VETERINARY AND BIOMEDICAL SCIENCES (VBSC)

VBSC 50: Mechanisms of Disease
3 Credits

Introduction to the study of disease pathogenesis and careers in Animal Health Research and Service. VB SC 050S Mechanisms of Disease (3)Mechanisms of Disease is a first year seminar directed to students with an interest in a career in veterinary medicine or in bio-medical disciplines. Students are introduced to the concepts of epidemiology, cell biology, clinical medicine and toxicology through use of appropriate case material. The importance of basic science courses to the understanding of this material is emphasized. Reading and written assignments are related to the case study material as well as adaptation to the college experience. Grading is based on class participation and written assignments.

First-Year Seminar

VBSC 101: Careers in Veterinary Medicine and the Allied Professions
1 Credits

Exploring career pathways in veterinary medicine and the allied health industry. VB SC 101 Careers in Veterinary Medicine and the Allied Professions (1) The course is intended for first year students with an interest in careers in veterinary medicine or in the allied industries. Upon completion of the course students will have an understanding of the various careers possible in veterinary medicine; including types of specialization by species and/or by discipline. Students will have the opportunity to discuss careers in industries related to animal health and animal health research. Student learning will occur through the use of guest speakers, written assignments and online discussion groups. Student evaluation will be based on performance on assignments and online discussion groups.

VBSC 130: Understanding Human Disease
3 Credits

An explanation of disease mechanisms, enabling non-scientists to better understand medical journalism and apply basic medical principles to everyday life. VB SC 130 Understanding Human Disease (3) (GHA) All humans are impacted by disease, either personally or through friends or family members who are affected. Understanding Human Disease is an overview of disease processes for individuals not majoring in a scientific field. Students will have the opportunity to study the basic knowledge tools required to understand how different diseases arise, how they progress, how they are treated and in many cases, how they can be prevented. The course material is divided into two segments: the first portion discussing the different ways that diseases develop and includes explanations on normal and abnormal inflammatory processes, different types of infectious diseases, genetic diseases and congenital abnormalities (birth defects), diseases that affect the immune system and metabolic diseases. Diseases that are affecting significant populations such as HIV, diabetes, cancer and heart disease will be discussed. The second segment includes a discussion of the significant diseases affecting different organ systems of the body. Student participation is encouraged through questions. Additional topics of immediate interest as identified by the news media or class interest will be discussed. The course is intended for those who wish to better understand published medical journalism, for individuals who want to be able to discern the caliber of medical information in the popular press, for those students who wish to make healthy choices in their lifestyle and for individuals who may not be destined for a career in a scientific field.

General Education: Health and Wellness (GHW)

VBSC 190: Careers in Veterinary and Biomedical Sciences
1 Credits

Career strategic planning and opportunities for Veterinary and Biomedical Sciences.

VBSC 211: The Immune System and Disease
3 Credits

Introduction to the immune system that emphasizes the immune response to infection and consequences of a defective immune response.

Bachelor of Arts: Natural Sciences
General Education: Natural Sciences (GN)

VBSC 230: The Science of Poisons
3 Credits

An introduction to toxicology using real world examples to highlight the impact of toxicants on environmental, biochemical and physiological processes. VB SC 230 The Science of Poisons (3) Toxicology is the study of poisons (natural and man-made) and how these agents adversely affect living organisms. It involves the prevention of harm and the development of measures to assess risk. As a science it borrows from many disciplines including biochemistry, chemistry, epidemiology, genetics, and physiology. It also has great societal impact with regard to the development and testing of consumer products, exposure to industrial chemicals, and maintaining safe food and water. The course format will be lectures that incorporate real world examples of the effects of toxicant exposure on many levels (cell, organ, whole body, environmental). Students will be evaluated by quizzes, exams, and class participation. Students are required to have a basic understanding of biology and chemistry. The course is offered once per year in the Fall semester.

