

# Molecular and Cellular Neurobiology

## BIO 4690

### Syllabus

**Credits:** 3  
**Type:** Online: synchronous and asynchronous  
**Live Classes:** M/W 2:30 – 3:45PM  
**Place:** <https://canvas.wayne.edu/courses/134740>

**Instructor:** Dr. Justin Kenney  
Biological Sciences Building, room 2117  
Ph: 313-577-5943  
Preferred method of contact: within Canvas  
Office hours: By appointments scheduled in Canvas. See “Office Hours” link on course homepage.

**Textbooks:** The primary textbook for this course is: *Neuroscience: Exploring the Brain*, 4<sup>th</sup> Ed. By Mark Bear et al. ISBN: 978-0-7817-7817-6

A significant portion of lecture material is also derived from: *Principles of Neural Science*, 5<sup>th</sup> Ed. By Eric Kandel et al. ISBN: 978-0071390118

**Course website:** <https://canvas.wayne.edu/courses/134740>

**Course pre-requisites:** Bio 3200 (Human Physiology) with a minimum of a C-

#### Course description

The brain is the most complex object known to man and is the storehouse of our lives. In the past century, humanity has made great strides in our understanding of the brain. In this class, we take a reductionistic approach to understanding how the brain works. We start with exploring many of the basic mechanisms by which neurons process information at the electrical (Unit I) and chemical (Unit II) levels. This serves as a foundation for building up an integrated (Unit III) appreciation for how the nervous system interacts with the outside world. Taken together, this class provides the necessary foundation for understanding the nervous system in more depth and tackling more advanced topics in of neuroscience. To achieve this goal, the course is broken down into the following units and learning objectives:

#### Unit I: Electrical signaling

*In this section you will learn about the different types of cells present in the brain and how they interact. You will also learn about the ionic and molecular basis for the resting membrane potential and action potential in neurons.*

### Unit II: Chemical signaling

*In this section you will learn about neurotransmitters, their release, and how they influence neuronal function. We will integrate what we learn about chemical signaling with the previous section on electrical signaling. I will also introduce and expand on some basic ideas in neuropharmacology and cell signaling.*

### Unit III: Sensory and Integrated Systems

*In this section you will learn about the different sensory systems. The focus will be on the cells involved in sensory processing and the mechanisms of sensory transduction. In doing so, you will further integrate your understanding of how chemical and electrical signaling interact to enable sensory representations of the external world.*

*In addition, you will also learn about synaptic plasticity and how neurons change their electrical and chemical properties in response to different stimuli.*

## **Learning objectives**

### Subject Specific

- Understand the molecular basis for how neurons process and transmit information using electrochemical signaling
- Understand how neurotransmitters contribute and modulate electrochemical signaling in neurons
- Integrate your electrochemical understanding of neurons to appreciate how the nervous system interacts with the external environment through the senses
- Describe how electric properties of neurons change in response to different inputs and the molecular basis for these changes.

### General Skills

*This course will challenge you to apply subject specific knowledge to enhance your critical thinking and problem-solving skills. Indeed, the true mark of understanding a subject is that you can use your knowledge to solve problems you have not previously encountered. This is a critical life skill that will help you succeed in all your future endeavors wherever they may take you. Towards this end, the class also includes the following learning objectives:*

- Proficient in interpreting experimental data and figures
- Understanding what data supports a given hypothesis, and why
- Generating hypotheses or expected data based on an experimental setup
- Translating between words and simple equations to solve a given problem

### General Class Structure

The primary form of delivering instructional material in the class will be asynchronous lectures with embedded questions. Synchronous learning time is largely **yours** and is where we will review specific topics or concepts of interest. The overall organization of assignments will adhere to the following structure to the extent possible (with exceptions for holidays and exams):

Mondays @ 12:00PM – Survey of topics for live class due

Mondays @ 2:30PM – Live Class: Discuss topics from surveys

Tuesdays @ 11:59PM – Homework is due

Wednesdays @ 2:30PM – Live Class: Discuss homework

All specific due dates will be in Canvas. **It is your responsibility to keep up with due dates. They may change. Times in Canvas will always be the most up to date.**

#### *Asynchronous lectures*

Asynchronous lectures constitute the bulk of the material for the class. To make lectures easier to watch, they will be available as ‘chunks’ of 10-15 minutes each. Thus, you could expect the material typically covered in a 75-minute lecture to be broken down into about 5-7 mini lectures.

Embedded in the asynchronous lectures will be questions based on the presented material. These questions are for *extra credit*; you can earn up to 3% extra credit by getting these asynchronous embedded questions correct.

