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SM 050. Forensic Neuroscience. Langleben.

Progress in behavioral neuroscience and brain imaging techniques, such as functional and structural Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET) has forced the courts to reconsider the role of behavioral sciences in courtroom decision-making. The goal of this course is to enable students understand and interpret the use of behavioral neuroscience evidence in the justice system. The course will introduce the students to the relevant behavioral neuroscience constructs, principles of brain imaging and rules of scientific evidence. Students will be asked to use this introductory knowledge to critically evaluate the use of brain imaging and other behavioral neuroscience techniques as evidence in representative legal cases. For each case, students will serve as neuroscience experts for the defense or prosecution and prepare, present and defend their testimony against the opposing team. Through this course, students will develop the ability to critically evaluate brain imaging and other neuroscience data in forensic and legal settings.

SM 060. Music and the Brain. Kaplan.

Every human culture that has ever been described makes some form of music. The musics of different cultures cover a wide range of styles, but also display fascinating similarities, and a number of features are shared by even the most disparate musical traditions. Within our own culture, music is inescapable-there are very few individuals who do not listen to some form of music every day and far more who listen to music virtually all day long. Appreciation of music comes very early: newborns prefer music to normal speech and mothers all over the world sing to their babies in a fundamentally similar way. And yet, despite this seeming ubiquity, the real origin and purpose of music remains unknown. Music is obviously related to language, but how? Why do so many cultures make music in such fundamentally similar ways? What goes into the formation of music "taste" and preferences? Does music have survival value, or is it merely "auditory cheesecake", a superfluous byproduct of evolution as some critics have maintained? What is the nature of musical ability and how do musicians differ from non-musicians?

In this course, we will look for answers by looking at the brain. Almost 200 years of scientific research into brain mechanisms underlying the production and appreciation of music is beginning to shed light on these and other questions. Although the sciences and the arts are often seen as entirely separate or even in opposition, studying the brain is actually telling us a lot about music, and studying music is telling us just as much about the brain.

109. (BIOL109, PSYC109) Introduction to Brain and Behavior. (C) Living World Sector. All classes. Kane and McLean. Lab Fee is $75.00

Introduction to the structure and function of the vertebrate nervous system. We begin with the cellular basis of neuronal activities, then discuss the physiological bases of motor control, sensory systems, motivated behaviors, and higher mental processes. This course is intended for students interested in the neurobiology of behavior, ranging from animal behaviors to clinical disorders.

150. (ANTH104, GSWS103) Sex and Human Nature. (B) Living World Sector. All classes. Schurr.

This is an introduction to the scientific study of sex in humans. Within an evolutionary framework, the course examines genetic, physiological, ecological, social and behavioral aspects of sex in humans. After providing the basic principles of evolutionary biology, the course will examine the development of sexual anatomy and physiology. How is sex determined? How is orgasm achieved? Why do girls and boys develop sexually at different ages? The role of ecology and social life in shaping human mating patterns will be evaluated through the use of ethnographies and cross-cultural materials on a variety of human cultures. Does everybody have sex the way we do? Why marry? Are there biological bases for love? Why do we experience jealousy? Finally, topics relevant to human sexuality today will be discussed, such as recreational sex, contraception, and sexually transmitted diseases. Examples are drawn primarily from traditional and modern human societies; data from studies of nonhuman primates are also considered.

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160. ABCS EVERYDAY NEUROSCIENCE. Lori Flanagan-Cato.Prerequisite(s): BIBB109.

This course is an opportunity for undergraduates to share their interest and enthusiasm for neuroscience with students in grades 9-12 attending urban public schools in West Philadelphia. The course will allow Penn students to develop their science communication and teaching skills. Students will prepare neuroscience demonstrations, hands-on activities, and assessment tools. In parallel, the course aims to engage local high school students, increasing their interest and knowledge in science, and ultimately promoting lifelong science literacy.

L/R 217. (PSYC217, VLST217) Visual Neuroscience. (B) Rust.Prerequisite(s): BIBB 109, PSYC 001, COGS 001 or VLST 101.

An introduction to the scientific study of vision, with an emphasis on the biological substrate and its relation to behavior. Topics will typically include physiological optics, transduction of light, visual thresholds, anatomy and physiology of the visual pathways, retinal processing, properties of visual cortex, and color vision.

227. (PSYC127) Physiology of Motivated Behaviors. (C) Grill.

