

# Biomedical Sciences

M.S. in Biomedical Sciences (<https://catalog.und.edu/graduateacademicinformation/departmentalcoursesprograms/biomedicalsciences/bmed-ms/>)

Ph.D. in Biomedical Sciences (<https://catalog.und.edu/graduateacademicinformation/departmentalcoursesprograms/biomedicalsciences/bmed-phd/>)

Joint MD/PhD program (<https://catalog.und.edu/graduateacademicinformation/departmentalcoursesprograms/biomedicalsciences/bmed-md-phd/>)

## **ANAT 501. Biomedical Information Retrieval. 1 Credit.**

This course integrates electron information retrieval techniques with biomedical research education to develop the student's ability to augment traditional learning and research. Electronic techniques covered include data base searching and internet resources. S/U grading. F,S,SS.

## **ANAT 505. Seminar in Anatomy and Cell Biology. 1 Credit.**

This course provides students an opportunity to organize and orally present scientific information to an audience in a forum conducive to the development of their skills in effective communication. Seminars delivered by students, UND faculty, and other invited speakers present current advancements in biomedical research that promote student learning of principles of biomedical sciences. Repeatable to 5.00 credits.

## **ANAT 513. Gross Anatomy. 6 Credits.**

Gross Anatomy will be an intensive one semester course that will use a regional approach to enhance the understanding of the structural and functional relationships as well as organization of the adult human body. Lectures will be reinforced with complete cadaver dissection and multiple clinical imaging modalities to strengthen problem solving and critical thinking skills. Prerequisite: ANAT 204L and permission of the instructor. S.

## **ANAT 521. Principles of Developmental Biology. 3 Credits.**

This is a student driven course designed to provide the student with a firm understanding of the concepts in developmental biology. Students will be using a wide range of materials from textbooks to the internet to gain a graduate level understanding including how to apply this knowledge to research applications. Student presentations will address advanced principles of developmental mechanisms and underlying human embryology. S.

## **ANAT 590. Readings in Anatomy and Cell Biology. 1-3 Credits.**

Students may elect to do a readings.

## **ANAT 591. Special Topics in Anatomy and Cell Biology. 1-3 Credits.**

A series of lectures, discussions and/or laboratory experiences developed around a specific topic in the anatomical or cell biological sciences. Prerequisite: Permission of instructor. Repeatable to 3.00 credits.

## **ANAT 593. Research in Anatomy and Cell Biology. 1-15 Credits.**

Research is offered in the specialty fields of the faculty of the department, and involves a variety of problems and research tools in morphology and cell biology. Repeatable.

## **ANAT 996. Continuing Enrollment. 1-12 Credits.**

Repeatable. S/U grading.

## **ANAT 997. Independent Study. 2 Credits.**

## **ANAT 998. Thesis. 1-9 Credits.**

Repeatable to 9.00 credits.

## **ANAT 999. Dissertation. 1-15 Credits.**

Repeatable to 15.00 credits.

## **BIMD 501. Scientific Discovery I. 6 Credits.**

A problem based course in which students will address a set of biomedical research scenarios that have been designed so that students will acquire skills in critical thinking, finding, interpreting, and analyzing scientific literature, developing hypothesis-driven questions, proposing and designing experiments, and communicating scientific outcomes orally and in written format. F.

## **BIMD 502. Scientific Discovery II. 6 Credits.**

A problem based course in which students will address a set of biomedical research scenarios that have been designed so that students will advance their skills in critical thinking, finding, interpreting, and analyzing scientific literature, developing hypothesis-driven questions, proposing and designing experiments, and communicating scientific outcomes orally and in written format. This course is a continuation and advancement of BIMD 501. Prerequisite: BIMD 501. S.

## **BIMD 510. Basic Biomedical Statistics. 2 Credits.**

A series of lectures, demonstrations and exercises to provide students with the basic rationales for the use of statistics in the assessment of biomedical data and a selected set of the most common and useful statistical tests. Prerequisite: BIMD 500 or permission of course director. S.

