

BIOMEDICAL SCIENCES

Professional Program of Study

For professional curriculum in veterinary medicine leading to the degree doctor of veterinary medicine, see Veterinary Medicine, Curriculum.

A good foundation in anatomy, physiology, and pharmacology of animals is necessary to understand the mechanisms of animal disease processes and their treatment. Study of mammalian anatomy and physiology prepares students with a background in the structural and functional activities of cells, tissues, organs, and body systems relevant to veterinary medicine.

An understanding of drug action is essential for rational drug therapy. The general pharmacology courses provide students with a background in basic pharmacology to include pharmacodynamics, toxicology, and the clinical application of drugs. Special emphasis is placed on chemical agents and therapeutic practices specific to veterinary medicine.

Graduate Programs

The department offers Master of Science and Doctor of Philosophy degrees with a major in Biomedical Sciences and specializations in Anatomy, Physiology, Pharmacology, and Cell Biology. Up to 10 credits of dual-listed veterinary courses may be applied for major graduate credit. Departmental research facilities allow for training in experimental anatomy, pharmacology, and physiology. Graduate studies are supervised by faculty members recognized in their areas of expertise. Current areas of research include: Alzheimer's disease, aquatic animal health, calcium and mineral homeostasis, diabetes mellitus, glia-neuron signaling, neurophysiology of pain, neurotoxicology, physiology and pharmacology of nematode ion-channels, Parkinson's disease, pharmacology of schistosomiasis, pharmacology of salmonellosis, physiology and pharmacology of thalamic neurons, physiology of the retina, Spinal Muscular Atrophy, and study of neural stem cells. The objective of the department is to prepare graduate students for successful careers in biomedical research and professional service. The department is part of interdepartmental programs in neuroscience, toxicology, and molecular, cellular, and developmental biology. The combined Ph.D./DVM program is an option offered by the department.

Courses primarily for professional curriculum students:

B M S 329: Anatomy and Physiology of Domestic Animals

(3-0) Cr. 3. S.

Prereq: BIOL 212, BIOL 212L

Survey of body systems of domestic animals. Provides a medical science orientation particularly useful to students in a preveterinary medicine curriculum.

B M S 330: Principles of Morphology I

(Dual-listed with B M S 530). (4-6) Cr. 6. F.

Prereq: 10 credits in biological science and permission of the instructor
Anatomy of the dog and cat: from basics to clinical application.

B M S 331: Principles of Morphology II

(Dual-listed with B M S 531). (2-6) Cr. 4. S.

Prereq: First-year classification in veterinary medicine. B M S 330
Comparative and topographic anatomy of horse, ruminants, pig, and chicken.

B M S 333: Biomedical Sciences I

(Dual-listed with B M S 533). (5-3) Cr. 6. F.

Prereq: First-year classification in veterinary medicine
Microscopic anatomy and physiology of cells, tissues, cardiovascular system, respiratory system, and urinary system.

B M S 334: Biomedical Sciences II

(Dual-listed with B M S 534). (5-3) Cr. 6. S.

Prereq: First-year classification in veterinary medicine
Microscopic anatomy of the immune system and integument.
Microscopic anatomy and physiology of the digestive system, endocrine system, and reproductive system.

B M S 335: Molecular and Cellular Basis of Disease

(1-0) Cr. 1. F.

Descriptions of molecular and cellular biology especially as it pertains to veterinary medicine. Discussions of cellular components, cellular functions and anomalies thereof. Emphasis placed on divergences relevant to companion animals and livestock.

B M S 336: Veterinary Nutrition

(2-0) Cr. 2. F.

Introduce basic biochemical aspects of metabolism and function of energy, protein, fat, minerals and vitamins in the diet. Determine nutrient requirements of food animals, pets, and horses under various physiological states. Understand fate of various nutrients in simple stomached animals, ruminants, and cecal fermenters. Discuss clinical nutrition problems specific to each species.

B M S 337: Neuroanatomy

(Dual-listed with B M S 537). (2-2) Cr. 3. S.

Prereq: First-year classification in veterinary medicine
Neuroanatomy of domestic animals.

B M S 339: Clinical Foundations I

(Cross-listed with V C S). (0-2) Cr. 1. F.

Prereq: First-year classification in veterinary medicine
Canine physical examination; basic behavior, animal handling and restraint; medical record keeping.

B M S 345: Case Study I

(0-2) Cr. 1. F.