This course focuses on evaluating the experiments that have sought to establish links between brain structure (the activity of specific brain circuits) and behavioral function (the control of particular motivated and emotional behaviors). Students are exposed to concepts from regulatory physiology, systems neuroscience, pharmacology, and endocrinology and read textbooks as well as original source materials. The course focuses on the following behaviors: feeding, sex, fear, anxiety, the appetite for salt, and food aversion. The course also considers the neurochemical control of responses with an eye towards evaluating the development of drug treatments for: obesity, anorexia/ cachexia, vomiting, sexual dysfunction, anxiety disorders, and depression.

231. (BIOL231, PSYC231) Animal Behavior. (C) Seyfarth/Cheney.Prerequisite(s): PSYC 001 or BIOL 102 or BIOL 122.

The evolution of social behavior in animals, with special emphasis on group formation, cooperation among kin, mating systems, territoriality and communication.

233. Neuroethology. (C) Judith McLean.Prerequisite(s): BIBB 109.

In course, students will learn how neurobiologists study the relationship between neural circuitry and behavior. Behaviors such as bat echolocation, birdsong, insect olfaction, spatial navigation, eye movement and others will be used to explore fundamental principles of brain function that include brain oscillations, population codes, efference copy, sensorimotor maps and sleep replay. The course will also discuss the various methodologies that are used to address these questions. The reading material will be derived mostly from the primary literature.

240. Human Chronobiology and Sleep. (M) Dinges.Prerequisite(s): BIBB109. Students may not receive credit for both BIBB240 and BIBB040

Topics to be covered include basic principles of chronobiology; neuroscience mechanisms of circadian rhythms and sleep; phylogeny and ontongeny of sleep; human sleep and sleep disorders; circadian dysfunction; circadian and sleep homeostatic influences in human health and safety.

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247. (PSYC247) Neuroscience and Society. (C) Farah.Prerequisite(s): BIBB 109 or BIBB 249.

Cognitive, social,and affective neuroscience have made tremendous progress in in the last two decades. As this progress continues, neuroscience is becoming increasingly relevant to all of the real-world endeavors that require understanding, predicting and changing human behavior. In this course we will examine the ways in which neuroscience is being applied in law, criminal justice, national defense, education, economics, business,and other sectors of society. For each application area we will briefly review those aspects of neuroscience that are most relevant, and then study the application in more detail.

L/R 249. (PSYC149) Cognitive Neuroscience. (C) Epstein.Prerequisite(s): PSYC 001 or BIBB 109.

The study of the neuronal systems that underlie human perception, memory and language; and of the pathological syndromes that result from damage to these systems.

251. (BIOL251) Molecular and Cellular Neurobiology. (A) Schmidt, M./Abel/Peachey.Prerequisite (s): BIOL 101 and 102, or BIOL 121; PHYS 102 or 151 strongly recommended. Lab fee $150. (3hrs. lec., 3hrs. lab, 1.5 c.u.)

Cellular physiology of neurons and excitable cells; molecular neurobiology and development. Topics include: action potential generation; synaptic transmission; molecular and physiological studies of ion channels; second messengers; simple neural circuits; synaptic plasticity; learning and memory; and neural development.

271. (ANTH207) Primate Behavior Ecology. (C) Fernandez-Duque.Prerequisite(s): ANTH 003.

This is a seminar that discusses methodological aspects of conducting field research on non-human primates. After discussions of issues related to the planning and design of field studies, and the proper training in necessary field techniques, students will conduct research on non-human primates. We will then discuss data management and analysis.

260. (PSYC139, PSYC239) Neuroendocrinology. (C) Flanagan-Cato.Prerequisite(s): BIBB 109 or Permission of Instructor.

This course is designed to examine the various roles played by the nervous and endocrine systems in controlling both physiological processes and behavior. First, the course will build a foundation in the concepts of neural and endocrine system function. Then, we will discuss how these mechanisms form the biological underpinnings of various behaviors and their relevant physiological correlates. We will focus on sexual and parental behaviors, stress, metabolism, neuroendocrine-immune interactions, and mental health.

