

NEUROBIOLOGY, PHYSIOLOGY, & BEHAVIOR (NPB)

College of Biological Sciences

NPB 010 – Elementary Human Physiology (3 units)

Course Description: Introduction to physiology for non-science majors. Includes basic cell physiology and survey of major organ systems and how they function in homeostasis and human health.

Learning Activities: Lecture 3 hour(s).

Credit Limitation(s): Not open for credit to students who have completed NPB 101.

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 011 – Exercise & Fitness: Principles & Practice (3 units)

Course Description: Human movement from physiological, psychological, sociological, and historical perspectives. Biology and psychology of exercise across the human lifespan.

Learning Activities: Lecture 3 hour(s).

Credit Limitation(s): Not open for credit to students who have taken EXB 010 or an upper division EXB or NPB course.

Grade Mode: Letter.

General Education: Science & Engineering (SE); Scientific Literacy (SL).

NPB 012 – The Human Brain & Disease (3 units)

Course Description: Normal function and diseases of the human brain and nervous system. Diseases discussed include Parkinson's, Alzheimer's, leprosy, amnesia and schizophrenia. Intended for non-science majors.

Learning Activities: Lecture 3 hour(s).

Credit Limitation(s): Not open for credit for students who have completed NPB 100, NPB 101, NPB 112, or PSC 121.

Grade Mode: Letter.

General Education: Science & Engineering (SE); Scientific Literacy (SL).

NPB 013 – Extreme Animal Athletes (3 units)

Course Description: Overview of biomechanics, focusing on animal locomotion. Physical principles underlying traits such as speed, maneuverability, endurance, and precision. Comparisons of animals and human athletes performing similar feats, with animals often outperforming humans by a wide margin. Biomechanical concepts through hands-on exercises, problem sets, and readings from the scientific literature.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

NPB 014 – Illusions: Fooling the Brain (3 units)

Course Description: Introduction to perceptual processing in the human nervous system; illusions.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE); Quantitative Literacy (QL); Scientific Literacy (SL).

NPB 015 – The Biology & Physiology of Aging (4 units)

Course Description: Broad examination of age-associated changes in body functions. Includes basic cell physiology, a survey of major organ systems and the age-induced alterations in system function. Some age-associated diseases will also be examined. Intended for non-science majors.

Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).

Credit Limitation(s): Not open for credit to students who have completed NPB 015V.

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 015V – The Biology & Physiology of Aging (4 units)

Course Description: Broad examination of the biological and physiological basis of aging in animals and plants. Concepts in demographic, evolutionary, genetic, and cell aging. Major human organ systems, age-related alterations in system function, and age-related diseases. Intended for non-science majors.

Learning Activities: Web Virtual Lecture 3 hour(s), Web Electronic Discussion 1 hour(s).

Credit Limitation(s): Not open for credit to students who have completed NPB 015.

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 017 – The Path to Cyborgs: Introduction to Prostheses & Human Machine Interfaces (3 units)

Course Description: Interface of biology and technology. Mind-controlled prosthetic limbs, artificial organs, and implantable devices. Emphasis on basic physiological functions and how they can be replaced by devices. Suitable for majors and non-majors.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE); Scientific Literacy (SL).

NPB 018 – Biological Science for Social Justice (3 units)

Course Description: Broad survey of the many ways one can use the biological sciences to better the lives of others and break down barriers that have restricted social mobility.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE) or Social Sciences (SS); Domestic Diversity (DD); Scientific Literacy (SL).

NPB 068 – Biology of Drug Addiction & Abuse (3 units)

Course Description: Broad examination of addictive substances and their use/abuse. Topics include historical perspective, physiological effects, etiology, neurobiology of addiction and the impact of drugs on contemporary society. Intended for non-science majors.

Learning Activities: Lecture 3 hour(s).

Credit Limitation(s): Not open for credit to students having completed NPB 168.

Grade Mode: Letter.

NPB 090C – Current Issues in Animal Behavior (2 units)

Course Description: The mechanisms and outcomes of sexual selection (mate choice and mate competition). Theory, current models and evidence that supports or refutes the models.

Prerequisite(s): Lower division standing.

Learning Activities: Seminar 2 hour(s).

Enrollment Restriction(s): Limited enrollment.

Grade Mode: Letter.

NPB 090F – Visual Impairment & Blindness: A World Wide Problem (2 units)

Course Description: Examination of various abnormalities of the eye and the important geographic and cultural factors that influence the epidemiology of those abnormalities.

Prerequisite(s): Lower division standing.

Learning Activities: Seminar 2 hour(s).

Grade Mode: Letter.

NPB 091C – Research Conference (1 unit)

Course Description: Research findings and methods in neurobiology, physiology, and/or behavior. Presentation and discussion of research by faculty and students.

Prerequisite(s): NPB 099 (can be concurrent); and consent of instructor; lower division standing in Neurobiology, Physiology and Behavior or related biological science; NPB 099 required concurrently.

Learning Activities: Discussion 1 hour(s).

Enrollment Restriction(s): Restricted to lower division students.

Repeat Credit: May be repeated.

Grade Mode: Pass/No Pass only.

NPB 092 – Internship (1-12 units)

Course Description: Work experience off and on campus in all subject areas offered in the Department of Neurobiology, Physiology, and Behavior. Internships supervised by a member of the faculty.

Prerequisite(s): Consent of instructor; lower division standing.

Learning Activities: Internship 3-36 hour(s).

Repeat Credit: May be repeated.

Grade Mode: Pass/No Pass only.

NPB 098 – Directed Group Study (1-5 units)

Course Description: Directed group study.

Prerequisite(s): Consent of instructor; lower division standing.

Learning Activities: Variable.

Grade Mode: Pass/No Pass only.

NPB 099 – Special Study for Undergraduates (1-5 units)

Course Description: Special study for undergraduates.