Prereq: First-year classification in veterinary medicine

Clinical applications of basic sciences taught concurrently in the fall semester of the first year curriculum in veterinary medicine.

B M S 346: Case Study II

(0-1) Cr. 1. S.

Prereq: First-year classification in veterinary medicine

Clinical applications of basic sciences taught concurrently in the spring semester of the first year curriculum in veterinary medicine.

B M S 354: General Pharmacology

(Dual-listed with B M S 554). (Cross-listed with TOX). (3-0) Cr. 3. S.

Prereq: B M S 549 and B M S 552; BBMB 404, BBMB 405

General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems.

B M S 401: Intro to Aquatic Animal Medicine

(Cross-listed with A ECL). (1-2) Cr. 1. S.

8-week course. Introductory course with focus on fin fish production, health and medicine. Course content will help define future roles for veterinarians, producers, and service providers. Emphasis will be placed on water-evaluation, anatomy, pathology, infectious diseases, nutrition, regulatory constraints in production, food safety, biosecurity and current research. Field trip to aquaculture facility.

B M S 403: Behavior of Domestic Animals

(1-0) Cr. 1. Alt. F., offered even-numbered years.

Prereq: Classification in veterinary medicine

Normal and abnormal behavior of domestic animals.

B M S 439: Principles of Pharmacology

(Dual-listed with B M S 539). (4-0) Cr. 4. S.

Prereq: A physiology course: B M S 329, BIOL 335 or equivalent; All non-graduate students must seek permission of the instructor in charge to register for B M S 539.

General principles of drug actions; drug disposition; drug acting on, cardiovascular, respiratory, renal, gastrointestinal, and endocrine systems; anti-inflammatory and antibiotic drug; anti-cancer drugs; anesthetics CNS stimulants; lifestyle drugs; drug addiction, abuse and dependence; drugs in sport; drugs for obesity; biopharmaceuticals and gene therapy; drug development.

B M S 443: Pharmacology and Therapeutics

(Dual-listed with B M S 543). (3-0) Cr. 3. F.

Prereq: B M S 354

Pharmacology and therapeutic uses of fluids, antimicrobial and antiparasitic drugs, clinical use of veterinary drugs, and adverse drug reactions.

B M S 447: Introduction to Human Gross Anatomy

(Dual-listed with B M S 547). (2.5-6) Cr. 4. F.

Prereq: Graduate standing and previous biology coursework or instructor permission.

Examination of gross anatomy and neuroanatomy of the human. Laboratories will center on regional anatomy study through human cadaver dissection in addition to models, virtual learning solutions, radiologic imaging and case studies.

B M S 448: Principles of Human Gross Anatomy

Cr. 4. Repeatable, maximum of 2 times. S.SS.

Prereq: BIOL 255 or equivalent AND an introductory biology course.

BMS 448 will be a laboratory-centered course that focuses on prosected human cadavers to develop an in-depth understanding of human anatomical function. The course will follow a regional approach and stress relationships between neighboring anatomical structures. During laboratory sessions, students teams will study anatomy from multiple individuals to gain an appreciation for anatomical variation and effects on the body from aging, disease, etc. Additional laboratory activities include study in osteology, radiograph interpretation and case studies. Only one offering of BMS 448 may count towards graduation.

B M S 490: Independent Study

Cr. 1-5. Repeatable. F.S.SS.

Prereq: Permission of instructor

B M S 490H: Independent Study, Honors

Cr. 1-5. Repeatable. F.S.SS.

Prereq: Permission of instructor

B M S 496: International Preceptorship

Cr. 1-12. Repeatable. S.

Prereq: Classification in veterinary medicine or permission of the instructor

International Preceptorships and Study Abroad Group programs.

This course will provide opportunities for students to be involved in applied clinical, production, and/or research experiences in international locations. The course consists of 40 hour per week experiential learning opportunities.

Courses primarily for graduate students, open to qualified undergraduates:

B M S 501: Selected Research Methods in Biomedical Sciences

(0-8) Cr. 3. F.S.SS.

Prereq: Graduate classification, permission of a BMS faculty member

Experience in biomedical techniques in selected BMS laboratories that include but is not limited to cytochemical methods, molecular biological techniques, extracellular and intracellular unit recording, microiontophoresis, microinjection, spectrophotofluorometric analysis of chemicals, use of radioisotopes, radioimmunoassay, Ca²⁺ imaging, confocal microscopy, fluorescence microscopy, and immunocytochemistry.