269. Autonomic Physiology. (B) Heerding.Prerequisite(s): BIBB 109.

This course will introduce the student to the functioning of the autonomic nervous system (ANS), which is critically involved in the maintenance of body homeostasis through regulation of behavior and physiology. The course will begin with a review of the basic anatomy and physiology of the ANS including the sympathetic, parasympathetic and enteric divisions. The mechanisms by which the ANS regulates peripheral tissues will be discussed, including reflex and regulatory functions, as will the effect of drugs which modulate ANS activity. The role of the ANS in regulating behavior will be addressed in the context of thirst, salt appetite and food intake.

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270. (PSYC225) Drugs, Brain and Mind. (A) Kane.Prerequisite(s): BIBB 109 or PSYC 109.

The course will begin with a review of basic concepts in pharmacology including: routes of drug administration, drug metabolism, the dose response curve, tolerance and sensitization. Following a brief overview of cellular foundations of neuropharmacology (neuronal biology, synaptic and receptor function), the course will focus on several neurotransmitter systems and the molecular and behavioral mechanisms mediating the mind-altering, additive and neuropsychiatric disorders, including depression, schizophrenia an anxiety, with an emphasis on their underlying neurobiological causes, as well as the pharmacological appraches for treatment.

310. Laboratory in the Structure of the Nervous System. (C) McLean.Prerequisite(s): BIBB 109 Permission of Instructor. Lab Fee: $50

A laboratory course designed to familiarize the student with the fundamental gross and histological organization of the brain. The mammalian brain will be dissected and its microscopic anatomy examined using standard slide sets. Comparative brain material will be introduced, where appropriate, to demonstrate basic structural-functional correlations.

331. Neuroscience of Emotions. (c) D. Leitman.Prerequisite(s): BIBB109.

This course will provide an overview of past and current theories of emotion and the neurobiological systems that underpin them. Topics will include how we perceive, express, and experience emotions and the role of emotion in motivated thoughts, actions, and experiences. Special attention will be paid to social aspects of emotion. The course will highlight the role that evolution, neurodevelopment, and clinical observation play in our understandingof emotional processes.

350. Developmental Neurobiology. (C) McGurk.Prerequisite(s): BIBB 109 and BIOL 101 or Permission of Instructor.

This course will focus on cellular and molecular mechanisms of the organogenesis of the central nervous system. A goal of the course will be to understand the form, function and pathology of the adult nervous system in terms of antecedent developmental processes.

399. Independent Research. (C) Standing Faculty.Prerequisite(s): BIBB 109 and Permission of the Director.

Individual research of an experimental nature with a member of the standing faculty leading to a written paper. The grade is based primarily on a serious term paper describing original research carried out by the student. Students must submit a proposal prior to registering. During the semester, students must attend two seminars to discuss planning and independent research project, ethical concerns in research and writing a scientific paper. Attendance at the meetings is manditory. Students doing more than one credit of independent study will be required to present a poster at the annual BBB Symposium.

409. CLINICAL RES. IN NEURO. (C)

SM 417. (PSYC417) Seminar in Perception: Visual Processing. (C) Rust.Prerequisite(s): BBB 109, Psych 149 or Psych 217,or permission of instructor.

This seminar will focus on how visual information is processed by the eye and the brain to produce visual perception. These issues will be explored through lectures and student presentations of journal articles, combined with Matlab- based tutorials and exercises. The course requires no prior knowledge of visual processing, math, or computer programming.

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SM 420. Smell and Taste. (M) Breslin/Teeter.Prerequisite(s): Introductory Psychology and Biology, BBB 109. PSYC 111 (Perception) preferred.

All organisms respond to chemicals in their environment. This chemosensation guides diverse behaviors such as a feeding, avoiding predators, sex, and social interactions. This course will provide a broad survey of our current understanding of taste and smell, focusing on insect and rodent model systems as well as studies in humans. The course will begin with a review of chemical signal transduction mechanisms, and build to an exploration of the cortical integration of chemical signals and chemical guided behaviors. Class time will emphasize primary literature, discussion, and student presentations. The goal is to reach an integrated understanding of the physiology and psychology of chemical sensory systems. In the process, students will learn to read and critically evaluate data from primary research articles.

SM 451. (PSYC407) Behavioral Genetics. (K) (c) Price.Prerequisite(s): BBB 109, Basic statistics or Permission of Instructor.

