BRAIN, MIND, AND BEHAVIOR: FOUNDATIONAL CONCEPTS IN NEUROSCIENCE
MCB C61 / PSYCH C61

Department of Molecular and Cell Biology, and Department of Psychology

University of California, Berkeley - Winter-Spring Semester 2021

The human brain is the most complex structure in the known universe. The study of its structure and function and how it figures into our actions and mental experience is among the most exciting projects of modern science. This class begins with molecules and cells, builds up to brains and nervous systems, encompasses neural signaling, sensory perception, memory, language, and emotion, and culminates with the great mystery of how brain processes relate to consciousness and mental experience — that is, how mind is related to brain. This is a comprehensive introduction to the exciting subject of contemporary neuroscience, open to all interested students.

This semester, as we all know, is very different from most — all being online. In my teaching of this and other classes over the years, I have always placed high value on in-person instruction, even in a large-enrollment class such as ours. While the factual content in a class such as this can be learned by reading, and listening to and watching recordings, I believe there are important elements of the material that are best, if not exclusively, transmitted through in-person contact.

Especially given pedagogy during these past 10 months, many of you no doubt already have considerable experience with remote classes. Despite my own limited and recently acquired experience, this will be the first time this particular course is being presented in a fully online mode. As I am still learning about options and ideas, I expect there may be changes in class format during the semester. That said, the framework presented here constitutes our initial plan.

Format: Two Lectures per week. The lectures are asynchronous and recorded. Audiovisual and audio recordings, as well as graphic summaries for each lecture will be posted on our class bCourses website under Files.

One Discussion Section meeting each week. These meetings are synchronous, meeting at their scheduled times each week.

Instructor: David Presti <presti@berkeley.edu>

Instructor's "office hours": Tuesdays at 2:10 PM to 3:30 PM (during our regular lecture time)
Wednesdays at 10:10 to 11:00 AM

Textbook: *Foundational Concepts in Neuroscience: A Brain-Mind Odyssey*
by David E. Presti (W.W. Norton, 2016)

This class will cover all the topics in this book, which was written specifically to accompany this class. Much of the material in the book will also be presented in lectures. However, exams may also include material presented in the book that was not in lecture. There is a Key Concepts study guide for the book that lists the concepts deemed to be most important to review and understand.

Other course readings: There will be additional readings (some required, some optional) posted throughout the semester on our class bCourses website under Files.

Time Zone: All times appearing in this syllabus and in materials on our course website refer to current time in Berkeley: that is west-coast USA Pacific Time zone.

Graduate Student Instructors (GSIs): The GSIs are here to help you get the very most from this class. You are encouraged to get to know and talk with your GSI. Your GSI will see you in weekly Discussion Section and will also be available to meet with you during weekly office hours. Office hours are an outstanding opportunity to deepen your connection with the course material, as well as with teachers and fellow students. It is not necessary to have specific questions. Moreover, you may visit office hours for any of the GSIs. This is an opportunity to maximize your benefiting from our class. **We encourage your visiting all of our office hours — and as often as you wish. Don't be shy!**

Graduate student instructors (GSIs) and their email addresses:

Ariel Munoz	<adhmunoz@berkeley.edu>
Christina Carr	<ccarr99@berkeley.edu>
Emilio Emilio Soto Soto	<emilioemilio@berkeley.edu>
Frederique Sauve	<frederique_sauve@berkeley.edu>
Gia Park	<gpark15@berkeley.edu>
Hollynd Boyden	<hollynd.boyden@berkeley.edu>
Mark Gorenstein	<gorenstein-gsi@berkeley.edu>
Naveed Ziari	<naveedziari@berkeley.edu>

Discussion section days, times, and GSIs:

101	Mon	9-10	Gia
102	Mon	10-11	Ariel
103	Mon	11-12	Naveed
104	Mon	12-1	Ariel
105	Mon	1-2	Frederique
106	Mon	2-3	Christina
107	Mon	3-4	Emilio
108	Mon	4-5	Naveed
110	Wed	9-10	Ariel
111	Wed	10-11	Naveed
112	Wed	11-12	Frederique
113	Wed	12-1	Mark
114	Wed	1-2	Mark
115	Wed	2-3	Christina
116	Wed	3-4	Frederique
117	Wed	4-5	Hollynd
119	Fri	9-10	Hollynd
120	Fri	10-11	Christina
121	Fri	11-12	Mark
122	Fri	12-1	Hollynd
123	Fri	1-2	Gia
124	Fri	2-3	Gia

Prerequisites: A passion to learn! There are no University course prerequisites for this class. The subject matter is of interest to both non-science and science majors, and the course touches upon many aspects of history and philosophy, as well as a great deal of biological science.

