

# MCB 160L: Neurobiology Laboratory

## Spring 2019

### Course description

In this course you will be introduced to a variety of techniques that are commonly used to study the nervous system. Neurobiology is a diverse field that utilizes an incredible variety of experimental techniques. We have selected a few examples for you to work with from electrophysiology, optogenetics, cell biology, psychophysics, imaging, genetics, and anatomy. Experiments will be done on cells, invertebrates, and humans, and will cover molecular channel properties, neuronal cell physiology, sensory systems, and behavior. We hope that by doing these experiments you will gain a better understanding of key principles in neuroscience. In addition, you will learn how to design experiments, keep a detailed laboratory notebook, troubleshoot experiments, analyze your data, and present your findings in written reports.

Prerequisites: Bio 1A/1AL; Physics 8A/B; MCB 160 or equivalents

### Course organization

Every week, there is one hour of lecture on Monday that will introduce you to that week's lab(s), and then two lab sections that are four hours each.

Lecture: Monday 3-4pm in 101 LSA

Lab section: T/Th or W/F 12-4pm in 4070 VLSB

### Instructors

Robin Ball (course director), [rball@berkeley.edu](mailto:rball@berkeley.edu), 134 LSA

Steve Brohawn, [brohawn@berkeley.edu](mailto:brohawn@berkeley.edu), 289 LSA

Marla Feller, [mfeller@berkeley.edu](mailto:mfeller@berkeley.edu), 195 LSA

### Graduate student instructors

GSI	Email	Section
Holly Gildea	<a href="mailto:holly_gildea@berkeley.edu">holly_gildea@berkeley.edu</a>	101: T/Th 12-4pm
Tobias Schmid	<a href="mailto:tschmid@berkeley.edu">tschmid@berkeley.edu</a>	101: T/Th 12-4pm
Chris Hoel	<a href="mailto:choel@berkeley.edu">choel@berkeley.edu</a>	102: W/F 12-4pm
Josh Tworig	<a href="mailto:jtworig@berkeley.edu">jtworig@berkeley.edu</a>	102: W/F 12-4pm

All office hours for instructors and GSIs will be announced and posted on bCourses

## Lab manual

You are required to purchase a lab manual from Replica Copy and to bring the lab manual with you to every lab. The manual provides important background information and the procedures for each lab. Before coming to each lab, you are expected to read the relevant section of the manual and to write a Prelab section for the experiment in your notebook (see the Lab Notebook Guidelines for more details). Your experiments will go much more smoothly and you will finish faster if everyone in your group has read the manual before class.

## Textbook

There is no required textbook for this course, but you may need to refer to a neuroscience textbook such as:

1. Kandel, E.R., Schwartz, J.H., Jessell, T.M. , Siegelbaum, S.A. , Hudspeth, A.J. Principles of Neural Science. 5th edition, McGraw-Hill, 2013. Available online through the UCB library.
2. Luo, L. Principles of Neurobiology. 1st edition. Garland Science, 2015.
3. Hille, B. Ion Channels of Excitable Membranes. 3<sup>rd</sup> edition. Sinauer, 2001.

## Assignments and grades

Lab notebook	10 %
4 Lab Reports (8% each)	32 %
Article presentation	5 %
Exam 1	25 %
Exam 2	25 %
Lab participation	3 %

### *Lab notebook*

You are required to bring your lab notebook with you to every lab session. Your notebook should include a summary of the procedures, notes about the experiment, data collected during lab, drawings and images you make during lab, and answers to questions in the lab manual or worksheets. You can find more details about the notebook after the course schedule (in the lab manual). GSIs will randomly check lab notebooks throughout the semester, so always bring your lab notebook and keep up with your work. This will be an invaluable resource when you study for the exams.

### *Lab reports*

You will write four lab reports. Guidelines for each report are found at the end of that lab in the lab manual. Think of the lab reports as journal articles where you can describe your experiments and results. You will upload your lab reports in pdf format directly into bCourses. Lab reports will always be due on Sundays at 11:59pm. Each student should write their own lab reports using their own words.

