding the molecular basis of various nervous system diseases, current treatments and rehabilitation, and advances in animal modeling of disease that address prevention and improved treatment modalities. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8807. Developmental Neurobiology. 2 Credit Hours.**

This course will focus on the molecular and cellular mechanisms that govern development of the mammalian central nervous system. Topics include but are not limited to: Development of the Cerebral Cortex, Retinal Development, Glial Development, White Matter Maturation, Neuroprogenitors Cells, Axonogenesis and Dendritogenesis.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8810. Special Topics in Neuroscience. 2 Credit Hours.**

This course is based on the breaking research findings in the area of Neuroscience and the interests of the faculty and students within this cluster. Topics will vary year to year. The course director will provide students with detailed course/grading policies, schedules and reading lists.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 8900. Organ Systems and Translational Medicine Student Seminar and Journal Club. 1 Credit Hour.**

This course will require that the student participate in two separate activities: (i) attend and participate in the student seminar series of the Organ Systems and Translational Medicine cluster and present a literature based seminar on a topic within this field of study, and (ii) attend and participate in a specialized journal club in an area of interest. The course director will provide students with detailed course/grading policies, schedules and a list of journal clubs.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 8902. Mechanisms of Cardiovascular Pathophysiology. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Organ Systems and Translational Medicine Cluster. The overall goal of this team-taught course is to introduce graduate students to the cellular and molecular mechanisms of multiple cardiovascular diseases, with a focus on experimental approaches. The approach will combine didactic presentation with relevant important scientific literature. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8903. Hemostasis and Thrombosis. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Organ Systems and Translational Medicine Cluster. Selected areas of Hemostasis and Thrombosis will be addressed from a historical perspective to state of the art technology and knowledge. This course will study molecular mechanisms and signal transduction events that regulate hemostasis through coagulation cascades and platelet function. The implications of treatments of bleeding disorders, thrombosis, and the therapeutics will be discussed. Students are expected to read seminal papers and participate in class by contributing to discussion. Each topic will have discrete study objectives. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8904. Translational Pulmonary Physiology - Experimental Basis. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Organ Systems and Translational Medicine Cluster. Selected areas of pulmonary physiology will be addressed from application, experimental, and historical perspectives. This course will study mechanisms that underlie major pulmonary diseases such as acute respiratory distress syndrome, chronic obstructive pulmonary disease, asthma, and ventilator induced lung injury. How these diseases modify the function of the pulmonary system, the mechanical, circulatory and inflammatory profiles of the lung, and interventions to attenuate dysfunction will be discussed. Students are expected to read seminal papers and participate in class by contributing to discussion. Each topic will have discrete study objectives. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8905. Advanced Pharmacology and Translational Medicine. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Organ Systems and Translational Medicine Cluster. Pharmacology is the study of biochemical and physiological processes mediated through exogenous or endogenous substances that interact with living systems. Translational medicine aims to use pharmacological discoveries to develop novel therapies in treatment of human disease. The overall goal of this course is to introduce students to the subject of advanced pharmacology and then to focus on recent advances in methodologies used to develop new therapeutics with an emphasis on experimental approaches. The approach will combine didactic presentation with a combination of informal discussion of important scientific literature. Course materials will be handouts/lecture slides provided by each instructor, and selected research papers from the literature. Each lecture will provide a solid foundation for students to understand the methods and techniques used in experimental pharmacology and translational medicine in addition to the concepts. Student participation in the form of questions and discussion is encouraged. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8906. Development, Function and Diseases of the Musculoskeletal System. 2 Credit Hours.**

This is a Cluster-based Advanced Elective Course offered by the Organ Systems and Translational Medicine Cluster. Lecture topics will include: musculoskeletal histology, development of limbs, muscle, bone and joints, diagnostic imaging of musculoskeletal system and cartilage repair/fracture, cell biology of osteoblasts and osteoclasts, biomechanics of musculoskeletal system, skeletal pathologies and central nervous system/bone interactions. Course syllabus is provided by the course director.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8907. Organ Metabolism - Molecular Pathology and Experimental Models. 2 Credit Hours.**

This is an advanced topics course offered to students in the second year of study in the Biomedical Science Graduate Program. The overall goal of this course is to introduce students to the subject of systemic metabolism and organ metabolism and relate this to various key organ pathologies and diseases. Emphasis will be placed on recent advances in molecular pathways along with the experimental models and methodologies used to develop new therapeutics.

**Repeatability:** This course may not be repeated for additional credits.

**BMSC 8910. Special Topics in Organ Systems and Translational Medicine. 2 Credit Hours.**

This course is based on the breaking research findings in the area of Organ Systems and Translational Medicine and the interests of the faculty and students within this cluster. Topics will vary year to year. The course director will provide students with detailed course/grading policies, schedules and reading lists.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 9991. Biomedical Science Research. 1 to 6 Credit Hour.**

Students will perform supervised laboratory research.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 9994. Preliminary Exam Preparation. 1 to 6 Credit Hour.**

Biomedical Science students will enroll in this course when they are preparing for the PhD Preliminary Examination.

**Repeatability:** This course may be repeated for additional credit.

**BMSC 9995. Master's Project. 1 to 6 Credit Hour.**

**Repeatability:** This course may be repeated for additional credit.

**BMSC 9996. Master's Thesis. 1 to 6 Credit Hour.**

**Repeatability:** This course may be repeated for additional credit.

**BMSC 9998. Postcandidacy Research. 1 to 6 Credit Hour.**

**Repeatability:** This course may be repeated for additional credit.

**BMSC 9999. Dissertation Writing. 1 to 6 Credit Hour.**

**Repeatability:** This course may be repeated for additional credit.