VTTP 605 Systemic Veterinary Physiology I
Credits 5. 5 Lecture Hours.
Aspects of cellular physiology, physiology of excitable membranes, physiology of body fluids, neurophysiology, and the physiology of smooth, cardiac and skeletal muscle; provides a basic understanding of mammalian physiology essential as a framework for advanced graduate studies.
Prerequisite: Graduate classification.

VTTP 606 Systemic Veterinary Physiology II
Credits 5. 5 Lecture Hours.
In-depth study covering cardiovascular, respiratory, renal physiology, gastrointestinal and endocrine physiology; provides a basic understanding of mammalian physiology essential as a framework for advanced graduate studies.
Prerequisite: VTTP 605.

VTTP 610 Physiology I
Credits 6. 5 Lecture Hours. 2 Lab Hours.
Introduction to physiology: cell physiology, cell signaling, cell cycle, body fluids, translocation of materials, membrane potentials, neurophysiology, autonomic nervous system, thermoregulation, cardiovascular, and muscle physiology.
Prerequisites: Enrollment in MS/PhD program in Veterinary Physiology and Pharmacology; approval of instructor.

VTTP 612 Physiology II
Credits 6. 5 Lecture Hours. 2 Lab Hours.
Blood and lymph, respiration, renal physiology, and acid-based balance, gastrointestinal physiology, metabolism, endocrinology, and reproduction.
Prerequisites: Enrollment in MS/PhD program in Veterinary Physiology and Pharmacology; approval of instructor.

VTTP 623 Biomedical Physiology I
Credits 4. 3 Lecture Hours. 2 Lab Hours.
Physiological principles, review of cellular physiology, and development of an understanding of the nervous system and muscle, cardiovascular, and respiratory physiology; clinical applications related to organ systems.
Prerequisites: Graduate classification; BICH 410 and VIBS 305 recommended.

VTTP 624/VIBS 624 Endocrinology
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Neuroendocrine control of puberty, menstruation, ovulation, pregnancy, labor, lactation, female reproductive cycles, male reproductive functions, thyroid and parathyroid, adrenal and kidney, diabetes, obesity, sleep, memory, learning and aging, and their endocrine disorders; overview on biosynthesis, transport and signaling of peptide and neuropeptide hormones, steroids and prostaglandins.
Prerequisite: Graduate classification.
Cross Listing: VIBS 624/VTTP 624.

VTTP 625 Pharmacology
Credits 3. 3 Lecture Hours.
Introduction to pharmacokinetics and pharmacodynamics; survey of major pharmaceutical classes; uses, mechanisms of action and adverse reactions of selected agents.
Prerequisites: Graduate classification; VTTP 423 or approval of instructor.

VTTP 627 Biomedical Physiology II
Credits 4. 3 Lecture Hours. 2 Lab Hours.
Continuation of VTTP 623. Fluid balance and acid-base balance; development of an understanding of renal, gastrointestinal, endocrine and reproductive physiology using human and other mammalian models; clinical applications related to organ systems.
Prerequisites: Graduate classification; VTTP 623.

VTTP 628 Pharmacology I
Credits 5. 4 Lecture Hours. 2 Lab Hours.
Pharmacokinetics, pharmacodynamics, CNS pharmacology, autonomic pharmacology, antineoplastic agents, immunopharmacology, recombinant products, fluid and electrolyte therapy, diuretics, pharmacology of the integument.
Prerequisite: Approval of instructor.

VTTP 629 Pharmacology II
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Antimicrobials, endocrine pharmacology, eicosanoids, anti-inflammatory agents, respiratory pharmacology, anticoagulants and hematinics, GI pharmacology, cardiovascular pharmacology.
Prerequisite: Approval of instructor.

VTTP 630 Pharmacology/Toxicology
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Management and treatment of toxicosis, antidotal pharmacology, toxic plants, mycotoxins, chemical toxicants, metals, euthanasia.
Prerequisite: Approval of instructor.

VTTP 633 Physiology for Bioengineers I
Credits 4. 3 Lecture Hours. 3 Lab Hours.
Cellular anatomy, cellular physiology and biochemistry; systems analysis of digestive, endocrine and musculoskeletal system function including information related to gross anatomy, histology and disease states; quantitative aspects of physiology and engineering applications to clinical medicine.
Prerequisite: Biomedical Engineering major or approval of instructor.

VTTP 635 Physiology for Bioengineers II
Credits 4. 3 Lecture Hours. 3 Lab Hours.
A systems analysis of nervous, cardiovascular, respiratory and urinary function including information related to gross anatomy, histology and disease states; quantitative aspects of physiology and engineering applications to clinical medicine.
Prerequisite: VTTP 634.