B M S 502: Methods in Biomedical Sciences

(0-6) Cr. 3. S.

Prereq: Graduate Student Status or Permission of the Instructor

Provides laboratory experience in the application of methods in biomedical sciences, including animal physiology and pharmacology laboratory techniques; human physiology recordings and urinalysis; pharmacokinetics; basic techniques in analytical laboratory; basic pathology, immunology, bacteriology, and virology laboratory techniques.

B M S 530: Principles of Morphology I

(Dual-listed with B M S 330). (4-6) Cr. 6. F.

Prereq: 10 credits in biological science and permission of the instructor

Anatomy of the dog and cat: from basics to clinical application.

B M S 531: Principles of Morphology II

(Dual-listed with B M S 331). (2-6) Cr. 4. S.

Prereq: First-year classification in veterinary medicine. B M S 330

Comparative and topographic anatomy of horse, ruminants, pig, and chicken.

B M S 533: Biomedical Sciences I

(Dual-listed with B M S 333). (5-3) Cr. 6. F.

Prereq: First-year classification in veterinary medicine or graduate student status

Microscopic anatomy and physiology of cells, tissues, cardiovascular system, respiratory system, and urinary system.

B M S 534: Biomedical Sciences II

(Dual-listed with B M S 334). (5-3) Cr. 6. S.

Prereq: First-year classification in veterinary medicine or graduate student status

Microscopic anatomy of the immune system and integument.
Microscopic anatomy and physiology of the digestive system, endocrine system, and reproductive system.

B M S 537: Neuroanatomy

(Dual-listed with B M S 337). (2-2) Cr. 3. S.

Prereq: 10 credits in biological science and permission of the instructor
Neuroanatomy of domestic animals.**B M S 538: Principles of Physiology**

(4-0) Cr. 4. F.

Prereq: Graduate Student Standing or Permission of Instructor

Principles of neurophysiology, endocrine and reproductive physiology, muscle physiology, cardiovascular, respiratory, renal, and digestive physiology, and regulation of body fluid.

B M S 539: Principles of Pharmacology

(Dual-listed with B M S 439). (4-0) Cr. 4. S.

Prereq: A physiology course: B M S 329, BIOL 335 or equivalent; All non-graduate students must seek permission of the instructor in charge to register for B M S 539.

General principles of drug actions; drug disposition; drug acting on cardiovascular, respiratory, renal, gastrointestinal, and endocrine systems; anti-inflammatory and antibiotic drug; anti-cancer drugs; anesthetics CNS stimulants; lifestyle drugs; drug addiction, abuse and dependence; drugs in sport; drugs for obesity; biopharmaceuticals and gene therapy; drug development.

B M S 542: Introduction to Molecular Biology Techniques

(Cross-listed with EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS.

Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

B M S 542A: Introduction to Molecular Biology Techniques: DNA Techniques

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

B M S 542B: Introduction to Molecular Biology Techniques: Protein

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, VDPAM). Cr. 1. Repeatable. S.SS.

Prereq: Graduate classification

Techniques. Includes: fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

B M S 542C: Introduction to Molecular Biology Techniques: Cell Techniques

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.

Includes: immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

B M S 542D: Introduction to Molecular Biology Techniques: Plant Transformation

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Includes: Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

B M S 542E: Introduction to Molecular Biology Techniques: Proteomics

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes: two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. Offered on a satisfactory-fail basis only.

B M S 542F: Introduction to Molecular Biology Techniques: Metabolomics

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.

Includes: metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects. Offered on a satisfactory-fail basis only.

B M S 542G: Introduction to Molecular Biology Techniques: Genomic

(Cross-listed with BBMB, EEOB, FS HN, GDCB, HORT, NREM, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S.

Offered on a satisfactory-fail basis only.

B M S 543: Pharmacology and Therapeutics

(Dual-listed with B M S 443). (3-0) Cr. 3. F.

Prereq: B M S 354

Pharmacology and therapeutic uses of fluids, antimicrobial and antiparasitic drugs, clinical use of veterinary drugs, and adverse drug reactions.

B M S 547: Introduction to Human Gross Anatomy

(Dual-listed with B M S 447). (2.5-6) Cr. 4. F.

Prereq: Graduate standing and previous biology coursework or instructor permission.

