

MCB 168 Sensory Neuroscience

Fall 2022 Syllabus

4 Units

COURSE DESCRIPTION

Sensory cells monitor the environment to trigger behaviors required to feed, avoid danger and thrive. This interactive course combines lectures with instructor-led discussions of research from the scientific literature. Our goals are two fold. First, we will present current concepts in sensory neurobiology by illustrating how different sensory inputs govern homeostasis and behavior. Second, through discussions of scientific data, the course will foster critical thinking skills and provide practice in drawing logical, evidence-based conclusions.

Topics

Topics include: principles of sensation across sensory systems (i.e., vision, hearing, olfaction, taste, somatosensation) and species (invertebrates to humans); biophysical, molecular and cellular mechanisms of sensory transduction; molecules & simple circuits that drive adaptive behaviors; genetic basis of human sensory impairments; interoception; sensory dysfunction in neurodevelopmental and neurological disorders.

Learning Objectives:

- Illustrate molecular and cellular principles of sensory coding across sensory systems.
- Explain modern technologies for analyzing sensory systems and the data they produce.
- Describe common display formats of neuroscientific research data (e.g., electrophysiological traces, current-voltage relationships, histograms) and summarize results from primary data.
- Critically analyze primary research literature, including identifying premise, stating the hypothesis, summarizing main results and evaluating conclusions.
- Construct a well-posed research question based on the literature and formulate a testable hypothesis.
- Apply knowledge of modern research methods by proposing logical experiments to test a hypothesis, predicting the likely experimental results, and drawing well-supported conclusions.

Course Schedule

Week Topic

1–2	Principles of sensation
3	Force-gated ion channels & hair cells
4	Touch & proprioception
5	Pain
6	Itch
7	Interoception
8	Neural control of homeostasis
	<i>Midterm I</i>
9	Taste & sensory control of feeding
10	Olfaction
11	Water sensing
12	Vision: evolution & transduction
13	Vision: Color vision
	<i>Midterm II</i>
14	Maps: Topography in the CNS
15	Sensory processing in the CNS
	RRR week
	<i>Final exam</i>

Prerequisites

MCB 160 or Biology 1A/1AL-1B, Physics 8A-8B and consent of Instructor

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INSTRUCTORS & COMMUNICATION

Professor Diana Bautista
Email: dbautista@berkeley.edu
Office Hours & Location: TBD

Professor Ellen A. Lumpkin ('she' pronouns)
Email: lumpkin@berkeley.edu
Office Hours & Location: TBD

Communication about course logistics

Please direct questions and concerns about course logistics to all Instructors via Canvas messaging. Discussion threads on bCourses are also available for posting logistics questions to all course participants.

Communication about course content outside of class

Piazza is available for posting questions and answers related to course content. You are encouraged to check Piazza often, and answer posted questions. Questions and answers will be reviewed daily Sunday through Thursday by GSIs and faculty. Note that Piazza will be turned off during exams, so please post your questions by 5 PM on the day before an exam.

DIVERSITY STATEMENT

The diversity that students bring to this class is a strength and benefit. It is our intention that students from diverse backgrounds and perspectives will be well served by this course, that all students' learning needs will be addressed. We intend to present in a way that is inclusive of our UC Berkeley community's identities: gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated.

COURSE FORMAT (3 hours of Lecture and 1 hour of Discussion per week; In person)

This new Course is designed to actively engage students, GSIs and Instructors in collaborative, discovery-based learning. Topics will be covered through a combination of:

- pre-class assignments
- in-class learning exercises and discussions
- reading and analysis of primary research literature

Two key strategies for achieving your learning objectives are:

- completing pre-class assignments before coming to class
- actively participating in the in-class learning activities

Pre-class assignments

Pre-class, required assignments will be posted on bCourses well in advance of each class. These materials will cover core concepts or skills that will be applied during in-class exercises. Material will be covered through a combination of videos, required reading, primary research papers and reading-guide worksheets. When lecture videos are assigned, lecture notes will also be posted to facilitate note-taking.

Time will be set aside during each class for students to ask clarifying questions about pre-course assignment.

