VTPP 123 Foundations of Physiology
Credits 3. 3 Lecture Hours. Introduction to fundamental concepts in physiology and the practice of physiology research through exploration of mathematical models used in physiology research; emphasis on prediction of complex adaptive behavior in health and disease from elementary math, physics, chemistry and biology. Prerequisite: Freshman or sophomore classification or approval of instructor.

VTPP 207 Methodologies of Physiology Education Research
Credits 3. 3 Lecture Hours. Creation and practice of physiology education research through quantitative, qualitative and mixed-methodology approaches; preliminary development of team-based research projects; emphasis on production and formal presentation of basic research using human subjects in a variety of physiology education topics. Prerequisite: VTPP 123 or approval of instructor.

VTPP 208 Analysis and Evaluation of Physiology Education
Credits 3. 3 Lecture Hours. Analysis and evaluation of research in physiology education; design of proper analytical techniques in qualitative, quantitative and mixed-methods analyses; emphasis on production of publishable applied research in physiology. Prerequisite: VTPP 207 or approval of instructor.

VTPP 223 Design of Experiments for Physiology Research
Credits 3. 2 Lecture Hours. 2 Lab Hours. Team or group formulation and refinement of novel hypotheses and design of controlled in vitro experiments; emphasis on production of publishable research in physiology. Prerequisite: VTPP 123 or approval of instructor.

VTPP 224 In Vitro Experimentation in Physiology Research
Credits 3. 2 Lecture Hours. 2 Lab Hours. Team or group collection, analysis and interpretation of data from in vitro experiments; emphasis on production of publishable research in physiology. Prerequisite: VTPP 223 or approval of instructor.

VTPP 232 Theoretical Foundations of Health Disparities Research
Credits 3. 3 Lecture Hours. Development of community intervention research in health disparities; emphasis on methods for culturally appropriate evaluation and reporting of community health needs and tools of intervention including qualitative, quantitative and mixed methodology. Prerequisite: VTPP 123 or approval of instructor.

VTPP 233 Health Disparities Research Parameters and Analysis
Credits 3. 3 Lecture Hours. Exploration of conducting and communicating research in health disparities; emphasis on methodology, data collection and analysis of data; development of research abstract in health disparities and presentation of research findings. Prerequisite: VTPP 232 or approval of instructor.

VTPP 234 Design of Models for Physiology Research
Credits 3. 3 Lecture Hours. Team or group design of novel models of physiological systems to predict homeostatic behavior arising from the interaction of subsystems; mastering bioinformatics toolboxes to process NextGen-omics data; emphasis on production and formal presentation of basic research in physiology. Prerequisite: VTPP 123 or approval of instructor.

VTPP 235 Analysis and Validation of Models for Physiology Research
Credits 3. 3 Lecture Hours. Team or group analysis and validation of models of physiological systems to explain disease states and design potential clinical interventions; analysis of NextGen-omics data; emphasis on production of publishable applied research in physiology. Prerequisite: VTPP 234 or approval of instructor.

VTPP 281 Seminar
Credits 4. 4 Other Hours. Exposure to scientists from a variety of biomedical disciplines through attendance at seminars followed by review and discussion of current scientific work in physiology and related subjects, and subsequent student seminar presentations. Prerequisites: Freshman or sophomore classification; approval of instructor.

VTPP 285 Directed Studies
Credits 0 to 4. 0 to 4 Other Hours. Course for freshman and sophomore students who desire additional laboratory work in physiology to supplement required courses. Prerequisites: Freshman or sophomore classification; approval of department head.

VTPP 289 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.

VTPP 291 Research
Credits 0 to 4. 0 to 4 Other Hours. Laboratory and/or field research supervised by a faculty member. Must be taken on a satisfactory/unsatisfactory basis. Prerequisites: Freshman or sophomore classification; approval of instructor.

VTPP 323 Physiology of Domestic Animals
Credits 3. 3 Lecture Hours. Physiology essential to the understanding of life processes; for animal science, wildlife, agriculture and related fields. Prerequisite: BIOL 111 or equivalent; junior or senior classification.
VTPP 401/BMEN 400 History of Human and Veterinary Medicine in Europe
Credits 4. 4 Lecture Hours. Addresses the major developments in human and veterinary medicine in Europe from the Middle Ages to the present; explores key events and figures in medical history and analyzes issues of current biomedical concern in a historical context; for example, animal rights, ethics of humane experimentation, euthanasia. Prerequisites: Admitted to major degree sequence in biomedical engineering; VTPP 434. Cross Listing: BMEN 400/VTPP 401.

VTPP 404 Food Toxicology and Safety
Credits 3. 3 Lecture Hours. Toxicity and safety of various foods and food additives, ingredients, and contaminants; occurrence, control and prevention of food transmitted diseases. Prerequisite: Junior or senior classification.

