# BIPN 140: Cellular Neurobiology
UC San Diego – Fall 2023

"[Las neuronas son] células de formas delicadas y elegantes, las misteriosas **mariposas del alma***, cuyo batir de alas quién sabe si esclarecerá algún día el secreto de la vida mental…"*

"[Neurons are] cells with delicate and elegant forms, the mysterious **butterflies of the soul***, the beating of whose wings may someday clarify the secrets of mental life…"* Santiago Ramon y Cajal, 1917.
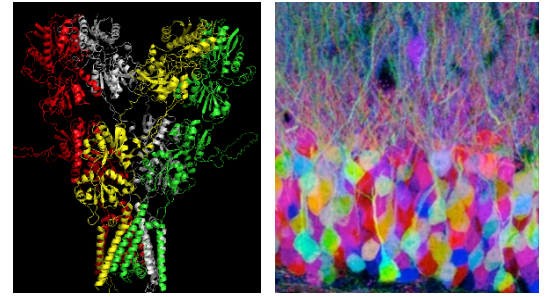
Welcome to BIPN 140!

BIPN 140 is an introduction to how the nervous system works on the **cellular and molecular level.** Neurons allow us to sense, remember, and think. However, they themselves are cells that are built from molecules that follow the laws of chemistry and physics. Therefore, we will dive deeply into the **chemistry and biophysics of how neurons receive and send signals,** including their **mathematical expression.** We will then use that understanding to understand how neurons **change their properties** to allow us to **learn and remember**. The prerequisites are BILD 1 and 2 or equivalent courses from elsewhere (see http://web2.assist.org/web-assist/UCSD.html). Also helpful is basic familiarity with current, voltage, and using logarithms.

This section of BIPN 140 will be **have in-person lectures** with **collaborative work.** We know that this method of learning may be unfamiliar to you. However, we know from extensive educational research that **people from all sorts of backgrounds learn best** when they are **actively engaging with the material through thinking, writing, and discussing**.[1] We would like to foster that kind of classroom through encouraging regular in-person attendance and group problem-solving.

In addition, we know from educational research that **courses with lots of low-stakes opportunities to explore ideas and get feedback** are generally better for student learning.[2] Therefore, in addition to lectures, we will provide many opportunities for you to think about biology in low-stakes ways. These include **pre-lecture Readiness Readings, post-lecture weekly homeworks,** and **prep questions and practice tests before each exam.**

We will also give you many opportunities to **connect with the teaching team and your fellow students.** These include **live and Zoom office hours** by the professor and the IAs. If you cannot make those, there will be a **discussion board on Piazza** (www.piazza.com, or linked through Canvas) where you can ask questions of your fellow students, the IAs, and the professor. Finally, the weekly Homeworks **will also ask for your feedback for the teaching team.** All of these (except the Homeworks) will be **optional but highly encouraged.**

While there is a lot of previous research suggests this kind of "high-structure" course[2] helps students learn, there are a lot of details that we are still trying out. As the quarter progresses, we will use your feedback to adjust the course. Let's face this challenge together!

[1] Freeman *et al.* 2014. Active learning increases student performance in science, engineering, and mathematics. http://www.pnas.org/content/111/23/8410 ; Theobald *et al.* 2020. Active learning narrows achievement gaps for under-represented students in undergraduate science, technology, engineering, and math. https://www.pnas.org/content/117/12/6476

[2] Eddy and Hogan. 2017. Getting Under the Hood: How and for Whom Does Increasing Course Structure Work? *CBE-Life Sciences Education*. 13(3): 361. https://www.lifescied.org/doi/full/10.1187/cbe.14-03-0050

How a typical week may look: connecting with neurobiology every day

Day	Do
Monday	Do pre-lecture Readiness Reading for Tuesday's lecture. Get one question wrong, so immediately redo it for full credit.
Tuesday	Come to lecture. Go to an office hour to ask about upcoming Writing Assignment.
Wednesday	Do pre-lecture journal for Thursday's lecture.
Thursday	Come to lecture. Ask about a confusion on Piazza.
Friday	Drop by section to ask a question. Complete weekly Homework and complete a few Prep Questions on those topics for upcoming exam. Get one Prep Question wrong, so redo it.

Required Materials

- **iClicker, iClicker+, or iClicker2**. *It must be registered on* **Canvas**.
- **Subscription to Codon Learning Platform**. Access online through the link in the Canvas module. You should not be charged.
- **Free subscription to Kritik software.** Initial access will be by an email sent from kritik.io. After you establish your account, access online in Canvas through the link on the left side of the Canvas page. You should not be charged.

More details about these materials and how to access them can be found below.

The Basics: Where to Find Lectures, Office Hours, and the Discussion Board

Where and when are the lectures? TuTh 3:30-5:00pm at **Ledden Auditorium**

Where are the lecture slides and podcast?

- **Slides** and **lecture handouts** will be posted in the Modules on the Canvas site for BIPN 140 (go to https://canvas.ucsd.edu/).
- A lecture **videocast** can be found on https://podcast.ucsd.edu/ and in the Media Gallery on Canvas.

Where are the professor's office hours?

- In-person office hours are on the tables between Ledden, McGill, and HSS before Tuesday's lecture (2:30-3:20pm).
- Zoom office hours are Mondays at 12-12:50pm. Go to the "**Zoom**" link on the side and click on the tab "**Upcoming Meetings**."

Where are the homeworks? The Readiness Readings, weekly Homeworks, and Exam Practice Problems are on the Codon Learning platform. There is a link from the Modules, or you can go directly to https://app.codonlearning.com/ .

Where are the writing assignments? The writing assignments are on the Kritik.io platform. There is a link from Canvas on the left side of the page, or you can go directly to https://us.kritik.io/ .