Prerequisite(s): Consent of instructor. Lower division standing.

Learning Activities: Variable.

Grade Mode: Pass/No Pass only.

NPB 100 – Neurobiology (4 units)

Course Description: Brains and nervous systems, neurons and neural circuits. Coordination of movement. Development of nervous systems. Vision, hearing, and feature extraction by the central nervous system. The cell biology of learning and memory. Perception, cognition, and disorders of the brain.

Prerequisite(s): BIS 002A; PHY 009A, PHY 009B or PHY 007A, PHY 007B recommended.

Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).

Credit Limitation(s): Not open for credit to students who have completed NPB 110B, NPB 112, NPB 160, NPB 161 or NPB 162, or NSC 221 or NSC 222.

Grade Mode: Letter.

General Education: Science & Engineering (SE); Quantitative Literacy (QL).

NPB 100L – Neurobiology Laboratory (3 units)

Course Description: Experimental basis of neurobiology principles discussed in NPB 100. Topics include neurophysiology, sensory systems, motor systems, cellular neuroscience, cognitive neuroscience, and quantitative data analysis and modeling techniques.

Prerequisite(s): NPB 100 (can be concurrent) or NPB 110B (can be concurrent).

Learning Activities: Lecture 1 hour(s), Laboratory 3 hour(s), Extensive Writing/Discussion.

Enrollment Restriction(s): Pass One restricted to Seniors.

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 100Q – Quantitative Foundations of Neurobiology (1 unit)

Course Description: Computational methods and mathematical models used to study phenomena in neurobiology.

Prerequisite(s): NPB 100 (can be concurrent).

Learning Activities: Auto Tutorial 1.5 hour(s), Extensive Problem Solving 1.5 hour(s).

Grade Mode: Letter.

NPB 101 – Systemic Physiology (5 units)

Course Description: Systemic physiology with emphasis on aspects of human physiology. Functions of major organ systems, with the structure of those systems described as a basis for understanding the functions.

Prerequisite(s): BIS 002A; (CHE 002B or CHE 002BH); PHY 001B or PHY 007C strongly recommended.

Learning Activities: Lecture 5 hour(s).

Credit Limitation(s): Not open for credit to students who have completed NPB 110C.

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 101D – Systemic Physiology Discussion (1.5 units)

Course Description: Discussion and problem solving related to fundamental principles of systemic physiology as presented in NPB 101.

Prerequisite(s): NPB 101 (can be concurrent); consent of instructor.

Learning Activities: Discussion 1.50 hour(s).

Grade Mode: Pass/No Pass only.

NPB 101L – Systemic Physiology Laboratory (3 units)

Course Description: Selected experiments to illustrate functional characteristics of organ systems discussed in NPB 101.

Prerequisite(s): ANS 100 or NPB 101 or NPB 110C.

Learning Activities: Laboratory 3 hour(s), Discussion 2 hour(s), Term Paper.

Enrollment Restriction(s): Pass One restricted to seniors in BBIS, ACNU, BHUB, ANSC, and BNPB.

Grade Mode: Letter.

NPB 102 – Animal Behavior (3 units)

Course Description: Basic principles of behavioral organization in vertebrate and invertebrate animals. Underlying physiological and ethological mechanisms. The evolution of behavior, with special emphasis on behavior under natural conditions.

Prerequisite(s): (BIS 001A, BIS 001B, BIS 001C) or (BIS 002A, BIS 002B, BIS 002C).

Learning Activities: Lecture 3 hour(s).

Credit Limitation(s): Not open for credit to students who have completed NPB 155. (Former NPB 155.)

Grade Mode: Letter.

General Education: Scientific Literacy (SL).

NPB 102Q – Quantitative Topics in Animal Behavior (1 unit)

Course Description: Study of the quantitative concepts and exemplar models used in animal behavior.

Prerequisite(s): MAT 016B; NPB 102 (can be concurrent).

Learning Activities: Auto Tutorial 1.50 hour(s), Extensive Problem Solving 1.50 hour(s).

Grade Mode: Letter.

NPB 103 – Cellular Physiology/Neurobiology (3 units)

Course Description: Cellular physiology with emphasis on membrane transport processes and neuronal physiology. Fundamental physical-chemical and biological mechanisms of membrane transport will be considered in relation to cytoplasmic homeostasis, communication between cells, and the cellular mechanisms of sensory and motor transduction.

Prerequisite(s): (BIS 103 or BIS 105); BIS 104; PHY 007C recommended.

Learning Activities: Lecture 3 hour(s).

Credit Limitation(s): Not open for credit to students who have completed NPB 100B. (Former NPB 100B.)

Grade Mode: Letter.

NPB 104L – Cellular Physiology/Neurobiology Laboratory (4 units)

Course Description: Experiments in the physical and chemical processes of cells and tissues.

Prerequisite(s): NPB 101L; (BIS 103 or BIS 105).

Learning Activities: Lecture 1 hour(s), Laboratory 3 hour(s), Discussion 1 hour(s), Term Paper/Discussion.

Grade Mode: Letter.

NPB 106 – Experiments in Neurobiology, Physiology, & Behavior: Design & Execution (3 units)

Course Description: Design and execution of experiments in neurobiology, physiology, and/or behavior. Choose and design a project in consultation with the sponsoring faculty member.

Prerequisite(s): (NPB 110A or NPB 100 or NPB 101 or NPB 102); NPB 199; and consent of instructor.

Learning Activities: Laboratory 7.50 hour(s), Discussion 0.50 hour(s).

Repeat Credit: May be repeated 1 time(s) to complete project; with consent of instructor.

Grade Mode: Pass/No Pass only.

General Education: Oral Skills (OL); Quantitative Literacy (QL); Visual Literacy (VL); Writing Experience (WE).

