

# BMED - Biomedical Sciences

## **BMED 694 Scholarly Research Project (5 Credit Hours)**

This course is taken in the final semester of the non-thesis track and is devoted to completion of a capstone scholarly research project. Students finalize a written research report and complete an oral presentation to their guidance committee.

## **BMED 698 Masters Research (1-6 Credit Hours)**

Provides supervised, Principal Investigator (PI)-mentored laboratory or scholarly research experience for master's students. Emphasizes development of foundational research skills, including experimental design, data collection and analysis, and scientific communication, in support of a master's thesis or capstone research project.

## **BMED 699 Thesis Research (5 Credit Hours)**

This course is taken in the final semester of the thesis track and is devoted to completion of the master's thesis. Under the supervision of the student's guidance committee, students finalize the written thesis and complete the formal oral defense.

## **BMED 700 Scientific Communication (1 Credit Hour)**

This course will develop skills to design clear, visually effective scientific presentations and to communicate their thesis research concisely, accurately, and professionally. The course will cover oral and visual communication formats, including journal club presentations, conference talks, posters, and elevator pitches. Students will also gain experience translating scientific findings for non-scientific audiences through lay presentations, outreach, education, and advocacy.

## **BMED 701 Biomedical Sciences Lab Rotation I (1 Credit Hour)**

Provides hands-on laboratory research experience through short-term rotations in biomedical and translational science laboratories. Students engage in mentored research under the supervision of Principal Investigators (PIs), gaining exposure to diverse experimental approaches, research cultures, and scientific disciplines within the Biomedical Sciences Program.

## **BMED 702 Biomedical Sciences Lab Rotation II (1 Credit Hour)**

Provides hands-on laboratory research experience through short-term rotations in biomedical and translational science laboratories. Students engage in mentored research under the supervision of Principal Investigators (PIs), gaining exposure to diverse experimental approaches, research cultures, and scientific disciplines within the Biomedical Sciences Program.

## **BMED 703 Biomedical Sciences Lab Rotation III (1 Credit Hour)**

Provides hands-on laboratory research experience through short-term rotations in biomedical and translational science laboratories. Students engage in mentored research under the supervision of Principal Investigators (PIs), gaining exposure to diverse experimental approaches, research cultures, and scientific disciplines within the Biomedical Sciences Program.

## **BMED 710 Core Concepts 1: Foundations of Biomedical Science (5 Credit Hours)**

This course provides an in-depth foundation in molecular and cell biology, biochemistry, genetics, and cell signaling. Graduate students gain essential knowledge of molecular structures and processes, as well as laboratory techniques central to advanced biomedical research. Emphasis is placed on understanding the molecular mechanisms that underlie cellular function, genetic regulation, and signaling pathways.

## **BMED 711 Molecular & Cellular Techniques (2 Credit Hours)**

This course provides foundational knowledge and hands-on, project-based training in core biomedical research techniques, including genetic engineering, molecular biology, cell culture, protein analysis, microscopy, and immunological assays. Students develop technical competency, data analysis and reporting skills, and professional laboratory practices essential for biomedical research.

## **BMED 720 Core Concepts 2: Systems and Translational Biology (5 Credit Hours)**

This course builds on Core Concepts 1 and explores the application of molecular, genetic, and signaling principles to physiological systems, human disease, and biomedical research. Students gain an integrated understanding of the molecular mechanisms that regulate organ function, as well as the interactions among organ cells, stroma, stem cells, microbiota, and the immune and nervous systems that maintain homeostasis. Additionally, they learn core principles of translational research and pharmacology.

## **BMED 721 Biostatistics for the Biomedical Sciences (1 Credit Hour)**

This introduction to biostatistics course will emphasize quantitative approaches to biomedical projects. This course is structured into biostatistics and AI-based, large-scale biometric analysis.

## **BMED 722 Responsible Conduct in Science (1 Credit Hour)**

Explores ethical, legal, and social issues in biomedical research, including responsible conduct, data management, and authorship. Students also gain exposure to peer review processes for manuscripts, fostering an understanding of ethical standards in the research enterprise.

## **BMED 730 Methods & Logic in Translational Biology (2-3 Credit Hours)**

This advanced course focuses on the design, execution, and communication of translational research projects that bridge basic science and clinical applications. Students will be exposed to a spectrum of principles related to translational biology and complete a group project exemplifying drug discovery related to a specific clinical condition/disease.