Where is discussion section? It is on Zoom. Section is optional and starts week 1. Go to the "**Zoom**" link on the side and click on the tab "**Upcoming Meetings**."

Where is the discussion board? This term we will be using Piazza for class discussion (www.piazza.com, or linked on Canvas). We encourage you to post your questions there instead of emailing the teaching team so that we can attend to your questions more quickly.

The Basics: When to Find the BIPN 140 Teaching Team

Office hours and contact information: You are encouraged to go to anyone's office hours. As you can see, we have office hours at a variety of dates and times! If these times do not work for you, you may also contact us with your availability for a different time. If they are on Zoom, please look for the link on Canvas.

Name	Role	Email	Date/ Time	Location
Melinda T. Owens	Assistant Teaching Professor, Neurobio.	mtowens@ucsd.edu Text: 415-290-9953	M 12-12:50pm Tu 2:30-3:20pm	M: Zoom Tu: Plaza outside Ledden
Aishu Balaje	MS, Bioengineering	abalaje@ucsd.edu	Tu 11am-12n Th 11am-12n	Tu: Plaza outside Ledden Th: Zoom
Yolanda Feng	2nd yr, Gen. Bio.	yuf019@ucsd.edu	W 3-4pm F 3-4pm	W: Plaza outside Ledden F: Plaza outside Ledden
Weiwei Liang	4th yr, Neurobio.	w1liang@ucsd.edu	W 8-9am F 2-3pm	W: Zoom F: Zoom

Section time: Friday, 1-1:50pm on **Zoom.** Section is optional.

The Basics: Enrollment and the Waitlist

If you are on the waitlist, you may be concerned and frustrated about whether you can enter the class. You may need this course to graduate on time. However, in Biological Sciences, **the instructor has no control over the waitlist or who can enter the course.**

Movement off the waitlist is handled **solely** by the Registrar and is based only on whether people enrolled **in your discussion section** drop the course. If someone does drop, the next person on the waitlist is automatically enrolled. The instructor cannot add more seats or more sections. (Any information online that implies otherwise is either outdated or not applicable to Biological Sciences.) In short, **there is nothing you or the instructor can do to get you off the waitlist and into the class.**

There is usually a great deal of movement in and out of the class in the first week. If you are on the waitlist and want to get into the course, we encourage you to complete assignments as if you were enrolled, so that you won't be behind if you do get in. Waitlisted students should all have Canvas access, starting from roughly 24hr after you get on the waitlist. That means that being on Canvas does not mean you are enrolled.

Good luck! If it looks like you may not be able to get into the course but you really need to take it, please contact the Virtual Advising Center (vac.ucsd.edu) or another advisor to discuss your options.

What will we learn in BIPN 140?

Overall Philosophy

Our aim in this course is not just a surface-level understanding of neuronal function. Instead, we aspire to have students be able to **solve problems** and **ask good scientific questions** about how neurons work so that you can **apply what you learn about biology in whatever context you find yourself in your future**. That requires **going beyond memorization of facts** to acquire an understanding of how and why neurons function as they do, and what happens when the components of neurons do not function properly. Therefore, instead

of memorization, we will focus on developing an understanding of **fundamental concepts as they apply to different examples**. Exams will include questions that are based on solving problems in new contexts.

In addition, the teaching strategies in this course will attempt to **engage all of you as a community of scientists in the classroom** to develop leadership and communication skills as well as support each other in understanding biological concepts.

High-level learning goals

We anticipate that you will learn many different things in BIPN 140! We anticipate that what you will be able to do by the end of the quarter includes, but is not limited to, the following:

- **Demonstrate an understanding of the structure and function of neurons,** particularly how the **receive and transmit signals**.
- **Predict how a perturbation** of a molecule or chemical or biophysical conditions (like through a disease or experimental manipulation) **will affect the function of the neuron and the organism** as a whole.
- **Demonstrate a mechanistic (how) and teleologic (why) understanding** of the physiological processes underlying neurons.
- **Develop critical thinking skills** to be able to think like a neuroscientist and **solve biologically-relevant problems**.
- **Increase your understanding of your own learning (metacognition)**, including recognizing what topics are easy or difficult for you to learn, learning what study strategies work best for you, and seeking help from instructors and colleagues at appropriate times.

The full list of specific neuroscience-related learning outcomes is listed near the end of this syllabus. These are intended guide your learning of the material. Every homework and exam problem will be tied to one or more of those specific learning outcomes.

Grading

The activities, requirements, and assignments that comprise this course are designed to **promote your learning** and facilitate your understanding of neuroscience using many different teaching methods. In addition, these assignments (particularly Readiness Reading and Homework assignments) give us valuable information that allows us to adjust the course to meet your educational needs.

How Your Letter Grade will be Assigned

Grade assignments will be based on the percentage of total points earned. We do not decide your grade, but rather **you as a student do the work to earn your grade**.

%	Grade	%	Grade	%	Grade	%	Grade
>98	A+	87-89	B+	77-79	C+	60-69	D
93-97	A	83-86	B	73-76	C	0-59	F
90-92	A-	80-82	B-	70-72	C-		

How Your Grade will be Calculated

Course Component	Total Points	~% of Grade
Lecture Participation	**45**	**4%**
Lecture attendance (9 @ 5 points each)	45	
Assignments and Homework	**330**	**27%**
More About You survey	5	
Follow-up survey	5	
Welcome to Codon Readiness Reading	5	
Using Codon to Study for Midterm 1 Readiness Reading	5	
Pre-lecture Readiness Readings (14 @ 10 points each)	140	
Weekly Homework (9 @ 10 points each)	90	
Practice Tests (3 @ 20 points each)	60	
Final Reflection	20	
Exams	**720**	**59%**
Highest scoring midterm	180	
Next highest scoring midterm	180	
Final Exam	360	
Writing Assignments	**115**	**9%**
Calibration assignment	5	
Highest writing assignment	55	
Next-highest writing assignment	55	
Professionalism	**10**	**1%**
TOTAL	**1220**	**100%**

Grades will be posted regularly on Canvas.