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Examples of typical pre-course assignments include:

Class #	Pre-class Assignment	Deadline
1	1a. review <i>MCB 168 syllabus</i> 1b. view lecture video: <i>Principles of sensory systems part 1 (Lumpkin)</i>	Thurs. 08.25.2022
2	2a. view lecture video: <i>Principles of sensory systems parts 2–3 (Lumpkin)</i>	Tues. 08.30.2022
3	3a. view lecture video: <i>How to read a scientific paper (Bautista)</i> 3b. read research paper, noting questions to ask in class: <i>Hudspeth & Jacobs (1979) Stereocilia mediate transduction in vertebrate hair cells. PNAS 76:1506–1509.</i>	Thurs. 09.01.2022 Thurs. 09.01.2022
4	4a. view lecture video: <i>Fundamentals of mechanotransduction (Lumpkin)</i> 4b. view lecture video: <i>Hair cells & the cochlea (Lumpkin)</i>	Tues. 09.06.2022
5	5a. read research paper, following the reading-guide worksheet: <i>Walker, Willingham & Zuker (2000) A Drosophila mechanosensory transduction channel. Science. 287:2229–2234.</i>	Tues. 09.06.2022

Office hours

We invite you to attend and ask questions in class and in office hours. You are encouraged to review core concepts and learning objectives shortly after each class so that you can ask questions during office hours. Collaborative learning with your peers in class and in study groups is also highly encouraged.

COURSE MATERIALS

Official course materials, including notes are available on bCourses in folders within the **Files** area. Your most useful resource will be your class notes and the information uploaded by Instructors on the bCourses website: <https://bcourses.berkeley.edu/>. Please note that the emphasis in this course is on the material covered in assignments, lecture AND in the lecture notes.

Note that in-class lectures and activities will not be recorded. You are encouraged to attend class in person to maximize your opportunities for learning.

All course materials are protected by copyright

Lecture notes, worksheets, videos, exams and assignments are provided for your use only, unless otherwise stated. Downloading, recording or otherwise copying videos is strictly prohibited in this Course. Buying or selling lecture notes, lecture videos, assignments, or other course materials is a breach of the UC Berkeley Code of Conduct. Any student found to violate these policies will be referred to the Center for Student Conduct.

TEXTBOOKS

You are NOT required to purchase a textbook for this course; however, Instructors will use materials and provide recommended reading from the textbooks below:

Liqun Luo's *Principles of Neurobiology* 2nd edition
ISBN: 9780815346050

Principles of Neural Science, 5th edition by Kandel et al
Available as a free e-textbook from the UC library:
<http://neurology.mhmedical.com/book.aspx?bookID=1049>

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COURSE MECHANICS & RESILIENCE

The official course syllabus can be found on bCourses. Any changes will be noted on this syllabus. Lectures and office hours will be held in-person unless otherwise noted.

Campus directives

We will adhere to UC Berkeley campus directives aimed at mitigating the spread of SARS-CoV-2 or other infectious agents. Refusal to comply with campus policies, such as masking indoors, may result in a student being asked to leave the class. Please contact the instructors if you have medical concerns about complying with campus policies. The instructors will keep you informed if campus directives change during the semester.

Access to technology

UC Berkeley students in need of hardware or internet access can apply for free loaner laptops and peripherals through Student Tech Services (STS; <https://technology.berkeley.edu/STEP>). STS also provides free software and helpdesk support. They can be reached at 510.642.HELP or sts-help@berkeley.edu. A list of resources is available on their website: <https://studenttech.berkeley.edu/home>

ASSESSMENTS & GRADING

Assessments will be conducted through Gradescope (<https://www.gradescope.com/courses/294519>) or in class. Assessments will be timed unless otherwise noted by Instructors.

In-class activities

Entry & exit tickets are short, timed quizzes that will be assigned at the beginning and end of some classes. They are designed to allow students to assess their grasp of key concepts related to that day's topic. When pre-lecture materials have been assigned, entry tickets also provide information about a student's preparation for the class. Entry and Exit tickets will not be announced in advance; therefore, you are encouraged to attend class in person. Ticket sets are worth 3 points each (Entry tickets: 1 point; Exit tickets: 2 points). Your top ten ticket set scores will count toward your.