VTTP 638 Analysis of Genomic Signals
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Overview of current high throughput technology for data acquisition and analysis of genomic signals (e.g., mRNA or proteins); emphasis on microarray technology, methods for analyzing microarray data, and approaches to model the underlying phenomena from the systems biology perspective.
Prerequisites: BIOL 451 or GENE 320/BIMS 320/BIMS 320/GENE 320 or equivalent; STAT 651 or equivalent; or approval of instructor.

VTTP 639 Non-Coding RNAs
Credits 3. 3 Lecture Hours.
Roles of non-coding RNAs in regulating gene expression for physiological functions, development and diseases; includes a brief history of the field, various categories and definitions of non-coding RNAs, research methodologies and animal models, and break-through advances in clinical applications.
Prerequisite: Approval of instructor.
VTTP 650 Stem Cell Biology  
Credits 3. 3 Lecture Hours.  
Wide-range of topics related to stem cells and tissue engineering,  
including a brief history of the field, various categories and definitions of  
stem cells, research methodologies and animal models, as well as break-  
through advances in the area of engineered stem cells.  
Prerequisite: Approval of instructor.

VTTP 651 Epigenetics & Systems Physiology  
Credits 3. 3 Lecture Hours.  
Epigenetics & Systems Physiology. Journal club format focusing on  
epigenetic regulation of physiological systems; assignment of  
papers from primary literature and weekly oral presentations detailing  
opinions on research; emphasis on fundamental concepts in epigenetics,  
physiology and the molecular techniques employed to address research  
hypotheses, discussions of scientific ethics and fraud.  
Prerequisite: Graduate classification.

VTTP 652 Fetal and Embryo Physiology  
Credits 3. 3 Lecture Hours.  
Introduction to the physiologic processes driving embryonic development  
and pregnancy; focus on embryo implantation, establishment of the  
placenta, development of the fetal circulatory systems and the molecular  
processes governing embryo differentiation and development; special  
emphasis on the major organ systems affected by pediatric disease and  
on the actions of teratogens.  
Prerequisites: Graduate classification.

VTTP 653 Developmental Physiology  
Credits 3. 3 Lecture Hours.  
Introduction to the physiologic processes driving embryonic development  
and pregnancy; focus on embryo implantation, establishment of the  
placenta, development of the fetal circulatory systems and the molecular  
processes governing embryo differentiation and development; special  
emphasis on the major organ systems affected by pediatric disease and  
on the actions of teratogens.  
Prerequisites: Graduate classification.

VTTP 654 Molecular Endocrinology  
Credits 3. 3 Lecture Hours.  
Structure-function relationships of hormones, their receptors and biologic  
activities.  
Prerequisites: VTPP 653 or BIOL 649 and BICH 410 or equivalent or  
approval of instructor.

VTTP 655 Vascular Physiology  
Credits 4. 4 Lecture Hours.  
Structure and function of blood vessels and vascular beds; molecular  
and cell biology of endothelium and vascular smooth muscle;  
microcirculation; capillary exchange; regulation of blood flow by local,  
nervous and humoral signals.  
Prerequisite: MPHY 901 or approval of department head.

VTTP 656 Physiology of the Heart  
Credits 4. 4 Lecture Hours.  
Structure and function of the heart; molecular and cell biology of cardiac  
myocytes; electrophysiology of myocardium, pacemaker cells and  
conducting tissue; cardiac mechanics; control of cardiac performance;  
coronary circulation.  
Prerequisite: MPHY 901 or MPHY 604 or approval of department head.

VTTP 657 Cardiovascular Physiology  
Credits 4. 4 Lecture Hours. 3 Lab Hours.  
Physiological considerations of the circulatory system including general  
and integrative aspects of the heart and blood vessels.  
Prerequisites: Approval of instructor.

VTTP 658 Physiology of Fertile Reproduction  
Credits 3. 2 Lecture Hours. 2 Lab Hours.  
Physiology of gametes and preimplantation embryos in livestock and  
laboratory animals; oocyte growth and maturation in-vivo and in-vitro,  
fertilization in-vivo and in-vitro, embryo transfer, cryopreservation, nuclear  
transfer, chimera formation, gene transfer.  
Prerequisite: Graduate classification.