This course covers basic principles of human and animal behavioral genetics, including normal variation and extreme phenotypes represented by behavioral, psychiatric and neurologic disorders. The course will focus on methods necessary to critically evaluate research findings on normal and abnormal human behavior. Animal models will also be reviewed. The first third of the class is in lecture format and reviews basic genetic methodologies as they apply to behavior. The remainder of the class is in seminar format and covers recently published work related to behavioral genetics.

SM 421. Functional Imaging of the Human Brain. (B) Newberg.Prerequisite(s): BIBB 109.

The course will provide a detailed overview of functional brain imaging and it's potential uses. Issues regarding advantages and disadvantages of different modalities, study design image analysis & interpretation and how these relate to varies neurological & psychological phenomena will be discussed. Class will cover the following specific topics in this general time frame: Introduction to functional brain function, basics of nuclear medicine imaging (including instrumentation, image acquisition, and radiopharmaceuticals for positron emission tomography and single photon emission computed tomography), imaging of neurological disorders, imaging of psychological disorders, introduction to activation studies, image analysis and statistical problems, study design, literature review, journal article presentation, tour of Penn imaging facilities, interpretation of imaging studies, implications for clinical and research, and implications for understand the human mind and consciousness.

430. Neurobiological Basis of Autism. (C) Staff.Prerequisite(s): BIBB 109.

This course examines the neurobiological processes underlying autism spectrum disorders. In this seminar course, we will first examine the brain phenotypes associated with Autism Spectrum Disorders (ASD). in addition to investigating the genetic and environmental contributions to the etiology and pathophysiology of ASD. After an initial examination of the clinical literature and research, we will focus on animal models of ASD, including those of syndromic causes of autism (Rett Syndrome, Tuberous Sclerosis, Fragile X) and investigate changes in neurotransmitter systems and synaptic dysfunctions in the brain of these models.

442. (BIOL442) Neurobiology of Learning and Memory. Abel.Prerequisite(s): BIOL 251, BIBB 251 or Permission of Instructor.

This course focuses on the current state of our knowledge about the neurobiological basis of learning and memory. A combination of lectures and student seminars will explore the molecular and cellular basis of learning in invertebrates and vertebrates from a behavioral and neural perspective.

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SM 460. (PSYC439) Neuroendrinology Seminar. (C) Flangan-Cato.Prerequisite(s): BIBB 109 or Permission of Instructor.

This course is an upper-level seminar, designed to examine the various roles played by the nervous and endocrine systems in controlling both physiological processes and behavior. We will focus on sexual and parental behaviors, stress, metabolism, neuroendocrine-immune interactions, and mental health. The format will be a mixture of lectures and journal club discussions based on recent primary literature in the field of neuroendocrinology. Students will also write several short papers based on the clinical neuroendocrinology.

SM 462. MUSIC AND THE BRAIN.

SM 469. Stress Neuroscience. Heerding/Grafe.Prerequisite(s): BIBB 109.

Stress can be caused by a variety of conditions, ranging from low-level noise in the workplace to life-threatening situations and these stressors can cause changes in the physiology and behavior of individuals. This course will examine the neural mechanisms underlying physiological and emotional responses to stress in a journal club format. Topics to be covered include anxiety disorders, depression and other mood disorders, the differential effects of stress on males and females, the physiological effects of stress on the immune system and feeding behavior, the effects of maternal stress on offspring as well as strategies to mitigate the effects of stress.

SM 473. (NGG 706, PSYC473) Neuroeconomics. Kable.Prerequisite(s): PSYC 149, 253, or 265.

This course will review recent research that combines psychological, economic and neuroscientific approaches to study human and animal decision-making. A particular focus will be on how evidence about the neural processes associated with choices might be used to constrain economic and psychological theories of decision-making. Topics covered will include decisions involving risk and uncertainty, reinforcement learning, strategic interactions and games, and social preferences.

SM 475. Neurodegenerative Diseases. (M) Lexow.Prerequisite(s): BIBB 109 or Permission of Instructor.

This course will familiarize students with advances in our understanding of the clinical features and pathogenesis of a wide range of neurodegenerative diseases, including Alzheimer's disease and other dementias, prion diseases, Parkinson's disease and atypical parkinsonisms, neurodegenerative ataxias, motoneuron diseases, degenerative diseases with chorea, iron and copper disorders, and mitochondrial diseases. Students will analyze original research reports on a range of proposed pathological cellular processes that may represent steps in cell dealth pathways leading to neuron loss seen in these diseases.Significant emphasis will be placed on the fast-expanding field exploring genetic contributions to neurodegenerative disease, as identification of genetic mutations pathogenenic for familial neurodegenerative diseases has been a major driving force in neurodegenerative research and pointed researchers towards essential molecular process that may underlie these disorders. Strategies for therapeutic intervention in the management, prevention, and cure of neurodegenerative disease will be addressed.

