

SYLLABUS FOR PSYC 4130, Physiological and Comparative Psychology, SPRING 2008

Philip V. Holmes, Ph.D.

Room 616 Psychology; Office hours: Mon. 9-11 am.

Laboratory instructor: Liz Rahn

Text: Breedlove, Rosenzweig, and Watson; *Biological Psychology, 5th ed.*

Supplies: Sheep brain, available at Bookstore; dissection kit optional

Lecture: Tues/Thurs 9:30-10:45 AM, rm. 120 PSY Bldg.

Lab: Tues 11:00-12:15, rm. 309 PSY Bldg.

Prerequisite: PSYC 2990 or BIOL 1108

Course description from bulletin: The biological bases of human and nonhuman behavior, with emphasis on underlying physiological mechanisms and on the development, evolution, and function of behavior.

Objectives: Upon successful completion of the course, students should understand: 1) the structure and function of neurons and basic neurophysiology; 2) basic neuroanatomy; 3) the anatomy and function of autonomic, endocrine, and sensory systems; 4) the evolutionary continuum between species and the evolution of behavior; 5) the neurobiological bases of fundamental behaviors such as feeding, reproduction, defense, circadian rhythms, learning, etc.; 6) the neurobiological bases for psychopathology.

Grading and assignments: 3 Exams: 70% ; 3 quizzes: 5%; Laboratory: 25%

Attendance policy: Attendance at every class session is required with reasonable exceptions (e.g. personal or family illness, professional meetings/interviews, official University functions, etc.).

Reference to University Honor Code and Academic Honesty Policy: All academic work must meet the standards contained in "A Culture of Honesty." All students are responsible to inform themselves about those standards before performing any academic work.

I. Introduction, definitions, and perspective (1/8)

Text: Chapter 1

II. Neuroanatomy (1/10-17)

Text: Chapter 2

A. Major cell types of the Central Nervous System

1. Neurons
2. Glia

B. Gross anatomy of the CNS

1. Orientation/planes of section
2. Anatomical subdivisions
 - a. forebrain
 - i. telencephalon
 - ii. diencephalon
 - b. midbrain (mesencephalon)
 - c. hindbrain
 - i. metencephalon
 - ii. myelencephalon

- d. spinal cord
- 3. Vascular and ventricular systems of the brain
- C. The Peripheral nervous system
 - 1. Cranial nerves
 - 2. The autonomic nervous system
 - a. sympathetic
 - b. parasympathetic

III. Review of basic cell biology (1/22)

- A. Chemical constituents of a cell
 - 1. Water and ions
 - 2. Fatty acids, phospholipids
 - 3. Amino acids, peptides, proteins
 - 4. Carbohydrates
 - 5. Nucleic acids, DNA, genes
- B. Organelles (eukaryotic cells)
 - 1. Membrane
 - a. receptors
 - b. ion channels/pumps
 - c. transporters
 - 2. Cytoskeleton
 - 3. Nucleus
 - 4. Ribosomes and rough endoplasmic reticulum (ER)
 - 5. Smooth ER and Golgi apparatus
 - 6. Mitochondria
- C. Gene expression: structural information flow from genes to amino acids
- D. Features of a typical neuron
 - 1. Dendrites
 - 2. Cell body
 - 3. Axon
 - 4. Terminal/synaptic bouton
- E. Functions of a neuron
 - 1. Intercellular communication
 - a. neurotransmitters
 - i. synthesis
 - ii. release
 - b. receptors
 - 2. Information processing

IV. Basic neurophysiology (1/24-31)

Text: Chapter 3

- A. Membrane potentials
 - 1. Ions
 - 2. Nernst equation
 - 3. Pumps/transporters
- B. Action potentials
 - 1. Sodium channels
 - 2. Potassium channels
 - 3. Calcium channels

4. Conduction
- C. Synapses
 1. Neurotransmission (presynaptic events)
 - a. depolarization
 - b. calcium channels
 - c. transmitter release
 2. Neurotransmission (postsynaptic events)
 - a. EPSP
 - b. IPSP

V. Methods in neuroscience (2/5-7)

Text: Appendix and Chapters 1-3

- A. Literature searches
- B. Surgical and behavioral methods (*in vivo*):
 1. Surgical methods
 - a. stereotactic surgery
 - b. lesions
 - c. electrophysiology
 - d. microdialysis
 2. Behavioral methods
 - a. spontaneous behavior
 - b. learning/memory paradigms
 - c. emotional behavior
 - i. appetitive
 - ii. aversive
 3. Transgenics and gene transfer
- C. Molecular and physiological methods (*ex vivo* or *in vitro*): *in situ* hybridization, immunocytochemistry, radioimmunoassay, receptor binding