## **BIMD 511. Laboratory Animal Use in Biomedical Research. 1 Credit.**

In biomedical research, laboratory animals are frequently used as models of human diseases to investigate pathology development and intervention strategies. Animal use is also required for therapeutic, toxicologic, metabolic, and diagnostic testing in vivo at the preclinical stages of translational studies. Proper handling and care of laboratory animals not only protect them from unnecessary harm and pain during experiments, but also generate reliable and reproducible results when practiced with appropriate collection, storage, and processing of biological samples that are carefully planned. In this course, students will be introduced to the basic knowledge, major considerations, and common methods essential for the use of animals and their tissues in biomedical research. With a focus on rodents as widely used laboratory animals, the course will cover regulatory and ethical standards of animal use, methods of blood collection, substance administration, anesthesia, and euthanasia based on the Institutional Animal Use and Care Committee (IACUC) guidelines. Furthermore, students will learn common methods used in biochemical and histological analyses and assay-specific sample preparations. Upon completing the course, students will establish a foundation for animal use in biomedical research. Prerequisite: BIMD 501, BIMD 502, or permission of the course director. F.

## **BIMD 513. Seminars in Biomedical Science. 1 Credit.**

A series of presentations on original research conducted by UND faculty members as well as extramural leaders in academic and industrial research in the biomedical sciences. Students will participate through assigned reading and writing exercises related to the presentations.

## **BIMD 514. Foundations of Bioinformatics. 3 Credits.**

In this course, students will learn fundamental concepts and methods in bioinformatics, a field at the intersection of biology and computing. The course surveys a wide range of topics including bioinformatics web resources, computational sequence analysis, sequence homology searching and motif finding, transcriptome analysis, and network/pathway analysis. Students will also have opportunities to learn about available bioinformatics web-resources (e.g. UCSC Genome Browser, STRING/BioGRID interaction databases, and etc), next-generation sequencing analysis (focusing on RNA-Seq data) as well as relevant data-analysis tools (R and BioConductor, Ingenuity Pathway Analysis, DAVID, etc). The course will also familiarize students with the Linux environment and computational tools needed to manipulate and analyze large biological sequencing data sets. Students will need a familiarity with basic biomedical concepts and basic knowledge of computer usage. No programming skills are required. Students should bring their own wifi-enabled laptop to lectures to fully benefit from the hands-on components of each lecture. Prerequisite: Open to graduate and senior undergraduate students with permission of the instructor. F.

## **BIMD 516. Responsible Conduct of Research. 2 Credits.**

A series of lectures and discussion sessions covering topics related to responsible conduct in research. Students will examine a variety of issues including introduction to ethical decision making, the experience of conflict, laboratory practices, data management, reporting of research, conflict of interest, and compliance. Examples and case studies will be drawn primarily from the biomedical sciences. F.

**BIMD 517. Principles of Histology. 3 Credits.**

Principles of Histology is a laboratory and discussion based course that builds on prior experience in cell biology and involves a strong self-study component through the use of virtual slides as well as lecture and laboratory orientation videos. By the end of the course the student will have demonstrated a significant knowledge base of tissue microanatomy sufficient for understanding and applying the principles to a wide range of research projects. The student will also have gained sufficient knowledge of histology to be capable of teaching this material to medical, professional, graduate, and undergraduate students. Prerequisite: PATH 500 or permission of instructor. S.

**BIMD 518. Grant Writing. 2 Credits.**

This is an advanced graduate grant writing and oral presentation course. The objectives of this course are to challenge students: (1) to critically evaluate their own research in an effort to clearly define the significance and innovation of their project, (2) to begin to develop novel ideas based on their research efforts that have the potential to significantly impact their field of study, and (3) to prepare students to present these ideas orally and in writing in a manner that is both logical and convincing. Prerequisite: BIMD 501 and BIMD 502, or consent of instructor. F.

