



Department of Psychology - Columbia University
Behavioral Neuroscience

UN2450 / Course Syllabus / Fall 2019

Instructor: Alfredo Spagna, Ph.D.

Class Meets: Monday Wednesday 1:10 PM - 2:25 PM

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Course Description

Behavioral Neuroscience explores behavior by understanding the influences of biological processes. Why do we dream? What makes us eat? Why are some drugs so addictive? How do we form memories? What are the biological bases of mental disorders? How does the environment interact with our genes? We will explore answers to questions like these by looking at the principles governing neuronal activity, the relationship between brain activity and subjective experience, the role of neurotransmitter systems in memory and motivational processes, and the presumed brain dysfunctions that give rise to mental illnesses like schizophrenia and depression.

Prerequisites

Psych W1001 or W1010 or permission of the instructor. Basic knowledge of biology and chemistry is helpful, but not necessary.

Full Description and learning objectives:

This course aims to provide students with a strong foundation in the new field of Behavioral Neuroscience.

- 👑 Historical Introduction, Neurons and Glia (Ch 1, 2):** Be able to contextualize historical and changing understandings of the function and organization of the nervous system with respect to influences of current technological advancements, scientist personalities, and prevailing cultural

metaphors (e.g. the brain as a computer). Understand the functional, anatomical and physiological differences between neurons and glia.

- 👑 **Membrane Potentials (Ch 3):** Describe the factors that govern the direction and rate of movement of ions across membranes. Understand the structural and functional differences among categories of membrane proteins including: channels, pumps, receptors, and pores. How do they open and close, and what passes across them, in which direction?
- 👑 **Action Potential (Ch 4):** Describe the phases of an action potential and the mechanisms underlying each phase in terms of the movement of ions across the cell membrane. Understand roles of K⁺, Na⁺, Ca²⁺, and Cl⁻ in action potential physiology and in releasing neurotransmitters at the synapse.
- 👑 **Synaptic Transmission (Ch 5):** Compare and contrast properties and locations of chemical and electrical synapses. Understand the mechanics of chemical synaptic transmission from the point of the action potential reaching the axon terminal to the point of the postsynaptic change in membrane potential.
- 👑 **Neurotransmitter systems (Ch 6):** Compare and contrast the major neurotransmitter systems, including pathways and the behavioral systems they regulate.
- 👑 **Structure of the nervous system (Neuroanatomy) (Ch 7):** Understand definitions, locations, and functions of the components and regions of the central and peripheral nervous systems. Be able to associate neurotransmitter systems and organismal-level behaviors with activity in specific neuroanatomical regions and pathways.
- 👑 **The Eye and the Central Visual System (Ch 9 and 10):** Be able to identify key components of the peripheral and central visual system, and the hierarchy of the cortical-subcortical enabling to perceive what is around us. Describe our current understanding of the ventral and dorsal visual pathways and their potential role.
- 👑 **Hearing and vestibular system (Ch 11):** Describe the translation of the physical properties of sound waves into the perception of sound attributes. Show a detailed understanding of the auditory pathway and auditory transduction from the level of channels and ions to perception.
- 👑 **The chemical senses (Ch 8):** Animals, including humans, depend on the chemical senses to help identify nourishment (the sweetness of honey, the aroma of pizza), noxious substances (the bitterness of plant poisons), or the suitability of a potential mate. Of all the sensory systems, chemical sensation is the oldest and most pervasive across species. This chapter considers the most familiar of our chemical senses: taste, or gustation, and smell, or olfaction.
- 👑 **Brain control of movement (Ch 14):** Describe how the brain influences the activity of the spinal cord to command voluntary movements. To appreciate the different contributions of the three hierarchical levels to movement, the highest level, represented by the association areas of

neocortex and basal ganglia of the forebrain, is concerned with *strategy*; the middle level, represented by the motor cortex and cerebellum, is concerned with *tactics*; the lowest level, represented by the brain stem and spinal cord, is concerned with *execution*.



The Resting Brain, Attention, and Consciousness (Ch21): The Default mode Network, the task positive networks of attention: how do we become aware of things? This chapter should give you a thorough examination of the neural pathways underlying attention and its interplay with perception and higher-level cognitive functions.



