

Biology of Learning – Psych114

Department of Psychology
University of California, Berkeley

Time: TBD

Location: On Campus

Instructor: TBD

Email: TBD

Office: TBD

Office hour Option 1: Low pressure discussion group discussion after Monday class, Please meet at podium after lecture. Note, discussion group may head to cafe in bad weather.

Office hour Option 2: Make an appointment for formal office hour (for example for a private matter by email) or set up a time after class.

Graduate Student Instructor (GSI): 5 # %

Email TBD

Office: R@B

Office Hours: TBD

Graduate Student Instructor (GSI): TBD

Email TBD

Office: TBD

Office Hours: TBD

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Course Description: The biology of learning and neural plasticity is critical to our understanding of development, culture, behavioral change, the uniqueness of individuals, and limits to an organism's potential. We will study experimental investigations of behavior and neurobiology at the cellular and circuit level to get a basic introduction to what is known and unknown about learning and neural plasticity. Topics may include associative learning, habit formation, fear, memory systems, neurons, synapses, dendritic spines and axonal boutons, LTP, and adult neurogenesis. We will discuss these topics in the context of normal development and disease. Students will become familiar with thinking about the brain at the level of circuits, cells, synapses, and proteins.

Prerequisites: None

Required textbook: "Neurobiology of Learning and Memory", by Jerry Rudy **2nd edition** (2013)

This book is available for purchase at campus bookstores. Additional short readings will be posted in bCourses. 1st edition is **not** suitable.

Attendance: We highly recommend that you attend lectures and discussion sections. Active participation in section activities will be built into your final grade (see below). Please read the chapter or readings indicated before class. This will enhance your ability to understand and learn the material.

I do not grant permission to record the class. Please turn up, listen and work with others to think and study. If you are confused, falling behind or need more information please attend office hours and organize a study group. We believe discussing the information in the textbook, lecture, and slides is more helpful than playing back recordings.

Discussion Sections: Sections are **TBD** in **TBD** :

101: TBD
102: TBD
103: TBD
104: TBD
105: TBD
106: TBD
107: TBD
108: TBD
109: TBD

Online Information: Website: <http://bcourses.berkeley.edu/>

bCourses Discussions: You are encouraged to post your questions to the Discussions site on bCourses. If you don't understand something, it's very likely other students in the course also don't understand it and could benefit from seeing the answer as well. We will check this site regularly and answer questions, but we also encourage you to answer your fellow students' questions if you feel comfortable doing so.

| Date | Day | Questions illustrating Learning goals | READ BEFORE CLASS |
|-------------|------------|---|--------------------------|
| TBD | | 1. Multiple learning and memory systems are filtering your experience? The case of H.M. | 15 Rudy |
| TBD | | 2. How can we use a neurobiological approach to study learning and memory? Welcome to the 'zoo' of neurons. | 1 Rudy plus P24-35 |
| TBD | | 3. How can we study brain function to understand learning? | 9 Rudy |
| TBD | | 4. What are the basic forms of learning? Associative learning and Hebbian learning basics (<i>Homework 1 due Feb 2nd</i>) | P11-13; P353-355 Rudy |

TBD 5. What other brain structures do we use for learning? Amygdala and Fear conditioning/extinction 19 Rudy

6. How is learning achieved and stored? Neurotransmission and action potentials in more detail 2 and 9 Rudy

TBD 7. How is learning achieved and stored? Going Inside Synapses: Glutamate receptors and signaling 2 Rudy and p. 48-54

Review

MIDTERM 1

Presidents' Day – Holiday (No Class)

TBD 8. How is learning achieved and stored? Cellular memory: Long term potentiation (LTP) (p44-63) Rudy

9. CaMKII: a kinase to remember p.59-65,191-194 Rudy

10. Can we connect LTP to behavior? 10 Rudy

11. How are memories consolidated? CREB and protein synthesis 11 Rudy

12. Where do flashbulb memories come from? Memory modulation and the Amygdala (*Home work 2 due March 10th*) 13 Rudy

13. How can learning and memory be modulated at the synapse: cAMP, PKA to CREB 13 Rudy

14. Where are memories stored? Hippocampus and Cortex, Indexing 16 Rudy

Review session

MIDTERM 2

Break

TBD

Break

15. What is neuroplasticity? How does it impact learning and memory? Cortical spine plasticity and *in vivo* imaging

Bourne and Harris
Extra reading:
HoltmaatSvobodareview2009.pdf; Chen, Lu, Zuo 2014

16. What is neuroplasticity? Neurogenesis: for learning or forgetting? (*Homework 2 due March 14th*)

Frankland et al. pdf
Extra reading:
AkersFrankland2014Science_Forgetting.pdf

17. How do we learn actions and learn/unlearn habits?

18 Rudy

18. How do we learn actions and learn/unlearn habits? Dopamine and reward prediction error

Chapter in b courses

19. How do we learn actions and learn/unlearn habits? Anatomy of cortical striatal circuits

TBD

20. What do drugs for ADHD do? Are they smart pills? Why or why not? (*Homework 3 due April 21st*)

SmithFarah.pdf
UrbanGao2014.pdf

21. How can we use animals to model Alzheimer's dementia? What can we learn about the disease and therapy?

YiuRashidJosselyn2011.pdf

22. Putting it all together

RRR

RRR Week

RRR

RRR Week

Final Exam 7-10PM location TBD

Course Assessment:

Homework Assignments:

We use homework assignments to expand your understanding of how neuroscience pertains to many aspects of our lives outside the classroom and to give you a feeling of independence in reading the basic scientific literature. Note that the section is intended to reinforce the lecture, but homework has this different more expansive goal. There will be three homework assignments in this class. Brief descriptions of each assignment are given below. You can ask your instructor or section leader if you have questions. Due dates are shown below and on the class schedule. Assignments will be turned in through bCourses.

Late assignments will lose 10% value per day. **Late assignments will not be accepted after 7 days.**

Assignment 1: Look for a newspaper / magazine article in which understanding or misunderstanding of learning impacts society. Summarize the article and explain your choice. 400 words max.

Homework 1 Due date: TBD

Assignment 2: Browse through recent scientific abstracts in the journals: Learning and Memory, Behavioral Neuroscience, or Journal of Neuroscience (use the UCB Library online to get access). Write a summary of the findings laid out in one abstract. Try to choose words appropriate for a lay person.

Make sure you state:

- 1) What was the question the experimenters were trying to answer? Or what did they hypothesize?
- 2) What array of methods did they use to answer the question?
- 3) What did they find?
- 4) How are these findings relevant to science or society more broadly?

600 words max. Copy the original abstract and link next to your summary.

<http://learnmem.cshlp.org/>

<http://psycnet.apa.org/journals/bne/128/2/>

<http://www.jneurosci.org/>

Homework 2 Due date: TBD

Assignment 3: Perform a literature search using scientific peer-reviewed journals to learn how synapses play a role in one of these developmental disorders, neurodegenerative diseases, psychiatric illnesses.

Choose one of the following 5 diseases to be your focus in your literature research. Based on your interest.

1. Fragile X Syndrome
2. Rett Syndrome
3. Huntington's Disease
4. Schizophrenia
5. Addiction

Only primary empirical studies will be acceptable as your two references. You may consult reviews too, but follow them to the original references. Two references (empirical papers) are required to support your discussion. If the two references' findings conflict, then feel free to also discuss this conflict.

In your paper, please state (in your own words, not copied directly from the refs)

- Short background on the disorder/disease including a short summary of the brain area, cells, and synapses that are implicated in the disease according to the refs you choose to focus on (two sentences approx.). There may be multiple areas implicated but you can focus on one. **You do have to ensure you find references that look at the synaptic level.**
- Identify **TWO synaptic proteins** that are implicated in the development or expression of the disease and describe differences (hypothesized or demonstrated) in the diseased and healthy state (can be human or animal model). Three to four sentences for each protein should be enough. Explain what is thought to be different about the synapses and their function [at the level of detail we have been learning about in class module 2]? How does this change at the synaptic level change affect the brain connectivity and its function [at the level of detail we have been learning about in class module 1]?

12pt, double spaced, 1" margin, 600 words maximum

In-text citation and reference page are required (APA format).

Homework 3 Due date: TBD

Discussion Section Presentations:

You will be expected to

- 1) present material twice in a small group format to partner or pair of students
- 2) contribute to a short group presentation to your discussion section once during the last third of the course. Groups will present a short (~15 minute) mini-lesson on a concept previously covered in lecture followed by leading a group activity of their design (e.g. game, worksheet, discussion). You will be encouraged to choose a topic that you feel deserves additional attention leading up to the cumulative final. These presentations are intended to be low-stress and primarily to engage you and your peers more deeply in the subject matter. Additional details will be given during discussion section.

Feedback/Interaction/Questions:

If you have questions and or feedback please ask in class and or come to office hours or make an appointment. In some classes you may be asked to write your questions down and turn them in and/or to discuss your questions with other classmates. Please feel free to use the bcourses page to invite others to form study and discussion groups. Please be inclusive and organize openly, especially those you may not be likely to know already or interact with.

Final Course Evaluation: The final course evaluation will also be online. It is very important to us that you complete this evaluation. It aids our learning to be better teachers, planning the

course for next year and is critical for our promotion processes. The Final Course Evaluation will be available just prior to the RRR week.

Exams:

Exams will consist of multiple choice and a few short answer questions. The class has 2 midterms and one final. Each midterm exam covers the preceding portion of the course and draws from material in lectures, discussion sections, and readings. The final exam is comprehensive and not only covers but integrates material from the entire semester.

All midterm exams will be during class time. Our desire is for you to learn the material and do well on the exams.