NPB 107 – Cell Signaling in Health & Disease (3 units)

Course Description: Basics of cell signaling pathways, their disruption in disease, and their current utility and future potential as therapeutic targets. Focus is on signaling pathways specific to nervous, endocrine and immune systems, and those fundamental to all cells.

Prerequisite(s): BIS 102 or BIS 105.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

General Education: Scientific Literacy (SL).

NPB 108Y – Animal Behavior Laboratory (3 units)

Course Description: Hybrid course, consisting of limited in-person lectures and the rest laboratory exercises. Laboratory exercises are online, and require students to view and score videos of animal behavior in order to test behavioral hypotheses.

Learning Activities: Lecture 3 hour(s), Web Electronic Discussion 12 hour(s).

Grade Mode: Letter.

NPB 109 – Kinesiology: Analysis & Control of Human Movement (4 units)

Course Description: Functional anatomy, motor control, and biomechanics of human movement understood in the context of body structures, basic principles of physics, and functional characteristics of muscle.

Prerequisite(s): PHY 007A; PHY 007B; NPB 101 or NPB 110C recommended; CHA 101 CHA 101L (same as EXB 106 EXB 106L) or equivalent recommended.

Learning Activities: Lecture 4 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 110A – Foundations 1: From Molecules to Individuals (5 units)

Course Description: Major concepts in cell biology with special emphasis on connections between cell biology and behavior. Includes: cellular metabolism, cellular sensing and signaling, membrane structure-function, molecular switches, electrical and chemical signaling, endocrine signaling, cell cycle and differentiation, cytoskeleton, and integrative examples.

Prerequisite(s): (BIS 002A, BIS 002B); (CHE 002B or CHE 003A); PHY 007A and PHY 007B recommended; BIS 002C recommended.

Learning Activities: Lecture 4 hour(s), Discussion 1 hour(s).

Enrollment Restriction(s): Pass One restricted to majors in Neurobiology, Physiology and Behavior.

Credit Limitation(s): Credit limited to 3 units for students who have taken BIS 104.

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 110B – Foundations 2: Neurobiology (5 units)

Course Description: Core concepts of neurobiology including single-neuron biophysics, synapses and transmitters, neuronal development, motor systems, central pattern generation, neuronal circuits, intracellular signal transduction, sensory processing, multisensory integration, autonomic nervous system, neuromodulation, learning and memory, and higher cognition and disease.

Prerequisite(s): NPB 110A C- or better; PHY 007A and PHY 007B recommended.

Learning Activities: Lecture 4 hour(s), Discussion 1 hour(s).

Enrollment Restriction(s): Open to declared NPB majors only.

Credit Limitation(s): Credit limited to 2 units for students who have taken NPB 100.

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 110C – Foundations 3: Physiology (5 units)

Course Description: Focuses on the structure, function, and interactions of human and other animal organ systems in homeostasis and reproduction, and the response to perturbations of homeostasis; neural and endocrine signaling; skeletal muscle and movement; cardiovascular and respiratory systems; renal, digestive, immune, and reproductive physiology.

Prerequisite(s): NPB 110A C- or better; PHY 007A; PHY 007B and PHY 007C recommended.

Learning Activities: Lecture 4 hour(s), Discussion 1 hour(s).

Enrollment Restriction(s): Open to declared NPB majors only.

Credit Limitation(s): Only 2 units for students who have taken NPB 101.

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 111L – Advanced Systemic Physiology Laboratory (4 units)

Course Description: Selected comprehensive experiments in the autonomic nervous system and the cardiovascular, respiratory, and neuromuscular systems. Emphasis on conceptual and methodological approaches in demonstrating the physiology of organ systems.

Prerequisite(s): NPB 101L.

Learning Activities: Lecture 1 hour(s), Discussion 2 hour(s), Laboratory 6 hour(s), Term Paper.

Grade Mode: Letter.

NPB 113 – Cardiovascular, Respiratory, & Renal Physiology (4 units)

Course Description: Intense and advanced presentation of concepts in cardiovascular, respiratory, and renal physiology including discussion of acid-base balance.

Prerequisite(s): (NPB 110C or NPB 101); CHE 008B, PHY 007B and PHY 007C recommended.

Learning Activities: Lecture 4 hour(s).

Grade Mode: Letter.

NPB 114 – Gastrointestinal Physiology (3 units)

Course Description: Gastrointestinal anatomy and physiology. Digestion, secretion, absorption, motility, comparative physiology and pathology. Strong emphasis on neural and hormonal regulation and on cellular mechanisms of secretion and absorption.

Prerequisite(s): (NPB 110C or NPB 101); BIS 105 or BIS 103 recommended, BIS 105 preferred.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

NPB 116 – Stress Physiology in Health & Disease (3 units)

Course Description: Adaptive and maladaptive physiological responses to acute and chronic stress in mammals, with emphasis on humans. Role of endocrine and autonomic nervous system in stress response. Prenatal and postnatal effects of stress on cognitive and affective development. Wellness interventions.

Prerequisite(s): BIS 002A C- or better; or consent of instructor.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

NPB 117 – Avian Physiology (3 units)

Course Description: Physiology of the various systems of birds with emphasis on digestion, respiration, excretion, and endocrine systems.

Prerequisite(s): (BIS 002A, BIS 002B); CHE 002B; NPB 101 or NPB 110C strongly recommended.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

NPB 118 – Comparative Biomechanics (3 units)

Course Description: Comparative biomechanics, exploring how animals and other organisms interact with their physical environment. Animal locomotion, form and function of morphological traits, mechanical properties of biological materials, and rules for fluid flow and structural design. Biomechanical concepts through hands-on exercises, quantitative problem sets, and readings from the scientific literature.

Prerequisite(s): (MAT 012 or MAT 016A or MAT 017A or MAT 021A or MAT 021AH or MAT 021M); (PHY 001A or PHY 007A or PHY 009A); (BIS 002A or BIS 002B or BIS 002C or BIS 010); or consent of instructor.