**BIMD 520. Principles of Neuroanatomy. 2 Credits.**

In this course students will learn the fundamental principles of neuroscience, particularly gross and cellular anatomy, development and systems physiology of the nervous system. Behavioral, cognitive and clinical manifestations of abnormal neural functions will also be addressed. Prerequisite: BIMD 502 or permission of instructor. F.

**BIMD 521. Neurophysiology. 2 Credits.**

This course is designed to introduce students to the electrical properties of neuronal membranes. The course is organized to first provide a brief review of the basic properties of semi-permeable membranes. The electrical and biochemistry principles that apply to neuronal membranes are discussed. Prerequisite: BIMD 502 or consent of instructor. F.

**BIMD 522. Principles of Neuropharmacology. 2 Credits.**

This course is designed to introduce students to the latest developments in molecular neuropharmacology. The course directive is to provide an up-to-date foundation for clinical neuroscience by emphasizing a comprehensive molecular and cellular approach to the effects of drugs on the nervous system. Prerequisite: BIMD 502 or consent of instructor. S.

**BIMD 523. Neurochemical Basis of the Nervous System. 2 Credits.**

This course is designed to introduce students to fundamental concepts of brain metabolism and neurochemical signaling. It emphasizes recent advances in understanding brain biochemical processes and molecular mechanisms occurring in health and disease. Prerequisite: BIMD 502 or consent of instructor. S.

**BIMD 524. Neurodegenerative Diseases and Pathophysiology. 2 Credits.**

This course exposes students to diverse neurodegenerative diseases and nervous system pathophysiology. The emphasis is on mechanistic understanding of the most recent advances in the field. Prerequisite: BIMD 502 or consent of instructor. S.

**BIMD 525. Readings in Neuroscience. 1-4 Credits.**

A supervised readings course on topics of mutual interest to the student and a faculty member. Prerequisite: BIMD 502 or consent of instructor. Repeatable to 4.00 credits. On demand.

**BIMD 526. Medical Experiences for Graduate Students. 1 Credit.**

The goal of this course is to introduce the graduate student to a "disease-specific" clinical experience so that the student can acquire a better understanding of the importance of translational medicine, develop a firm appreciation of a patient's and a physician's understanding of disease and its treatment, and to introduce the student to the overall culture of clinical research. Prerequisite: Successful completion of comprehensive exam and permission of academic advisor and Instructor of Record; student should initiate discussion with the Instructor of Record at least one month prior to the start of enrollment. S/U grading. On demand.

**BIMD 527. Advanced Studies in Biological Safety. 3 Credits.**

This course is designed to provide fundamental concepts and methods in biological safety to typical biomedical, public health, and biology graduate students who do not have advanced training in microbiology, epidemiology, and environmental health sciences. Additionally, this course will fulfill some of the registration requirements for Registered Biosafety Professional (RBP) and Certified Biosafety Professional (CBSP) credential for individuals looking for careers in the field of biological safety. This course is open to graduate students and to senior undergraduate students with permission of the instructor. Prerequisite: Permission of the instructor.

**BIMD 530. Components of the Immune System. 2 Credits.**

Have you ever wondered why you don't get sick every time you breathe air which can carry as many as 2000 different kinds of microbes on any given day? Or what keeps your defense system from attacking your own cells but can get rid of most invaders without you even noticing? This is the amazing task of your fascinating immune system! This course will provide an overview of cellular and molecular components of mammalian immune system and their function. The students will learn how these components are derived and how they interact and communicate with each other to coordinate a response to pathological insults in order to protect the human body. Prerequisite: BIMD 502 or consent of instructor. F.

**BIMD 531. Components of Microbial Pathogenesis. 2 Credits.**

The objective of the course is to provide students with a background in the mechanisms of microbial pathogenesis. Students will learn basic principles of host-parasite interactions. Paradigms of host-parasite interactions will be illustrated by studying, at the molecular and cellular levels, specific infectious diseases and the agents that cause them. Prerequisite: BIMD 502 or consent of instructor. F.