## **BMED 740 Histology for Researchers (2 Credit Hours)**

This course introduces the structure and organization of cells, tissues, and organs, emphasizing the relationship between form and function. Through a lecture-laboratory format, students develop skills in morphological pattern recognition and identification of cellular and tissue structures using light and virtual microscopy.

## **BMED 741 Cancer Biology, Translational and Clinical Research, AI/ML/Big Data in Medicine and Science (2 Credit Hours)**

This course provides a graduate-level educational program and a boot-camp style hands-on training to integrate cancer biology, preclinical and clinical oncology, and surgical interventions, as well as an introduction to current state-of-the-art technology utilizing artificial intelligence (AI), Machine Learning (ML), and Big data analytic tools, and how these AI/ML tools are being applied/can be applied to translational and clinical research in medicine and science at the interface of cancer biology.

## **BMED 742 Comparative Reproductive Biology (2 Credit Hours)**

This course provides students with a foundation to recognize and understand the similarities and key differences in reproductive mechanisms across animal models, including rodents, farm animals, nonhuman primates, and humans. Through lectures, guided readings, and student-led discussions, participants explore testicular and ovarian development, fertility, implantation, embryogenesis, placentation, pregnancy, fetal development, and parturition, while developing skills in critical analysis and scientific communication.

## **BMED 743 Aging and Age-Related Diseases (2 Credit Hours)**

This advanced course explores the molecular and cellular hallmarks of aging and age-related diseases, emphasizing the principles of geroscience. Students examine how aging contributes to disease onset, evaluate interventions that may delay or prevent age-associated changes, and gain insight into established and emerging animal models and cutting-edge techniques in aging research.

## **BMED 744 AI-Assisted RNA Sequencing Data Analysis and Visualization (2 Credit Hours)**

This course provides hands-on training in using artificial intelligence tools to analyze RNA sequencing (RNA-seq) data. Emphasizing Python programming, students learn to preprocess, normalize, and visualize RNA-seq datasets with AI-assisted code generation. Through problem-solving exercises with real datasets, students develop practical computational skills for biological data analysis, even if they have no prior coding experience, gaining confidence in applying AI to interpret genomic data in research contexts.

**BMED 745 Integrative Neuroscience (2 Credit Hours)**

This course examines the interactions between the central nervous system and peripheral systems that are critical for health and disease, providing a foundation for transdisciplinary research. Students explore the anatomical, cellular, molecular, and systems-level basis of neural-body communication, including the glymphatic system, sleep-immune interactions, stress responses, and the microbiota-gut-brain axis, using current reviews and primary literature to integrate substantive content with scientific methodology.

**BMED 746 Neuroscience Concepts and Methods (2 Credit Hours)**

This course provides an overview of the principles and experimental approaches used to study the brain and nervous system at the molecular, circuit, and functional levels. Students examine modern neuroscientific methods and their applications to understanding normal brain function and neurological disease, drawing on current research and scientific methodology.

**BMED 747 Noncoding RNA Networks in Cancer & Metastasis (2 Credit Hours)**

This course examines the role of noncoding RNAs, particularly microRNAs, in cancer progression and metastatic disease. Students explore how microRNAs regulate tumor invasion and epithelial-mesenchymal transition through control of extracellular matrix remodeling, cell adhesion, protease systems, and signaling pathways that drive invasive and migratory phenotypes, using primary research literature as the core learning resource.

**BMED 748 Glycosylation in Health and Disease (2 Credit Hours)**

This course examines protein and macromolecule glycosylation as a fundamental post-translational modification regulating cellular structure, signaling, immunity, and disease. Students explore glycan biosynthesis, structural diversity, and functional roles in physiology and pathology, with emphasis on cancer, inflammation, infectious disease, and congenital disorders, as well as modern analytical approaches and translational applications.

**BMED 749 Genetic Animal Models for Biomedical Research (2 Credit Hours)**

This course provides advanced training in molecular genetics using model organisms to investigate gene function, signaling pathways, cell-tissue-organ-body networks, and their roles in human disease. Students learn genetic and epigenetic analysis, forward and reverse genetic screens, and epistasis in systems including yeast, worms, flies, fish, and mice, with applications to clinical genetics and precision medicine.

**BMED 800 Scientific Communication (1 Credit Hour)**

This course will develop skills to design clear, visually effective scientific presentations and to communicate their thesis research concisely, accurately, and professionally. The course will cover oral and visual communication formats, including journal club presentations, conference talks, posters, and elevator pitches. Students will also gain experience translating scientific findings for non-scientific audiences through lay presentations, outreach, education, and advocacy.