Prerequisite: CHEM 110, BIOL 110

VBSC 231: Introduction to Cancer Research and Medicine
3 Credits

An understanding of the terminology, basic concepts, techniques, multidisciplinary approaches and challenges in cancer research and medicine. VB SC 231 Introduction to Cancer Research and Medicine (3) Introduction to Cancer Research and medicine is designed for second year undergraduate students preparing for careers in biomedical research. Students will develop an understanding of the theories, scope, approaches and challenges of cancer related biomedical research. The lectures and discussions will emphasize the interdisciplinary character of the discovery process. Students will be introduced to topics on cellular mechanisms responsible for cancer development and
principles of animal disease prevention. This requires exposure to the principles of animal disease prevention. This requires students to the history of human and veterinary public health, the structure of the human and veterinary public health system (CDC, FDA, and USDA) and the various sectors of veterinary and human public health practice, in order to gain an understanding of the complex factors that determine the health status of a human and animal populations. National, state, and local level practices will be analyzed, as well as the roles that law and government play in human and veterinary public’s health. The course will simulate the students’ interest in other public health course and program offerings.

VBSC 395: Internship
1-10 Credits/Maximum of 10

Independent study and supervised field experience related to the student’s professional interest. Limited to students in animal agriculture majors.

Prerequisite: fifth-semester standing in an animal agriculture major; approval by department of proposed plan before registration
Full-Time Equivalent Course

VBSC 402: Biology of Animal Parasites
3 Credits/Maximum of 3

An introduction to animal parasitology. Emphasis placed on host/parasite interactions, parasites of zoonotic importance, control programs and taxonomy. VB SC 402W Biology of Animal Parasites (3) This course provides students an opportunity to obtain an introduction to the field of animal parasitology. Material presented emphasizes life cycle patterns of animal parasites, host-parasite interactions and pathology, disease patterns and zoonotic potential of parasites to human disease, economic importance of parasitic diseases, taxonomy and parasite control programs. Information presented in this course will be useful to students interested in pursuing a career in veterinary medicine or careers dealing with animal care and management. Evaluation of student performance is achieved by 6 quizzes, three examinations and 3 writing assignments. The course is offered each spring semester with an enrollment of 15 to 25 students.

Prerequisite: BIOL 110
Cross-listed with: ENT 402
Writing Across the Curriculum

VBSC 403: Principles of Animal Disease Control
3 Credits

Principles of disease control based on knowledge of the multiple causes of animal disease.

Prerequisite: MICRB106 or MICRB201 . Prerequisite or concurrent: AN SC301

VBSC 403H: Principles of Animal Disease Control
3 Credits

Principles of disease control based on knowledge of the epidemiology of animal disease. VB SC 403H Principles of Animal Disease Control (3) Animal Health and well being has emerged as a clear concern of society. The general public is concerned about the health and well-being of their companion animals as well as the animals that provide them with portions of their daily diet. The Foot and Mouth Disease outbreak that occurred in Great Britain in the spring of 2001 coming on the heels of increased concern about Bovine Spongiform Encephalopathy and its possible links to the human disease; variant Creutzfeldt Jacob Disease, resulted in an increased awareness for the potential for animal disease to have adverse effects on society. These effects range from availability of wholesome food products to the zoonotic transmission of diseases between humans and animals. The goal of this course is to introduce students to the principles of animal disease prevention. This requires
the student recall relevant background knowledge in biology, nutrition, microbiology and animal husbandry and management. Students will develop an understanding of the complex physiological, biochemical and microbiological mechanisms of importance to the maintenance of health and the prevention of disease. Examples of certain diseases are used to illustrate the application of general principles of disease control. Diseases of world wide importance as discussed in addition to the major diseases of importance to Pennsylvania animal owners. Collectively, the course material should provide animal owners, managers and future animal health professionals with the background to improve the decision making process required to maintain animal health and prevent losses from disease. The inherent, environmental and special factors involved in the maintenance of health and the prevention of disease will be emphasized.