During your initial watching of the asynchronous lectures, *you will not be able to fast forward through the lecture*. After our class period in which we discuss the lectures (Mondays) I will enable free navigation of lectures.

In order to submit the survey by 12:00PM on Monday’s before class, you **must watch all the asynchronous lectures**. This is meant to encourage you to watch lectures throughout the preceding week and minimize the incentive to binge watch lectures immediately prior to homework due dates or exams.

#### *Synchronous (live) lectures*

During live lectures on Mondays we will discuss embedded asynchronous questions and other topics based on the responses to the surveys.

During live lectures on Wednesdays we will discuss homework questions that were submitted the evening before.

I do not anticipate live classes taking the entire class period, but I will remain available to discuss material the entire time. Much of the initial learning will occur during your engagement with asynchronous lectures and reading the book. Synchronous class time is **yours** to ask for clarification of materials from lectures or the book. I do not intend to introduce new material during live class lectures.

## Technology Requirements

### *Free Software*

- Web browser (I recommend Chrome)
- Canvas
  - Free app is available for iOS and Android.
  - Accessible via web browsers
- Zoom (free app is available for all platforms)
  - For office hours and live lectures
- Drawing software
  - Some homework questions and exam questions will require you to draw diagrams or graphs. There are many ways to achieve this using free tools such as:
    - [Zoom whiteboard](#): You can open a zoom meeting, click on 'share screen', then click on 'white board'. Any items you draw on the whiteboard can be saved by clicking the 'save' button.
    - For Windows: Microsoft has a whiteboard app that is simple to use. Images can be saved as png files for upload.

### *Hardware*

- At a minimum you need to have a microphone and speakers to participate in class
- Webcam (recommended)
  - Most webcams contain a microphone
  - Most laptops have a webcam and microphone built in
- Speakers/headphones
  - This is necessary for both asynchronous and synchronous lectures
- Reliable internet connection
- *Optional*: A pen tablet for easily 'drawing' on any device. This may be a good option to consider if you have several classes that may use diagrams or drawing or if you wish to draw on power point slides etc. Some examples are:
  - <https://www.storexppen.com/list/star-series-tablet.html>
  - <https://www.wacom.com/en-us/products/pen-tablets>

**Support for Online Learning**

For some of you this may be the first time you have enrolled in an online course. Wayne State University has several resources to help you be successful for online learning:

[\*The Effective Online Learner\*](#)

This is a self-paced course to bolster the skills needed for remote and online learning.

[\*Learn Anywhere\*](#)

This is a webpage that provides resources and tips for taking online courses.

[\*Academic Success Center\*](#)

They offer resources for improving study skills, building study groups and other activities

To be successful in this course, you will need to keep up with the material. The course is designed to encourage you to engage with the material on a consistent (daily/every other day) basis. This is the most effective way to learn. The course is explicitly designed to discourage cramming or binge-watching videos immediately prior to an assignment due date. Neuroscience is a challenging, yet immensely rewarding, topic. To truly partake in this bounty of modern scientific knowledge class videos should be digested, pondered, slept-on, thought about, and engaged with. You will be rewarded with a deeper understanding of the human condition and its cellular/molecular basis.

**Grading***Grade Weighting:*

Pre-class surveys	3%
Homework	18%
Unit I Exam (9/30)	18%
Unit II Exam (10/26)	18%
Unit III Exam (12/7)	18%
Final Exam	25%
<hr/> Total	<hr/> 100%*

\*Up to 3% Extra credit can be earned through correctly answering asynchronous lecture questions.

\*Up to 1% Extra credit can be earned through the graduate student Q&A session on Nov. 23rd

*Grade Scale:*

A	92.5 – 100%
A-	90.0 – 92.4%
B+	87.0 – 89.9%
B	82.5 – 86.9%
B-	80.0 – 82.4%
C+	77.0 – 79.9%
C	72.5 – 76.9%
C-	70.0 – 72.4%
D+	67.0 – 69.9%
D	62.5 – 66.9%
D -	60.0 – 62.4%
F	< 60%

*You can get up to 3% extra credit via asynchronous lecture questions and 1% extra credit from the graduate student Q&A session. It is up to you to earn any additional boost to your grade. I do not offer any other options for extra credit.*

The most updated grades will always be calculated and available in Canvas. These grades will automatically be weighted as indicated in the “grade weighting” table.

*See “grades” link on the course homepage to access grades.*

### Exams

There will be three midterm exams, each worth 18% of your final grade, and a cumulative final exam worth 25% of your final grade. Exam grades will be posted on Canvas.