**BIMD 532. Microbial Gene Regulation. 1 Credit.**

This course will provide an understanding of genetic regulation in bacteria. Classic pathways will be examined as paradigms of regulatory circuits. These examples will be expanded to learn how bacteria exploit host cells as well as the use of bacterial regulatory circuits in modern molecular biology. S.

**BIMD 533. Microbial Membranes and Transport. 1 Credit.**

This course will explore bacterial membranes with particular emphasis on generation of energy and transport of molecules across the membranes. Prerequisite: BIMD 502 or consent of instructor. S.

**BIMD 534. Microbial Cell Structure and Function. 1 Credit.**

Microbial cells have unique structures that relate their functions. Students completing this course will have an understanding of how prokaryotic and eukaryotic organisms differ and how different structures can be used to obtain similar functions. They will understand how microbial structures influence interactions between microbes and between microbes and eukaryotic organisms. Prerequisite: BIMD 502 or consent of instructor. S.

**BIMD 535. Bacterial Host: Pathogen Interactions. 1 Credit.**

The objective of the course is to provide students with a background in the fundamental aspects that occur at the bacterial: host interface. Students will learn the interplay between bacterial virulence factors, strategies used to evade host defenses, and host responses to infection. Prerequisite: BIMD 502 or consent of instructor. S.

**BIMD 536. Molecular Biology and Pathogenesis of Viruses. 1 Credit.**

This course will cover the structure, replication, and pathogenesis of human RNA and DNA viruses, the host immune response to viral infection and the strategies employed by viruses to escape immune detection and elimination. Prerequisite: BIMD 502 or consent of instructor. S.

**BIMD 537. Host-Pathogen Interactions Involving Eukaryotic Microbes (Parasites/Fungi). 1 Credit.**

Eukaryotic microbe infections have a devastating impact on global health and economic development as they infect over one third of the world's population and cause acute and chronic pathologies. Furthermore, macroscopic parasites (helminths/ worms) are master regulators of host inflammatory response and hence reduce the immune response to coinfections and negatively affect the success of vaccination programs against many other pathogens. In contrast, it has been proposed that the rise in autoimmune diseases in the developed world could be a direct result of the successful complete elimination of parasitic helminths in these communities. Thus, the purpose of this course is to provide a basic knowledge of the clinically important eukaryotic microbe pathogens and the immune response associated with their infections. A series of lectures will cover course components; a) basic introduction to protozoa, helminth, and fungi, and b) basic knowledge of the immune response and its involvement in parasitic/ fungal infections. An effort has been made to increase clinical relevance and problem-solving skills through a team-learning exercise involving quiz and paper presentations. S.

**BIMD 538. Immunological Disorders. 1 Credit.**

This course will include discussion of cellular and molecular immunopathologies leading to autoimmune diseases, and primary and secondary immunodeficiencies; and the role of the immune system in tumorigenesis and transplantation, as well as various methods of modification of the immune response. Prerequisite: BIMD 502 or consent of instructor. S.

**BIMD 539. Readings in Microbiology and Immunology. 1-4 Credits.**

A supervised readings course on topics of mutual interest to the student and a faculty member. Prerequisite: BIMD 502 or consent of instructor. Repeatable to 4.00 credits. On demand.

**BIMD 540. Physiology of Human Integrative Systems. 2 Credits.**

A graduate course covering foundational core concepts of human physiology. The first half of this course covers energy and mass balance, gas exchange, fluid balance, acid-base balance, electrical conductance, musculoskeletal function, and endocrine regulation. The second half of this course explores specific physiological topics of research interest to the course cohort. Prerequisite: Graduate standing or instructor permission. S.

**BIMD 590. Research. 1-12 Credits.**

The course allows research in pertinent problems in various aspects of biomedical sciences. Repeatable. F,S,SS.