Learning Activities: Lecture/Discussion 3 hour(s).

Grade Mode: Letter.

NPB 119 – Physiology of Aging & Senescence (3 units)

Course Description: Molecular and genetic basis of aging and senescence in various model organisms, from yeast to mammals. Organ and system level changes that take place as organisms age and their impact on their fitness and outcomes. The role of inflammation as a key contributor to aging. Mechanisms of common diseases of aging including: Alzheimer's, arthritis, atherosclerosis, osteoporosis. Theories of Aging. Ageism in modern society. Course is based on reading and evaluating primary literature.

Prerequisite(s): NPB 101 or NPB 110C or ANS 100.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 121 – Physiology of Reproduction (4 units)

Course Description: Physiological mechanisms related to reproduction, breeding efficiency and fertility, with special reference to domestic animals.

Prerequisite(s): NPB 101 or NPB 110C or ANS 100.

Learning Activities: Lecture/Discussion 4 hour(s).

Grade Mode: Letter.

General Education: Quantitative Literacy (QL); Scientific Literacy (SL).

NPB 121L – Physiology of Reproduction Laboratory (1 unit)

Course Description: Experiments on the reproductive systems of domestic animals including male and female gametes.

Prerequisite(s): NPB 121 (can be concurrent).

Learning Activities: Laboratory 3 hour(s).

Grade Mode: Letter.

NPB 122 – Developmental Endocrinology (3 units)

Course Description: Hormonal control of development, maturation and senescence from the cellular to organismal level, with emphasis on the human. Prenatal and neonatal life, childhood and adolescence, adulthood and pregnancy, as well as the endocrinology of aging.

Prerequisite(s): NPB 101.

Learning Activities: Lecture 3 hour(s).

Enrollment Restriction(s): Restricted to upper division standing.

Grade Mode: Letter.

NPB 123 – Comparative Vertebrate Organology (4 units)

Course Description: Functional anatomy of major organ systems in vertebrates. Each system examined from cellular to gross level in fish, birds, and mammals. Emphasis on how differentiated cell types are integrated into tissues and organs to perform diverse physiological functions.

Prerequisite(s): (BIS 001A, BIS 001B) or (BIS 002A, BIS 002B).

Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).

Cross Listing: APC 100.

Grade Mode: Letter.

NPB 124 – Comparative Neuroanatomy (3 units)

Course Description: Overview of the neuroanatomy in mammalian vertebrates, focusing on the cerebral cortex and experimental techniques. Examine changes or modifications to neural structures as a result of morphological or behavioral specializations.

Prerequisite(s): NPB 101 or NPB 100 or NPB 110B or PSC 121.

Learning Activities: Lecture 3 hour(s).

Cross Listing: PSC 124.

Grade Mode: Letter.

NPB 124L – Comparative Neuroanatomy Laboratory (2 units)

Course Description: Comparative neuroanatomy laboratory illustrating modern neuroanatomical techniques in determining neural connections within the mammalian brain. Includes experimentation and presentation of results.

Prerequisite(s): NPB 124 (can be concurrent).

Learning Activities: Laboratory 6 hour(s).

Enrollment Restriction(s): Pass One restricted to PSC and NPB majors; must be concurrently enrolled in NPB 124.

Cross Listing: PSC 124L.

Grade Mode: Letter.

NPB 126 – Comparative Physiology: Sensory Systems (3 units)

Course Description: Basic physiological mechanisms involved in sensory systems. Comparative approach to considerations of mechanosensitive systems (audition, lateral lines, touch, echolocation, equilibrium), chemosensitive systems (olfaction, taste, pheromones), photosensitive systems (vision, infrared detection, UV detection), electroreception, and pain. Emphasis on receptors.

Prerequisite(s): NPB 100 or NPB 101.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

NPB 128 – Comparative Physiology: Endocrinology (3 units)

Course Description: Comparison of physiological functions in the animal kingdom: animal hormones and their functions.

Prerequisite(s): NPB 101.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

NPB 130 – Physiology of the Endocrine Glands (4 units)

Course Description: Advanced presentation of concepts in endocrinology with emphasis on the role of hormones in reproduction, metabolism, and disease.

Prerequisite(s): (ANS 100 or NPB 101 or NPB 110C).

Learning Activities: Lecture 4 hour(s).

Grade Mode: Letter.

General Education: Visual Literacy (VL).

NPB 132 – Nature vs. Nurture: Physiological Interactions Among Genes, Nutrients & Health (3 units)

Course Description: Biochemical, physiological, genetic, and nutritional causes of important medical problems such as obesity, anorexia, heart disease and diabetes.

Prerequisite(s): BIS 001A or BIS 002A; or consent of instructor.

Learning Activities: Lecture 3 hour(s).

Credit Limitation(s): Only 1 unit of credit allowed to students who have completed NPB 131.

Grade Mode: Letter.

NPB 133 – Genes & the Brain (4 units)

Course Description: Genetic contributions to brain evolution, development and disorders. Topics include evolution of genomic programs of neurodevelopment and the role of genetics in autism, intellectual disability, and schizophrenia.

Prerequisite(s): NPB 110B or NPB 100; or consent of instructor. BIS 101 recommended.

Learning Activities: Lecture 4 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 134 – General Immunology for Physiologists (3 units)

Course Description: Immunology for undergrads interested in physiology aimed at understanding the physiological role of immune responses. Illustrated with examples of human diseases including diabetes, allergies and asthma, and emerging diseases such as Ebola and Zika.

Prerequisite(s): NPB 101 C- or better or NPB 110C C- or better; or consent of instructor.