Students with any exam scheduling conflicts must notify Dr. Kenney by September 18<sup>th</sup>, 2020. There will not be any alternate make-up exams other than for University-sanctioned obligations, such as WSU team athletic competitions or University recognized religious holidays. No make-up exams will be given unless notified in writing by this date.

Reasonable exceptions will be granted in cases of illness, which will require notification prior to the exam and must be followed up with an original signed note from a physician.

Cheating on exams will not be tolerated. Anyone caught cheating will get a zero for the assignment and be reported to the Dean's office for disciplinary action. Exams will be designed to catch cheaters.

### Mid-term Exam Policies

- Exams may include multiple choice, fill-in-the-blank, problem solving, drawing, or short answers.
- Exam will be available with a buffer around our typical class time: 2:00-4:15PM.
  - To accommodate any needed flexibility for taking an online exam, they will be **available** for an additional 30 minutes before and after our scheduled class time.
  - Once the exam is started, you will have **75 minutes** to complete the assignment. **THE EXAM MUST BE SUBMITTED PRIOR TO 4:15PM.** *Thus, if you start your exam after 3PM, you will not have the full 75 minutes to take the exam.* It is up to you to start your exam on time.
- Exams will be open book and open notes **BUT NOT OPEN TO DISCUSS.**
  - Your work must be your own only. You can use whatever resources (book, notes, etc.), but you cannot discuss the exam with anyone else.
- You should make sure you have access to the following:
  - A calculator
  - A way to upload drawings (see technology requirements section for suggestions)

### Final Exam Policies

- The final exam will follow the same policies as the mid-term exam except that more time will be available for the exam.
- The final exam will be on **December 16<sup>th</sup>, 2:45-4:45PM**
- The final exam will be **cumulative**

### A note on open book/open note exams

Open book/note exams will have a greater emphasis on critical thinking and problem solving than a closed book exam. Please do not take this to mean that you do not have to study for the exams. This format should encourage you to study the material *more* deeply. A basic understanding of the material is a prerequisite to *apply* your knowledge. Also keep in mind that you will have a time limit of only 75 minutes to complete the exam. Sifting through large quantities of information for each question will simply not be practicable.

## Homework

I consider homework to be an essential part of the learning process. It is in engaging with the homework that you can take as much time as needed and identify gaps in your understanding. You are welcome to consult with one another on the homework. However, I would caution against copying the answers of someone else. While this may increase your homework grade, it will negatively impact your exam grades. Recall that each individual homework is worth only 1.8% of your grade whereas each exam is worth 18%.

My suggestion in getting the maximum benefit from the homework would be to:

1. Watch the appropriate lectures
2. Attempt the homework **on your own**
3. Ask for clarification of any topics that are unclear prior to our synchronous lecture time via the surveys or directly sending me a message
4. Attempt the homework again **on your own**
5. Consult with classmates on any concepts that you may be struggling with
  - a. Ask your classmates to explain their choices on the homework and walk you through their thought process. Be careful not to co-opt their understanding as your own; you should be able to explain the ideas accurately in your own words.
6. Consider coming to office hours if concepts are still unclear.

There will be homework assignments due throughout the semester (due dates within Canvas). *Typically, homework will be due at midnight on Tuesday before our live lecture on Wednesdays.* The Wednesday live lecture will then be spent going over the homework and any questions that arose. You will only have one opportunity to answer the questions correctly. You will be able to see your scores and correct answers after the due date has passed and everyone has had a chance to submit the assignment.

**Any homework submitted late will have the grade automatically reduced by 50%.**

**Homework cannot be submitted after it is discussed in class (i.e. at the start of class time at 2:30PM).**

### Expected homework due dates:

Homework #	Date	Time
1	Sept. 10 <sup>th</sup>	11:59 PM
2	Sept. 15 <sup>th</sup>	11:59 PM
3	Sept. 22 <sup>nd</sup>	11:59 PM
4	Oct. 6 <sup>th</sup>	11:59 PM
5	Oct. 13 <sup>th</sup>	11:59 PM
6	Oct. 20 <sup>th</sup>	11:59 PM
7	Nov. 3 <sup>rd</sup>	11:59 PM
8	Nov. 10 <sup>th</sup>	11:59 PM
9	Nov. 17 <sup>th</sup>	11:59 PM
10	Nov. 29 <sup>th</sup>	11:59 PM

NOTE: These due dates may change. If they do, the Canvas website will be updated. It will be your responsibility to keep up with any changes. Dates on Canvas are always the most up to date.