VTTP 659 Gamete and Embryo Physiology  
Credits 3. 2 Lecture Hours. 2 Lab Hours.  
Physiology of gametes and preimplantation embryos in livestock and  
laboratory animals; oocyte growth and maturation in-vivo and in-vitro,  
fertilization in-vivo and in-vitro, embryo transfer, cryopreservation, nuclear  
transfer, chimera formation, gene transfer.  
Prerequisite: Graduate classification.

VTTP 660 Fetal and Embryo Physiology  
Credits 3. 3 Lecture Hours.  
Introduction to the physiologic processes driving embryonic development  
and pregnancy; focus on embryo implantation, establishment of the  
placenta, development of the fetal circulatory systems and the molecular  
processes governing embryo differentiation and development; special  
emphasis on the major organ systems affected by pediatric disease and  
on the actions of teratogens.  
Prerequisites: Graduate classification.

VTTP 661 Epigenetics & Systems Physiology  
Credits 3. 3 Lecture Hours.  
Epigenetics & Systems Physiology. Journal club format focusing on  
epigenetic regulation of physiological systems; assignment of  
papers from primary literature and weekly oral presentations detailing  
opinions on research; emphasis on fundamental concepts in epigenetics,  
physiology and the molecular techniques employed to address research  
hypotheses, discussions of scientific ethics and fraud.  
Prerequisite: Graduate classification.

VTTP 662 Molecular Endocrinology  
Credits 3. 3 Lecture Hours.  
Structure-function relationships of hormones, their receptors and biologic  
activities.  
Prerequisites: VTPP 653 or BIOL 649 and BICH 410 or equivalent or  
approval of instructor.

VTTP 663 Vascular Physiology  
Credits 4. 4 Lecture Hours.  
Structure and function of blood vessels and vascular beds; molecular  
and cell biology of endothelium and vascular smooth muscle;  
microcirculation; capillary exchange; regulation of blood flow by local,  
nervous and humoral signals.  
Prerequisite: MPHY 901 or approval of department head.

VTTP 664 Physiology of the Heart  
Credits 4. 4 Lecture Hours.  
Structure and function of the heart; molecular and cell biology of cardiac  
myocytes; electrophysiology of myocardium, pacemaker cells and  
conducting tissue; cardiac mechanics; control of cardiac performance;  
coronary circulation.  
Prerequisite: MPHY 901 or MPHY 604 or approval of department head.

VTTP 665 Cardiovascular Physiology  
Credits 4. 4 Lecture Hours. 3 Lab Hours.  
Physiological considerations of the circulatory system including general  
and integrative aspects of the heart and blood vessels.  
Prerequisites: Approval of instructor.

VTTP 666 Physiology of Fertile Reproduction  
Credits 3. 3 Lecture Hours.  
Introduction to the physiologic processes driving embryonic development  
and pregnancy; focus on embryo implantation, establishment of the  
placenta, development of the fetal circulatory systems and the molecular  
processes governing embryo differentiation and development; special  
emphasis on the major organ systems affected by pediatric disease and  
on the actions of teratogens.  
Prerequisites: Graduate classification.

VTTP 667 Current Topics in Pharmacology  
Credits 3. 3 Lecture Hours.  
Discussions of literature regarding topics of current research interest;  
physiochemical or physiologic effects of drugs at sites from molecular to  
whole body.  
Prerequisite: Approval of instructor.

VTTP 668 Metabolic and Detoxication Mechanisms  
Credits 3. 3 Lecture Hours.  
Fate of foreign compounds; their inhibitory and antagonistic action  
toward normal metabolic processes of the animal body.  
Prerequisites: BICH 603; approval of instructor and department head.

VTTP 669 Industrial and Environmental Toxicology  
Credits 3. 3 Lecture Hours.  
Fundamentals of toxicology and risk assessment; effects of selected  
classes of hazardous chemicals encountered in the workplace or  
environment on human health will be considered.  
Prerequisite: Approval of instructor.

VTTP 670 Genetic and Molecular Toxicology  
Credits 3. 3 Lecture Hours.  
Mechanisms of toxicant-induced target organ toxicity with emphasis on  
molecular control of mammalian and cell growth differentiation.  
Prerequisite: Graduate course in cell biology and biochemistry.

VTTP 671 Fluorescence Detection: Steady State, Time Resolved and Imaging  
Credits 4. 4 Lecture Hours.  
Fluorescence spectroscopy and confocal/multiphoton microscopy in  
research; intro of pharmacology, life science, and physical  
sience students to fluorophores, anisotropy, ligand binding, energy  
transfer, cytometry, lifetime imaging, correlation spectroscopy,  
imunocytochemistry, and image analysis with an emphasis on  
instrumental/sample artifacts, fluorescence application, literature  
evaluation, and communication of rationales to other scientists.  
Prerequisite: General chemistry and biology course.

