The Brain and Behavior

Course Description

Have you ever wondered how memories of your favorite childhood family vacation, or the first time you took the field at your favorite sport, seem as visceral now as if they occurred only last week? How are such memories stored in the brain? What happens in the brain when someone is suffering from depression, and how can changing the chemistry of a small percentage of brain cells help her recover? In this class, we'll answer these questions and many more, examining the biology of the brain from its individual cells up to its coordinated circuits—and how these biological underpinnings influence behavior. More importantly, this class will teach you how to think and communicate like a scientist. We'll learn how new tools are allowing researchers to ask more specific questions and reach more precise conclusions about the function of the brain.

Instructor

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Office hours:
Tues. 10:00am-12:00pm
or by appointment

Meeting Times

Monday, Wednesday, and Friday 9:05-9:55am in Corson-Mudd W364

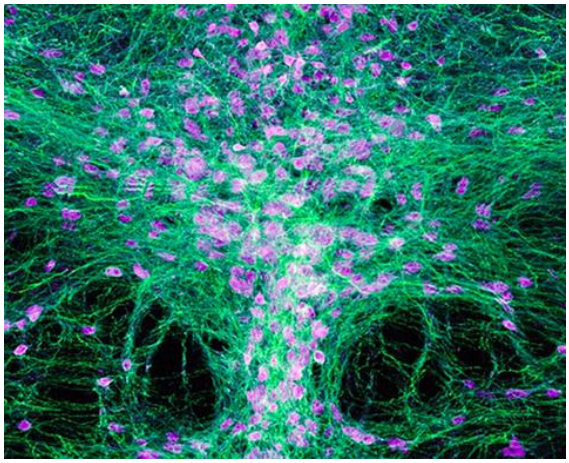
Learning Outcomes

By completing this course, students will *learn to think and communicate like a scientist* through:

- Critically analyzing primary literature by evaluating the evidence authors use to support their conclusions.
- Solving research-based problems in small groups.
- Applying their knowledge of the brain and research methods to a question that interests them.

Students will *become proficient in the basics of neurobiology* by:

- Recognizing how the biochemical properties of neurons and synapses allows information to propagate through the brain.
- Extrapolating general principles of neural circuit organization from specific examples.
- Recognizing how different internal and external states an organism's physiology and behavior.



A confocal microscope image showing serotonin neurons and cortical axons in the dorsal raphe nucleus. *Credit: M. Warden*

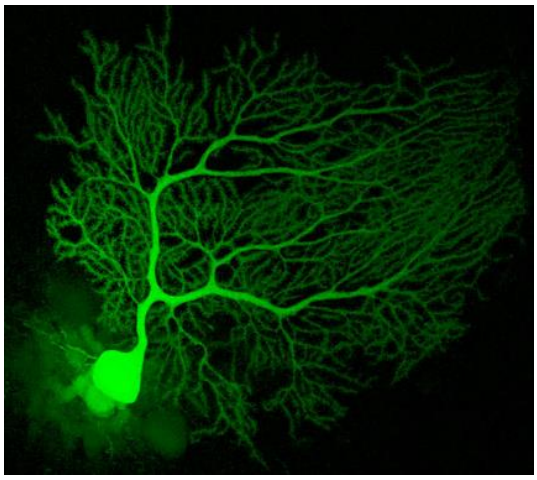
Course Rationale

This course has two, synergistic goals: (a) to develop both your thinking and communication as a scientist, and (b) to develop a broad understanding of neurobiology such that you will be prepared

for more advanced courses in biology and psychology, either here in college or beyond in graduate school. Toward the second aim, we will examine the function of the brain across biological levels, including cellular, circuit, organismal, and evolutionary. At each of these levels, we'll see how biological activity, both normal and impaired, influences behavior. Toward the first aim, we'll regularly refer to current primary literature, discerning how scientists ask—and design experiments to answer—questions about the brain and behavior. Additionally, the majority of your homework assignments and your final paper are designed such that you learn to apply your knowledge of neurobiology and the scientific method to questions you find interesting. After completing the course, you will have an intimate understanding of the scientific method and have sharpened your scientific communication, tangible skills that will aid you in further pursuits, both academic and professional.

Grading

General information and breakdown. My goal for this course is for you to be able to extrapolate general principles of neurobiology and apply them to novel situations. I intend to avoid the pattern of memorization and recall for an exam. To that end, exams count for a smaller percentage of your final grade than in most classes and will contain primarily open response questions. Assignments allow you to collaborate with your peers to solve problems using the principles learned in class. Your final paper will allow you to apply what you've learned about neurobiology and experimental techniques to a topic that interests you. Finally, I value engaged, discussion-centered classrooms and therefore count your participation toward your final grade.



A single Purkinje neuron from the cerebellum of a mouse. *Credit: M. Marton*

Exams (3)	40 %
Assignments	30 %
Final Paper	20 %
Participation	10 %

Exams. Three exams scheduled at roughly equal intervals throughout the semester will cover a third of the semester's material each. *Exams will not ask you to memorize and recall information presented in readings and class*. Rather, exam questions will be open response (i.e. not multiple choice) and ask you to apply the general principles you've learned in class to new situations. The average of the three exams will constitute 40% of your final grade.

Assignments. Homework assignments will ask you to apply the principles learned in class to a novel set of situations, similar to exam questions. Most of these assignments will be research-based, asking you to interpret quantitative results and extrapolate conclusions from them. The problems posed in these assignments are often difficult and require a good deal of critical thinking. As science is best done collaboratively, you are allowed to work with as many as your classmates

as you like for each of these assignments. Each student must submit his or her own response to the assignment and must credit all collaborators.