**Prerequisite:** MICRB106 or MICRB201. Prerequisite or concurrent: AN SC301

**VBSC 405: Laboratory Animal Science**

**3 Credits**

Principles involved in maintaining laboratory animals. Emphasis is on management, preventive medicine, and surgical considerations used in laboratory animal colonies. VB SC 405 Laboratory Animal Science (3) This course in Laboratory Animal Science introduces students to the biology and characteristics of a variety of laboratory animal species, explores the care and use of animals in various research environments and examines ethical/legal issues pertaining to the use of animals in research and teaching. The laboratory section reinforces topics discussed in lecture and provides an opportunity for students to learn basic animal handling techniques in a safe and professionally supervised environment. Students work with live laboratory animals including mice, rats, hamsters, guinea pigs, and rabbits. They learn handling techniques, administration techniques (such as by injection), and sample collection techniques (such as blood collection). They also learn surgical principles and perform a surgical procedure using aseptic technique. The Laboratory Animal Science course appeals to and benefits several general groups of students. Those who plan to pursue careers involving animal research such as in academia or industry receive a broad foundation in the field of laboratory animal science as well as an introduction to techniques commonly employed when handling animals. Those pursuing careers involving veterinary medicine or veterinary technology receive training and the opportunity to develop clinical/technical skills focused on a unique group of species. Students that are undecided in their career choice find that the field of laboratory animal science holds many opportunities for those with animal knowledge, handling skills and an understanding of the societal issues surrounding the use of animals in research.

**Prerequisite:** AN SC201 , AN SC301 , BIOL 110

**VBSC 407: Dairy Herd Health Programs**

**2 Credits**

A discussion of health programs for dairy herds to assist in the control of infectious and metabolic diseases of dairy animals. VB SC 407 Dairy Herd Health Programs (2) Dairy Herd Health Programs provides students interested in dairy farm management and/or herd health medicine the opportunity to integrate basic knowledge of dairy cattle diseases into a comprehensive and practical herd health program. Herd health management is discussed as it relates to infectious disease control including mastitis and calf diseases, reproductive management, metabolic disease control and parasite control. A text book is not required. Readings are provided via ANGEL and students are strongly encouraged to read current scientific and lay press literature in the appropriate subject areas.

**Prerequisite:** AN SC301 , AN SC310 , AN SC427 , AN SC431W

**VBSC 409: Wildlife Diseases**

**3 Credits**

An introduction to wildlife diseases emphasizing their impact on wildlife, domestic animals and humans in today’s world.

**Prerequisite:** BIOL 110 , W F S209

**VBSC 410: Principles of Immunology**

**3 Credits**

The MICRB 410 / VBSC 410 Theories of immunity (3cr.) course provides a basic foundation in immunology with a focus on the progression from antigen recognition and innate immune responses to the development of acquired immunity. During the course, students will have the opportunity to learn about key topics that lead to an understanding of how the human immune system functions. Such topics include the primary cells and anatomical sites of the immune system as well as the activation and processes of innate immunity. In addition, students will learn about the organization and generation of lymphocyte antigen receptors, major histocompatibility complexes, and antigen presentation. Topics will also be presented that allow students to build an understanding of how antigen recognition and presentation leads to the development, selection, and survival of B and T lymphocytes. T-cell mediated immunity, humoral immunity, and the dynamics of the immune response will also be discussed in depth. Topics such as the immunobiology of allergy, transplantation, autoimmunity, immunodeficiency, diseases, vaccines, and/or cancer will also be presented in order to help students build an understanding of the interplay between the immune system and health and disease will be discussed throughout the semester.

**Enforced Prerequisite at Enrollment:** (MICRB 201 or MICRB 201H) and (BMB 251 or MICRB 251 or BMB 251H or BIOL 230W or BIOL 230M)

**VBSC 418: Bacterial Pathogenesis**

**2 Credits**

Study of molecular interactions between bacterial pathogens and their hosts.

**Prerequisite:** MICRB201 , MICRB410

**VBSC 420: General Animal Pathology**

**3 Credits**

Nature and mechanisms of the disease process including degenerations, growth disturbances, inflammation, host-parasite relationships and neoplasia. VB SC 420 General Animal Pathology (3) The objectives of this course are to help the student develop an understanding of the concepts and general principles of disease processes in vertebrate species, attain skills required to observe and describe tissue changes in animals and develop critical thinking skills required for problem solving. In addition to text materials, photographs and photomicrographs of a variety of tissue lesions will be presented and discussed to emphasize concepts of disease processes as described in the course. Specific subjects that
will be presented include cellular injury and necrosis, inflammation, blood coagulation, hemodynamic disorders, diseases of immunity, cell growth and adaptation and neoplasia. This course utilizes knowledge previously attained from courses in physiology, chemistry, immunology and biochemistry.