Please read this syllabus carefully. We have worked to make it comprehensive and address most questions that might arise. That said, this semester it is an evolving document — a work in progress.
15-Minute Rule: Since the live (synchronous) discussion-section and office-hour meetings rely on broadcast technologies that can fail (e.g., wifi, Zoom, power loss due to rolling blackouts, etc.), a "15-minute rule" will apply for our class this semester. If the scheduled Zoom session does not begin within 15 minutes of the start time of the session, then you can assume there has been a failure somewhere in the technology link and that there will not be a live (synchronous) meeting that day. Similarly, if the instructor's connection ceases in the middle of a meeting and does not resume within 15 minutes, consider the live session to be finished for the day. In either case, a follow-up message will be posted as soon as technology permits.

Recordings and other course materials: Recorded lecture materials (audiovisual, audio, and graphics) and other materials created for instructional use in this class are proprietary and **not meant for distribution beyond our class.** We ask that you not further distribute any of these materials, including posting or streaming online in any manner. There is a UC Berkeley policy statement that directly addresses this: https://sa.berkeley.edu/classroom-note-taking-and-recording-policy

In this era where it is often assumed that freely sharing anything and everything online is okay, and is actually the stated mission of so much material (e.g., social media posts made with the expressed hope of be widely distributed, regardless of their societal value or accuracy), it is important to appreciate that this is not the case for materials on bCourses, which is a closed website access to which is available only to students enrolled in our class.

Contributions to Course Grade:
Midterm exams: 15% each (30% of course grade)
Final exam: 21% of course grade
Discussion–section debates: two debates at 7% each (14% of course grade)
Discussion–section homework: five homework assignments at 7% each (35% of course grade)

If you are taking this class for a letter grade, you cannot earn better than a "C-" grade without completing ALL five of the homework assignments, participating in both the debates, and taking the final exam. If you are taking this class P/NP, you must turn in ALL five of the homework assignments, participate in both the debates, and take the final exam in order to PASS the class. The homework and debate assignments are required in this way because we believe them to be an important component of the learning in this class.

Your letter grade in the course will be determined according to absolute standards of performance. This hopefully relates to your acquisition of knowledge and understanding of the material. Importantly, you will not be competing against fellow students in the sense that **we do not force letter grades to conform to a predetermined distribution; this is another way of saying we do not "grade on a curve."** If everyone does extremely well, everyone could receive an "A" grade. If everyone does poorly (highly unlikely), then everyone could get a low grade. Rather than devoting energy to worrying about letter-grade cut-offs, if you are truly interested in this subject and in getting the most from this class, we urge you to study seriously from the beginning, attend discussion-section meetings, visit office hours, do the readings, and truly make an effort to learn the material. You will be rewarded with knowledge and understanding of some really fascinating topics. Good grades will be a natural side effect.

In past years the percentage of students earning an "A" or a "B" in this class has typically been between 60 and 70%. Thus, the majority of students do well in this class. However, in order to do well in the class you do need to learn a bunch of stuff. It is also easy to get a "C" or even lower grade in the class, if you don't put in sufficient effort. Do not make the mistake of not keeping up with the material and then trying to negotiate a last-minute deal to improve your grade. On the bCourses website (in Files: Course Information) there are some

examples (Emails to Avoid) of desperate emails I have received in past years. Please read this document. It is very sad. We recommend that you not get yourself into the position of needing to write such emails. We do not offer extra credit or make other arrangements to boost grades. If you want a good grade, you must learn the course material in a timely manner. It's as simple as that.

Exams will consist of multiple-choice, short-answer, and longer essay-type questions. We are in the process of designing the precise format of the exams, as being exclusively online they will be different from those of past years. They may, for example, allow for the use of your books and notes. We do not know yet. Just as for an exam in a classroom, the online exams will be timed, meaning you will have a specific length of time (probably 80 minutes, possibly longer for the final) in which to complete the exam. However, in order to accommodate the spectrum of time zones where you all residing, as well as other issues that might limit ready and reliable access to a good internet connection for taking the exam, there will be a 24-hour window in which you may take the exam on the day of its administration.

Exams will draw upon material presented in lectures, material from the textbook (whether or not it is covered in lecture), and other material (designated as required) posted on bCourses. 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 covers material from the entire semester. Key-Concept study guides will be posted on bCourses to assist in identifying material from the lectures and textbook that we feel are essential foundational concepts. Review sessions will also be conducted prior to exams. There will be practice quizzes in discussion sections, so that you may experience the format of questions. There will be no surprises or trick questions. Our desire is for you to learn the material and do well on the exams!