Policy on missed exams:

- If a midterm exam is missed without a valid excuse, then the student will receive a zero.
- If a midterm exam is missed WITH a valid excuse (which was discussed with the instructor **BEFORE** the date of the exam), then the final exam will be worth the value of the final exam and midterm combined. **There will be no make-up exams.**
- Missing the final exam results in an F in the class.

Regrade Policy:

Reevaluation of your final grade is not allowed per campus policy, except in cases of clerical error.

Regrading of midterms will be available on request within 7 days of receipt of grades provided the exam was written in pen and is returned accompanied by a regrade form (to be provided). Regrading will trigger re-examination of the whole exam.

<http://registrar.berkeley.edu/grdchgs.html>

Grades:

Grades on this class are based on exams (2 midterms, 1 final), and discussion section score. The discussion section score will include: (1) homework assignments, (2) group presentation, and (3) active participation.

Grade distribution will be as follows:

| | |
|--------------------|------|
| Discussion Section | 15 % |
| Midterm 1 | 25 % |
| Midterm 2 | 25 % |
| Final | 35 % |

How do we Address Learning Goals for the Undergraduate Psychology Major:

1. *Understand basic concepts that characterize psychology as a field of scientific inquiry, and appreciate the various subfields that form the discipline as well as things that differentiate it from other related disciplines.*

In this course we will examine how biology and medicine intersect with behavior, informing both psychology, medicine and education.

2. *Develop an understanding of the central questions/issues in contemporary psychology as well as a historical perspective of psychological theories and key empirical data*

Here we will explore theories of learning and memory and the cellular bases of learning and memory that span more than a century: From Ramon y Cajal and Thorndike to modern work.

3. *Develop a thorough understanding of one of the major content areas of psychology (i.e., Social/Personality, Developmental, Clinical, Cognitive, Biological)*

Here we develop a thorough understanding of biological psychology.

4. *Develop skills to critically evaluate the presentation of scientific ideas and research in original scientific papers as well as in the popular media.*

We teach about experimental methods and demonstrate how to reason from experimental data, enabling students to see the origin of arguments and narratives about ‘how the brain works.’

5. *Become familiar with research methods used in psychological research, and become proficient in basic concepts of statistical analyses and familiar with more advanced methods in data analyses and modeling.*

We will explore advanced methods including: behavioral methods, animal models, electrophysiological, genetic and optogenetic methods used in brain tissue. We also will learn about pharmacology and drugs used to treat Alzheimer’s, attention disorders, so called ‘study drugs’ and drugs with abuse potential.

6. *Learn to develop, articulate, and communicate, both orally and in written form, a testable hypothesis, or an argument drawing from an existing body of literature*

Tests and class discussion are intended to help develop students’ ability to use argument from evidence.

7. *Apply a psychological principle to an everyday problem, or take an everyday problem and identify the relevant psychological mechanisms/issues*

Students are asked to apply learning to everyday life and common disease through homework assignments. We also discuss common issue of use of study drugs.

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.

Other resources

Urgent medical or mental health problems

If you have an urgent medical or mental health problem that cannot wait until the Tang Center is open:

- Call the After Hours Counseling Line at (855) 817-5667.
- Find a local [Urgent Care Center](#) with extended hours.
- Find a phone number for a [crisis/suicide prevention hotline](#).
- See [After Hours Assistance resources](#) for information on emergency contraception, dental emergency, pharmacy refills and other services when Tang Center is closed.
- Find a [local emergency room](#). The closest to campus is Alta Bates Hospital, 2450 Ashby Ave., just east of Telegraph Ave.
- Crisis Text Line: [Crisis Text Line \(link is external\)](#) is free, 24/7 emotional support for those in crisis via text messaging.

Tang Counseling and Psychiatry

To get started in counseling, students typically have a brief (15-minutes) telephone triage appointment with a CPS staff member to assess a student's needs and to direct you to the most appropriate counselor.

Please call the CPS front desk to schedule this telephone triage appointment with a counselor.

During the triage appointment the counselor will assist you with determining appropriate next steps. This might include any of the following:

- a 45-minute in-person counseling appointment (generally available within 1 - 2 weeks)
- emergency counseling (available each weekday 10am - 5pm for urgent concerns)
- group counseling
- a referral to other resources

For questions or to set up a phone triage:

- call (510) 642-9494
- schedule a CPS phone triage appointment online through eTang ([link is external](#)) patient portal

Community based support groups

<https://uhs.berkeley.edu/counseling/social-services/counseling/aod/community-based-support-groups>

Tang Self Help Links

<https://uhs.berkeley.edu/counseling/self-help>

Stories of Recovery from Mental Illness

<https://bbrfoundation.org/stories-of-recovery>

Confidential Care Advocate

The [Confidential Care Advocate](#) provides affirming, empowering, and confidential support for those who have experienced gendered violence, including: sexual harassment, dating and intimate partner violence, sexual assault, stalking, and sexual exploitation. Advocates bring a non-judgmental, caring approach to exploring all options, rights, and resources. You can reach The Confidential Care Advocate at (510) 642-1988 or via thsiang@berkeley.edu.