Brain Rhythms and Sleep (Ch19): Brains have evolved a variety of systems for rhythmic control. Sleeping and waking are the most striking periodic behavior. We will explore selected brain rhythms and summarize what is known about the timers that regulate the everyday ups and downs of our hormones, body temperature, alertness, and metabolism.

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Role of PSYC UN2450 in the curriculum

PSYC UN2450 Behavioral Neuroscience is an intermediate-level lecture course, open to undergraduates and students in the Post-baccalaureate Psychology program. It fulfills the following degree requirements:



For the Neuroscience & Behavior major, this course can be used to fulfill either the P2 Course in Neuroscience requirement or the P4 Additional 2000-level Psychology lecture course, but not both.



For the Psychology major and concentration, and for the Post-baccalaureate Psychology program, this course meets the Group II – Psychobiology & Neuroscience – distribution requirement.

Course website

The most up-to-date information, including changes to the syllabus or to the class schedule, announcements, lecture slides and additional materials are contained on the course website on CourseWorks (Canvas). Be sure you are familiar with it, that you are easily able to login to the website, and that you always have the lecture slides with you (whether printer or digital). If you have problems accessing the course website at any point during the semester, please let me know.

Readings



Required Textbook

Neuroscience Exploring the Brain. Mark R. Bear, Barry W. Connors, Michael A. Paradiso, Lippincott Williams and Wilkins, Fourth Edition, 2016; ISBN 9780781778176

Copies of this book are on reserve at the Science & Engineering Library in the Northwest Corner building. Call number: QP355.2 .B425 2016

👑 Additional Materials:

Various supplemental materials will be provided by the instructor on the course website.

Such material will be selected from:

- Hudspeth, A. J., Jessell, T. M., Kandel, E. R., Schwartz, J. H., & Siegelbaum, S. A. (Eds.). (2013). *Principles of neural science*.

Grades

👑 Exam1: 30% of the final grade

👑 Exam 2: 30% of the final grade

👑 Exam 3: 30% of the final grade (cumulative)

👑 Paper and Seminar: 10% of the final grade

Letter Grade Assignment (in between whole numbers? 0.5+ will be rounded up)

97-100: A+	87-89: B+	77-79: C+	67-69: D+	<60: F
94-96: A	84-86: B	74-76: C	64-66: D	
90-93: A-	80-83: B-	70-73: C-	60-63: D-	

Exams: will be a mix of multiple choice, fill-in, and short-answer questions. The majority of each test will focus on material covered in the lectures, and the corresponding sections in the textbook.

→ While studying, try to emphasize *understanding* and *critical thinking*. Knowing key concepts and definitions is highly valued, of course, but successful students use that knowledge to scaffold a more comprehensive understanding of the material. This is highly advisable for these exams and in general for your career. Rather than simply “memorizing,” try to “understand” the material and use your Instructor and the TAs for clarification. Test questions will include more basic definitional / conceptual knowledge as well as application of that knowledge to new scenarios.

→ Slides on the course website should be considered as a study aid, but they may not be “good enough” on their own unless you come to class and take notes. Sometimes I may have to skip slides in the posted lectures if we run out of time in class. If that happens, you should still read the relevant sections in the textbook, as the textbook material may be included in exams.

Make-up exams: will be allowed only with written justification (e.g., by your doctor or advising dean) and must be taken within one week *after* the exam. (Make-up exams will not be offered before the scheduled exam date.)

Paper and Seminar: This semester you have an opportunity to explore the world of behavioral neuroscience in two ways in addition to attending class: by attending a seminar given by a scientist about their work, and by writing about a recent and exciting finding in the current neuroscience literature. Both assignments are due by 5pm on Friday, April 21st. Late assignments will only earn half credit and must be submitted by 5pm on the last day of classes (May 1st). All assignments must be submitted through the Assignments area on Courseworks. You can complete the assignments at any time during the semester so please plan appropriately as there are no extensions for these assignments.

Class policies: Important Information below – please read carefully!

👑 Disability Services: In order to receive disability-related academic accommodations for this course, students must first be registered with their school Disability Services (DS) office. Detailed information is available online for both the [Columbia](#) and [Barnard](#) registration processes. Refer to the appropriate website for information regarding deadlines, disability documentation requirements, and [drop-in hours](#)(Columbia)/[intake session](#) (Barnard).