## Surveys

Surveys make up 3% of your final grade. Surveys only need to be submitted to receive full points.

Survey due dates are in Canvas but are typically due at 12PM on Monday's prior to our synchronous class. You are responsible for checking in Canvas for due dates/times.

Late submissions of surveys will be reduced by 50% and are only allowed up to the class time in which they will be discussed after which they will be automatically scored zero.

To access and submit the survey, you will need to watch all the lectures associated with a section. Before the survey is due, you will not be able to skip through the lectures (but lectures can be sped up 2X). Asynchronous lectures will be made available at least one week prior to the survey due date.

The purpose of the surveys is twofold:

1. To let me know what topics from the previous week's lecture may need further clarification during our live lecture time
2. To encourage you to watch lectures throughout the week

## Asynchronous lecture questions

Pre-recorded asynchronous lectures are the *primary* form of instruction for this course. Within these lectures will be embedded questions for you to answer. Answering these questions correctly will contribute to up to 3% of *extra credit*.

Asynchronous lecture questions can only be submitted for extra credit up to the time the associated survey is due (typically Monday's at 12PM). Late submissions will be reduced by 50% and are only allowed up to the live class time in which the lectures will be discussed after which they will be scored a zero.

I will drop up to 10 of your lowest asynchronous lecture question scores in calculating your grade (this is done automatically in Canvas).

## Graduate Student Q&A Session

There are several graduate students taking this course for credit. As an additional requirement, they will put together a presentation of a journal article. The presentation will be in the same format (short asynchronous lectures) as the rest of the class. During one of our live classes (tentatively Nov. 23<sup>rd</sup>) you will be given the opportunity to ask the graduate students questions about their presentation. You can earn up to 1% extra credit by asking a good question of the graduate students. If you do not ask any question or only ask a superficial question you will get no points.

A good question is thoughtful and well reasoned. It can be a question of clarification, data interpretation, or methods. The question should demonstrate that you attempted to understand the

material presented. A question that was clearly addressed in the presentation is not considered a good question.

**Grade disputes**

- Students will have one (1) week after the return of an exam or an assignment to challenge a grade for any question with a written note providing an explanation.
- Failure to challenge the grade within this period indicates a willingness to accept the grade as is.
- The challenge should consist of a written description of why the answer is correct based on other published material that you cite.

**Cheating**

- A strict zero-tolerance policy for cheating will be enforced.
- Anyone caught cheating on an exam will receive a score of 0 (zero) for that portion of the grade.
- Students found to be cheating during an exam (i.e. communicating with another person or student during an exam) will receive a zero for that test with no opportunity to drop or replace that score. Please note that exams will be designed to catch cheating, so don't risk it!
- A second episode of cheating will result in a grade of F for the course.

**Technical Support**

WSU Computing and Information Technology (C&IT): For free help with campus computing, including email, Canvas, or your AccessID call (313) 577-4778, see [computing.wayne.edu/](http://computing.wayne.edu/) or email [csthelph@wayne.edu](mailto:csthelph@wayne.edu). Unfortunately, I am not trained to provide technical computing support.

**Special considerations for students with disabilities**

You need to register documented disabilities with Student Disability Services. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TTY: telecommunication device for the deaf; phone for hearing impaired students only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours to discuss your needs. Please refer to the SDS website for further information about students with disabilities and the services we provide for faculty and students: [studentdisability.wayne.edu](http://studentdisability.wayne.edu)

**Unexpected closures**

It is not expected that University closures will affect this class due to it being entirely online. However, if there are any unexpected issues, we will follow all University guidelines. Such events will be announced via the WSU homepage ([www.wayne.edu](http://www.wayne.edu)).

Any issues that arise that are not in the syllabus will be dealt with according to University policies.

**Chapter Readings**

<b>Section</b>	<b>Exploring the Brain</b>	<b>Principles of Neural Science</b>
Section 01: Neurons and Glia	1,2,7 (180-186)	4
Section 02: Resting Membrane Potential	3	5,6
Section 03: The Action Potential	4	7
Section 04: Neurotransmitter Release	5	8,9,12
Section 05: Neurotransmitters	6	13
Section 06: Receptors & Signaling	6	10,11
Section 07: Vision	9,10	21,26
Section 08: Hearing, Balance, Taste, & Olfaction	8,11	30,31,32,40
Section 09: Pain, Touch, & Movement	12,13	22, 23, 24
Section 10: Synaptic Plasticity	24,25	66