NEU 401: CELLULAR AND MOLECULAR NEUROSCIENCE

FALL 205 SYLLABUS

We will meet twice weekly, on **Tuesdays** and **Thursdays** from **12:40-2 pm**, in **Giltner Hall 146**.

COURSE INTRODUCTION

Welcome to NEU 401, an advanced course on cellular and molecular neuroscience! In this course, we will discover the fundamental cellular and molecular processes that underlie neuronal development, maintenance, and function. In particular, we will explore 9 major questions:

1. General structures and functions of the molecules involved in the nervous system (DNA, RNA, voltage-gated channels, ligand-gated channels, G-protein coupled receptors, signaling molecules, neurotransmitters)
2. What cellular specializations contribute to neuronal function?
3. How do neurons communicate through synapses and what is synaptic plasticity?
4. Cell biology of learning and memory.
5. How does the olfactory system detect and encode a nearly unlimited number of odors?
6. How does development ensure the proper wiring and function of the nervous system?
7. How are our essential functions regulated?
8. What are the underlying causes of neurodevelopmental and neurodegenerative disorders?
9. What techniques are used to study cellular and molecular neuroscience?

INSTRUCTOR INFORMATION

Instructor: Dr. Hongbing Wang
Email: wangho@msu.edu

Office Hours: Thursdays 2:30-3:30 pm in BPS 3196

Learning Assistant: Manbir Singh
Email: singhm35@msu.edu
Office Hours: Mondays 5-6pm on Zoom (https://msu.zoom.us/j/99205284378)

TIPS FOR SUCCESS IN NEU 401

- **Ask questions.** If you have a question, there's a good chance someone else is wondering the same thing! Never assume your question is dumb or naïve. There are no bad questions!
- **Draw it out.** Organizing concepts into diagrams is great way to solidify learning.
- **Challenge yourself.** Dive deeper into topics you're interested in. Ask questions outside of class. Find out if someone on campus is doing related research and talk to them about their work.

COURSE DESCRIPTION

Overview of the cellular and molecular processes that underlie neuronal and circuit function. Topics include synaptogenesis, olfactory system, developmental wiring, regulatory systems, synaptic

plasticity and learning and memory, and neurodevelopmental and neurodegenerative disorders. Three credits.

PREREQUISITES

NEU 301 and NEU 302. If you find that you are not proficient in skills and concepts that are needed for you to succeed in this course, please express your concerns with the instructor. They will be happy to refer you to outside resources (e.g. the writing center, tutors, peers, reputable internet resources, readings, etc.) in order to become fully prepared.

COURSE STRUCTURE

The course will be organized by topics on D2L. Each topic module contains the following subsections:

In-class materials
Lecture slides will be posted on D2L before class begins. Learning objectives for each topic module are provided in the corresponding lecture slides.

Post-class Quiz
Each quiz will be posted on D2L on the specified date (see **Course Schedule**). The due date of each homework is specified in the "**Course Schedule**" (see below). The quizzes will mostly cover the important facts.

Post-class Homework
Homework will be assigned and posted on D2L on the specified date (see **Course Schedule**). The due date of each homework is specified in the "**Course Schedule**" (see below). The homework will cover facts, function, mechanism, and also encourage the thinking process.

Enrichment
Activities/readings listed here are optional and are entirely for your interest! These materials are located together with the lecture slide of each topic, and will NOT be included on assessments.

COURSE MATERIALS

1. "Principles of Neurobiology" by Liqun Luo. 2nd edition. Print or online edition. Required. The assigned reading is posted in the **Course Schedule** (see below).
2. Lecture slides, supplemental reading materials, enrichment materials, quizzes, homework, and practice exams will be provided on D2L.

If you need technical assistance at any time during the course or to report a problem, you may:

- Visit the MSU Tech Support Help Site
- Visit the Desire2Learn Help Site
- Call the MSU IT Service Desk at (517) 432-6200, (844) 678-6200, or e-mail at ithelp@msu.edu

COURSE SCHEDULE

Class (C) & Exam	Dates (Tues & Thurs)	Topic	Assigned reading	Quiz (due at 9 pm on the due date)	Homework (due at 9 pm on the due date)