Exam I: February 12

VI. Psychopharmacology (2/14-19)

Text: Chapter 4-5

- A. Principles of pharmacology
 1. Potency
 2. Efficacy
 3. Agonist
 4. Antagonist
- B. Receptors
 1. Ligand-gated ion channels
 2. Ligand-gated transporters
 3. Second messenger systems
- C. "Classical" or "small molecule" transmitter/receptor systems
 1. Acetylcholine
 2. Dopamine
 3. Norepinephrine and epinephrine
 4. 5-hydroxytryptamine (serotonin, 5-HT)
 5. Excitatory amino acids (glutamate)

6. Inhibitory amino acids (gamma-amino-butyric acid, GABA)

- D. Peptide neurotransmitters
- E. Neurohormones and neurotrophic factors

VII. Neuroendocrine systems (2/21-28)

Text: Chapter 5

- A. The Hypothalamo-Pituitary-Adrenal or HPA axis (anterior pituitary)
- B. The HP-Gonadal axis
- C. Neurohypophysis (posterior pituitary)

VIII. Somatosensory systems (3/4)

Text Chapter 8

- A. Cutaneous receptive organs
- B. Somatosensory pathways
 - 1. Spinothalamic pathway (anterolateral system)
 - 2. Dorsal column-medial lemniscal pathway
- C. Pain
 - 1. Ascending pathways
 - 2. Descending pathways

IX. Visual systems (3/6)

Text: Chapter 10

- A. The anatomy of the eye
- B. Photoreceptors
 - 1. Rods
 - 2. Cones
- C. The retina
 - 1. Coding of stimulus intensity
 - 2. Coding of stimulus wavelength
 - a. ganglion cells
 - b. opponent process coding

X. Auditory systems (3/18)

Text: Chapter 9

- A. The anatomy of the ear
- B. Coding of auditory information
 - 1. Intensity
 - 2. Frequency
- C. Auditory pathways
- D. Auditory perception
- E. The vestibular system

XI. Olfaction and gustation (3/20)

Text: Chapter 9

- A. Taste buds and gustatory pathways
- B. The olfactory apparatus
 - 1. Olfactory epithelium
 - 2. The olfactory nerve (cranial nerve I)
 - 3. The olfactory bulb
- C. Olfactory pathways

D. Olfactory perception, olfactory memories, and emotion

EXAM II: March 25

XII. Evolution of brain and behavior (3/27)

Text: Chapter 6

XIII. Reproductive behavior (3/31)

Text: Chapter 12

- A. Embryonic sexual differentiation and development
 - 1. Wolffian system
 - 2. Mullerian system
- B. Estrous cycle
- C. Sexual behavior

XIV. Ingestive behavior (4/1)

Text: Chapter 13

- A. Fluid regulation
 - 1. Osmotic thirst
 - 2. Volumetric thirst
- B. Food and energy regulation

XV. Biorhythms and sleep (4/3)

Text: Chapter 14

- A. Circadian rhythms
 - 1. Zeitgebers
 - 2. Suprachiasmatic nucleus
- B. Sleep
 - 1. EEG sleep stages
 - 2. Neural mechanisms
 - 3. Sleep disorders

XVI. Defensive/aggressive/emotional behavior (4/8)

Text: Chapter 15

- A. Aversively motivated behavior
 - 1. Fear
 - a. Fight or flight response revisited
 - b. Stress
 - 2. Defensive aggression
- B. Appetively motivated behavior
 - 1. Reward systems
 - 2. Offensive aggression

XVII. Learning and memory (4/10-15)

Text: Chapter 17-18

- A. Basic concepts in learning and memory
 - 1. Nonassociative
 - a. habituation
 - b. sensitization
 - 2. Associative
 - a. classical (Pavlovian) conditioning
 - b. operant conditioning
- B. Complex learning and memory

1. Declarative
2. Nondeclarative
- C. Neurobiological bases for learning
 1. Brain circuits
 2. Long-term potentiation (LTP)

XVIII. Psychopathology (4/22-24)

Text: Chapter 16

- A. Schizophrenia
 1. Symptoms
 2. Neurobiological bases
- B. Depression
 1. Symptoms
 2. Neurobiological bases
- C. Animal models of psychopathology

FINAL EXAM: May 6; 8:00 a.m.