MCB 167: Physiological and Genetic Basis of Behavior

Syllabus, Spring 2014

Instructors: Dan Feldman, 185 LSA, dfeldman@berkeley.edu, 3-1723
Kristin Scott, 71A Koshland Hall, kscott@berkeley.edu, 3-4144

Course Description

Behavior is an essential feature of animal life, and a delight to observe and study. How is behavior determined in organisms? Because brain cells and circuits organize and mediate behavior, one place to seek an answer is neurobiology. Evolutionary genetic changes also shape behavior, so another explanation is in genetics (specifically, behavioral genetics). In this class, we will ask how brains and genes work together to produce behaviors, including sensory behavior, movement, learning, and some higher functions. The focus is on mechanistic biological processes that generate animal behavior. These include molecular, cellular, and neural circuit specializations, neural computations, and general principles. We also consider the complex interplay between nature and nurture in specifying behavior. We focus on animal behavior, rather than human behavior, because mechanisms are known most richly in animals.

This course assumes familiarity with basic neurobiology (electrical signaling by neurons, molecular biology, neuronal cell biology, overall organization of sensory and motor systems in the mammalian brain), as covered in MCB C160. MCB C160 is a required prerequisite (or corequisite) for this class.

In addition to textbook readings and lectures, you will read primary research literature in this class. This is a great way to explore the excitement of research, and to understand how ideas are proposed and tested in biology.

Lecture and Discussion Format

This is a 3-unit course with 2 weekly hours of **lecture**, plus 1 hour of required discussion section. **Discussion sections** are co-taught by faculty and GSIs, and center around reading and in-depth discussion of a paper from the primary research literature. (Discussions are not designed to review prior material from lectures.) Your reading will be guided by a short reading guide from the instructors, which will give background and pose important questions about the work and its interpretation. You will compose a short written response to these questions (a few paragraphs). Your responses to these questions will form the basis for group discussion during section. These writing assignments will be handed in as a record of section participation. Individual writing assignments are not graded. However, section participation (based on active participation and turning in the writing assignments) is worth 10% of your class grade.

Textbook and Reading List

Textbooks
Unfortunately there is no single textbook that covers this material comprehensively. We will use two textbooks (hopefully, most students will already own Kandel et al.):
Carew TJ. Behavioral Neurobiology. Sinauer. 2000.
Kandel Schwartz & Jessel, Principles of Neuroscience. McGraw-Hill, 4th Ed. (2000).

Weekly readings
Students will read one **scientific research paper** each week. The paper will be discussed in the required weekly discussion sections.

Grading
Midterm 1: 25%
Midterm 2: 25%
Section participation: 10%
Final: 40% (inclusive of all material, including assigned research papers)

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://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.

Lecture Plan

Date	Day	#	Instr.	Topic
1/22	W	1	DF	Foundations of behavioral neuroscience.
1/24	F	2	DF	DISCUSSION: *D. Bray, "Wetware", Ch 1, and Pirri & Alkema, Curr. Opin. Neurobiol. 2012*
1/27	M	3	KS	*C elegans*: Fixed Circuit, Variable behavior
1/29	W	4	KS	*Drosophila* courtship as a model of genes, circuits, behavior
1/31	Fr	5	KS	DISCUSSION: *Fruitless, Demir and Dickson, Cell 2005.*
2/03	M	6	KS	Taste: Labeled Lines *KSJ, Ch 29*
2/05	W	7	KS	Olfaction: Odor Encoding *KSJ, Ch 32*
2/07	F	8	KS	DISCUSSION: *Piriform cortex, Choi, Cell 2011*
2/10	M	9	KS	Olfaction: Gain Control *KSJ, Ch 32*
2/12	W	10	KS	Vision: Evolution of sensory receptors for color vision *KSJ, Ch 29*
2/14	F	11	KS	DISCUSSION: *Color vision, Mancuso, Nature 2009*
2/17	M	--	--	HOLIDAY
2/19	W	12	DF	Vision: Detecting motion *KSJ Ch 26*
2/21	Fr	13	DF	DISCUSSION: *Direction Selectivity, Yoshida et al., Neuron 2001.*
2/24	M	14	DF	Vision: Building bug, object & face detectors *KSJ Ch 27, Carew Ch 4*
2/26	W	15	DF	Touch: Perceptual channels and parallel pathways *KSJ Ch 22 & 24*
2/28	F	16	DF	DISCUSSION: *Infrared vision in snakes. Gracheva et al., Nature 2010.*
3/03	M	--	DF	**MIDTERM 1 (Lectures 1-16)**
3/05	W	17	DF	Touch: Cortical circuits, computation, and sparseness *KSJ Ch 23*
3/07	F	18	DF	DISCUSSION: *Single-neuron coding, Houweling et al. 2007.*
3/10	M	19	DF	Hearing: Passive sound localization *KSJ Ch 30 Carew p. 61-81*
3/12	W	20	DF	Hearing: Bat echolocation *KSJ Ch 30. Carew Ch 2.*
3/14	F	21	DF	DISCUSSION: *Sound localization, Seidl et al. 2010.*
3/17	M	22	DF	Communication: Insect song and bird song *Carew Ch 5*
3/19	W	23	DF	Communication: Bird song learning *Carew Ch 8.*
3/21	F	24	DF	DISCUSSION: *Bird song learning, Brainard & Doupe, 2000.*
3/24-28	MWF	--	--	SPRING BREAK
3/31	M	25	DF	Hippocampus and spatial navigation *Carew p. 375-400*

4/02	W	26	DF	Hippocampus and learning *KJS Ch 62*
4/04	F	27	DF	DISCUSSION: *Hippocampal memory consolidation, Girardeau et al., 2009.*
4/07	M	28	DF	Evolution of brain and behavior *TBA*
4/09	W	29	DF	**SECOND MIDTERM (covers lectures 17 to 26)**
4/11	F	30	KS	DISCUSSION
4/14	M	31	KS	Central Pattern generators *Carew, Ch 6 and 225-8.*
4/16	W	32	KS	Voluntary movement
4/18	F	33	KS	DISCUSSION
4/21	M	34	KS	Emotion & mood: Dopamine *KSJ Ch 50, 61*
4/23	W	35	KS	Emotion & mood: Serotonin *KSJ Ch 50, 61*
4/25	F	36	KS	DISCUSSION
4/28	M	37	KS	Social behavior in prairie voles
4/30	W	38	KS	Social hierarchy in mammals
5/02	F	39	DF & KS	Review
5/05-5/09				READING PERIOD
5/13	Tuesday		7-10 PM	**FINAL EXAM**