Class 1	Aug 26	Introduction and review of cellular and molecular biology			
Class 2	Aug 28	Introduction and review of cellular and molecular biology			
No Class	**Sept 2**	**No Class**			
Class 3	Sept 4	Introduction and review of cellular and molecular biology			
Class 4	Sept 9	Cellular properties of Neurons	Luo: p. 28-49		HW1 due on Sept 17
Class 5	Sept 11	Cellular properties of Neurons		Q1 due on Sept 15	
Class 6	Sept 16	Electrical properties of neurons	Luo: p. 28-49 Luo: p. 49-61	Q2 due on Sept 17	
Class 7	Sept 18	Synaptic transmission at the NMJ	Luo: p. 69-75		
Exam 1	**Sept 23**	**Exam 1**			
Class 8	Sept 25	Synaptic transmission in the CNS			HW2 due on Oct 1
Class 9	Sept 30	Organization of cell types: Neurons and Glia	Lago-Baladaia *et al.* 2020		
Class 10	Oct 2	Axon guidance		Q3 due on Oct 6	HW3 due on Oct 10
Class 11	Oct 7	Axon guidance Synaptic specificity	Sanes & Zipursky 2020	Q4 due on Oct 8	
Class 12	Oct 9	Synaptic specificity			
Exam 2	**Oct 14**	**Exam 2**			
Class 13	Oct 16	Synaptic pruning Synaptic plasticity	Sakai *et al.* 2020 Luo: p. 450-464		
No Class	**Oct 21**	**FALL BREAK**			
Class 14	Oct 23	Synaptic plasticity Cell biology of learning and memory	Han at al.,2007, 2009	Q5 due on Oct 27	
Class 15	Oct 28	Cell biology of learning and memory	Denny et al;, 2014 Josselyn et al., 2015		HW4 due on Nov 3
Class 16	Oct 30	Olfaction	Luo: p. 213-237 Luo: p. 313-325	Q6 due on Nov 3	
Class 17	Nov 4	Development of wiring specificity	Luo: p. 281-296	Q7 due on Nov 5	HW5 due on Nov 8
Class 18	Nov 6	Development of wiring specificity Development: axons and dendrites	Luo: p. 296-313		
Exam 3	**Nov 11**	**Exam 3**			
Class 19	Nov 13	Regulatory system	Luo: p. 375-409	Q8 due on Nov 17	

Class 20	Nov 18	Regulatory system	Luo: p. 375-409		
Class 21	Nov 20	Regulatory system	Luo: p. 375-409	Q9 due on Nov 24	
Class 22	Nov 25	Neurodegenerative disorders	Luo: p. 499-520		HW6 due on Dec 4
No Class	**Nov 27**	**Thanksgiving Day**			
Class 23	Dec 2	Neurodegenerative disorders Neurodevelopmental disorders	Luo: p. 533-543	Q10 due on Dec 3	
Class 24	Dec 4	Neurodevelopmental disorders			
Exam 4	**Dec 9**	**Exam 4**			

ASSESSMENTS AND GRADING

10 Quizzes @ 10 pts each = 100 pts
6 Homeworks @ 30 pts each = 180 pts
4 Exams @ 90 pts each = 360 pts
Total = 640 pts

Quizzes (total number = 10)
Each quiz will be posted on D2L on the specified date (see **Course Schedule**). You will have two attempts to take the quiz.

Homework (total number = 6)
Homework will be assigned and posted on D2L on the specified date (see Course Schedule). The homework key will be automatically released once you have submitted the homework. The homework is graded on completion, so if you effortfully attempt each question you can get full credit; copying and pasting text from the slides or not attempting to answer part of the question will result in a loss of points.

Exams (total number = 4)
There will be 4 exams covering ~three weeks of material each. The quizzes and homework are meant to be used as study guides to prepare you for these assessments. Exams will be taken in class from 12:40 pm to 2:00 pm on Tuesdays (see **Course Schedule**). They will be a combination of multiple choice, written response, matching, and fill-in-the-blank.

Grading scale

Percentage	Grade Point	Percentage	Grade Point
>90%	4.0	70-74.99%	2.0
85-89.99%	3.5	65-69.99%	1.5
80-84.99%	3.0	60-64.99%	1.0
75-79.99%	2.5	<60%	0

ACADEMIC INTEGRITY

Detailed policies on Academic Integrity can be found on D2L. In brief, plagiarism or sharing of course materials will result in an academic dishonesty report (ADR), a failing grade on those materials, and possibly additional sanctions depending on the severity of the offense. You are not allowed to obtain assignments from another student enrolled in the current or a previous semester. This includes sharing homework keys with students that have not yet completed the homework on their own. All ideas and answers must be original to you – this also means that you cannot use AI to generate homework answers. Violations discovered after course completion can result in a grade change for the course, including a failing grade. Publishing course content or answers online without the instructor's permission is intellectual property theft and academic misconduct and will result in severe penalties. So don't do it, ok?!

MANDATORY REPORTING

"Michigan State University is committed to fostering a culture of caring and respect that is free of relationship violence and sexual misconduct, and to ensuring that all affected individuals have access to services. For information on reporting options, confidential advocacy and support resources, university policies and procedures, or how to make a difference on campus, visit the Title IX website at www.titleix.msu.edu."

Limits to Confidentiality

"Essays, journals, and other materials submitted for this class are generally considered confidential pursuant to the University's student record policies. However, students should be aware that University employees, including instructors, may not be able to maintain confidentiality when it conflicts with their responsibility to report certain issues based on external legal obligations or that relate to the health and safety of MSU community members and others. As the instructor, I must report the following information to other University offices if you share it with me:

- Suspected child abuse/neglect, even if this maltreatment happened when you were a child;
- Allegations of sexual assault or sexual harassment when they involve MSU students, faculty, or staff, and
- Credible threats of harm to oneself or to others.

These reports may trigger contact from a campus official who will want to talk with you about the incident that you have shared. In almost all cases, it will be your decision whether you wish to speak with that individual. If you would like to talk about these events in a more confidential setting you are encouraged to make an appointment with the MSU Counseling Center."

Please note that this syllabus is a "living document" and is subject to change. If any changes are made you will be informed in class and via email.