For this course, students are not required to have testing forms or accommodation letters signed by faculty. However, students must do the following:

1. The Instructor section of the form has already been completed and does not need to be signed by the professor.
2. The student must complete the Student section of the form and submit the form to Disability Services.
3. Master forms are available in the Disability Services office or online:<https://health.columbia.edu/services/testing-accommodations>

👑 Religious observances: If you are going to miss class(es) due to religious holidays, you must notify me during the first week of class so that accommodations may be made.

👑 Academic integrity: As members of this academic community, we are responsible for maintaining the highest level of personal and academic integrity: “Each one of us bears the responsibility to participate in scholarly discourse and research in a manner characterized by intellectual honesty and scholarly integrity.... The exchange of ideas relies upon a mutual trust that sources, opinions, facts, and insights will be properly noted and carefully credited. In practical terms, this means that, as students, you must be responsible for the full citations of others’ ideas in all of your research papers and projects... [and] you must always submit your own work and not that of another student, scholar, or internet agent” (from the Columbia University Faculty Statement on Academic Integrity) <http://www.college.columbia.edu/academics/academicintegrity> . Cheating and plagiarism – whether intentional or inadvertent – is a serious violation of academic integrity. Plagiarism is the practice of claiming or implying original authorship of (or incorporating materials from) someone else’s written or creative work, in whole or in part, without adequate

acknowledgement. If you have any questions about what constitutes plagiarism and/or how to properly cite sources, please come to me. I am more than happy to help. Similarly, if you put yourself in a situation in which you think your best option might be to cut some corners, see me. If you feel like you are falling behind, don't understand the material, or are not confident about your ability to take tests, talk to me as soon as possible instead of taking measures that go against principles of academic integrity. We are here to learn, not to merely judge. It is a far better option to come talk to me than compromise your academic integrity and potentially put your academic standing in jeopardy.

- 👑 Sexual Respect: Any form of gender-based misconduct will not be tolerated. Columbia University is committed to fostering an environment that is free from gender-based discrimination and harassment, including sexual assault and all other forms of gender-based misconduct. Visit this website for more information: <http://sexualrespect.columbia.edu/>
- 👑 Attendance: Coming to class is meaningless if class time is spent inappropriately. Chatting with friends, watching videos online, and browsing social media are not appropriate activities for the classroom. Also, remember to silence your cell phone before class. Generally, eliminate distractions as much as possible to respect your classmates, as well as increase your chance of staying focused and learning the material during class.

Schedule

The calendar below details topics, readings, and assignments for each class period. Students are responsible to be prepared to discuss the assigned readings for each class period.

Date(s)	Topic	Readings
Sept 4th (W)	Info about the Course, historical Intro	Ch 1
Sep 9 th – 11 th	Neurons and Glia	Ch 2
Sep 16 th – 18 th	Membrane Potential	Ch 3
Sep 23 rd – 25 th	Action Potential	Ch 4
Sep 30 th – Oct 2 nd	Synaptic Transmission	Ch 5
Oct 7 th - 9 th	Neurotransmitter systems	Ch 6
Oct 14th	Exam # 1	Ch 1 - 6
Oct 16 th – 21 st	Structure of the nervous system (Neuroanatomy)	Ch 7
Oct 23 rd – 28 th	The Eye and the Central Visual System	Ch 9 and 10
Oct 30 th – Nov 6 th	Hearing and vestibular system	Ch 11
Nov 4 th and 5 th	NO CLASS SCHEDULED	
Nov 11 th – 13 th	The chemical senses	Ch 8

Nov 18 th – 20 th	Brain control of Movement	Ch 14
Nov 25th	Exam # 2	Ch 7,8,9,10,11,14
Nov 27 th	NO CLASS SCHEDULED	
Dec 2 nd – 4 th	Resting Brain, Attention, and Consciousness	Ch 21
Dec 9 th	Brain Rhythms and Sleep	Ch 19
Dec 16th	Final Exam	Cumulative

* SUBJECT TO CHANGES *

Any changes will be announced in lecture and posted as an announcement on CourseWorks (Canvas).