A note on re-grading

We are always happy to communicate with you **to discuss your learning.** If you believe that a grading error has been made, please contact your IA with an explanation of the error. If your IA agrees that an error has occurred, email me with an explanation of the error. **If you think your work deserves more points,** please include in your explanation a concise description of how your answer compares to the rubric or answer key and why you think it should have earned more points.

Explanation of Course Components

The course may seem like a lot of work with all these assignments, but we believe that each of the course components is important for **supporting your learning** and structuring your studying. If it becomes apparent that this is not the case, we reserve the right to alter the course structure to support you and your learning.

Lecture attendance

Active participation in lecture is important for your learning. Therefore, every day, we will engage in in-class activities and use **iClickers**. iClicker usage is how we measure lecture participation for points.

For your iClicker to correctly be associated with your name, **you must register your clicker** on iclicker.com. To do that, make an iClicker student account on https://student.iclicker.com/#/login (if you haven't already) and register your remote's ID on your iClicker student account.

You can re-use clickers for multiple courses and multiple quarters. You can also use a used clicker from someone else. You can even share an iClicker with someone in another class, but you cannot share with someone else who is also in this class. Please be aware that it is dishonest and does not represent your learning if someone else uses your iClicker in class when you are not there, so in that situation we cannot give participation points to you or the person using your iClicker.

We will start counting iClicker participation for points starting on the Thursday of Week 1. Everyone has different circumstances and life events. Therefore, to get full attendance points, you only need to attend and click in during 9 lectures (out of 17 total), which allows you to miss 3 weeks (6 class sessions) of class after the first week. **If you feel sick, we encourage you to use these dropped lectures and stay home.**

If you believe that you might have a situation or condition that will cause you to miss more than 3 weeks of lectures, please contact us right away, so we can strategize about accommodations.

Pre-lecture Readiness Readings

Before every lecture, there will be an assignment called a **Readiness Reading** on Codon. The main purpose of these assignments is to **prepare you for class** by having you watch **short lecture videos** and answering **multiple-choice questions** to check your comprehension. Each Readiness Reading is specific to the lecture that happens the day after it is due. It is meant to be exploratory. Therefore, you may retake the questions as many times as necessary to view all the feedback and find the correct answers.

Some Readiness Readings may also have free-response questions to explore your ideas on certain topics or have you reflect on your performance. These will be graded solely on completion, as these questions usually do not have right or wrong answers

Readiness Readings will be made available on Codon at least several days before they are due. They will be due most Monday and Wednesday nights, except if an exam is released the following day. **They will be due at 11:59pm the night before class.**

You can submit 85% of the Readiness Readings (14/16) and still receive full credit, as the lowest two Journal scores are dropped.

Post-lecture Weekly Homeworks

At the end of every week, there will be a **post-lecture weekly Homework posted on Codon.** These feature hard questions from previous exams on the learning objectives covered that week. They will be free-response and graded solely on completion. You will be able to see the correct answers after initially submitting an answer.

In addition, we will ask 2-4 optional ungraded open-ended questions that allow you to give feedback to us about your experiences in the course.

Weekly Homeworks will be due every Saturday night **no later than 11:59pm.** Completion of at least 85% of quizzes (9/10) can give you full credit, as the lowest Homework score will be dropped.

Pre-exam Practice Tests and Prep Questions

The day before every exam, there will be a **Practice Test** posted on **Codon.** These are part of the "Study Path." In order to access them, you can either **have completed the Weekly Homeworks** relevant to that exam, or you can wait until they automatically unlock two days before the exam. (If you want to see them earlier, you can "skip" practicing certain learning objectives by clicking "skip" in the lower left corner of each Checkpoint 2 card.) Similar to the weekly homeworks, the Practice Tests feature hard questions from previous exams, are free-response, and are graded solely on completion. They have one question per learning objective. You will be able to see the correct answers after initially submitting an answer.

The Study Path will also have Prep Questions. These are optional multiple-choice questions that check comprehension of each learning objective.

Practice Tests for the Midterms will be due the night before the exam **no later than 11:59pm.** For the Final Exam, the Practice Test will be due **the minute before the Final Exam starts.** The lowest Practice Test is dropped.

Final Reflection

A final reflection on your experiences in this course is due at the end of the quarter on the **Saturday of finals week at 11:50pm**. The prompt for this reflection will be: "What did you learn in BIPN 140 that will continue to influence you for many years to come? How did you learn these things?"

Discussion Sections

Weekly discussion sections are on Zoom. They are optional. Activities in the discussion section may include review of previous lecture, watching videos from the upcoming Readiness Readings, and answering student questions. They are a good opportunity to get extra attention from the IAs.

Exams

To facilitate developing useful knowledge and skills for the long term, tests in this course will focus on **applying knowledge to assess and solve novel problems.** Questions will be largely be short answer, including graphing. Any material covered in or closely related to each lesson's learning objectives may be tested.

Exams will be in-person. You will handwrite your responses on an exam paper we give you. You may bring **one 8.5"x11" study sheet** to the exam that can be filled, back and front, with your notes (three sheets for the Final Exam). You should also bring a calculator that can do exponents and logarithms, such as a graphing or scientific calculator. Other than that, you may not use any other aides.