Active learning exercises are also formative assessments that will contribute toward your grade. Some of these will be collected during the class for grading. These will also be posted on Gradescope after class; however, exercises turned in after class will not be eligible to earn points, unless otherwise noted by Instructors. Your top ten scores will contribute toward your grade.

Problem sets

Problem sets are assignments designed to solidify your mastery of quantitative concepts in neuroscience. Wrong answers are okay, but you should fully complete and explain your thought process because working through these problem sets will be critical to your successfully mastering course material. You are welcome to discuss problem sets with your peers; *however, students are expected to turn in their own work.*

Exams

There will be two mid-term exams and a cumulative final exam. Exams will be administered in an open-note format; however, students are expected to work independently, consult only their own lecture notes/assignments, and to turn in their own original work.

Grades

Your grade will be based on a total of 300 points. *We do not use a curve in this course, though the number of points used to determine percentages (and letter grades) may be decreased to work in your favor.*

Entry & Exit tickets:	3 pts X 10 sets =	30 pts
In-class exercises:	4 pts X 10 exercises =	40 pts
Problem sets:	20 pts X 4 sets =	80 pts
Midterm & Final exams:	50 pts X 3 exams =	<u>150 pts</u>
Total:		300 pts

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Regrade policy

A fundamental goal of our course is to enable all students to learn and demonstrate their knowledge. To ensure fairness, this course does not allow regrade requests except in the event of a procedural error (e.g., incorrect addition of points). If you find such an error, please email all Instructors via Canvas within 48 hours of receiving the score. Loss of points resulting from student errors, such as those arising from misinterpreting exam instructions, answers that restate the question, or incorrect/incomplete answers, will not be regraded. All answers for each exam question are carefully graded by a single grader. Answers are also reviewed by Instructors for fairness. Note that graders are instructed to award points generously for answers that are partially correct. Please do not approach your GSI to review perceived errors in assigning partial credit to exam answers.

COURSE POLICIES

Accommodations

Your experience in this class is important to us. If you have already established accommodations with the DSP office, please communicate your approved accommodations to us at your earliest convenience so we can discuss your needs in this course.

Late Work Policy

Be sure to pay close attention to deadlines. Problem Sets and Exams that are turned in on or before the deadline will be eligible to earn full credit. After a deadline, one point per hour will be deducted from an assignment's total possible points. In-class activities and entry/exit tickets will not be accepted late as lowest scores will be dropped.

Life Happens passes

We understand that emergencies and other unforeseen circumstances arise; therefore, each student will be eligible to redeem up to two *Life Happens* passes. One pass will extend the deadline for a Problem Set or Midterm Exam by 24 hours. Thus, two passes can be used to extend a single assignment by 48 hours, or to extend two assignments by 24 hours each. Passes cannot be used to extend deadlines for the Final Exam. To redeem a pass, please contact Instructors via Canvas before the assignment's deadline stating that you are using a pass. *Passes cannot be redeemed after the assignment's deadline.* In such cases, assignments will receive points deductions based on the policy above. Once both passes are redeemed, a student will not receive further extensions for assignments.

Scheduling Conflicts

If you must miss a deadline because of an extracurricular conflict or professional school interview, please inform Instructors via Canvas by the second week of the term. If your absence is excused, the assignment will be dropped and your grade for the course will be based on the remaining assignments.

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 should be a safe and inclusive environment 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, or go to <http://survivorsupport.berkeley.edu/>.

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MENTAL HEALTH & BASIC NEEDS

If you experience stress, anxiety, or other forms of distress during the semester, we hope to be a resource for you. Please reach out to one of the Professors if you need support. As a Cal student, you have access to many resources. A summary of these resources can be found at the Center for Support & Intervention's (CSI) website:

<https://csi.berkeley.edu/process/>

Basic Needs assistance

Housing, food insecurity and financial instability impact one's ability to thrive in college. UC Berkeley's [Basic Needs Center](#) aims to promote justice and belonging for all members of the UC Berkeley community by assisting with basic needs, including emergency housing and a Food Pantry. See their website for a list of services and resources: <https://basicneeds.berkeley.edu/services-and-resources>

Counseling and Psychological Services

All registered Berkeley students are eligible to use UC Berkeley's Counseling and Psychological Services (CAPS; <https://uhs.berkeley.edu/caps>). You do not have to purchase the Student Health Insurance Plan to use these services. The first five counseling sessions are free for registered Berkeley students. Counselors can provide support in academic success, life management, career and life planning, and personal growth and development.