Learning Activities: Lecture 2 hour(s), Lecture/Discussion 1 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 136 – Neural Networks & Machine Learning in Biology (4 units)

Course Description: Neural networks as models of brain function and as powerful tools in machine learning. How neuroscience and machine learning have shaped each other. Applications of machine learning tools to biological research and health.

Prerequisite(s): MAT 017C C or better or MAT 021B C or better; or consent of Instructor; some background in neuroscience, cognitive science or programming (any one of the three) is recommended.

Learning Activities: Lecture 2 hour(s), Discussion/Laboratory 2 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 139 – Frontiers in Physiology (3 units)

Course Description: Lectures by leading authorities and discussion of the latest research in newly emerging areas in physiology. Offered every fourth year.

Prerequisite(s): NPB 100; NPB 101; NPB 102 (can be concurrent).

Learning Activities: Lecture 2 hour(s), Discussion 1 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE); Quantitative Literacy (QL).

NPB 140 – Principles of Environmental Physiology (3 units)

Course Description: Physiological aspects of interactions of organisms and environmental, cellular, system, and organismal levels. Emphasis on regulatory responses/mechanisms to thermal, pressure, gravity and light environmental variables.

Prerequisite(s): NPB 101 or NPB 110C; BIS 102 recommended.

Learning Activities: Lecture 3 hour(s).

Credit Limitation(s): Not open for credit to students who have completed NPB 148. (Former NPB 148.)

Grade Mode: Letter.

General Education: Writing Experience (WE).

NPB 143 – Neurobiology & Pathophysiology of Mental Illness (3 units)

Course Description: Comparison of the neurobiology and physiology of mental health to the pathophysiology of mental illness. Causative factors of mental illness (e.g., genetic, social, environmental) through a neurobiology and pathophysiology lens (e.g., neurotransmission, neuroimmunology, nervous system malfunction).

Prerequisite(s): NPB 100 C- or better; or NPB 110B C- or better; or consent of instructor.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 150 – Advanced Animal Behavior (4 units)

Course Description: Advanced integrative survey of biological principles of behavioral organization, emphasizing historical roots, current research directions, conceptual issues and controversies. Laboratory exercises on the description and analysis of the behavior of captive and free-living animals.

Prerequisite(s): NPB 102 or PSC 101; or consent of instructor.

Learning Activities: Lecture 3 hour(s), Laboratory 3 hour(s).

Cross Listing: PSC 122.

Grade Mode: Letter.

NPB 152 – Hormones & Behavior (3 units)

Course Description: Endocrine physiology with an emphasis on the principles of behavior. Fundamental relationships between hormones and various behaviors engaged in by the organism during its lifetime. Role of hormones in behavioral homeostasis, social behavior, reproductive behavior, parental behavior, adaptation to stress.

Prerequisite(s): (NPB 101 or NPB 110C); (NPB 102 or PSC 101).

Learning Activities: Lecture 3 hour(s).

Cross Listing: PSC 123.

Grade Mode: Letter.

NPB 154 – Diabetes: Physiology & Management (4 units)

Course Description: Normal regulation of blood glucose contrasted with dysfunction in diabetes. Types of diabetes, physiological consequences of diabetes, as well as current and future medications and treatments.

Prerequisite(s): NPB 110C or NPB 101.

Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE); Scientific Literacy (SL); Visual Literacy (VL).

NPB 157 – Advanced Physiology of Animal/Human Disease (3 units)

Course Description: Centers on fundamental mechanisms and pathophysiological basis for animal and human diseases. Case-based and uses animal and human diseases to help exemplify the physiological consequences of organ dysfunction.

Prerequisite(s): NPB 101 B+ or better or NPB 110C B+ or better; consent of instructor.

Learning Activities: Lecture 1 hour(s), Lecture/Discussion 2 hour(s).

Enrollment Restriction(s): Limited to 35 students initially.

Cross Listing: HPH 157.

Grade Mode: Letter.

NPB 159 – Frontiers in Behavior (3 units)

Course Description: Lectures by leading authorities and discussion of the latest research in newly emerging areas in behavioral biology. Offered every fourth year.

Prerequisite(s): (NPB 100, NPB 101, NPB 102) or (NPB 110A, NPB 110B, NPB 110C).

Learning Activities: Lecture 2 hour(s), Discussion 1 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE); Quantitative Literacy (QL).

NPB 161 – Developmental Neurobiology (3 units)

Course Description: Issues, theoretical concepts, and methodologies in developmental neurobiology. Topics include prenatal and postnatal differentiation of neurons, and plasticity in the mature and aging brain. Integration of neurochemical, structural, physiological and behavioral perspectives.

Prerequisite(s): NPB 100 or NPB 101 or NPB 110B.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 162 – Neural Mechanisms of Behavior (3 units)

Course Description: Relationship between brain and behavior. Identification and analysis of the relevant neural circuits involved. Examples of systems to be considered are birdsong, locomotion, echolocation.

Prerequisite(s): NPB 100 or NPB 101 or NPB 110B.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

NPB 163 – Systems Neuroscience (4 units)

Course Description: Concepts and techniques in systems neuroscience: e.g., measuring and manipulating neural activity, structure of neocortex, sensory processing, motor control, storage of information, neural codes, neural mechanisms underlying cognitive functions.

Prerequisite(s): NPB 100 or NPB 110B; or equivalent basic neuroscience training with consent of instructor.

Learning Activities: Lecture 3 hour(s), Lecture/Discussion 1 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 164 – Mammalian Vision (4 units)

Course Description: Structure and function of the mammalian visual system, from the formation of images on the retina through visually guided behavior and perception. Emphasis on biological mechanisms underlying vision.

Prerequisite(s): NPB 100 or NPB 110B or PSC 101.

Learning Activities: Lecture 3 hour(s), Discussion 1 hour(s).

Grade Mode: Letter.