All exams are cumulative (except the first midterm) to promote long-term retention of knowledge. If you want to remember this material years from now in your career or life, you certainly want to remember it until the end of the term.

There will be 4 exams in this course: 3 midterms and 1 Final exam. Midterms are given during class time, while the Final Exam is given at the official time slot given on this website: https://blink.ucsd.edu/instructors/academic-info/exams/schedule.html The dates for the exam are in the Course Schedule in the back of this syllabus. **If you need to miss an exam date, please let us know as soon as is reasonable, and we will arrange for a make-up.** The make-up will also be in-person. Make-up exams will be arranged through the Triton Testing Center. To use the Testing Center, please login to the RegisterBlast system with your UCSD login: https://www2.registerblast.com/ucsd/Exam/List. Then, you can schedule a test using their interface.

Your lowest **midterm** grade will be dropped. If you miss one of the midterms, that will be the exam dropped. The Final will be longer and is worth more points, so it **cannot be dropped**.

Writing Assignments

Writing about biology not only helps you develop professional communication skills; it also has been shown to help you learn the material. Therefore, we will have **three short writing assignments** (roughly a paragraph in length) that focus on concepts that have been tricky for students in the past. These will be similar to in structure exam free response questions, but to answer them, you will have to read a particular paper and analyze some data in that paper.

Peer review is an important part of the process of scientific writing, and both giving and receiving peer feedback can help you learn. Therefore, for each writing assignment, you will give peer feedback on three other student submissions. Then, you will give feedback on how useful your peer evaluations were.

The writing assignments will take place on the **Kritik** platform, which can be accessed from the link on the left side of the Canvas page. Each writing assignment will have three phases:

- **Create:** You will write your response to the given prompt. You will have 4 days for this phase.
- **Evaluate:** You will be given three other student's submissions and will have to evaluate them according to a given rubric. The other students will be anonymous to you. You will have 4 days for this phase. Even if, for some reason, you could not turn in a "create" submission, you can participate in this phase.
- **Feedback:** You will receive the feedback your submission received from other students. You will rate and write about how useful their feedback was. You will have 2 days for this phase.

Your total score for each Writing Assignment will be determined by the sum of the grades you received for your submission and the determination of how useful your evaluations were. We will spot-check the grades to make sure that you all graded each other fairly and accurately. As with every other assignment, if you feel that your grade was not accurate, you may ask us for a regrade.

In addition, before the first writing assignment, there will be a short **"calibration" assignment** that will help you get comfortable with Kritik and better understand how to evaluate writing submissions. In this assignment, you will be shown three different submissions for a fake prompt and evaluate them using a rubric. Even though the prompt and rubric are fake, they will be similar in style to the real prompts.

The due dates for each phase of the writing assignments are given in the schedule at the back of the syllabus. Your lowest total Writing Assignment score (1 of 3) will be dropped.

Professionalism

This portion of the course grade is intended to motivate you to **consider the impact of your actions on your own learning and the learning of others** in the course. Unprofessional interactions consume time yet have no meaningful benefits to you, your fellow students, and/or the teaching team. Analogously in the workplace, being unprofessional to your colleagues or supervisors will only discount you. When you are discounted, you will not be invited for new opportunities that you may or may not be aware of.

By default, everyone is assumed to be professionally mature, so this component is automatically awarded to you at the beginning of the quarter. During the quarter, based on observations by the teaching team, including but not limited to one-on-one interactions, electronic communication, and follow-up conversations on grades, **your professionalism credit may be deducted** in steps of 5pts.

Examples of interactions with meaningful benefits:
- Working collaboratively to improve in building knowledge and skills
- Asking questions about course policies or course material to clarify it and facilitate learning
- Clarifying how a response was incomplete or incorrect in order to learn how to correct one's own ideas
- Reporting errors or issues in class, on assignments, or in other course material
- Respectfully giving feedback about the course
- Treating everyone in the class community, including the instructional team and other students, with respect

Examples of interactions that have no meaningful benefits and thus should be avoided:
- Contributing inequitably to team work in class, in discussion section, or on exams
- Harassing and/or bullying the instructional team or other students
- Ignoring the directions or requests from the instructional team
- Asking for course credit when such credit would conflict with stated course policies (such as the policy on late assignments), when it would be applied inequitably (such as just for you), or when the instructor has already explained that the answer did not earn such credit
- Being disruptive to fellow students online, in discussion section, or on exams

Extra Credit Opportunities

You have several opportunities for extra credit. Extra credit questions will be offered on each exam to make up for exam points missed. In addition, there are two other opportunities for extra credit:

- 10 points for **meeting with Prof. Owens or an IA during office hours** or another meeting. If the office hours times do not work for you, email us and let us know what times work for you!
- 5 points for completing CAPEs. **If 90% or more of all students complete all CAPEs**, 5 points will be awarded to everyone in the course.

Other opportunities may occur as necessary. Extra credit opportunities are always awarded to the entire class, **never to just one student.**

Late Policy

Because of the size of this class and to prepare you for hard deadlines later in your career, **we cannot award full points for assignments, quizzes, exams, or anything else submitted late** without our prior agreement. Late assignments will be given 75% or less credit after the due date.

To mitigate the impact of this policy, remember that in nearly all cases, you can drop one or two assignments without any impact on your score. That means if you happen to miss one or turn it in late, or your life is too busy a certain week, it will not negatively impact your score. Even if you miss the deadline for an assignment, we still highly recommend doing the work to prepare for class and exams.

Exception: **if you have a situation that would require you to miss two or more weeks of assignments, please reach out to us as soon as possible** so we can discuss accommodations.

