Course Information

Syllabus

Introduction to Neuroscience
Hunter College- Fall 2018

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BIOL 2700
Course code: 44777
Lectures: Mon, Thursday: 9:45 am -11:00 am
Location: Rm. 926 Hunter North
Office hours: Dr. Friedman (942 HN): Thursday 11-1
Dr. Likhtik (906 HN): TBA
COURSE DESCRIPTION: This is a one-term lecture introductory course. The main focus is to provide an understanding of the principles underlying the function of the nervous system while comprehending certain experimental procedures that have lead to this knowledge. In the first part of the course, the cellular and molecular mechanisms that regulate the activity of individual neurons will be discussed. Then, based on model systems, we will examine how neurons are assembled in networks to give rise to function. Finally, topics related to the development, maintenance, and plasticity of these networks will be covered.
Learning Objectives:
1) Describe the ionic basis of neuronal membrane potentials.
2) Understand the principles of chemical synaptic transmission.
3) Describe the basic features of nervous system development and organization.
4) Understand the processes by which physical stimuli are transformed into electrochemical signals by the five senses (sensory transduction).
5) Interpret and evaluate primary literature.
Prerequisites: BIOL 101 & BIOL 102
Textbook (required): "Neuroscience", fifth edition. Dale Purves, George J. Augustine, David Fitzpatrick, William C. Hall, Anthony-Samuel LaMantia, Leonard E. White, Eds. Sinauer Associates.
COURSE REQUIREMENTS:
Reading: Additional handouts or reading assignments to accompany the reading and lecture material will be available on BlackBoard.
Examinations: There will be 3 in-class written exams based on the lecture material. None of the exams will be cumulative; however, as the term progresses new information will be based on information provided previously. Various types of questions (e.g., multiple-choice, short-answer, fill-ins, true-false, problem solving, matching) will be included. If you are going to miss an exam, you must contact one of the instructors before the exam takes place, and you must produce a written excuse from your doctor or the dean's office. If you miss an exam and you do not contact any of the instructors before the exam, you will receive a score of zero (0) for that exam.
Grade distribution:

3 exams	65% of final course grade (20% + 20% + 25%)
Homework assignments	20% of final course grade (5 homeworks 4% each)
Presentation	10% of final course grade
Effort and participation	5% of final course grade

How is effort and participation scored?
You don't come to class: 0%
You come to class and never participate (never ask or answer questions, never partake in discussion): 2%
You come to class and ask us questions if you don't understand something, bring up an idea you'd like to discuss, speak up if what we are saying isn't making sense to you, ask "what if" questions of your classmates after a presentation, etc: 5%
Policy on Academic Integrity
Academic integrity is a guiding principle at Hunter College. As stated in the Hunter Policy on Academic Integrity, "The College has the responsibility to review all charges of academic dishonesty and implement sanctions, including, but not limited to, failing the course, official transcript notation, suspension or expulsion from the College when it has been determined that academic dishonesty did occur. Academic dishonesty includes, but is not limited to, cheating, plagiarism, obtaining an unfair advantage, and falsifying records or documents whether intentional or not." **Plagiarizing on any assignment (e.g. HW assignments) will result in an F.**
Think about what it means to plagiarize: From Webster's New World College Dictionary (4th ed.): "plagiarize = to take (ideas, writings, etc.) from (another) and pass them off as one's own". Make appropriate references in your written assignments.
Behavior that is disrespectful to the instructor or fellow students during class will not be tolerated. **This includes exchanging electronic or other notes, web-surfing, talking amongst each other, playing with any electronic gadget, etc.**
Late submissions will result in a 50% reduction in score for the particular assignment.
What is a late submission? Day after due date or later.

LECTURE SCHEDULE

Monday, Aug. 27—Dr. Likhtik & Dr. Friedman
Introduction: structure and diversity of neurons, glial cells.
Chapter 1. *Studying the Nervous System.*
Thursday, August 30, 2018 -Dr. Friedman
Resting membrane potential
Chapter 2. *Electrical signals of nerve cells*
Monday, September 3, 2018
No class, Labor Day

Wednesday, September 5, 2018 Classes follow Monday schedule) –Dr. Friedman
Equilibrium potential
Chapter 2. *Electrical signals of nerve cells*
Thursday, September 6, 2018 – Dr. Friedman
Active properties of the neuronal membrane: generation and propagation of the action potential.

Chapter 3. *Voltage-dependent permeability*
Huxley, A. F. (2002). "Hodgkin and the action potential 1935–1952." The Journal of Physiology **538**(1): 2.