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SM 482. Clinical Psychopharmacology. (M) Lexow.Prerequisite(s): BIBB 109 or Permission of Instructor.

This course examines the history, rationale and putative mechanism of action of drugs used in the treatment of psychiatric disorders. Emphasis is placed on neurobiological processes underlying psychopathology and pharmacological intervention. Drugs currently in use as well as new drugs in development will be covered. Strategies, techniques, issues and challenges of clinical psychopharmacological research will be addressed and new approaches to drug discovery, including the use of pharmacogenomics and proteomics to understand variability in drug response and identify new molecular drug targets, will be covered in depth. Specific drug classes to be considered include antidepressants, anxiolytics, typical and atypical antipsychotics, narcotic analgesics, sedative hypnotics, and antiepileptic medications. A contrasting theme throughout the course will be the use of drugs as probes to identify neural substrates of behavior.

479. (BIOL451, PSYC479) Neural Systems and Behavior. (M) Schmidt, M./Medina.Prerequisite(s): BIOL 251/BIBB 251 and permission of instructor.

This course will investigate neural processing at the systems level. Principles of how brains encode information will be explored in both sensory (e.g. visual, auditory, olfactory, etc.) and motor systems. Neural encoding strategies will be discussed in relation to the specific behavioral needs of the animal. Examples will be drawn from a variety of different model systems.

SM 480. Biological Basis of Psychiatric Disorders. (C) Lexow.Prerequisite(s): BIBB 109 or Permission of Instructor.

The contributions of basic sciences (neuroanatomy, neurophysiology, neurochemistry, and neuropharmacology) to an understanding of behavior and behavioral disorders will be covered and important psychiatric disorders will be discussed, primarily from the viewpoint of their biological aspects. Emphasis will be placed on critical evaluation of research strategies and hypotheses.

SM 481. Behavioral Pharmacology. (A) Heerding.Prerequisite(s): BIBB 109.

This seminar course reviews the behavioral effects of drugs in animals, the general biological and psychological principles of drug action, and the relationship between drugs that affect brain monoamine and opiate systems and their behavioral effects. Introductory lectures on general topics will be followed by advanced discussion of specific topics in a journal club format through student presentations.

492. Experimental Methods in Synaptic Physiology. (C) Kaplan.Prerequisite(s): BIBB 251. Lab fee $100

In this lab course, a small number of students meet once per week to discuss topics in synaptic physiology and to become proficient at sharp electrode techniques for intracellular recording, using isolated ganglia from the snail Heliosoma. The first part of each class will consist of discussion of weekly reading from the primary literature, with the remainder of the class devoted to hands-on experiments. After learning to record from and characterize single neurons, students will study synaptic transmission by stimulating incoming nerve trunks or by recording from pairs of interconnected neurons. As a midterm assignment, students will prepare and present a short research proposal using this model system, to be evaluated by the class. For the last half of the course, the class will work together on one or two of these proposals, meeting at the end of each class to pool our data, analyze the results and discuss their significance.

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499. Senior Honors Thesis. (C) Standing Faculty.Prerequisite(s): BIBB 399, Permission of BIBB Director and a GPA of 3.5 or better.

Continuation of BIBB 399 research. Students will be required to give an oral presentation of their research at the annual BBB symposium Honors Seminar.

585. (BE 530, NGG 594, PHYS585, PSYC539) Theoretical and Computational Neuroscience. (M) Balasubramanian.

This course will develop theoretical and computational approaches to structural and functional organization in the brain. The course will cover: (i) the basic biophysics of neural responses, (ii) neural coding and decoding with an emphasis on sensory systems, (iii) approaches to the study of networks of neurons, (iv) models of adaptation, learning and memory, (v) models of decision making, and (vi) ideas that address why the brain is organized the way that it is. The course will be appropriate for advanced undergraduates and beginning graduate students. A knowledge of multi-variable calculus, linear algebra and differential equations is required (except by permission of the instructor). Prior exposure to neuroscience and/or Matlab programming will be helpful.