- **Midterm Exam One: Tuesday, February 23.**
  - covers Lectures of Jan 19 through Feb 18 and corresponding material from the textbook (approximately chapters 1-8) and any supplementary readings
- **Midterm Exam Two: Tuesday, April 13.**
  - covers Lectures of Feb 25 through April 8 and corresponding material from the textbook (approximately chapters 9-17) and any supplementary readings
- **Final Exam: Monday, May 10.**
  - comprehensive, covering the entire semester, including all Lectures, all 22 chapters of the textbook, and all supplementary readings
- there will be a 24-hour window available during which you can take the exam.
- within that window, the exam will have a fixed duration, probably 80 minutes, possibly longer for the final.
- we cannot change the days and times for these exams; mark your calendars now.
- there will be no make-up exams; if you miss an exam, you will receive zero points for that exam.
- if you miss a midterm exam with a credible excuse (e.g., significant medical problem documented with verifiable documentation), your final exam score will count proportionally more in determining your course grade. **Verifiable documentation must be presented to me (David Presti) and to your GSI. The material must also be presented in a timely manner, within a week of the missed exam.**

Homework:
- homework 1: analysis of an article you find from the recent news media
  - due by **Friday January 29** at 6 PM
- homework 2: reflecting on conscious experience in non-humans
  - due by **Friday February 5** at 6 PM
- homework assignment 3 – reflection essay on mind-body expectation/belief in your own life
  - due by **Friday March 12** at 6 PM
- homework 4: comparative analysis of a news-media article and the scientific publication upon which it is based
  - due by **Friday April 2** at 6 PM

- homework 5 - haiku poetry composition about brain, mind, and behavior
    - due by **Friday April 23** at 6 PM
- detailed instructions for composing the homework in Files: Homework.
- Assignments submitted up to one week after the due date receive half-credit. Assignments submitted more than one week after the due date receive zero points, but will still be credited as having been completed. Note that you must complete all five homework assignments in order to receive better than a C- grade (for a letter grade) or a passing grade (for a P/NP grade) in the class.
- **No late assignments will be accepted after Wednesday May 5, 2021 (Wed of RRR week).**
- Homework assignments are meant to contribute substantially to the learning trajectory of the class, and to be interesting, informative, and enjoyable as well.

Discussion-section debates:
There will be two participatory debates that will take place during discussion section. Details of the debate format are posted in Files: Debate. The debates will take place during the week of March 1-5 and the week of April 19-23. Topics will be decided as the semester progresses. We endeavor to develop debate topics that are relevant and timely, and for which strong arguments can be made for both sides.

Getting the most from the class AND preparing to do well on the exams: Keep up with the lecture material, readings, and homework. As a guide to preparing for exams, we will post a regularly updated list of Key Concepts from lectures. Review these Key Concepts and use them as a framework for creating your own expanded study outline / study guide. Review the Key Concepts, look up what you don't understand — in your notes, in the readings, and on the internet (e.g., Wikipedia is often pretty good for many of the topics in this class). Come to discussion section and office hours with any questions on things needing clarification. Repeat throughout the semester. It's really a pretty simple recipe for success.

Honor Code: The students at UC Berkeley have 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: Anyone caught cheating on an assignment 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. A good lifetime strategy is always to act in such a way that no one would ever imagine that you would even consider cheating.

Plagiarism: Your homework essays must be original writing composed by you. Copying 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 as well. The originality of your essays may be checked against the entire worldwide web and additional databases of written material. For additional information on plagiarism and how to avoid it, see: http://gsi.berkeley.edu/teachingguide/misconduct/prevent-plag.html

Academic Integrity and Ethics: Cheating on exams and plagiarism are two 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 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 (of course, this refers to the usual in-person scenario). 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 the most important lesson of all.

Mental Health and Wellness: All students — regardless of background or identity — may experience a range of issues that can become barriers to learning. These issues include, but are not limited to, strained relationships, anxiety, depression, alcohol and other drug problems, difficulties with concentration, sleep, and eating, and/or lack of motivation. Such mental health concerns can diminish both academic performance and the capacity to participate in daily activities. In the event that you need mental health support, or are concerned about a friend, UC Berkeley offers many services, such as free short-term counseling at University Health Services.
An excellent campus website having links to many resources is: http://recalibrate.berkeley.edu/
Another campus website addressing mental health services in specific reference to this time of the coronavirus pandemic is: https://uhs.berkeley.edu/coronavirus/student-mental-health
Remember that seeking help is a good and courageous thing to do — both for yourself and for those who care about you.

Thanks again for your interest in this subject. The GSIs and I are excited about being together with you this semester, for what we hope to be an enjoyable and fulfilling adventure in learning!