BIPN 140 Class Culture

BIPN 140 is a **community of scientists** trying to increase their understanding of the biological world. The classroom culture is designed to engage you in collaborating and thinking like a scientist.

When people collaborate to work towards a common goal, in this case building our learning, we must **establish shared values** so that everyone understands acceptable ways of working together. In organizations, these are commonly called codes of conduct or ethics. In this course, we use the following statement, adapted from the International Center for Academic Integrity (https://academicintegrity.org/) and Dr. Tricia Bertram Gallant, to explicitly state our values and describe the behaviors that maintain and protect these values.

	As students we will…	As the teaching team we will…
Honesty	• Honestly demonstrate your knowledge and abilities according to expectations listed in the syllabus or in relation to specific assignments and exams • Communicate openly without using deception, including citing appropriate sources	• Give you honest feedback on your demonstration of knowledge and abilities on assignments and exams • Communicate openly and honestly about the expectations and standards of the course through the syllabus and in relation to assignments and exams
Responsibility	• Complete assignments on time and in full preparation for class • Participate fully and contribute to team learning and activities • Take ownership of your own learning by using course and outside resources, including the teaching team, to clarify confusions and extend your knowledge	• Give you timely feedback on your assignments and exams • Show up to office hours and class on time and be mentally and physically present • Create relevant assessments and class activities • Providing selected resources and a helpful environment to help you address your confusions and extend your knowledge
Respect	• Speak openly with one another while respecting diverse viewpoints and perspectives • Provide sufficient space for others to voice their ideas	• Respect your perspectives even while we challenge you to think more deeply and critically • Help facilitate respectful exchange of ideas
Fairness	• Contribute fully and equally to collaborative work, so that we are not freeloading off of others on our teams • Not seek unfair advantage over fellow students in the course	• Create fair assignments and exams and grade them in a fair and timely manner • Treat all students and collaborative teams equitably
Trustworthiness	• Be open and transparent about what we are doing in class • Not distribute course materials to others in an unauthorized fashion	• Be available to all students when we say we will be • Follow through on our promises

		• Not modify the expectations or standards without communicating with everyone in the course
Courage	• Say or do something when we see actions that undermine any of the above values • Accept the consequences of upholding and protecting the above values	• Say or do something when we see actions that undermine any of the above values • Accept the consequences of upholding and protecting the above values

Course Policies

Students with Disabilities

If you have a disability, **including mental health issues,** that might affect your attendance or performance in this course, please contact us early in the quarter to work out reasonable accommodations to support your success. To ensure fairness and proper support, anyone who requests accommodations because of a disability must get a current Authorization for Accommodation (AFA) letter issued by the Office for Students with Disabilities (OSD). To contact OSD, use the student portal: https://academicaffairs.ucsd.edu/sso/osdsp/home, email the Biology OSD liaison at bioosd@ucsd.edu, or call 858-534-4382.

Whenever possible, we strive to use universal designs that are inclusive. If you have feedback on how to make the class more accessible and inclusive, please get in touch!

Podcasts and Lecture Recording

Barring technical difficulty, **classes will be recorded and made available online** as a resource for learning (http://podcast.ucsd.edu and the course Media Gallery). However, remember that active participation and contribution are highly encouraged, and many important concepts and ideas will be developed collaboratively by doing in-class activities that cannot be replicated by watching a video.

Academic Integrity and Originality

Integrity of scholarship and learning is fundamental to creating our classroom community and the academic community at large. The University expects that both students and faculty will honor this principle and in so doing protect the validity of University intellectual work.

For you, this means that all academic work you submit for this course should be **your own new original work.** We emphasize this for several reasons. First, **using your own thoughts and putting things in your own words helps you learn.** There is no better way to discover quickly what you understand and what you don't than to explain a concept to someone else. Second, in professional settings, trying to hide dishonest behavior or pass someone else's words off as your own can lead to trouble. To encourage original thought and writing in this class, we take precautions. For example, Canvas uses Turnitin to scan Journals for plagiarized material. **Our goal is not to** *catch* **anyone** (although we can't give credit for dishonest work or plagiarized material), **but to help everyone make a habit of using their own thoughts and voice.**

In addition, part of being a good member of a community **is not facilitating dishonest behavior by others**. No course materials, particularly homework and exams, may be posted online, submitted to private or public repositories, or distributed to unauthorized people outside of the course.

To hold everyone accountable for their actions, any serious suspected instances of a breach of academic integrity will be reported to the Academic Integrity Office for review. For more information on academic integrity, please visit https://students.ucsd.edu/academics/academic-integrity/index.html.

Use of ChatGPT and other artificial intelligence tools

ChatGPT and other artificial intelligence such as Bard and Bing Chat are online services that can answer questions in human-like ways. These tools can help you in many tasks. However, they have serious downsides. As they merely string words together without employing logic, they may not give the correct answers to questions that require logical analysis. They also do not necessarily understand how we will be evaluating their writing.

In this course, you may use ChatGPT and other artificial intelligence tools as one way to study or understand a topic or to do non-logic tasks like checking your spelling. **However, you may not submit a response that is substantially authored by an artificial intelligence tool as your own final work.** In addition, remember that whatever you do, you are ultimately responsible for the work you turn in and, more importantly, for the learning that does or does not take place. For example, if you do not write your own submission for the "Create" phase of a Writing Assignment, you may have a difficult time evaluating the scientific merits of your fellow students in the "Evaluate" phase.

Helpful Resources at UCSD

If you are experiencing anxiety, depression, or worse, you are not alone. On top of facing the normal stresses of college, many college students are in their late teens or early twenties, which is when many mental illnesses emerge for the first time because of brain maturation. In addition, you may be experiencing the effects of trauma or violence. Or, you might be one of the 19% of UC students who report not being able to access adequate food[3] or who do not have a safe, stable place to live.