VTPP 420 Applied Pharmacology
Credits 2. 2 Lecture Hours. Modern themes about therapeutic drugs in animals and people including drug discovery and development, clinical use of drugs and drug regulation. Prerequisites: Grade of C or better in BICH 410, BIOL 320, VTPP 423, VTPP 434, or approval of instructor.

VTPP 423 Biomedical Physiology I
Credits 4. 3 Lecture Hours. 2 Lab Hours. Human physiological principles, review of cellular physiology, and development of an understanding of the nervous system and muscle, cardiovascular, and renal physiology; clinical applications related to organ systems. Prerequisites: Grade of C or better in PHYS 202 and CHEM 228; junior classification.

VTPP 424/VIBS 424 Biomedical Neuroendocrinology and Endocrine Disorders
Credits 3. 3 Lecture Hours. Neuroendocrine (hypothalamus-pituitary) control of puberty, menstruation, ovulation, pregnancy, 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. Prerequisites: Honors, junior or senior classification, or approval of instructor. Cross Listing: VIBS 424/VTPP 424.

VTPP 425 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: VTPP 423 or grade of C or better in BIOL 320; junior or senior classification or approval of instructor.

VTPP 427 Applied Biomedical Physiology
Credits 3. 3 Lecture Hours. Human physiology focused on fluid balance and acid-base balance; development of an understanding of physiology as it applies to the cardiovascular, autonomic, renal, respiratory, gastrointestinal, endocrine, reproductive system; clinical applications related to organ systems. Prerequisites: VTPP 423 or grade of D or better in BIOL 320; junior or senior classification.

VTPP 429 Introduction to Toxicology
Credits 3. 3 Lecture Hours. Principles of toxicology with emphasis on environmental issues and human and animal health issues; study of the regulatory processes concerning toxic chemicals. Prerequisite: VTPP 423 or grade of C or better in BIOL 320; junior or senior classification.

VTPP 433 Physiology for Bioengineers I
Credits 4. 3 Lecture Hours. 2 Lab Hours. Engineering analysis of living systems; quantitative aspects of physiology and engineering applications to clinical medicine; body fluid balance, solute transport, endocrinology, reproduction physiology, neurophysiology, skeletal and smooth muscle physiology. Prerequisite: Biomedical engineering (BMEN) major or approval of instructor.

VTPP 434 Physiology for Bioengineers II
Credits 4. 3 Lecture Hours. 2 Lab Hours. Engineering analysis of living systems; quantitative aspects of physiology and engineering applications to clinical medicine; vascular physiology, cardiac physiology, bone physiology, regenerative medicine, renal physiology, pathophysiology. Prerequisite: VTPP 434 or approval of instructor.

VTPP 435 Pharmacology
Credits 3. 3 Lecture Hours. Modern themes about therapeutic drugs in animals and people including drug discovery and development, clinical use of drugs and drug regulation. Prerequisites: Grade of C or better in BICH 410, BIOL 320, VTPP 423, VTPP 434, or approval of instructor.

VTPP 438 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 the microarray technology, methods for analyzing microarray data, and approaches to model the underlying phenomena from the systems biology perspective. Prerequisites: Junior or senior classification, BIMS 320/GENE 320 or GENE 320/BIMS 320 and BIOL 111, BIOL 112 or BIOL 213 or equivalent; STAT 302 or equivalent.

VTPP 444 Practicum in Biomedical Research
Credits 3. 3 Other Hours. Team or group development of sustainable collaborations that include biomedical research, high-impact educational practices and community service; emphasis on lifelong learning and the impact of research on biomedical issues and physiology; focus on connecting research experience to future career goals. Prerequisites: VTPP 223 and VTPP 224, or VTPP 234 and VTPP 235, or VTPP 232 and VTPP 233, or VTPP 207 and VTPP 208; junior or senior classification; instructor approval.

VTPP 452 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. Prerequisite: BICH 410 or equivalent, or approval of instructor.

VTPP 481 Seminar
Credits 4. 4 Other Hours. Exposure to scientists from a variety of biomedical disciplines through attendance at seminars followed by review and discussion of current scientific work in physiology and related subjects, and subsequent student seminar presentations. Prerequisites: Junior or senior classification; approval of instructor.
VTPP 485 Directed Studies
Credits 0 to 4. 0 to 4 Other Hours. Course for junior and senior students who desire additional laboratory work in physiology to supplement required courses. Prerequisites: Junior or senior classification and approval of department head.

VTPP 489 Special Topics in...
Credits 1 to 4. 1 to 4 Lecture Hours. 0 to 4 Lab Hours. Selected topics in an identified area of physiology, pharmacology, endocrinology or toxicology. May be repeated for credit. Prerequisite: Junior or senior classification.

VTPP 491 Research
Credits 0 to 4. 0 to 4 Other Hours. Laboratory and/or field research supervised by a faculty member. Prerequisites: Junior or senior classification; approval of instructor.