NPB 165 – Neurobiology of Speech Perception (3 units)

Course Description: Interdisciplinary approach to speech perception with emphasis on functional neuroanatomy and behavior. Topics include auditory processing in time and space, intelligibility in noisy environments, visual speech, evolution of vocal communication, models of speech perception, development, and hearing impairment.

Prerequisite(s): NPB 110B or NPB 100 or NPB 101; or consent of instructor.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

General Education: Scientific Literacy (SL).

NPB 166 – Math Tools for Neuroscience (4 units)

Course Description: Introduction to mathematics techniques used in neuroscience. Applications to neuroscience of differential equations, linear algebra, Fourier transforms, correlation and convolution, and probability theory.

Prerequisite(s): (NPB 100 or NPB 110B); (MAT 016A, MAT 016B, MAT 016C) or (MAT 017A, MAT 017B, MAT 017C) or (MAT 021A, MAT 021B, MAT 021C); or consent of instructor.

Learning Activities: Lecture 4 hour(s).

Grade Mode: Letter.

NPB 167 – Computational Neuroscience (5 units)

Course Description: Mathematical models and data analysis techniques used to describe computations performed by nervous systems. Lecture topics include single neuron biophysics, neural coding, network dynamics, memory, plasticity, and learning. Lab topics include programming mathematical models and data analysis techniques in MATLAB.

Prerequisite(s): (NPB 100 or NPB 110B); (MAT 016A, MAT 016B, MAT 016C) or (MAT 017A, MAT 017B, MAT 017C) or (MAT 021A, MAT 021B, MAT 021C); or consent of instructor; PHY 007A, PHY 007B or equivalent recommended.

Learning Activities: Lecture 4 hour(s), Lecture/Lab 3 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 168 – Neurobiology of Addictive Drugs (4 units)

Course Description: Neurobiological basis for the effects and mechanisms of action of drugs with addictive potential, including opiates (morphine, heroin, methadone), amphetamines, cocaine, nicotine, marijuana (cannabinoids), alcohol, caffeine, and mind-altering drugs such as LSD and antidepressants.

Prerequisite(s): NPB 100 or NPB 110B or NPB 110C or NPB 101; or equivalents.

Learning Activities: Lecture/Discussion 4 hour(s).

Grade Mode: Letter.

General Education: Scientific Literacy (SL); Visual Literacy (VL).

NPB 169 – Frontiers in Neurobiology (3 units)

Course Description: Lectures by leading authorities and discussion of the latest research in newly emerging areas in neurobiology. Offered every fourth year.

Prerequisite(s): NPB 100 or NPB 110A.

Learning Activities: Lecture 2 hour(s), Discussion 1 hour(s).

Grade Mode: Letter.

General Education: Quantitative Literacy (QL).

NPB 171 – Physiology of Neuroimmune Interactions (4 units)

Course Description: Explores the complex interactions of the nervous and immune systems, and examine how the systems function together to serve homeostasis, behavior, and disease (such as Alzheimer's, autism, and multiple sclerosis).

Prerequisite(s): BIS 002A; (NPB 012 (can be concurrent) or NPB 100 (can be concurrent) or NPB 110B (can be concurrent)); or consent of instructor; completion of PMI 126 or MMI 188 recommended prior to this course.

Learning Activities: Lecture 3 hour(s), Lecture/Discussion 1 hour(s).

Grade Mode: Letter.

General Education: Scientific Literacy (SL).

NPB 172 – Map Formation in the Brain (3 units)

Course Description: Topographic map connection is a fundamental principle for establishing neural network in the brain. Provides comprehensive understanding of the current concepts of map formation in various sensory and motor nervous systems.

Prerequisite(s): NPB 100 C- or better or NPB 110B C- or better; or equivalent basic neuroscience training with consent of instructor.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

General Education: Science & Engineering (SE).

NPB 173 – Neurobiology of Brain Disorders (3 units)

Course Description: Examination of brain disorders from a basic science perspective to gain insights into the mechanisms of their action. Genetic, molecular, cellular, circuit, and environmental basis of a variety of brain disorders. How insights about underlying mechanisms may lead to the development of improved therapies.

Prerequisite(s): NPB 110B or NPB 100; or consent of instructor.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

NPB 190C – Research Conference (1 unit)

Course Description: Research findings and methods in neurobiology, physiology, and/or behavior. Presentation and discussion of research by faculty and students.

Prerequisite(s): NPB 199 (can be concurrent); and consent of instructor; upper division standing in Neurobiology, Physiology, and Behavior or related biological science; NPB 199 required concurrently.

Learning Activities: Discussion 1 hour(s).

Repeat Credit: May be repeated.

Grade Mode: Pass/No Pass only.

NPB 192 – Internship (1-12 units)

Course Description: Work experience off and on campus in all subject areas offered in neurobiology, physiology, & behavior.

Prerequisite(s): Consent of instructor; completion of 84 units.

Learning Activities: Internship 3-36 hour(s).

Repeat Credit: May be repeated.

Grade Mode: Pass/No Pass only.

NPB 194HA – Neurobiology, Physiology, & Behavior: Honors (1 unit)

Course Description: Honors project in Neurobiology, Physiology, and Behavior. Laboratory research on a specific question. Project is developed with the sponsoring faculty member and approved by the student's Honors Thesis Committee. Honors thesis to be submitted upon completion of the project.

Prerequisite(s): Senior standing; minimum 3.500 GPA in courses counted toward major; approval by the master advisor.

Learning Activities: Laboratory 12 hour(s).

Grade Mode: Pass/No Pass only.

NPB 194HB – Neurobiology, Physiology & Behavior: Honors (4 units)

Course Description: Honors project in Neurobiology, Physiology, and Behavior. Laboratory research on a specific question. Project is developed with the sponsoring faculty member and approved by the student's Honors Thesis Committee. Honors thesis to be submitted upon completion of the project.