### *Journal article presentation*

Periodically throughout the semester, a group of students will give an oral presentation (15 minutes + 5 minutes for questions/discussion) based on a primary research article. Faculty instructors will choose articles related to the topics and techniques covered in the laboratory. Students will meet with the faculty in charge of that article to discuss the paper. Students should read the paper thoroughly before the meeting and be prepared to ask any questions that will help them to understand the goals of the work, technical details, results, or interpretations. These meetings usually last for about an hour. Faculty instructors will assign points for this meeting, based primarily

on students' preparedness and their participation in the discussion. Students should use PowerPoint or other presentation tools to prepare graphical aids for their presentations. GSIs will grade the presentations, based on guidelines that they will communicate.

### *Written exams*

There are two exams in this course: Exam 1 covers material from Labs 1-6 and Exam 2 covers material from Labs 7-13. The exams will be 2 hours long and take place during your lab section. They may include a practical component like how to use the electrophysiology equipment, microscope or identifying a structure in a slide.

### *Missed exams*

If you have official school travel that conflicts with the exams, please inform your GSI and the professors, and we will do our best to give you a make-up exam. Unexcused missed exams will receive 0 points.

### *Lab participation*

GSIs have the discretion to assign these points based on attendance (and being on time), effort, preparedness, experimental technique, and active participation during class and presentations.

### *Attendance in lab*

Attendance in laboratory sessions is **required**. A laboratory missed for a documented medical reason can be made up through arrangement with your GSI. More than one missed lab requires a written excuse from a relevant health professional on their letterhead within one week. Labs missed for other than medical or official school function reasons are considered unexcused and cannot be made up. Official school-related excused absences include trips for music or sports activities or travel for scientific meetings, medical school/grad school interviews, etc.

Only one unexcused absence from a lab is permitted. A subsequent unexcused laboratory absence will decrease your total grade by up to 5%. Regardless of the reason for the absence, your lab notebook should still be up to date. Get information about the lab and missing data from other students in your lab section.

Be on time to your lab section. If you are more than 10 minutes late for 3 days, your total grade will decrease by up to 5%. Each subsequent tardy will result in further loss of points.

## **Student Honor Code**

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://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. We 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. 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.

### **Safe, Supportive, and Inclusive Environment**

Whenever a faculty member, staff member, post-doc, or GSI is responsible for the supervision of a student, a personal relationship between them of a romantic or sexual nature, even if consensual, is against university policy. Any such relationship jeopardizes the integrity of the educational process. Although faculty and staff can act as excellent resources for students, you should be aware that they are required to report any violations of this campus policy. If you wish to have a confidential discussion on matters related to this policy, you may contact the Confidential Care Advocates on campus for support related to counseling or sensitive issues. Appointments can be made by calling (510) 642-1988.

The classroom, lab, and work place should be safe and inclusive environments for everyone. The Office for the Prevention of Harassment and Discrimination (OPHD) is responsible for ensuring the University provides an environment for faculty, staff and students that is free from discrimination and harassment on the basis of categories including race, color, national origin, age, sex, gender, gender identity, and sexual orientation. Questions or concerns? Call (510) 643-7985, email [ask\\_ophd@berkeley.edu](mailto:ask_ophd@berkeley.edu), or go to <http://survivorsupport.berkeley.edu/>.

### **DSP Students**

Please inform your instructor of any accommodations needed during the first week of the course.

### **Letters of Recommendation**

Any of the three instructors may be approached for a letter of recommendation. We are willing to provide a written evaluation for this purpose. So that we may prepare effective evaluations we ask that you follow the procedure outlined here. Be sure to attend the journal club discussion session with the instructor and attend office hours. In addition, ask your laboratory section GSI to write a couple of paragraphs about your participation in section. Sometime after the end of the course, send a copy of your CV or resume and Personal Statement to the instructor and GSI. Please note that some instructors get asked for letters from many students and will only be able to accommodate a certain number of requests.