- University holidays: no discussion sections or lectures on these days
  - Monday, January 18: Honoring Martin Luther King Jr., and by association other leaders in, and elements of, the American Civil Rights Movement.
  - Monday, February 15: Honoring U.S. presidents, may they be up to the enormous tasks at hand.
  - March 22-26: Spring Break – Enjoy a well-deserved rest.

- Important astronomical dates and days of ancient ritual

New Moons:	January 12, February 11, March 13, April 11, May 11
Full Moons:	January 28, February 27, March 28, April 26, May 26
Vernal (Spring) Equinox:	March 20
Beltane:	May 1
Total Lunar Eclipse:	May 26 (visible in Berkeley, ~2 to 5 AM)
Summer Solstice:	June 20

Brain, Mind, and Behavior 2021: Approximate timeline of topics, with corresponding chapter readings from the textbook. Additional readings will be posted on bCourses.

Week 1		
1	Tue Jan 19	2001, kindness, hominin evolution, logistics, HAL, brain, mind, mind-body problem (1)
2	Thu Jan 21	brain and nervous evolution, nervous systems, brain anatomy, electricity, neurons (2)
Week 2		
3	Tue Jan 26	ions, molecules, water, polarity, hydrocarbons, hydrophilic/phobic, phospholipids, membrane, proteins, Pauling, DNA (3)
4	Thu Jan 28	gene, double-helix backstory, Darwin, Bohr, Delbrück, bacteriophage (4) HW 1 due Fri Jan 29 at 6 PM; discussed in section the following week
Week 3		
5	Tue Feb 2	ion channels, Na/K pump, membrane potential, action potential, myelin (5)
6	Thu Feb 4	Loewi, chemical synapse, ACh, glutamate, GABA, iontropic, EPSP, IPSP, GPCR (6) HW 2 due Fri Feb 5 at 6 PM; discussed in section the following week
Week 4		
7	Tue Feb 9	neurotransmitters, autonomic NS, neurotransmitter anatomy, seizures, botulinum toxin (7)
8	Thu Feb 11	pharmakon, Paracelsus, Na-channel pharmacology, TTX, drugs (8)
Week 5		
9	Tue Feb 16	caffeine, nicotine, sedative-hypnotics drugs, cocaine, opioids (9)
10	Thu Feb 18	psychedelics, cannabis (9) Monday Feb 15 President's Day Holiday Exam Reviews in Section this week and Live during lecture time on Thu Feb 18
Week 6		
-	Tue Feb 23	Midterm Exam One
11	Thu Feb 25	mental illness, antipsychotics, antidepressants Debate preparation in Section this week (February 22-26)
Week 7		
12	Tue Mar 2	placebo/expectation/mind-body holotropic effects
13	Thu Mar 4	neural wiring and guidance, neuroplasticity (10) Debate 1 in discussion Section this week (March 1-5)
Week 8		
14	Tue Mar 9	sensory worlds, chemostaxis (11)
15	Thu Mar 11	olfaction, pheromones (12) HW 3 due Fri Mar 12 at 6 PM; discussed in Section the following week
Week 9		
16	Tue Mar 16	taste, flavor, capsaicin, TRP (13)
17	Thu Mar 18	vision (14)
-	Tue Mar 23	no class - Spring Break
-	Thu Mar 25	no class - Spring Break

Week 10

18	Tue Mar 30	vision concluded (14)
19	Thu Apr 1	hearing (15)
		HW 4 due Fri Apr 2 at 6 PM; discussed in Section the following week

Week 11

20	Tue Apr 6	somatosensation, motor, mirror neurons (16)
21	Thu Apr 8	lesions, brain imaging, x-rays, CT, EEG, MEG, ECoG, PET, fMRI (17)
		Exam Reviews in Section this week and Live during lecture time on Thu Apr 8

Week 12

-	Tue Apr 13	Midterm Exam Two
22	Thu Apr 15	cortical connectivity, language (18)
		Debate preparation in Section this week (April 12-16)

Week 13

23	Tue Apr 20	memory (19)
24	Thu Apr 22	rhythms, sleep, dreams (20)
		Debate 2 in Discussion Section this week (April 19-23)
		HW 5 due Fri Apr 23 at 6 PM; discused in section the following week

Week 14

25	Tue Apr 27	emotion (21)
26	Thu Apr 29	science, reality, mind, ways forward (22)

Final Exam on Monday May 10

This timeline is approximate, and the exact correspondence between topic and date may not be maintained. The order of topics will be preserved, and all topics in the Textbook will be covered. Best wishes for an enjoyable semester together!