Prerequisite(s): Senior standing; minimum 3.500 GPA in courses counted toward major; approval by the master advisor.

Learning Activities: Laboratory 12 hour(s).

Grade Mode: Pass/No Pass only.

NPB 194HC – Neurobiology, Physiology, & Behavior: Honors (2 units)

Course Description: Honors project in Neurobiology, Physiology, and Behavior. Laboratory research on a specific question. Project is developed with the sponsoring faculty member and approved by the student's Honors Thesis Committee. Honors thesis to be submitted upon completion of the project.

Prerequisite(s): Senior standing; minimum 3.500 GPA in courses counted toward major; approval by the master advisor.

Learning Activities: Laboratory 12 hour(s).

Grade Mode: Pass/No Pass only.

NPB 197T – Tutoring in Neurobiology, Physiology, & Behavior (1-5 units)

Course Description: Assisting the instructor by tutoring students in one of the Department's regular courses.

Prerequisite(s): Consent of instructor; upper division standing.

Learning Activities: Discussion 2-6 hour(s).

Repeat Credit: May be repeated.

Grade Mode: Pass/No Pass only.

NPB 198 – Directed Group Study (1-5 units)

Course Description: Directed group study.

Learning Activities: Variable.

Grade Mode: Pass/No Pass only.

NPB 199 – Special Study for Advanced Undergraduates (1-5 units)

Course Description: Special study for advanced undergraduates.

Prerequisite(s): Consent of instructor.

Learning Activities: Variable.

Grade Mode: Pass/No Pass only.

NPB 211 – Advanced Topics in Neuroimaging (3 units)

Course Description: Critical presentation and discussion of the most influential advanced issues in neuroimaging, emphasizing fMRI design/analysis and the integration of fMRI with EEG/MEG.

Prerequisite(s): PSC 210; or consent of instructor.

Learning Activities: Seminar 2 hour(s), Laboratory 1 hour(s).

Enrollment Restriction(s): Restricted to 16 students.

Repeat Credit: May be repeated when topic differs.

Cross Listing: NSC 211, PSC 211.

Grade Mode: Satisfactory/Unsatisfactory only.

NPB 212 – Light & Fluorescence Microscopy (3 units)

Course Description: Theory and practical application of light and fluorescence microscopy in the biological sciences. Laboratory component focuses on an optics bench, where we build simple compound and confocal microscopes on an optical rail.

Prerequisite(s): Consent of instructor.

Learning Activities: Lecture 2 hour(s), Laboratory 1 hour(s).

Enrollment Restriction(s): Restricted to 16 students.

Grade Mode: Letter.

NPB 217 – Advanced Avian Physiology (1 unit)

Course Description: Study in depth of a topic in avian physiology through development of a lecture with associated instructional materials such as lesson plan, readings, presentation, and evaluation aids.

Prerequisite(s): NPB 117 required concurrently; and consent of instructor; graduate standing.

Learning Activities: Project 1 hour(s).

Grade Mode: Letter.

NPB 221 – Cellular Neuroscience (4 units)

Course Description: Advanced course on cellular and subcellular organization of the nervous system. Membrane channels, sensory transduction, synaptic transmission and cellular aspects of development and learning.

Learning Activities: Lecture 3 hour(s), Discussion 1.50 hour(s).

Grade Mode: Letter.

NPB 222 – Systems Neuroscience (5 units)

Course Description: Integrative and information-processing aspects of nervous system organization. Topics include sensory systems, motor function, sensorimotor integration, the limbic system, and the neurobiology of learning and memory.

Prerequisite(s): Graduate standing or consent of instructor.

Learning Activities: Lecture 4 hour(s), Discussion 1 hour(s).

Cross Listing: NSC 222.

Grade Mode: Letter.

NPB 245 – Computational Models of Cellular Signaling (3 units)

Course Description: Computational and mathematical techniques in modeling of regulatory and signaling phenomena in neurobiology and cell physiology, focusing on linear and nonlinear ordinary differential equation models. Applications include ion channel kinetics, electrical activity, signal transduction, calcium oscillations, and simple neural circuits.

Prerequisite(s): Consent of instructor.

Learning Activities: Lecture 3 hour(s).

Grade Mode: Letter.

NPB 247 – Topics in Functional Neurogenomics (2 units)

Course Description: The theory, methods and principles of functional neurogenomics with emphasis on the relationship to molecular mechanisms involved in development and disease of the nervous system.

Prerequisite(s): Graduate standing or consent of instructor.

Learning Activities: Lecture 1 hour(s), Discussion 1 hour(s).

Cross Listing: NSC 247.

Grade Mode: Letter.

NPB 261A – Topics in Vision: Eyes & Retinal Mechanisms (2 units)

Course Description: Structure and function of the visual system, with emphasis on the eye and retina, including optics, anatomy, transduction, retinal synapses, adaptation, and parallel processing.

Prerequisite(s): NPB 100 or NPB 112; or the equivalent; graduate standing.

Learning Activities: Lecture/Discussion 2 hour(s).

Cross Listing: NSC 261A, MCP 261A.

Grade Mode: Satisfactory/Unsatisfactory only.

NPB 261B – Topics in Vision: Systems, Psychophysics, Computational Models (2 units)

Course Description: Functions of the central visual pathways and their underlying mechanisms. Recent research on aspects of anatomy, biochemistry, electrophysiology, psychophysics, development, and genetics of the visual system.

Prerequisite(s): Consent of instructor; NPB 261A recommended.

Learning Activities: Lecture/Discussion 2 hour(s).

Cross Listing: NSC 261B, MCP 261B.

Grade Mode: Satisfactory/Unsatisfactory only.

NPB 261C – Topics in Vision: Clinical Vision Science (2 units)

Course Description: Causes and mechanistic bases of major blinding diseases. Recent research on aspects of anatomy, biochemistry, electrophysiology, psychophysics, development, and genetics of the visual system related to disease.

