MCB 165: Molecular Neurobiology

University of California, Berkeley

Spring 2014

Tu and Th 5-6:30 pm, 105 North Gate

Instructor: Natalia Caporale
Caporale.n@berkeley.edu
308 Barker Hall
Office Hours: TBD

GSI: Alex Naka
alex.naka@berkeley.edu
Office Hours: TBD

Course Description:

The goal of this course is to provide students with insights into the molecular mechanisms underlying development, function and pathology of the nervous system. This course will focus on three main topics: synaptic transmission, synaptic plasticity and regeneration and development. We will explore each of these topics at the molecular and cellular levels, reviewing what is currently known, what are the areas of active research and what happens to the organism when they malfunction. In the context of synaptic plasticity, we will not only discuss the molecular mechanisms and learning rules that allow for activity dependent modification of neuronal connectivity, but we will also explore how these change through the development of an organism, as well as the role of experience in guiding these changes. In the context of diseases, we will explore the molecular, cellular and circuit basis of disorders such as Fragile X Syndrome, Alzheimer's Disease and Schizophrenia.

This course assumes that students have a working understanding of basic neurobiological concepts such as electrical signaling of neurons, principles of synaptic transmission and overall organization of the nervous system, as they are covered in the course MCB 160.

Pre-requisites:

MCB 160 is a pre-requisite for this class. You can also take MCB 165 if you are taking MCB 160 concurrently. While we will not check each student for pre-requisites, we believe that having the appropriate background will be key to the success of students in this class.

Textbook:

Kandel Schwartz & Jessel, Principles of Neuroscience. McGraw-Hill, 5th Ed. (2012).

Unfortunately, there is not one single textbook that covers all these topics in adequate level of details. We will use the book Principles of Neural Science, by Kandel, as it is one of the most comprehensive resources available and we hope that students will have it from MCB 160. However, **due to the novelty of some of the topics that we will cover, we will be complementing textbook readings with current reviews and articles**.

Primary Literature Analysis

In addition to lectures and readings from the textbook, students will also be asked to read primary research articles in this class. Reading articles critically is a very important skill for all biologists and a great way to learn how research is carried out and tested.

Throughout the course students will be asked to read **5 research papers** relevant to the topics covered in class. A **reading guide** accompanies each of the papers with some background and questions about the work, its methodology, possible caveats, and its interpretation. Students are expected to submit a written response to these questions by the dates shown in the syllabus. While you are encouraged to discuss the papers with others and your GSI, answers should be submitted individually, IN YOUR OWN WORDS! Papers and guides will be available online two weeks before the deadline.

All papers will be discussed in discussion section the week before deadline. We encourage everyone to attend!

Answes to the literature analysis **guides must be submitted in writing (typed)** at the beginning of lecture on the due date. Late submissions will be penalized 20%/day. **Students are responsible for keeping an electronic version of their work in case the original is lost.**

Discussion Section

Attendance at discussion section is not compulsory in this course but it is recommended. The schedule of topics to be covered in discussion section is shown in the class schedule. Discussion section will alternate between reviewing the material from the prior lectures and discussing the papers given as homework. We are lucky to have an amazing GSI with us this semester, Alex Naka, so I hope that you will take advantage of him and all his knowledge!

Exams

Exams in this class will consist mostly on short answer questions and analysis of figures. Midterms will include all the material covered in lecture and the homework papers. The final exam is comprehensive including all the material and papers.

Surveys:

Throughout this course you will be asked to complete 3 online surveys. The goal of these surveys is for you to provide us with feedback on sections (survey 1); lectures and the first exam (survey 2) and the class (survey 3). These surveys are reviewed for completion and answers are kept confidential. We strongly believe that student feedback is key to the success of this class! Open and due dates for the surveys are listed in the class schedule.

Grading

Grades on this class are based on exams (2 midterms, 1 final), the literature analysis guides (5) and the completion of three online surveys.

Grade distribution will be as follows:

Literature Analysis Guides	10 %
Survey Responses	1 %
Two Midterms	50%
Final	39 %

Your letter grade in the course will be determined according to **absolute standards of performance**. You will not be in competition with your classmates for the grades nor will the class be curved to a predetermined distribution. It would be wonderful if everyone would get an A in the class. However, as you all know letter grades are based upon the points that you EARN (not based upon needs or wants).

Grades are usually assigned following the guidelines below:

A (some form of an A)	100-90%	D (some form of a D)	69-60%
B (some form of a B)	89-80%	F	59-00%
C (some form of a C)	79-70%		

We strongly recommend that you focus on learning and enjoying the material! If you are enjoying the class and excited about the materials we are discussing, the good grades will follow!

Berkeley Honor Code Statement

The student community at UC Berkeley has adopted the following Honor Code:
"As a member of the UC Berkeley community, I act with honesty, integrity, and respect for others." The hope and expectation is that you will adhere to this code.

Collaboration and Independence: Reviewing lecture and reading materials and studying for exams can be enjoyable and enriching things to do with fellow students. This is recommended. However, unless otherwise instructed, homework assignments are to be completed independently and materials submitted as homework should be the result of one's own independent work.