**BMED 801 Biomedical Sciences Lab Rotation I (1 Credit Hour)**

Provides hands-on laboratory research experience through short-term rotations in biomedical and translational science laboratories. Students engage in mentored research under the supervision of Principal Investigators (PIs), gaining exposure to diverse experimental approaches, research cultures, and scientific disciplines within the Biomedical Sciences Program.

**BMED 802 Biomedical Sciences Lab Rotation II (1 Credit Hour)**

Provides hands-on laboratory research experience through short-term rotations in biomedical and translational science laboratories. Students engage in mentored research under the supervision of Principal Investigators (PIs), gaining exposure to diverse experimental approaches, research cultures, and scientific disciplines within the Biomedical Sciences Program.

**BMED 803 Biomedical Sciences Lab Rotation III (1 Credit Hour)**

Provides hands-on laboratory research experience through short-term rotations in biomedical and translational science laboratories. Students engage in mentored research under the supervision of Principal Investigators (PIs), gaining exposure to diverse experimental approaches, research cultures, and scientific disciplines within the Biomedical Sciences Program.

**BMED 810 Core Concepts 1: Foundations of Biomedical Science (5 Credit Hours)**

This course provides an in-depth foundation in molecular and cell biology, biochemistry, genetics, and cell signaling. Graduate students gain essential knowledge of molecular structures and processes, as well as laboratory techniques central to advanced biomedical research. Emphasis is placed on understanding the molecular mechanisms that underlie cellular function, genetic regulation, and signaling pathways.

**BMED 811 Molecular & Cellular Techniques (2 Credit Hours)**

This course provides foundational knowledge and hands-on, project-based training in core biomedical research techniques, including genetic engineering, molecular biology, cell culture, protein analysis, microscopy, and immunological assays. Students develop technical competency, data analysis and reporting skills, and professional laboratory practices essential for biomedical research.

**BMED 820 Core Concepts 2: Systems and Translational Biology (5 Credit Hours)**

This course builds on Core Concepts 1 and explores the application of molecular, genetic, and signaling principles to physiological systems, human disease, and biomedical research. Students gain an integrated understanding of the molecular mechanisms that regulate organ function, as well as the interactions among organ cells, stroma, stem cells, microbiota, and the immune and nervous systems that maintain homeostasis. Additionally, they learn core principles of translational research and pharmacology.

**BMED 821 Biostatistics for the Biomedical Sciences (1 Credit Hour)**

This introduction to biostatistics course will emphasize quantitative approaches to biomedical projects. This course is structured into biostatistics and AI-based, large-scale biometric analysis.

**BMED 822 Responsible Conduct in Science (1 Credit Hour)**

Explores ethical, legal, and social issues in biomedical research, including responsible conduct, data management, and authorship. Students also gain exposure to peer review processes for manuscripts, fostering an understanding of ethical standards in the research enterprise.

**BMED 830 Scientific Writing (2 Credit Hours)**

In this course, students learn how to design and write a realistic research proposal (F31) and gain a general understanding of how different techniques can be used to address a wide range of research questions. The final version of the proposal will be peer-reviewed and discussed in the format of an NIH grant study section. This course complements the Dissertation Proposal phase (PhD).

**BMED 840 Applied Bioinformatics and Structural Biology (3 Credit Hours)**

This course introduces students to large-scale biometric analysis of gene expression and provides basic concepts of protein structure determination, classification, and prediction.

**BMED 898 Doctoral Research (1-9 Credit Hours)**

Provides advanced, Principal Investigator (PI)-mentored research experience for PhD students engaged in independent dissertation research. Emphasizes the design, execution, analysis, and dissemination of original scholarly work leading to completion of the doctoral dissertation.

**BMED 899 Dissertation Research (1 Credit Hour)**

This course is taken in the final semester of the PhD program and is devoted to the completion of the doctoral dissertation. Under the supervision of the student's dissertation committee, students finalize the written dissertation and prepare for and complete the formal oral defense of their research.

**BMED 998 Masters Graduate Credit (1 Credit Hour)**

An optional research extension course taken by master's students who require additional time to complete degree requirements, including thesis or scholarly project milestones.

**BMED 999 Doctoral Graduate Credit (1 Credit Hour)**

An optional research extension course taken by PhD students who require additional time to complete doctoral degree requirements, including dissertation or defense milestones.