Problem set 1 due
Thursday, September 13, 2018 –Dr. Friedman
Chapter 3. *Voltage-dependent permeability*
Chapter 4. *Ion channel and transporters*
Monday, September 17, 2018 - Dr. Friedman
Chapter 4. *Ion channel and transporters*

HW#2 Due

Student Presentation 1: Mechanisms of diseases that affect neural conduction
Anita, Michelle, Leslie
Tuesday, September 20, 2018- Dr. Friedman
Chapter 5: *Synaptic transmission*
Monday, September 24, 2018
EXAM I – Dr. Friedman
Thursday September 27, 2018 – Dr. Friedman
Chapter 6: *Neurotransmitters and their receptors*
Monday, October 1, 2018 - Dr. Friedman
Chapter 6: *Neurotransmitters and their receptors*
Student Presentation 2: Neurotoxins in Nature, Medicine and War
Shereen, Hira, Franklin
Thursday, October 4, 2018- Dr. Friedman
Chapter 7: Molecular signaling
Monday, October 8, 2018
No class Columbus Day
Thursday, October 11, 2018 – Dr. Friedman
Chapter 7: *Molecular signaling within neurons*
HW#3 Due
Monday, October 15, 2018 – Dr. Friedman
Chapter 8: *Synaptic Plasticity*
Thursday, October 18, 2012 – Dr. Friedman
Chapter 8: *Synaptic Plasticity*
Student Presentation 3: The mechanisms behind Improving your memory with training.
Alicia, Samrat, Mehriniso
Tang Ya-Ping, Shimizu E., Dube G.R., Rampon C., Kerchner G.A., Zhuo M., Liu G., Tsien J.Z. (1999)
Genetic enhancement of learning and memory in mice. *Nature* 401: 63-69.

Review for Exam II.
Monday, October 22, 2018
Exam II. – Dr. Friedman
Thursday, October 25, 2018 Dr. Likhtik
Mix of Chapter 22: *Early brain development* and Chapter 23: *Construction of Neural Circuits*
Monday, October 29, 2018 - Dr. Likhtik
Chapter 11: *Vision - The Eye*
Thursday, November 1, 2018 - Dr. Likhtik
Chapter 12: *Central Visual Pathways*
Monday, November 5, 2018 –
Guest speaker

Thursday, November 8, 2018 – Dr. Likhtik
Chapter 13: *The Auditory System*
Student Presentation 4: Psychedelics: visual hallucinations and treating depression
Ilana, Ylona, Phuong, Aliyah
HW #4 due

Monday, November 12, 2018 Dr. Likhtik
Chapter 14: *The Vestibular System*
Thursday, November 15, 2018 - Dr. Likhtik
Chapter 15: The Chemical Sense (Focus on olfactory & taste)
Monday, November 19, 2018 - Dr. Likhtik
Chapter 28: *Sleep and Wakefulness*
Student Presentation 5: Using the insect olfactory system to control malaria and the dog olfactory system to detect cancer
Tanubrata,Roy , Megan
Thursday, November 22, 2018
Thanksgiving Holiday. University Closed.
Monday, November 26, 2018 – Dr. Likhtik
Chapter 18: *Modulation of movement by the basal ganglia*
Thursday, November 29, 2018 – Dr. Likhtik
Chapter 29: *Emotion*
HW# 5 Due
Monday, December 3, 2018 - Dr. Likhtik
Chapter 31: *Memory*
Thursday, December 6, 2018 – Dr. Likhtik
Neuroscience Techniques - studying the structure and function of the nervous system

Student Presentation 6: Basal Ganglia in Parkinson's and Huntington's Disease
Juan, Rebecca, Lin

Chen F., Tillberg P.W., Boyden E.S. (2015) Expansion microscopy. *Science* 347: 543-548.
Kolar K., Weber W. (2018) Synthetic biological approaches to optogenetically control cell signaling. *Curr Opinions Biotech* 47: 112-119.
Hutchinson E.B., Schwerin S.C., Avram A.V., Juliano S.L., Pierpaoli C. (2018) Diffusion MRI and the detection of alterations following traumatic brain injury. *J Neurosci Res* 1-14.

Monday, December 10, 2018 - Dr. Likhtik
Tying up loose ends
Review for Exam III

Presentation sign up sheet

Attached Files: CCF08302018.pdf (347.939 KB)