Please call (510) 642-9494 or stop by the office on the 3rd floor of the Tang Center to make an appointment with a counselor.

- Drop-in counseling for emergencies: Monday - Friday, 10:00AM - 4:30PM
- After-hours counseling: In the case of emergencies at night or on weekends, call (855) 817-5667 for free assistance and referrals. Request to speak with a counselor.
- For emergency support (imminent risk of harm to self or others): Call UCPD: 911 or (510) 642-3333

24-hour Crisis Hotlines:

- Alameda County Crisis Line: (offers confidentiality, TDD services for deaf and hearing impaired callers and translation in 140 languages) Call 1-800-309-2131
- National Crisis Help Line: Call 1-800-273-TALK
- National HopeLine Network: Call 1-800-SUICIDE

Please also look out for your peers

CSI notes that peer support is one of the most important and effective resources for students managing distress or difficult life circumstances. If you see any of the signs below that indicate your classmate might need assistance, please use the resources above, or reach out to Instructors or GSIs.

- Withdrawing from other people
- Changes in weight or eating patterns
- Changes in sleeping patterns
- Fatigue or lack of energy
- Increased anxiety or irritability
- Feeling worthless or hopelessness
- Repeatedly missing class

If you or a peer exhibit concerning behaviors related to personal, physical, and emotional well-being, please file a [Care Report](#) for referral to the Center for Support & Intervention (CSI).

Indicators of distress can be found on CSI's website:

<https://csi.berkeley.edu/socc-when-to-refer/>

CSI Care Report website:

https://berkeley-advocate.symplicity.com/care_report/index.php/pid760334?

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ACADEMIC INTEGRITY AND ETHICS

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 expectation is that you will adhere to this code.

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 can 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.

A good lifetime strategy is always to act in such a way that no one would ever imagine that you would consider cheating. To guarantee that you are not suspected of cheating, please keep your eyes on your own materials and do not communicate with others during quizzes and exams, unless they are assigned as group projects.

Collaboration and Independence

Reviewing lectures and reading materials and studying for exams can be enjoyable and enriching activities to do with your peers. This is recommended; however, unless otherwise instructed, homework assignments and exams are to be completed independently and materials submitted should be the result of one’s independent work.

Plagiarism

UC Berkeley’s Code of Student Conduct defines plagiarism as the use of intellectual material produced by another person without acknowledging its source. Common Examples: 1) Direct copying of passages of works from others directly into homework, essay, term paper, or dissertation without acknowledgment; 2) Using the views, opinions, or insights of another without acknowledgment; 3) Paraphrasing another person’s characteristic or original phraseology, metaphor, or other literary device without acknowledgment. <https://sa.berkeley.edu/cite-responsibly>. Note that assignments might be analyzed using plagiarism detection software.

Academic misconduct

Cheating on assignments, plagiarism, and purchasing or selling course materials are 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.

This course will follow UC Berkeley’s policy on academic misconduct:

<http://bulletin.berkeley.edu/academic-policies/#studentconductappealstext>. In fairness to students who put in an honest effort, students that copy another’s answer, use the internet during exams, plagiarize, or engage in other forms of cheating, will be assigned a zero for that entire assignment. The Office of Student Conduct will also be notified.

LETTERS OF RECOMMENDATION

Any instructor may be asked for a letter of recommendation. So that we may prepare effective evaluations we ask that you do the following: be sure to attend the instructor’s office hours and lectures. Ask your GSI to co-write the letter based on your in-class participation. Provide both the GSI and Professor a copy of your unofficial transcript, CV and finalized personal statement, along with a waiver form/statement from AMCAS, Interfolio, graduate/professional school admissions office, or other letter service providers. Only confidential letters will be provided.