Examination of gross anatomy and neuroanatomy of the human. Laboratories will center on regional anatomy study through human cadaver dissection in addition to models, virtual learning solutions, radiologic imaging and case studies.

B M S 554: General Pharmacology

(Dual-listed with B M S 354). (Cross-listed with TOX). (3-0) Cr. 3. S.

Prereq: B M S 549 and B M S 552; BBMB 404, BBMB 405

General principles; drug disposition; drugs acting on the nervous, cardiovascular, renal, gastrointestinal, and endocrine systems.

B M S 556: Cellular, Molecular and Developmental Neuroscience

(Cross-listed with GDCB, NEURO). (3-0) Cr. 3. Alt. F., offered odd-numbered years.

Prereq: BIOL 335 or BIOL 436; physics recommended

Fundamental principles of neuroscience including cellular and molecular neuroscience, nervous system development, sensory, motor and regulatory systems.

B M S 575: Cell Biology

(Cross-listed with TOX). (3-0) Cr. 3. F.

Prereq: 10 credits in biological sciences and graduate student standing or permission of instructor

A multi-instructor course covering major topics in cell structure and function, including: universal features of prokaryotic and eukaryotic cells, types of utilization and conversion of energy, genetic control of cell shape and functionality, internal organization of cells, communication between cells and their environment, development of multicellular systems. Students have to write a term paper.

B M S 590: Special Topics

Cr. 1-7. Repeatable. F.S.SS.

Prereq: Permission of instructor

B M S 590A: Anatomy

Cr. 1-7. Repeatable. F.S.SS.

Prereq: Permission of instructor

B M S 590B: Physiology

Cr. 1-7. Repeatable. F.S.SS.

Prereq: Permission of instructor

B M S 590C: Pharmacology

Cr. 1-7. Repeatable. F.S.SS.

Prereq: Permission of instructor

B M S 590D: Cell biology

Cr. 1-7. Repeatable. F.S.SS.

Prereq: Permission of instructor

B M S 599: Creative Component

Cr. 1-3. F.S.SS.

Prereq: Enrollment in BMS graduate program, and permission of instructor.
Creative component for non-thesis Master of Science degree.

Courses for graduate students:**B M S 688: Research Review**

Cr. 1. Repeatable. F.S.

Prereq: Enrollment in BMS graduate program.

A forum for B M S students to gain experience in the critical exchange of ideas through oral presentation and discussion of scientific information.

B M S 690: Advanced Topics

Cr. 1-5. Repeatable. F.S.SS.

*Prereq: Permission of instructor***B M S 690A: Anatomy**

Cr. 1-5. Repeatable. F.S.SS.

*Prereq: Permission of instructor***B M S 690B: Physiology**

Cr. 1-5. Repeatable. F.S.SS.

*Prereq: Permission of instructor***B M S 690C: Pharmacology**

Cr. 1-5. Repeatable. F.S.SS.

*Prereq: Permission of instructor***B M S 690D: Cell biology**

Cr. 1-5. Repeatable. F.S.SS.

*Prereq: Permission of instructor***B M S 698: Seminar**

Cr. arr. Repeatable. F.S.SS.

*Prereq: Enrollment in BMS graduate program.***B M S 698A: Seminar: Attendance**

Cr. R. Repeatable. F.S.

*Prereq: Enrollment in BMS graduate program.***B M S 698B: Seminar: Attendance and Presentation**

(1-0) Cr. 1. Repeatable. F.S.SS.

Prereq: Enrollment in B M S graduate program.

Attendance and presentation required. Offered on a satisfactory-fail basis only.

B M S 698C: Seminar: Attendance and Report

Cr. 1. Repeatable. F.S.

Prereq: Enrollment in BMS graduate program.

Attendance to all B M S seminars and written reports are required.

B M S 699: Research

Cr. arr. Repeatable. F.S.SS.

*Prereq: Enrollment in BMS graduate program.***B M S 699A: Research: Anatomy**

Cr. arr. Repeatable. F.S.SS.

*Prereq: Enrollment in BMS graduate program.***B M S 699B: Research: Physiology**

Cr. arr. Repeatable. F.S.SS.

*Prereq: Enrollment in BMS graduate program.***B M S 699C: Research: Pharmacology**

Cr. arr. Repeatable. F.S.SS.

*Prereq: Enrollment in BMS graduate program.***B M S 699D: Research: Cell biology**

Cr. arr. Repeatable. F.S.SS.

Prereq: Enrollment in BMS graduate program.