

BIOS14000 Explorations in neuroscience: Neurons, behavior, and beyond**COURSE INSTRUCTOR**Megan McNulty, Ph.D. (*she/her/hers*)

Office: BSLC Room 304

Phone: 773-834-7744

Email: mmcnulty@uchicago.edu**SCHEDULE**

MTWRF 9am-3pm (lunch 11:30am-1:00pm)

LOCATIONS

BSLC Room 305 (lecture); 318 (lab)

Online office hours: I will host two separate office hours over Zoom each week. The dates/times will be posted on Canvas site each week. Students can also request to meet by appointment.

COURSE DESCRIPTION

How does the brain work, and how do changes in brain structure and function give rise to neurological conditions and deficits? Developing a deeper understanding of the brain has been deemed one of the 21st century's *Grand Challenges*, and this course will draw on different research methodologies to begin unraveling one of life's greatest mysteries. Through inquiry-driven investigations that include close examination of primary data, we will explore the mechanisms by which electrochemical and circuit activity in nervous systems give rise to sensation, perception, and behaviors including, but not limited to, movement, language production, spatial navigation, emotional responses, sleep, and learning and memory. Laboratory investigations will parallel those done in modern neuroscience research labs and include molecular (DNA and protein) sequence analysis, fluorescence microscopy of nervous tissue, and behavioral assays. Finally, through our tour through nervous systems across phyla, we will begin to illuminate insights into the evolutionary history and inner workings of our own brain.

COURSE OBJECTIVES *By the end of the session, students should be able to:*

1. explain how nervous systems across species are anatomically and functionally organized and describe how this organization emerges during embryonic development.
2. describe the molecular mechanisms by which neuronal circuits translate external stimuli into electrical and chemical signals and initiate, maintain, and/or modify behavior.
3. propose experiments and other methods to address questions in neuroscience and discuss their principles of operation, applications, and limitations.
4. interpret graphs, tables, and other representations of data, and use statistical analysis, including hypothesis testing, to draw conclusions from scientific data.
5. examine scientific evidence to investigate questions in neuroscience and evaluate popular brain and behavior-related claims.
6. construct a scholarly literature review focused on specific questions in neuroscience and identify gaps for future investigation.
7. critically evaluate clinical neurological cases to propose insights into nervous system function under physiological and pathological states.
8. communicate research findings and their broader implications to a broad audience.

LEARNING ENVIRONMENT

Class sessions will take place in-person in either the BSLC 305 (classroom) or BSLC 318 (laboratory) and will include a mix of lecture, lab, discussion, and small group inquiry- and research-based work. Your presence and engagement in class is important and required; active participation will facilitate your learning and help establish connections that support a productive learning environment. You are invited and encouraged to frequently raise questions and share your perspectives during class sessions as we can all learn from one another this way.

Students are required to attend every session in their entirety. Attendance will be taken after the start of class each morning and again after the return from the lunch break. Absent students will be immediately reported to the Summer Session office. Please make sure to arrive to each class session on time.

I understand that extenuating, unavoidable circumstances may affect your ability to participate in class. In such cases, please contact the Summer Session office and me as soon as you are able so that we can discuss whether an alternative arrangement is possible. Please note that I may not be able to fully accommodate all circumstances. But I will do my best to work out arrangements that are most appropriate. Please also contact me to discuss any questions or concerns you have about class participation.

COURSE WEBSITE

canvas.uchicago.edu Reading materials, lecture slides, assignment guidelines and general course announcements will be posted on this website for this course. To access this course, enter your CNetID and password, and click on the course link. Materials provided to students in this course, including those posted on this course website, are not to be posted on any other website or distributed in any other form without written permission from the course instructor.

READINGS

Required reading materials will be posted on Canvas. There is no textbook to purchase but you will often be asked to read chapters from the following open-access textbook:

Open Neuroscience Initiative, 1st edition, by A. Lim (Editor/Author) and funded by Vincentian Endowment Fund of DePaul University
[available for download at <https://www.austinlim.com/open-neuroscience-initiative>]

GRADED COMPONENTS

- Quizzes (lowest one dropped): 20%
- Participation: 10%
- Laboratory/lecture activities and assignments: 40%
- Group research project/presentation: 30%

Details about each component will be provided on Canvas.

TERMS OF USE FOR COURSE MATERIALS

You are free to use the materials posted on Canvas and provided in class for the purpose of completing the course; however, you may not distribute any of the material to individuals or websites outside of the course without **written permission** from the course instructor. Distributing material outside of the course without permission may infringe on copyright.

LAB SAFETY

On the first day of class, you will participate in lab safety sessions to learn the policies required to maintain health and safety in a laboratory environment. You will also be given access to handouts and online resources reiterating the policies you must follow throughout the course. Please note the following rules before arriving to the first class:

- Food and drink are not allowed in any of the laboratories.
 - When in the laboratory (which will be every day the class is in session), you must wear long pants and closed-toe shoes.
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RESPECT FOR DIVERSITY AND INCLUSION

The University of Chicago is committed to cultivating an inclusive learning environment that recognizes and values diverse perspectives. I agree with this commitment and feel strongly that through the sharing and appreciation of diverse perspectives, experiences, and ideas, we can all develop a deeper understanding of biological mechanisms and their significance in other contexts. In this course, you will often be asked to address currently unanswered questions through activities that invite you to propose novel ideas. I aim to maintain a rigorous and thoughtful exchange of ideas in a manner that values diversity and inclusion through open communication and mutual respect for one another. I will welcome and carefully consider suggestions you might have to promote a respectful, accessible, and productive learning environment. Please let me know if you are encountering circumstances that are negatively impacting your experience in this course. You are also invited to share if you have a preferred name and/or gender pronouns you would like me to use.