**Prerequisite:** AN SC423 or BIOL 472, MICRB201, AN SC301

VBSC 421: Comparative Anatomy of Vertebrates

4 Credits

BIOL 421 / VBSC 421 Comparative Anatomy of Vertebrates Students will study vertebrate anatomy from an evolutionary and developmental perspective. They will become familiar with important structures, terminology and function; a basic requirement of the biomedical sciences. Comparisons between representative vertebrate groups (including fish, amphibians, reptiles, birds and mammals) will be used to illustrate structural adaptations of each organ system from an evolutionary perspective. Specific examples comparing ancestral and descendant species will demonstrate the relationships between the lifestyle of an organism and the morphology of homologous structures. A study of early embryonic development, differentiation of primary germ layers and organ formation will provide a basis for understanding organ structure and function. Laboratory activities will involve work with preserved specimens and will focus heavily on anatomic structure identification and function. Topics include anatomic directional terminology, vertebrate classification systems, early embryonic development and a detailed examination of the various organ systems. Specimens are selected to illustrate the anatomy of ancestral vertebrate species, the evolutionary changes observed in descendant species and the association of morphology with lifestyle. Although students will invest the majority of their time becoming familiar with the anatomy of a representative mammal (the cat), multiple species will be examined, and students will be expected to recognize selected anatomic structures in each species studied.

**Enforced Prerequisite at Enrollment:** BIOL 129 or BIOL 141 or BIOL 220W or BIOL 220M or BIOL 230W or BIOL 230M or BIOL 240W or BIOL 240M or BMB 251 or BMB 251H

Cross-listed with: BIOL 421

VBSC 423: Pathology of Nutritional and Metabolic Diseases

3 Credits

Overview of nutritional and metabolic diseases of animals integrating concepts from biochemical and physiologic abbreviations to clinical applications. VB SC 423W Pathology of Nutritional and Metabolic Diseases (3)Nutrition plays a critical role in health, disease and convalescence of man and animals. Understanding the role of nutrition in disease pathogenesis, recovery and prevention requires an integration of biochemical and physiologic sciences and clinical practice. The intent of this course is to help the student integrate their knowledge from various basic science disciplines to real-world clinical issues related to the role of nutrition in disease pathogenesis, management and prevention across various animal species. Common nutrition and metabolic disease of production and companion animals will be used to demonstrate various principles of disease pathogenesis from a biochemical to whole animal basis. Deficiency and toxicity diseases of all essential nutrients will be addressed. In addition, a secondary role of nutrition in disease susceptibility and recovery mediated through immunologic and physiologic processes will be highlighted. In completing the course, students will have an understanding of comparative gastrointestinal anatomy and how this influences essential nutrients required and unique nutritional disease conditions. Additionally, students will gain appreciation for clinical management of nutritional diseases from diagnosis to prevention. Course format will be lectures and case-based discussions.

**Prerequisite:** B M B 211 or B M B 401, and AN SC 301 or equivalent nutrition course

Writing Across the Curriculum

VBSC 425: Principles of Avian Diseases

3 Credits

Principles of pathogenesis and control of diseases in poultry and other avian populations. Case material used where appropriate. ANSC 425 / VBSC 425 Principles of Avian Diseases (3) This course discusses the major diseases of domestic poultry, with etiology, prevention, and treatment reviewed on each disease. Since many of these diseases also affect wild birds and pet birds these are also reviewed. Lastly, avian disease with zoonotic (human public health) potential are also discussed in the course. This course is required by those seeking a poultry minor. Previous coursework in pathogenic microbiology is beneficial.

**Prerequisite:** MICRB 106 and MICRB 107 or MICRB 201 and MICRB 202

CONCURRENT: AN SC 211, AN SC 311

Cross-listed with: ANSC 425

VBSC 430: Principles of Toxicology

3 Credits

Introduction to the biomedical aspects of toxicology with emphasis on the mechanisms and fate of chemical interaction with biological systems.

**Prerequisite:** BIOL 110, BIOL 240W; B M B 211 or B M B 401

VBSC 431: Environmental Toxicology

3 Credits

Effects of pollutants on animal health at the chemical, physical, and cellular level.