Whatever your situation, whether your problems feel big or small, we encourage you to seek help and support, either from us or from professional resources on campus. Some are listed below.

Help and Resources
Academic Support
OASIS (http://oasis.ucsd.edu) The Office of Academic Support & Instructional Services (OASIS) offers math and science tutorial programs for everyone. They also have services and scholarships for those of you who have overcome significant obstacles to become successful.
Teaching + Learning Commons (http://commons.ucsd.edu) The Teaching + Learning Commons offers tutoring, consultations, and workshops on learning strategies as well as assistance with writing in the Writing + Critical Expression Hub.
1st Gen Student Success Coaching Program (https://successcoaching.ucsd.edu/) The 1st Gen Student Success Coaching Program offers coaching that addresses academics, skill development, and advocacy for those of you who are in the first generation in your family to go to college.

Educational Technology (https://digitallearning.ucsd.edu/learners/learning-remotely/tools.html)
EdTech has resources for understanding educational technologies like Zoom and Canvas.

Psychology & Physical Safety*

CAPS (http://caps.ucsd.edu)
CAPS offers free, confidential counseling. They can help with urgent crises, such as an assault or thoughts of self-harm. They can also talk if you are worried about a friend or classmate. (However, it may take a while to get ongoing services.

CARE at SARC (http://care.ucsd.edu)
Campus Advocacy, Resources, and Education at the Sexual Assault Resource Center (CARE at SARC) offers support for those of you who have experienced sexual violence or violence from a partner. They have free confidential counseling, including on nights and weekends.

Basic Needs

Triton Food Pantry (http://basicneeds.ucsd.edu/triton-food-pantry/)
The Triton Food Pantry discreetly offers food for current UCSD students to ensure each of you has enough nutrition to get through the day.

The Hub (https://basicneeds.ucsd.edu)
The Hub serves those of you who have trouble accessing basic needs, including food or stable housing, or who have financial emergencies. They can help you connect with a variety of on- and off-campus programs, including the Food Pantry, CalFresh, emergency loans, emergency housing, or changes to your financial aid.

Other Situations

Dean of Student Affairs of your College
Each of UCSD's seven Colleges has a Dean of Student Affairs who can help students in challenging situations. They can pull together campus and outside resources and reach out to instructors and campus resources on your behalf. If you are not exactly sure what you need or how UCSD can help, they are a good place to start. They are also a good place to turn to if you are worried about another student.

It is also important to find **a community of like-minded people around you**. You may be interested in the following resources: APIMEDA Programs & Services (apimeda.ucsd.edu), the Black Resource Center (brc.ucsd.edu), the Cross-Cultural Center (ccc.ucsd.edu), the Intertribal Resource Center (itrc.ucsd.edu), the LGBT Resource Center (lgbt.ucsd.edu), the Raza Resource Centro (raza.ucsd.edu), the Student-Parents Resource page (students.ucsd.edu/well-being/wellness-resources/student-parents), the Student Veterans Resource Center (students.ucsd.edu/sponsor/veterans), Undocumented Student Services (uss.ucsd.edu), the Women's Center (women.ucsd.edu).

[3] Martinez *et al.* 2016. University of California Global Food Initiative: Student Food Access and Security Study. https://www.ucop.edu/global-food-initiative/best-practices/food-access-security/student-food-access-and-security-study.pdf

*Please note that while we on the instructional team are here to support you, instructors are obligated by law to notify UCSD's Title IX coordinator if a student (or any person at UCSD) discloses to us a personal experience of sexual harassment, sex or gender discrimination, domestic violence, or stalking. This is so that the University can properly address the issue. If you do not want your experiences to be reported, please contact CAPS or CARE, which can talk to you confidentially.

List of Content Learning Objectives

Learning objectives are specific skills you will hopefully be able to do by the end of the course. We suggest paying attention to the verbs- for example, being able to *explain* something is a different skill than being able to *predict* it.

This list starts at Learning Objective 2.1 because Learning Objectives 1.1-1.3 are about being prepared for and participating in the course, so they will not be tested on exams or writing assignments.

LO	Class	Learning objective
2.1	0	Recognize and distinguish between the morphology (shape) and functions of the following cell types: neurons, astrocytes, ependymal cells, microglia, oligodendrocytes, satellite cells, Schwann cells
2.2	0	Recognize and distinguish between the functions of axons, dendrites, and spines.
2.3	0	Recognize and distinguish between projection neurons and interneurons.
2.4	0	Justify when it would be appropriate to use genetically coded reporters, immunohistochemistry, or viral tracers to answer specific questions about the location and structure of neurons.
3.1	0	Predict how perturbations of kinesin, dynein, microtubules, and ATP will affect the speed and direction of slow, fast, and intermediate axonal transport.
4.1	1	Explain how the normal resting membrane potential arises from ion concentrations, ion permeabilities, and the sodium/potassium pump.
4.2	1	Predict qualitatively (using words, not numbers) how changes in ion concentrations will change the membrane potential.
4.3	1	Define the equilibrium potential for a single ion and calculate it using the Nernst equation given its concentrations.
4.4	1	Use the GHK equations to calculate the membrane potential given ion concentrations and relative permeabilities.
5.1	2	Distinguish between active and passive electrical signaling in neurons.
5.2	2	Qualitatively explain how the resistance and capacitance of the neural membrane cause the voltage of a membrane to react in a certain way to injections of current.
5.3	2	Use equations from cable theory to qualitatively and quantitatively predict how an injection of current changes the membrane potential over time.
5.4	2	Use equations from cable theory to qualitatively and quantitatively predict how an injection of current changes the membrane potential over distance.
6.1	3	Explain how to use the voltage-clamp technique to measure currents.
6.2	3	Use the reversal potential, changes in ion concentrations and channel blockers to determine which ion or ions a membrane or channel is permeable to.
6.3	3	Justify the use of whole cell recording, cell-attached recording, inside-out recording, and outside-out recording for a particular experimental question involving channel function.
6.4	3	Visually distinguish between whole cell and single channel currents and explain why they look different.
6.5	3	Calculate how whole cell currents arise from single channel currents.
7.1	4	Use electrophysiology to determine how well a channel opens in response to various stimuli.
7.2	4	Use an IV curve to determine whether and how a voltage-gated channel is rectified.