## Schedule

Date	Day	Lab/Lecture	Assignments due
Jan 22/23	Tu/W	Intro to course + library exercise, start Lab 1	
Jan 24/25	Th/F	Lab 1: Intro to electrophysiology equipment	
Jan 28	M	Lec 1: Action potential conduction (SB)	
Jan 29/30	Tu/W	Lab 2: Earthworm action potentials	
Jan 31/Feb 1	Th/F	Lab 2: Earthworm action potentials	
Feb 4	M	Lec 2: Voltage-clamp (SB)	
Feb 5/6	Tu/W	Lab 3: Voltage-clamp computer simulations	
Feb 7/8	Th/F	Lab 3: Voltage-clamp computer simulations Journal article #1	Journal article #1 Lab 2 report due 2/10
Feb 11	M	Lec 3: Drosophila NMJ and optogenetics (RB)	
Feb 12/13	Tu/W	Lab 4.1: Introduction to Drosophila dissections and optogenetics	
Feb 14/15	Th/F	Lab 4.2: Drosophila NMJ intracellular recording	
Feb 18	M	No class (President's Day)	
Feb 19/20	Tu/W	Lab 4.2: Drosophila NMJ intracellular recording	
Feb 21/22	Th/F	Lab 4.2: Drosophila NMJ intracellular recording Journal article #2	Journal article #2
Feb 25	M	Lec 4: EEG and axon growth (RB)	
Feb 26/27	Tu/W	Lab 5: Electroencephalogram (EEG)	
Feb 28/Mar 1	Th/F	Lab 6: Neurite outgrowth Journal article #3	Journal article #3
Mar 4	M	Lec 5: Sensory and reflexes (RB)	
Mar 5/6	Tu/W	<b>Exam 1 in lab section (Labs 1-6)</b>	Exam 1
Mar 7/8	Th/F	Lab 7: Human sensory and reflexes	Lab 4 report due 3/10
Mar 11	M	Lec 6: Oocyte system and ATP receptor (SB)	
Mar 12/13	Tu/W	Lab 8.1: Voltage-clamp oocytes (ATP receptor)	
Mar 14/15	Th/F	Lab 8.1: Voltage-clamp oocytes (ATP receptor) Journal article #4	Journal article #4
Mar 18	M	Lec 7: K channels (SB)	
Mar 19/20	Tu/W	Lab 8.2: Voltage-clamp oocytes (K channels)	
Mar 21/22	Th/F	Lab 8.2: Voltage-clamp oocytes (K channels) Journal article #5	Journal article #5
		Spring Break	
Apr 1	M	Lec 8: Allen brain atlas (RB)	
Apr 2/3	Tu/W	Lab 9: Mammalian neuroanatomy	

Apr 4/5	Th/F	Lab 10: Allen brain atlas <a href="#">Journal article #6</a>	Journal article #6 Lab 8 report due 4/7
Apr 8	M	Lec 9: Immunocytochemistry (MF)	
Apr 9/10	Tu/W	Lab 11.1: Immunocytochemistry (staining)	
Apr 11/12	Th/F	Lab 11.2: Immunocytochemistry (imaging)	
Apr 15	M	Lec 10: Calcium imaging (MF)	
Apr 16/17	Tu/W	Lab 12: Calcium imaging	
Apr 18/19	Th/F	Lab 12: Calcium imaging <a href="#">Journal article #7</a>	Journal article #7
Apr 22	M	Lec 11: Intro to <i>C. elegans</i> and RNAi (MF)	
Apr 23/24	Tu/W	Lab 13.1: <i>C. elegans</i> axon guidance	
Apr 25/26	Th/F	Lab 13.2: <i>C. elegans</i> axon guidance <a href="#">Journal article #8</a>	Journal article #8
Apr 29	M	Lec 12: Axon guidance (MF)	
Apr 30/May 1	Tu/W	Lab 13.3: <i>C. elegans</i> axon guidance	
May 2/3	Th/F	<b>Exam 2 in lab section (Labs 7-13)</b>	Exam 2
May 12*			Lab 13 report due

\* We cannot accept Lab 13 reports after May 12, because the GSIs need time to grade them before final grades are due. Start working on this report early, so you can be sure to submit it on time.