**Prerequisite:** BIOL 110, CHEM 110, CHEM 112

Cross-listed with: ERM 431

VBSC 432: Advanced Immunology: Signaling in the Immune System

3 Credits

The study of signaling pathways that regulate the immune response. BMB 432 / MICRB 432 / VBSC 432 Advanced Immunology. Signaling in the Immune System (3) This course will use the immune system as a model in which to study how cells communicate in order to coordinate an immune response. We will focus on signaling mechanisms that regulate such immune responses as T cell activation, Th1/Th2 differentiation, macrophage activation, and migration of immune cells.
to sites of inflammation. All lectures are based on recent reviews by
key investigators in each field, as well as primary articles to present
students with the most recent advances, techniques, and approaches
used. The goal of the course will be to convey a basis understanding
of intracellular signaling mechanisms that will pertain to all areas of
biology, an appreciation for current questions and future directions in
the field, and an in depth understanding of the signals that govern immune
responses. The material presented will build on the basic concepts
learned in BMB 400 and MICRB 410, and will lay the foundation for more
advanced courses at the graduate level.

Enforced Prerequisites at Enrollment: (BMB 251 or MICRB 251 or
BIOL 230W or BMB 251H or BIOL 230M) and (MICRB 410 or VBSC 410)
Cross-listed with: BMB 432, MICRB 432

VBSC 433: Molecular and Cellular Toxicology
3 Credits

In-depth coverage of processes by which drugs/chemicals interact with
biological systems and the experimental approaches used to study these
interactions.

Enforced Prerequisites at Enrollment: BMB 401 or BMB 401H or BMB 211
Cross-listed with: BMB 433

VBSC 435: Viral Pathogenesis
3 Credits

Viral Pathogenesis provides students with a general knowledge of
medically relevant viruses, with a specific focus on important human
viral pathogens. The course is meant to help students understand how
viruses cause diseases in humans and animals. Lectures and in-class
discussions will focus both on the fundamentals of viral infection and
disease mechanisms, and on contemporary virology-related topics in the
scientific literature. Topics discussed can be divided into two main areas:
(1) general concepts related to viral pathogenesis and the control of viral
infections; and (2) specific viruses that cause human disease including
HIV-1, herpes viruses, papillomaviruses, influenza virus, West Nile virus,
Ebola virus, and SARS virus. Although prior knowledge of virology is not
required for taking this course, a working knowledge of molecular biology,
cell biology, immunology, and some microbiology is helpful.

Enforced Prerequisites at Enrollment: (MICRB 201 or MICRB 201H) and
(BMB 252 or MICRB 252 or BMB 252H) or (BIOL 230W or BIOL 230M)
Cross-listed with: BMB 435, MICRB 435

VBSC 438: Introduction to Molecular Pharmacology
3 Credits

Upon completion of this course the student will be able to correlate their
knowledge of basic and organic chemistry, biochemistry and physiology
to the understanding of drug actions. The molecular interactions between
drugs and their tissue receptors and possible modifications of drugs to
target different receptors will be discussed. Drugs used to treat infectious
disease, treat cardiovascular disease, modulate the immune system, and
treat cancer will be examined for their molecular interactions. Students
will understand the complexities of new drug design and development from
the initial stages of laboratory development to final approval for use
by the Food and Drug Administration.

Prerequisite: CHEM 202, CHEM 201, BIOL 110, BMB 211; BIOL 230W;
BMB 251

VBSC 439: Mucosal Immunology and the microbiome
3 Credits

Mucosal tissues are gateways into the body. Because of their direct
interaction with the environment, a specialized immune response is
needed. Unlike the systemic immune system, which functions in a
sterile environment inside the body, mucosal immune responses must
be able to discriminate between harmful pathogens and benign stimuli
like commensal organisms and food. The emphasis of this course is
to understand the unique properties of the mucosal immune system.
This course will build on the general understanding of immunology
presented in MICRB410 and provide a detailed discussion of the
symbiotic relationship between the microbiome and the development
and function of the mucosal immune system. The effects of disruptions
in the microbiome and the effects on disease will also be a major theme
of the course. The course will include lecture and discussion of the
topics presented in the textbook. In addition, articles from the primary
literature will be presented and discussed. These articles will also
provide an experimental framework for understanding the mucosal
immune system. The topics presented here will provide a greater
understanding of mucosal immunology and its interactions with the
microbiome for students majoring in Immunology and Infectious Disease,
Veterinary and Biomedical Sciences, Animal Science, Biochemistry and
Molecular Biology, Biology, Microbiology, Food Science and Nutrition. The
course would also be appropriate for Graduate students seeking more
information about mucosal immune responses.