VTTP 672 Seminar  
Credit 1. 1 Lecture Hour.  
Review and discussion of current scientific work in physiology and  
related subjects.  
Prerequisite: Approval of department head.

VTTP 673 Directed Studies  
Credits 1 to 4. 1 to 4 Other Hours.  
Problems in physiology, pharmacology or toxicology.  
Prerequisite: Approval of instructor.

VTTP 674 Special Topics in...  
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours.  
Selected topics in an identified area of veterinary physiology and  
pharmacology. May be repeated for credit.  
Prerequisite: Approval of instructor.

VTTP 675 Theory of Research  
Credits 3. 3 Lecture Hours.  
Theory and design of research related to current biomedical problems  
especially those involving study of animal disease; philosophical  
perspectives underlying historical advances in research pertaining to the  
study, prevention and treatment of disease.  
Prerequisite: Graduate classification.  
Cross Listing: VIBS 690 and VPAT 690.
VTPP 691 Research
Credits 1 to 23. 1 to 23 Other Hours.
Original investigations in veterinary physiology, pharmacology or toxicology to be submitted by writing of thesis or dissertation as partial fulfillment for MS or PhD degree.
Prerequisite: Approval of department head.

VTPP 910 Physiology I
Credits 6. 5 Lecture Hours. 2 Lab Hours.
Introduction to physiology: cell physiology, cell signaling, cell cycle, body fluids, translocation of materials, membrane potentials, neurophysiology, autonomic nervous system, thermoregulation, cardiovascular, and muscle physiology.
Prerequisite: Enrollment in first year of professional curriculum.

VTPP 912 Physiology II
Credits 5. 4 Lecture Hours. 2 Lab Hours.
Respiration, renal physiology, acid-base physiology, reproductive physiology, molecular biology and gastrointestinal physiology.
Prerequisite: Enrollment in the first year of professional DVM curriculum.

VTPP 914 Professional & Clinical Skills I
Credits 3. 1 Lecture Hour. 6 Lab Hours.
Professional & Clinical Skills I. Integration and reinforcement of foundational knowledge offered in concurrent courses through critical thinking exercises, professional skills application activities (ethics/contextual decision-making, leadership, skills for well-being, personal/practice financial literacy, core communication skills) and application of technical skills; opportunities for learning include didactic, hands-on and case-based interactions utilizing simulation, models, animals, actors and case scenarios; part I of a VI part series.
Prerequisite: Enrollment in the first year of professional DVM curriculum.

VTPP 924 Pharmacology
Credits 3. 3 Lecture Hours.
Drug disposition, pharmacodynamics, drug regulations, critical appraisal of evidence about use of drugs, drugs that affect respiratory, reproductive, gastrointestinal, endocrine, immune, urinary, integumentary, cardiovascular, musculoskeletal, and nervous systems, and drugs for pain, anti-inflammatories, antineoplastics, antibiotics, and other antiinfectives in animals.
Prerequisite: Enrollment in the second year of professional DVM curriculum.

VTPP 925 Pharmacology/Toxicology II
Credits 3. 5 Lecture Hours. 2 Lab Hours.
Antimicrobials, endocrine pharmacology, eicosanoids, antiinflammatory agents, respiratory pharmacology, anticoagulants and hematinics, GI pharmacology, cardiovascular pharmacology.
Prerequisite: Enrollment in the second year of professional curriculum.

VTPP 926 Pharmacology/Toxicology III
Credits 3. 2 Lecture Hours. 2 Lab Hours.
Management and treatment of toxicoses, antidotal pharmacology, toxic plants, mycotoxins and mycotoxicoses, chemical toxicants, metals, euthanasia.
Prerequisite: Enrollment in the second year of professional curriculum.

VTPP 948 Didactic Elective in Veterinary Physiology and Pharmacology
Credits 1 to 12. 1 to 12 Lecture Hours.
Elective course in physiology and pharmacology for professional students who wish to supplement required curriculum. May be repeated for credit.
Prerequisite: Enrollment in the fourth year of professional curriculum.

VTPP 985 Directed Studies
Credits 1 to 4. 1 to 4 Other Hours.
Directed, individual study of selected problems in physiology, pharmacology or toxicology. May be repeated for credit.
Prerequisite: Approval of instructor and department head.

VTPP 989 Special Topics In...
Credits 1 to 4. 1 to 4 Other Hours.
Selected topics in an identified area of veterinary physiology and pharmacology. May be repeated for credit.