**BIMD 591. Advanced Topics in Biomedical Sciences. 1-3 Credits.**

A series of lectures, discussions and/or laboratory experiences developed around a specific topic in the biomedical sciences. Repeatable as topics vary. Prerequisite: BIMD 502 or consent of instructor. Repeatable to 6.00 credits. On demand.

**BIMD 597. Biomedical Sciences Internships. 1 Credit.**

The purpose of this course is to introduce graduate students to industry and governmental research experiences relevant to their graduate studies and career plans. The goal is to provide the student with the opportunity to expand upon their research training, develop a firm appreciation of the industry and governmental expectations, and be introduced to the overall culture of industry and governmental research. Prerequisite: Acceptance into internship program, permission from advisor, two months' notice before enrolling, good standing within the program, and completion of the comprehensive exam; international students can enroll after first year of study. F,S,SS.

**BIMD 996. Continuing Enrollment. 1-6 Credits.**

This is a continuation course to allow graduate students, who have reached 90 credit hours, the ability to enroll so that they can continue working on research projects needed to complete their dissertation or thesis projects. Prerequisite: Permission of Graduate Advisor and Graduate Program Director. Repeatable to 40.00 credits. F,S,SS.

**BIMD 998. Thesis. 1-6 Credits.**

Completion of thesis required for M.S. Repeatable to 6.00 credits. F,S,SS.

**BIMD 999. Dissertation. 1-12 Credits.**

Completion of dissertation required for Ph.D. Repeatable to 12.00 credits. F,S,SS.

**BMB 514. Current Literature. 1 Credit.**

Students of the department rotate in leading informal reviews, analyses, and the discussions of research papers selected from current journals in the areas of biochemistry and molecular biology. Prerequisite: BIMD 500 or consent of instructor. S/U grading.

**BMB 521. Seminar. 1 Credit.**

Students present topics in biochemistry and molecular biology based on reviews of the current literature. Each presentation is followed by a discussion of the topic by the faculty and students of the department. Prerequisite: BIMD 500 or consent of instructor. S/U grading.

**BMB 533. Advanced Topics. 1 Credit.**

The purpose of this course is to provide an in-depth exploration of selected areas of protein structure and function, metabolism, regulation of cell functions, proteomics, recombinant DNA technology, eukaryotic nucleic acid metabolism, and gene expression with the intent of complementing and extending the knowledge base gained in BIMD 500. Extensive independent learning is expected. Prerequisite: BIMD 500; alternatively, BMB 301 or equivalent and permission of instructor. Repeatable to 9.00 credits.

**BMB 540. Special Topics. 1-3 Credits.**

Discussion of a topic in biochemistry and/or molecular biology of current interest to faculty and students. Prerequisite: BIMD 500 or consent of instructor. Repeatable to 3.00 credits.

**BMB 590. Research. 1-12 Credits.**

The assignments deal with pertinent research problems in various aspects of biochemistry and molecular biology. Repeatable.

**BMB 594. Special Problems in Biochemistry and Molecular Biology. 1-6 Credits.**

The student in consultation with a faculty member of the department undertakes a laboratory research project. Prerequisite: Consent of instructor.

**BMB 595. Readings in Biochemistry and Molecular Biology. 1-3 Credits.**

Selected readings and library research in an area of mutual interest to the student and a faculty member of the department. Conferences and/or written reports are required. Prerequisite: BIMD 500 or consent of instructor.

**BMB 996. Continuing Enrollment. 1-12 Credits.**

Repeatable. S/U grading.

**BMB 998. Thesis. 1-9 Credits.**

Repeatable to 9.00 credits.

**BMB 999. Dissertation. 1-15 Credits.**

Repeatable to 15.00 credits.

**MBIO 507. Seminar in Microbiology. 1 Credit.**

S/U grading. F.

**MBIO 511. Microbiology and Immunology Literature. 1 Credit.**

A series of reports of current scientific literature in Microbiology and Immunology. S/U grading. S.