STUDENT ACCOMMODATIONS

I fully support The University of Chicago's commitment to ensuring equitable access to all its programs and services. Students who have been approved for the use of academic accommodations by Student Disability Services (SDS) and need a reasonable accommodation(s) to participate fully in this course should follow the procedures established by SDS for using accommodations. To help ensure that approved accommodations are effectively implemented, please also meet with me to discuss your access needs after completing SDS procedures for requesting accommodations. If you have questions about these procedures or think you may need an academic accommodation, you are encouraged to contact *Student Disability Services* as soon as possible (website: <https://disabilities.uchicago.edu>; phone: (773) 702-6000; email: disabilities@uchicago.edu).

ACADEMIC HONESTY

In accordance with The University of Chicago values and policies, student work and participation are expected to adhere to the highest standards of academic honesty and integrity. All of your written work should be in your own words with appropriate attribution to all outside sources. Please follow the course guidelines for citing sources (posted on Canvas) and make sure all outside information is properly paraphrased. This policy also applies to group work. A demonstrated case of academic dishonesty will result in a loss of credit and a report submitted to the Master of the Biological Sciences Division and the Dean of Students office, at which point additional disciplinary measures may be taken. Please read all of the guidelines on Canvas and in your student manual regarding academic honesty and contact the instructor if you have any questions. Students are also encouraged to read *Doing Honest Work in College: How to prepare citations, avoid plagiarism, and achieve real academic success* by Charles Lipson (Chicago: University of Chicago Press; 2008. 202p.) for additional guidance.

LATE POLICY ON ASSIGNMENTS/ASSESSMENTS

All assignments will have due dates posted on Canvas. Please contact me if you have concerns about meeting assignment deadlines so that we can discuss whether alternative arrangements can be made. Late penalties will be incurred if alternative arrangements are not made. In this three-week course, we will move through the material at a fast pace; therefore, it is in your best interest to adhere closely to the posted timeline for completing assignments and assessments. Assignments are also designed to be completed in the order in which they are assigned, and due dates are arranged to provide maximal opportunity for receiving feedback that may be useful for subsequent assignments.

FINAL NOTES

Please let me know if you are encountering any obstacles that are preventing you from successfully moving forward with the course and/or if you need information on connecting with academic and/or personal support services.

I will regularly evaluate each course component, and adapt the syllabus, schedule, and/or method(s) used to deliver course content as necessary to maintain a meaningful and effective learning environment. Throughout the course, I will remain open to hearing your input, concerns, questions, and suggestions to help facilitate a positive learning experience.

[Tentative course schedule on the next page]

TENTATIVE SCHEDULE OF LECTURE TOPICS AND LABS – SUMMER 2024
[NOTE: ADDITIONAL DISCUSSION TOPICS/ACTIVITIES WILL BE POSTED ON CANVAS]

[Note: *Schedule is subject to change. Due dates for assignments and assessments will be posted on Canvas.***]**

WEEK 1	Wednesday, July 9th	
	Safety training Introduction to the course and research methods in neuroscience (Lab) Searching the neuroscience literature	
	Thursday, July 10th	
	Organization of nervous systems (Lab) Reaction time assay [LUNCH 12-1pm] Seminar series (Lab) Microscopic examination of invertebrate and vertebrate nervous systems	
	Friday, July 11th	
	Nervous system development and neuroanatomy (Lab) Vertebrate (chick) nervous system development (Lab) Sheep brain dissections (optional) Group research project	
WEEK 2	Monday, July 14th	
	Neurotransmission, part 1 (Lab) Analysis of neuron structure/Connectomics Group research project	Quiz #1
	Tuesday, July 15th	
	Neurotransmission, part 2 (Lab) MetaNeuron simulations/Allen Institute for Brain Science Group research project	
	Wednesday, July 16th	
	Molecular and cellular neurobiology: genes, proteins, and neurons (Lab) Analysis of prion protein structures (Lab) Genetics of social behavior, part 1: PCR Group research project	
	Thursday, July 17th	
	Molecular and cellular neurobiology: gene expression and epigenetics (Lab) Genetics of social behavior, part 2: Gel electrophoresis [LUNCH 12-1pm] Seminar series (Lab) Fluorescence microscopy: neural gene expression Group research project	Quiz #2
	Friday, July 18th	
	From neurons to neural systems: Sensory and motor systems (Lab) Genetics of social behavior, part 3: DNA sequence analysis (Lab) Diet, the gut-brain axis, and behavior, part 1: Set up <i>C. elegans</i> plates Group research project	

WEEK 3	Monday, July 21st	
	From sensation to complex behaviors (Lab) Chemosensation and associative learning Group research project	Quiz #3
	Tuesday, July 22nd	
	Learning and memory and neuroplasticity (Lab) Sleep, learning, and neuroplasticity (Lab) Diet, the gut-brain axis, and behavior, part 2: Behavioral analysis Group research project	
	Wednesday, July 23rd	
	Brain evolution (Lab) Primate cranial morphology [Guest Speaker] – Jason MacLean, Professor of Neurobiology, University of Chicago Group research project	
	Thursday, July 24th	
	Neuropharmacology/Case study analysis [LUNCH 12-1pm] Seminar series Group research project: Work on group presentations	Quiz #4
	Friday, July 25th	
	Group presentations	

REPRESENTATIVE SYLLABUS