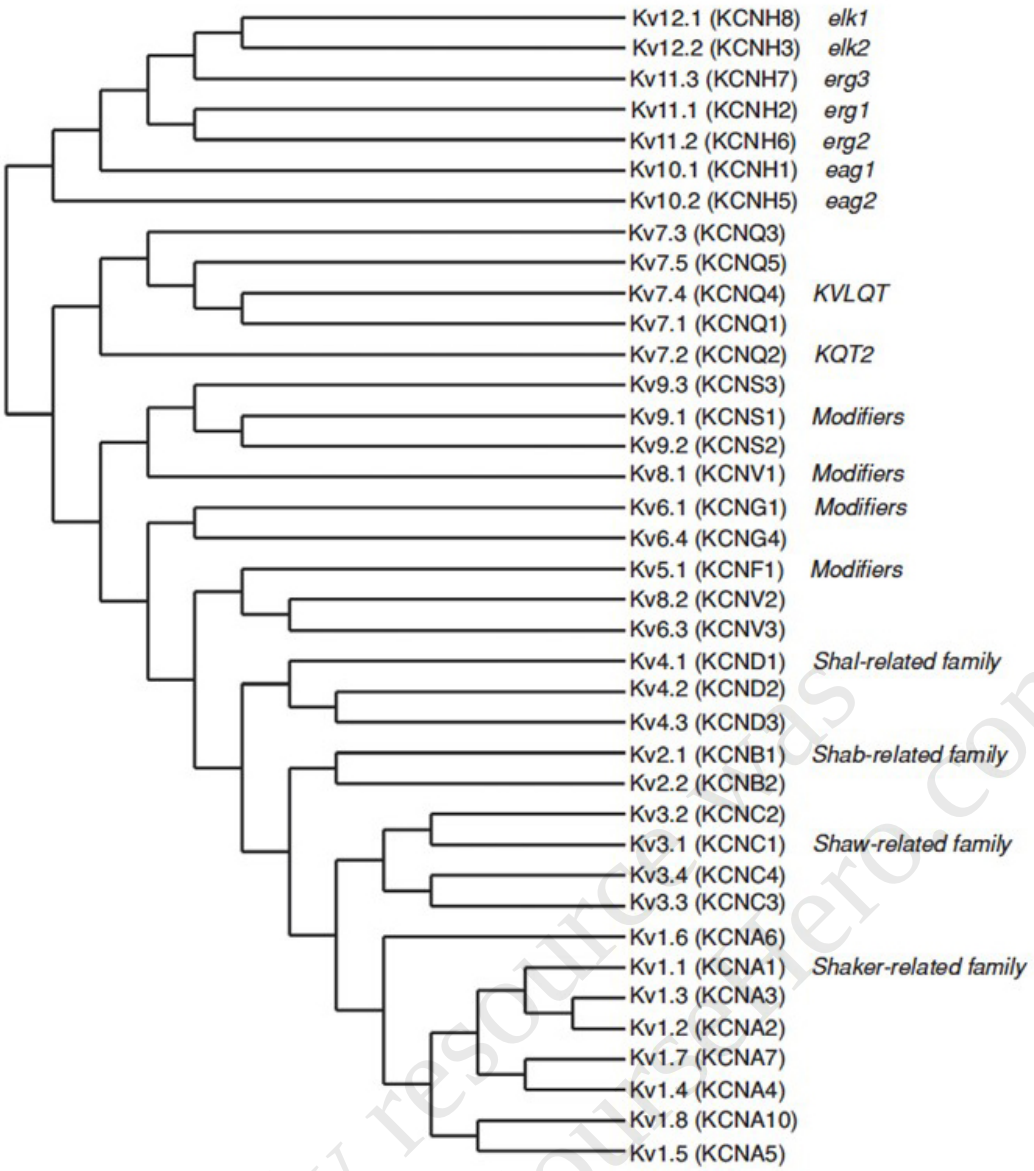
Presentation Evaluation

Attached Files: PresentationEvaluation.pdf (53.497 KB)

Diversity of voltage-gated potassium channels

Diversity of voltage-gated potassium channels

The human genome contains ~80 potassium channel genes of which 40 genes encode voltage-gated potassium channel pore-forming subunits that fall into 12 subfamilies . Physiologically subdivided into A-type potassium channels that display fast inactivation and delayed rectifier potassium channels without fast inactivation, these K_V channels are molecularly and functionally diverse. Fast inactivation, which may impact the action potential duration during repetitive firing, is evident in K_V1 channels containing $K_V1.4$ or $K_V\beta1$, K_V3 channels, and K_V4 channels. The delayed rectifier potassium current originally characterized by Hodgkin and Huxley for its role in action potential likely corresponds to the squid K_V1 channels that may rely on RNA editing to achieve the flexible functional diversity as many small axons of the giant fiber lobe neurons fuse to form the squid giant axon with greater action potential conduction rate .



Sodium-Potassium Pumps

The Sodium-Potassium Pumps are always at work. One can think of them as a continuous process that maintains the equilibrium potential for the individual ions. They always are grabbing internal sodium and exchanging it with external potassium at the cost of ATP.

The Sodium-Potassium pump is a slower process, so it usually can be ignored over a single spike. But If there is a high frequency spike train then the small amount of sodium that enters the cell and potassium that exits the cell can add up and effect the equilibrium potentials of the individual Ions. This of course can change the firing properties of the neuron.