**MBIO 513. Research Tools. 2 Credits.**

Orientation to research and laboratory safety. The theory and application of modern laboratory techniques include tissue culture, cell fractionation, enzyme assay, immunization procedures, bacterial growth curves, photomicrography, strain construction, genetic engineering, gel electrophoresis, enzyme immunoassay, and western blot techniques are presented. S/U grading. F.

**MBIO 515. Advanced Topics. 2 Credits.**

A series of topics in microbiology and immunology presented on an episodic basis. The topics may vary, but are expected to include: (A) Immunology, (B) Infectious Diseases, and (C) Molecular Biology. Prerequisite: Previous basic course in the area to be covered.

**MBIO 590. Research in Microbiology. 2-6 Credits.**

Advanced problems in microbiology and related fields. Hours arranged. Repeatable.

**MBIO 591. Special Problems in Microbiology. 1-6 Credits.**

Short-term research projects.

**MBIO 996. Continuing Enrollment. 1-12 Credits.**

Repeatable. S/U grading.

**MBIO 997. Independent Study. 2 Credits.**

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**MBIO 998. Thesis. 1-8 Credits.**

Repeatable to 8.00 credits.

**MBIO 999. Dissertation. 1-15 Credits.**

Repeatable to 15.00 credits.

**PPT 500. Principles of Physiology and Pharmacology. 6 Credits.**

Graduate level survey course covering basic principles of human physiology and pharmacology. Material covered will include the physiology (how the body works) and the pharmacology (how drugs affect physiological functions) of the major organ systems. Covered also will be basic pharmacological principles including pharmacodynamics, pharmacokinetics and therapeutics. Teaching modalities used are designed to actively engage students in critical thinking and knowledge application. Prerequisite: BIMD 500 or consent of instructor.

**PPT 503. Advanced Pharmacology or Physiology. 3 Credits.**

Prerequisite: PPT 500 or consent of instructor.

**PPT 505. Research Techniques. 1-3 Credits.**

Prerequisite: Consent of instructor.

**PPT 511. Biochemical and Molecular Mechanisms of Pharmacology. 3 Credits.**

Fundamental concepts of pharmacology with emphasis on biochemical and molecular mechanisms. Prerequisite: BIMD 500 and PPT 500, or consent of instructor.

**PPT 512. Special Topics in Pharmacology, Physiology and Therapeutics. 2 Credits.**

An in-depth coverage of a particular topic chosen by the instructor.

Prerequisite: Consent of instructor.

**PPT 521. Seminar in Pharmacology, Physiology and Therapeutics. 1 Credit.**

S/U grading.

**PPT 525. Advanced Renal Physiology. 3 Credits.**

Prerequisite: PPT 500 or consent of instructor.

**PPT 526. Advanced Respiratory Physiology. 3 Credits.**

Prerequisite: PPT 500 or consent of instructor.

**PPT 528. Advanced Endocrinology. 3 Credits.**

Prerequisite: PPT 500 or consent of instructor.

**PPT 529. Adv Cardiovascular Physiology. 3 Credits.**

Prerequisite: PPT 500 or consent of instructor.

**PPT 530. Advanced Neurochemistry. 3 Credits.**

This course is designed to introduce graduate students to the discipline of neurochemistry. This course builds on concepts introduced in PPT 500, with an emphasis on brain biochemical processes occurring in health and disease.

Prerequisite: PPT 500 or consent of instructor.

**PPT 590. Readings in PPT. 1-4 Credits.**

Prerequisite: Consent of instructor. Repeatable to 8.00 credits.

**PPT 591. Research in PPT. 1-15 Credits.**

Repeatable.

**PPT 996. Continuing Enrollment. 1-12 Credits.**

Prerequisite: Consent of instructor. Repeatable. S/U grading.

**PPT 998. Thesis. 1-9 Credits.**

Prerequisite: Consent of instructor. Repeatable to 9.00 credits.

**PPT 999. Dissertation. 1-12 Credits.**

Prerequisite: Consent of instructor. Repeatable.