7.3	4	Use an IV curve to measure the conductance of an ion at various voltages.
7.4	4	Use prepulses to measure the amount of channel inactivation.
7.5	4	Use two voltage pulses to measure the timing of recovery from inactivation.
8.1	6	Explain how X-ray crystallography, affinity chromatography with gel electrophoresis, and mutagenesis are used to understand channel structure.
8.2	6	Use biochemical logic and published diagrams of channels to make predictions about whether a specific mutation might affect gating, activation, ion selectivity, or inactivation of a channel.
8.3	6	Predict how specific mutations in or pharmacological modifications to the activation gate, pore, and inactivation gate will affect channel function.
9.1	7	Use the concept of frequency coding to explain how neurons encode information.
9.2	7	Describe how the currents and conductances of Na^+ and K^+ change during the action potential.
9.3	7	Predict how changes to ion channels, ion concentrations, or other molecules will affect each step of the action potential.
9.4	8	Define threshold and predict how changes to ion channels or other molecules may affect it.
9.5	8	Predict how altering Na+ or K+ channels and their currents and conductances will affect absolute and relative refractory periods.
9.6	8	Use the properties of voltage-gated sodium channels to explain accommodation and anode break excitation.
9.7	8	Predict how adding more currents to the standard two currents in the action potential will affect whether the neuron will burst or be a pacemaker.
10.1	9	Use electrophysiology, dyes, and anatomy to distinguish between electrical and chemical synapses.
10.2	9	Outline the basic steps of neurotransmission at the chemical synapse.
10.3	9	Predict how altering Ca^{2+} entry, vesicle type, SNARE proteins, synaptotagmin, or vesicle recycling will change the ability of the synapse to release neurotransmitters.
10.4	9	Explain how the quantal nature of synaptic transmission causes mPSPs and PSPs.
10.5	9	Predict how changing the action potential, Ca^{2+} entry, vesicle recycling, or vesicle properties will change the amplitude and frequency of PSPs and mPSPs.
11.1	11	Distinguish between ionotropic and metabotropic receptors.
11.2	11	Distinguish between excitatory and inhibitory postsynaptic potentials and currents.
11.3	11	Define and recognize temporal and spatial summation of PSPs.
11.4	12	Predict how manipulating the synthesis, recycling, vesicle loading, and major receptors of glutamate, GABA, biogenic amines, and peptides would affect neurotransmitter function.
11.5	12	Predict the physiological outcome of activating the major receptors for glutamate, GABA, biogenic amines, and peptide neurotransmitters in terms of ion flows, current flows, and EPSC/IPSCs.
12.1	13	Predict how perturbations of GPCRs, G-proteins, GTP, GEFs, GAPs, and effector proteins will alter neural signaling.
12.2	13	Predict how perturbations of β-arrestin signaling will alter neural signaling.
12.3	13	Outline the steps of G_s, G_q, and $G_{i/o}$ signaling pathways and predict how altering these pathways will affect neural signaling.
12.4	13	Outline possible steps leading to Ca^{2+} signaling in neurons and predict how altering these pathways will affect neural signaling.
12.5	13	Explain how CREB and c-fos expression are activated.

13.1	14	Use patient symptoms to correlate certain types of memory with certain brain areas.
13.2	14	Identify the brain areas associated with working memory, non-declarative memory, the acquisition of declarative memory, and the short-term and long-term storage of declarative memory.
13.3	14	Interpret the results of contextual fear conditioning experiments to draw conclusions about the mechanisms of memory in animals.
13.4	14	Interpret the results of water maze experiments to draw conclusions about the mechanisms of memory in animals.
13.5	14	Predict how activation of ChR2, NpHR, and other optogenetic tools will influence the behavior of neurons and circuits.
14.1	16	Explain how Ramirez and colleagues created a false memory and why their procedure.
14.2	16	Interpret electrophysiological data to draw conclusions about the mechanisms of synaptic plasticity.
14.3	16	Distinguish between the timecourse and molecular mechanisms of short-term and long-term plasticity.
14.4	16	Use the concept of "coincidence detection" to predict when long-term plasticity would occur.
14.5	17	Predict how manipulating ion channels, enzyme phosphorylation, and expression of various genes would affect hippocampal E-LTP, L-LTP, and LTD.
14.6	17	Explain, compare, and contrast the role of AMPARs and NMDARs in hippocampal LTP.
14.7	17	Predict how manipulating ion channels, enzyme phosphorylation, and expression of various genes would affect cerebellar LTD.
14.8	17	Recognize and distinguish between "fire together, wire together" plasticity and spike-timing-dependent plasticity.
14.9	17	Use typical spike-timing-dependent plasticity rules to predict how the timing of two neuron's firings might influence synaptic strength.
15.1	18	Describe the process of establishing a mature synaptic connection between a motor neuron and a skeletal muscle fiber.
15.2	18	Predict how perturbations of synaptic adhesion, presynaptic and postsynaptic signaling molecules, and receptor clustering will affect whether a synapse forms and how strong it is at the NMJ.
15.3	18	Predict how perturbations of synaptic adhesion, presynaptic and postsynaptic signaling molecules, and receptor clustering will affect whether a synapse forms and how strong it is at a CNS synapse.
15.4	18	Predict how perturbations of neural activity will affect synaptic pruning, synapse number, and the connections between neurons.
16.1	19	Given the VTA-NAc circuit, predict the effect of various drugs and interventions on dopamine release and feelings of reward.
16.2	19	Differentiate between tolerance and addiction.
16.3	19	Given an effect of a drug, predict how the brain will respond to develop tolerance to that drug.
16.4	19	Discuss the role of long-term plasticity in developing drug addiction.