Prerequisite(s): NPB 261A; NPB 261B; or consent of instructor.

Learning Activities: Lecture/Discussion 2 hour(s).

Cross Listing: NSC 261C, MCP 261C.

Grade Mode: Satisfactory/Unsatisfactory only.

NPB 263 – Modeling in Systems Neuroscience (4 units)

Course Description: Modeling as a tool in systems neuroscience. Mathematical techniques will be introduced and used to explore advanced topics in echolocation, sound localization, electroreception, communications, and motor systems. Other topics include transforms, modeling assumptions, scales and linearity.

Prerequisite(s): Consent of instructor.

Learning Activities: Lecture 3 hour(s), Lecture/Lab 1 hour(s).

Grade Mode: Letter.

NPB 267 – Computational Neuroscience (5 units)

Course Description: Mathematical models and data analysis techniques used to describe computations performed by nervous systems. Lecture topics include single-neuron biophysics, neural coding, network dynamics, memory, plasticity, and learning. Lab topics include programming mathematical models and data analysis techniques in MATLAB.

Prerequisite(s): One course in general Neuroscience at the level of NPB 100 or NPB 110B; one year college-level Calculus at the level of MAT 016A, MAT 016B, MAT 016C or higher; one year Physics at the level of PHY 007A, PHY 007B, PHY 007C recommended; or consent of instructor.

Learning Activities: Lecture 4 hour(s), Lecture/Lab 3 hour(s).

Cross Listing: NSC 267.

Grade Mode: Letter.

NPB 270 – How to Write a Fundable Grant Proposal in the Biomedical Sciences (2 units)

Course Description: Teaches the do's and don'ts of writing grants in the biomedical sciences and the mechanisms of the review process.

Prerequisite(s): Consent of instructor.

Learning Activities: Lecture/Discussion 2 hour(s).

Enrollment Restriction(s): Restricted to members of the Neuroscience and BMCDB graduate groups; graduate students in other biomedical programs may enroll with instructor permission.

Repeat Credit: May be repeated.

Cross Listing: NSC 270.

Grade Mode: Letter.

NPB 271A – Core Concepts & Methods in Learning, Memory, & Plasticity (2 units)

Course Description: Core concepts and methods used in studies of learning, memory and plasticity. Behavioral paradigms and measurement approaches in human and animal studies of learning and plasticity, as well as a consideration of the functional, anatomical and neuronal mechanisms underlying brain plasticity.

Prerequisite(s): Graduate Standing or consent of instructor.

Learning Activities: Lecture/Discussion 2 hour(s).

Cross Listing: PSC 271A, NSC 271A.

Grade Mode: Satisfactory/Unsatisfactory only.

NPB 271B – Core Concepts & Methods in Learning, Memory, & Plasticity (2 units)

Course Description: Core concepts and detailed survey methods used in studies of learning, memory and plasticity, from the cellular and molecular level to the level of neural circuits. Areas of learning, memory, and plasticity research where recent progress has been made in linking across these levels of analysis.

Prerequisite(s): NPB 271A or NSC 271A or PSC 271A.

Learning Activities: Lecture/Discussion 2 hour(s).

Cross Listing: PSC 271B, NSC 271B.

Grade Mode: Satisfactory/Unsatisfactory only.

NPB 271C – Translational Approaches to Learning, Memory, & Plasticity Disorders (2 units)

Course Description: Neurological disorders, the effect of these disorders on learning, memory and plasticity, approved therapeutic options and current research designed to improve understanding and treatment of these diseases: (i) the clinical presentation, diagnostic criteria, and existing therapies, (ii) mechanistic studies in humans and animal models, and (iii) molecular pathways involved in the disease and approaches for drug discovery.

Prerequisite(s): NPB 271B or NSC 271B or PSC 271B.

Learning Activities: Lecture/Discussion 2 hour(s).

Cross Listing: PSC 271C, NSC 271C.

Grade Mode: Satisfactory/Unsatisfactory only.

NPB 285 – Literature in Visual Neuroscience (2 units)

Course Description: Literature in visual Neuroscience.

Learning Activities: Seminar 2 hour(s).

Repeat Credit: May be repeated.

Cross Listing: NSC 285.

Grade Mode: Satisfactory/Unsatisfactory only.

NPB 287A – Topics in Theoretical Neuroscience (2 units)

Course Description: In-depth exploration of topics in theoretical neuroscience. Topic varies each year. Fall quarter (287A): foundational material from books and review articles. Spring quarter (287B): continuation of year's topic through readings of seminal articles from the primary literature.

Prerequisite(s): Consent of instructor.

Learning Activities: Lecture/Discussion 2 hour(s).

Repeat Credit: May be repeated.

Cross Listing: NSC 287A.

Grade Mode: Satisfactory/Unsatisfactory only.

NPB 287B – Topics in Theoretical Neuroscience (2 units)

Course Description: In-depth exploration of topics in theoretical neuroscience. Topic varies each year. Fall quarter (287A): foundational material from books and review articles. Spring quarter (287B): continuation of year's topic through readings of seminal articles from the primary literature.

Prerequisite(s): Consent of instructor.

Learning Activities: Seminar 2 hour(s).

Repeat Credit: May be repeated.

Cross Listing: NSC 287B.

Grade Mode: Satisfactory/Unsatisfactory only.

NPB 291 – Auditory Neuroscience (1 unit)

Course Description: Exploration of various important aspects of auditory physiology, behavior and psychophysics through review of original literature. New topic each quarter.

Prerequisite(s): NPB 100 or NPB 112 or NSC 222; or the equivalent.

Learning Activities: Seminar 0.50 hour(s), Discussion 0.50 hour(s).

Repeat Credit: May be repeated with consent of instructor.

Grade Mode: Satisfactory/Unsatisfactory only.