Cheating: A good lifetime strategy is always to act in such a way that no one would ever imagine that you would even consider cheating. Anyone caught cheating on a quiz or exam in this course will receive a failing grade in the course and will also be reported to the University Center for Student Conduct. In order to guarantee that you are not suspected of cheating, please keep your eyes on your own materials and do not converse with others during the quizzes and exams.

Plagiarism: To copy text or ideas from another source without appropriate reference is plagiarism and will result in a failing grade for your assignment and usually further disciplinary action. For additional information on plagiarism and how to avoid it, see, for example:
http://www.lib.berkeley.edu/instruct/guides/citations.html#Plagiarism
http://gsi.berkeley.edu/teachingguide/misconduct/prevent-plag.html

Academic Integrity and Ethics: Cheating on exams and plagiarism are two common examples of dishonest, unethical behavior. Honesty and integrity are of great importance in all facets of life. They help to build a sense of self-confidence, and are key to building trust within relationships, whether personal or professional. There is no tolerance for dishonesty in the academic world, for it undermines what we are dedicated to doing – furthering knowledge for the benefit of humanity.

Your experience as a student at UC Berkeley is hopefully fueled by passion for learning and replete with fulfilling activities. And we also appreciate that being a student may be stressful. There may be times when there is temptation to engage in some kind of cheating in order to improve a grade or otherwise advance your career. This could be as blatant as having someone else sit for you in an exam, or submitting a written assignment that has been copied from another source. And it could be as subtle as glancing at a fellow student's exam when you are unsure of an answer to a question and are looking for some confirmation. One might do any of these things and potentially not get caught. However, if you cheat, no matter how much you may have learned in this class, you have failed to learn perhaps the most important lesson of all.

Class Schedule (Subject to Change – This will be updated online)

Date		Day	Lec #	Topic	Chap	Discussion
Jan	21	Tu	1	Introduction to the course Review of Ionic Mechanisms	6, 7	Review of Materials of Lectures 1-2
	23	Th	2	Ion Channels / Metabotropic Signaling	5, 9, 13	
	28	Tu	3	Synaptic Transmission: Presynaptic Side	12	Paper 1 Discussion
	30	Th	4	Synaptic Transmission: Postsynaptic Side (Including clearance and extra synaptic receptors)	5, 9, 13	
Feb	4	Tu	5	Neurotransmitters and Neuromodulators **(Paper 1 Due)**	13	Discussion of Recent Lectures
	6	Th	6	Psychoactive Drugs & Reward Systems: VTA and nACC	49	
	11	Tu	7	Dopamine: Addiction / Parkinson's	43, 49	Paper 2 Discussion
	13	Th	8	Serotonine: Depression / Aggression / Therapeutics	63	
	18	Tu	9	Schitzophrenia:Dopamine /Glutamate Theories **(Paper 2 Due)**	62	Discussion of Recent Lectures
	20	Th	10	***TBD / Spill Over***		
	24	**Mon**		**GSI Led Review Session on Lectures 1-10 (Location & Time TBD)**		NO DISCUSSION SECTIONS
	25	Tu		**In-Class Exam I (Lec 1-10)**		
	27	Th	11	Circuits: The Canonical Cortical Column / CPGs	36	
Mar	4	Tu	12	Methods to study and modulate circuits (ChR2/Virus/etc)		Paper 3 Discussion
	6	Th	13	Synaptic Plasticity: LTP/LTD/STDP; Cerebellar LTD; mGluR-LTD	66	
	11	Tu	14	Strutural Plasticity/ Synaptic Tagging/ Silent Synapses **(Paper 3 Due)**	66	Discussion of Recent Lectures
	13	Th	15	Plasticity of Inhibitory Synapses		
	18	Tu	16	Homeostatic Plasticity / Dev. Changes in Plasticity		Paper 4 Discussion
	20	Th	17	Alzheimer's Disease	59	
	25	Tu		***Spring Break***		
	27	Th		***Spring Break***		
April	1	Tu	18	Fragile X / Autism Disorder **(Paper 4 Due)**	64	Discussion of Recent Lectures
	3	Th	19	***TBD / Spill Over***		
	7	**Mon**		**GSI Led Review Session on Lectures 1-10 (Location & Time TBD)**		NO DISCUSSION SECTIONS
	8	Tu		**In- Class Exam II (Lec 11-19)**		
	10	Th	20	Overview of Early Stages in Development	52	
	15	Tu	21	Determination of Cell Fate, Growth Factors, Apoptosis	53	Discussion of Recent Lectures
	17	Th	22	Synaptogenesis	55	
	22	Tu	23	Stem Cells and Adult neurogenesis	56	Paper 5 Discussion
	24	Th	24	Regeneration in PNS and CNS	57	
	29	Tu	25	Critical Periods / Effects of Experience on CP **(Paper 5 Due)**	56	Discussion of Recent Lectures
May	1	Th	26	TBD (Might be Epigenetics or Continuation of Lec 25)		
May 5-9				***RRR week (Lectures on Tu and Th will meet to review Lectures 1-19)***		**Review in DS**
	9	**Fri**		**GSI Led Review Session on Lectures 1-10 (Location & Time TBD)**		
May 16		Fri		**Comprehensive Final Exam @ , 11:30 -2:30 pm , Location TBD**		