Lecture Overview and Course Schedule

More specific information will be provided on the Canvas, Codon Learning, and Kritik platforms. We may adjust the schedule, assignments, and readings as necessary while still focusing on the learning objectives. All assignments are due at 11:59pm, except for the Final Exam practice test, which is due at 2:59pm (right before the Final Exam.)

Key:
- Due BEFORE = Assignment due 11:59pm the night before class
- HW = Homework
- LO = Learning Objectives
- RR = Readiness Reading
- WA = Writing Assignment

Date	Guiding Questions	LOs	Assignments Due
Class #0 Th Sep. 28	Welcome! Who are we? What are neurons and glia?	2.1-2.4, 3.1	
Class #1 Tu Oct. 3	What factors contribute to the voltage inside of a neuron?	4.1-4.4	- **Class 1 RR** due BEFORE - **Welcome to Codon RR** due BEFORE
Class #2 Th Oct. 5	How does electricity spread inside of a neuron, at rest?	5.1-5.4	- **Class 2 RR** due BEFORE - **More about YOU survey** due BEFORE - **HW 1** due Sat. Oct. 7
Class #3 Tu Oct. 10	What do currents look like? How do we study them?	6.1-6.5	- **Class 3 RR** due BEFORE - **Using Codon to Study for Midterms RR** due BEFORE
Class #4 Th Oct. 12	What are the electrical properties of channels? How do we study their function?	7.1-7.5	- **Class 4 RR** due BEFORE - **Kritik Calibration Assignment** due BEFORE - **HW 2** due Sat. Oct. 14
Class #5 Tu Oct. 17	**Midterm 1 (all learning objectives up and including 6.5)**		- **Midterm 1 Practice Test** due BEFORE
Class #6 Th Oct. 19	What are the biochemical properties of channels? How do we study their function?	8.1-8.3	- **Class 6 RR** due BEFORE - **HW 3** due Sat. Oct. 21 - **WA 1 Create** due Sun. Oct. 22
Class #7 Tu Oct. 24	What are action potentials? How do channels function in how they work?	9.1-9.3	- **Class 7 RR** due BEFORE
Class #8 Th Oct. 26	What are action potentials? How do channels function in how they work?	9.4-9.7	- **Class 8 RR** due BEFORE - **WA 1 Evaluate** due Th. Oct. 26 - **HW 4** due Sat. Oct. 28 - **WA 1 Feedback** due Sat. Oct. 28
Class #9 Tu Oct. 31	What are synapses? How are neurotransmitter released?	10.1-10.5	- **Class 9 RR** due BEFORE
Class #10 Th Nov. 2	**Midterm 2 (all learning objectives up and including 9.7)**		- **Midterm 2 Practice Test** due BEFORE - **HW 5** due Sat. Nov. 4
Class #11 Tu Nov. 7	How do neurotransmitters cause effects in the receiving cell?	11.1-11.3	- **Class 11 RR** due BEFORE

Class #12 Th Nov. 9	How do neurotransmitters cause effects in the receiving cell?	11.4-11.5	- **Class 12 RR** due BEFORE - **WA 2 Create** due Fri. Nov. 10 - **HW 6** due Sat. Nov. 11
Class #13 Tu Nov. 14	What signaling occurs inside a neuron after receptor activation?	12.1-12.5	- **Class 13 RR** due BEFORE - **WA 2 Evaluate** due Tu. Nov 14
Class #14 Th Nov. 16	What is learning and memory? How do we study learning and memory?	13.1-13.5	- **Class 14 RR** due BEFORE - **WA 2 Feedback** due Th. Nov. 16 - **HW 7** due Sat. Nov. 18
Class #15 **Tu Nov. 21**	**Midterm 3 (all learning objectives up and including 12.5)**		- **Midterm 3 Practice Test** due BEFORE
Th. Nov. 23	**No class: Happy Thanksgiving!**		
Class #16 Tu Nov. 28	What are the synaptic mechanisms of learning and memory?	14.1-14.4	- **HW 8** due BEFORE - **Class 16 RR** due BEFORE
Class #17 Th Nov. 30	What are the synaptic mechanisms of learning and memory?	14.5-14.9	- **Class 17 RR** due BEFORE - **WA 3 Create** due Fri. Dec. 1 - **HW 9** due Sat. Dec. 2
Class #18 Tu Dec. 5	How are new synapses formed?	15.1-15.4	- **Class 18 RR** due BEFORE - **WA 3 Evaluate** due Tu. Dec. 5
Class #19 Th Dec. 7	What are the synaptic mechanisms involved in drug addiction?	16.1-16.4	- **Class 19 RR** due BEFORE - **WA 3 Feedback** due Fri. Dec. 8 - **HW 10** due Sat. Dec. 9
M Dec. 11	**Final Exam (all learning objectives), 3-6pm**		- **Final Exam Practice Test** due 2:59pm - **Final Reflection** due Sat, Dec. 16