Prerequisite: MICRB 410

VBSC 444: Epidemiology of Infectious Diseases
3 Credits

An introduction to epidemiology of infectious diseases with emphasis on
understanding epidemiologic concepts for identifying, preventing and
controlling infectious diseases.

Prerequisite: BIOL 220, STAT 200 or STAT 250

VBSC 445: Molecular Epidemiology of Infectious Diseases
3 Credits

A discussion and practicum of the molecular laboratory techniques used
to study molecular epidemiology of infectious diseases.

Prerequisite: BIOL 220, STAT 200 or STAT 250 and VB SC444

VBSC 448: Current Topics in Immunology
3 Credits

Study of current approaches and questions driving research in
immunology and infectious diseases.

Writing Across the Curriculum

VBSC 450: Medical Entomology
3 Credits/Maximum of 3

Transmission of human and animal pathogens by insects, mites and ticks, including emergent
pathogens, envenomization, and forensic entomology.

This course presents principles of transmission of human and animal pathogens by insects, mites and ticks. Non-
transmission based aspects of medically important arthropods such as environmental and economic systems, and trans-border mobility of humans, entomology and genomics will be discussed also. Basic arthropod biology with special emphasis on biological properties of vectors and their interactions with pathogens will be presented. We will cover basic components of arthropod disease cycles and principles of pathogen transmission dynamics. The major groups of arthropod-borne pathogens and vectors will be discussed. Special topics will include emergent pathogens, vector genetics, traditional and modern disease control strategies.

**Prerequisite:** ENT 313, or BIOL 011 and BIOL 012, or BIOL 110 or BIOL 220W

VBSC 451: Immunotoxicology of Drugs and Chemicals

3 Credits

An in depth discussion of the effect of xenobiotics and drugs on host immune mechanisms. VB SC 451 Immunotoxicology of Drugs and Chemicals (3) Maintaining good health is a priority for most of us, and a key element in staying healthy is a properly functioning immune system. However, we are constantly exposed to a barrage of chemicals in the environment both natural and man-made. Some of the key questions asked included: 1) do environmental chemicals affect the generation of immunity?, 2) is our environment to blame for bad health?, and 3) can natural compounds cause immunotoxicity? These questions and more will be addressed in Immunotoxicology. This course will focus primarily on the effects of chemicals in the environment but will also cover the impact of other factors such as therapeutics, recreational drugs, and dietary factors on the immune system. Immunomodulatory mechanisms will be examined at systemic, cellular and molecular levels. Discussions will include theory, principles, and methodology and key issues in immunotoxicology, host immune mechanisms, and tumorigenesis. Key issues in regulatory immunotoxicology will be discussed to make students prepared for jobs in Federal Regulatory Agencies. Grading for undergraduates will include midterm and finals, and class participation; while graduate students will be required to also write a short, immunotoxicologically-related research proposal. Our intent is to provide a bridge between the two sciences and the undergraduate majors of Immunology and Toxicology, with an introduction to the basic mechanisms by which environmental, occupational, and therapeutic agents may interfere with immunologic systems. Immunotoxicology is offered every fall semester and is designed for undergraduate students from toxicology, immunology, and forensic science majors.

**Prerequisite:** MICRB201 or B M B251

VBSC 455: One Health

3 Credits

This course addresses the challenges and opportunities at the convergence of One Health/public health, animal health, and environmental/ecosystem health. This interdisciplinary course will introduce the concept of One Health as an increasingly important approach to a holistic understanding of disease prevention and the maintenance of human and animal health. The list of topics will include lectures that emphasize the bidirectional impact of animal health on human health, the impact of the earth’s changing ecology on health, issues of food and water security and preparedness and the benefits of comparative medicine. The course will also explore short and long term approaches to address the problems that emerge from growing interaction between human and animal populations driven by growth in the human population, new trends in animal production practices, industrial pollution, changing patterns of wildlife populations, human
VBSC 497: Special Topics
1-9 Credits/Maximum of 9

Formal courses given infrequently to explore, in depth, a comparatively narrow subject that may be topical or of special interest.

VBSC 499: Foreign Studies
0.5-4 Credits/Maximum of 10

Courses offered in foreign countries by individual or group instruction.