Final paper. In addition to studying the brain itself, we'll also study how researchers ask and answer questions about neurobiology. In your final paper, you will be asked to apply what you've learned about neurobiology research to a question you find intriguing. You'll be required to identify an unanswered question, summarize the background of what is already known in this area of neuroscience, and describe a set of experiments that might shed light on this question. This 3-page paper will be due during the final exam period.

Participation. The learning environment is enriched for everyone when students learn from each other. Many of our classes will include small-group discussion of problems relevant to the material, peer review of your assignments, and other open-ended discussions. I understand that different students have differing levels of comfort participating in larger and smaller groups. To this end, I've designed the course to balance working groups between full-class, small group, and partner activities. The successful student will contribute their ideas to the collective work of their group and will listen respectfully to their peers.

Final grade. Your total score will be assigned a letter grade according to the standard scale: $x \geq 97\%$ = A+; $93 \leq x < 97\%$ = A; $90 \leq x < 93\%$ = A-, etc. *Despite your numerical grade, you are guaranteed at least a B- if you*:

1. Miss class no more than 3 times—talk to me if you foresee major issues with this.
2. Routinely come to class on time—arriving more than 5 minutes late counts as an absence.
3. Meet due dates and assignment criteria for all assignments.
4. Regularly participate in all in-class activities.

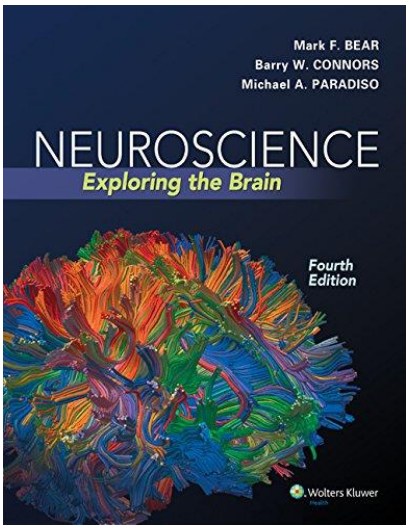
I use this "grading contract" to relieve some of the stress you may feel about grades and your GPA, and because I believe that if you genuinely put forth your full effort, you deserve a B- even if your numerical grades are lower. Note that *if you do not put forth your full effort and do not meet the above criteria, your letter grade will match your numerical grade.*

Course Policies

My promises to you. You will do a good deal more writing in this course than in most science courses, and I intend to give substantial feedback on all of it. I aim to make my feedback constructive and respectful, with the goal of helping all of you improve your writing, no matter the skill set with which you entered my class. I will do my best to comment on and grade your work within *three weekdays* of the due date. I also aim to be an accessible and approachable teacher for everyone. To this end I will respond to all of your emails within *one weekday* and will make an effort to be available for appointments outside of office hours. If circumstances arise such that I cannot meet these expectations, I will let you know ahead of time.

Required texts. All students must obtain a copy of *Neuroscience: Exploring the Brain* (4^{th} ed.) by Baer, Connors, and Paradiso. This can be purchased at the bookstore or various online outlets. On some days you will need to bring one of these books to class--I will notify you when this is the

case. I will provide PDFs or web links to other assigned readings. If you are unable to afford this book, please reach out to me and we can identify a solution together.



Office hours and individual conferences. My regular office hours are Tuesdays from 11:00am-12:00pm, but you should always feel free to set up a different time to talk with me if this doesn't fit your schedule. Office hours are held in my office, Mudd W211, but as I share this office with other graduate students I'll often have a sign on my door describing where I am in the building's atrium. You must schedule *2 individual conferences with me over the course of the semester* during which we will discuss your final paper. In the course schedule, I've highlighted when these conferences will take place. I'll distribute sign-up sheets to facilitate this as those weeks approach.

Peer review. The writing and scientific processes require that we seek and receive feedback on our work so that it can improve. While I will always provide feedback on your assignments, it's equally beneficial to get comments from your peers who are working on the same assignments. Therefore, know that everything you write in this class may be read by others in the class. When working one-on-one with a partner, your name will of course be attached to your writing. When I use examples to share with the class, your name will not be revealed. Such openness is essential for a class like this to work well.

Technology. Note-taking during class is important, especially as a good deal of our class material will spring from discussion. I understand that many students prefer to type rather than handwrite. Laptops and tablets are therefore always allowed in class, though I will ask that all laptop users sit on one side of the classroom so that those who don't use laptops aren't distracted.

Attendance. Because active participation is key to a successful seminar class, I do keep track of student attendance (this will be partially reflected in your *Participation* grade--see "Grades" section above). I fully understand that illness, religious holidays, and other life events may arise causing you to miss class. Please let me know if this is the case, and I will accommodate you. Repeated or unexplained absences will decrease your participation grade.

Plagiarism. Plagiarism is defined as the practice of taking someone else's work or ideas and passing them off as one's own. Cornell's Academic Code strictly prohibits plagiarism and lists the sequence of repercussions if you are found guilty of plagiarism. Because this is an introductory writing course, I assume good will in all of my students and will work with you if your writing inadvertently approaches plagiarism. Given this assumption of good will, I will be particularly disappointed if any student tries to pass off copy-and-pasted text as their own work.

Disability. I am happy to accommodate any student who has a learning or cognitive disability, a physical disability that makes it difficult for you to get across campus from class-to-class, or mental

health issues such as anxiety and depression. Please feel free to reach out to me if any of the above (or other illnesses or disabilities that I've failed to mention) apply to you, and we will work to find a solution.

Disclaimer. Although it is unlikely, I reserve the right to change components of this syllabus. I will always notify you of changes, and will never make any assignment due dates or exam dates earlier than initially published.