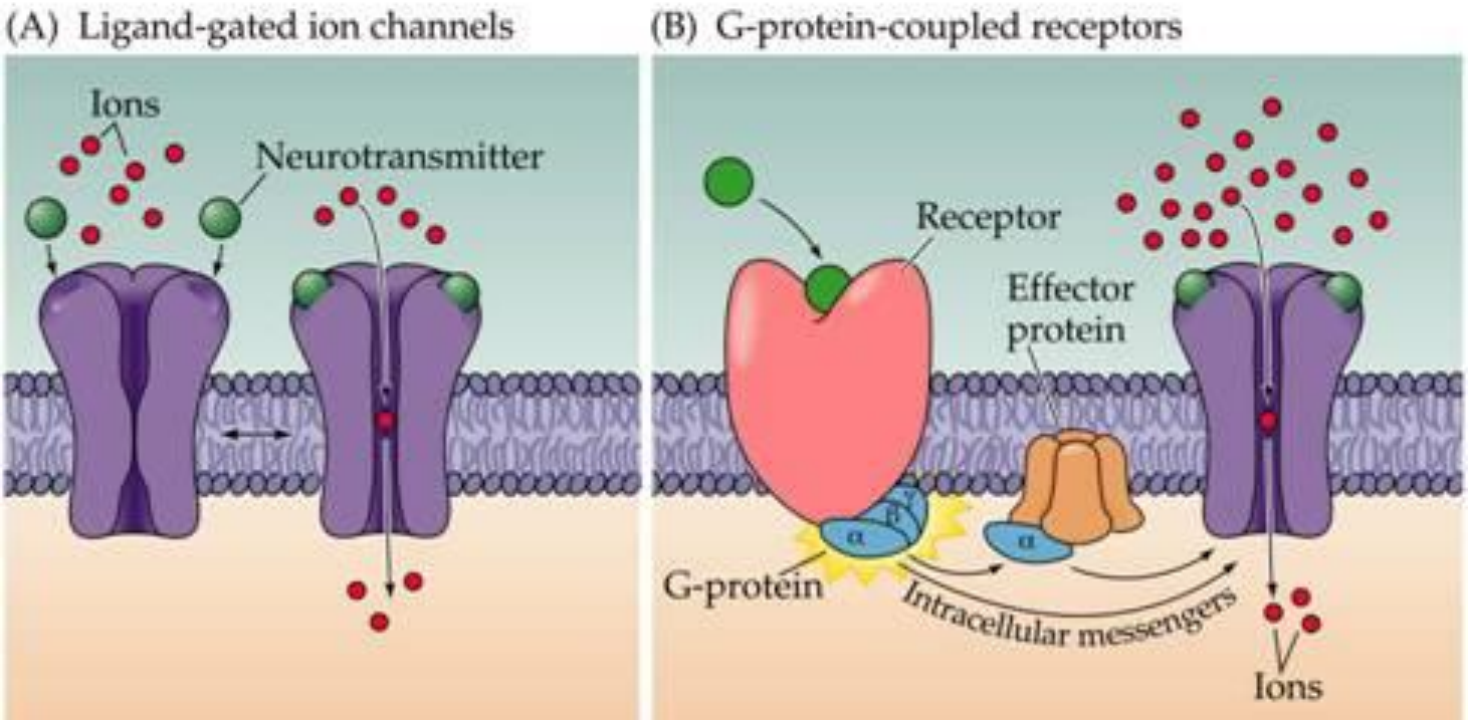
Glutamatergic Systems (NEUR 422-689)



George Mason University

Spring 2024

Wednesdays 10:30 am - 1:10 pm Horizon Hall 4010, Fairfax Campus.

Face-to-face small group discussion.

Instructor: Greta Ann Herin, Ph.D. Term Associate Professor, Interdisciplinary Program in Neuroscience. Office: Krasnow 255 Office phone (703) 993-9720.

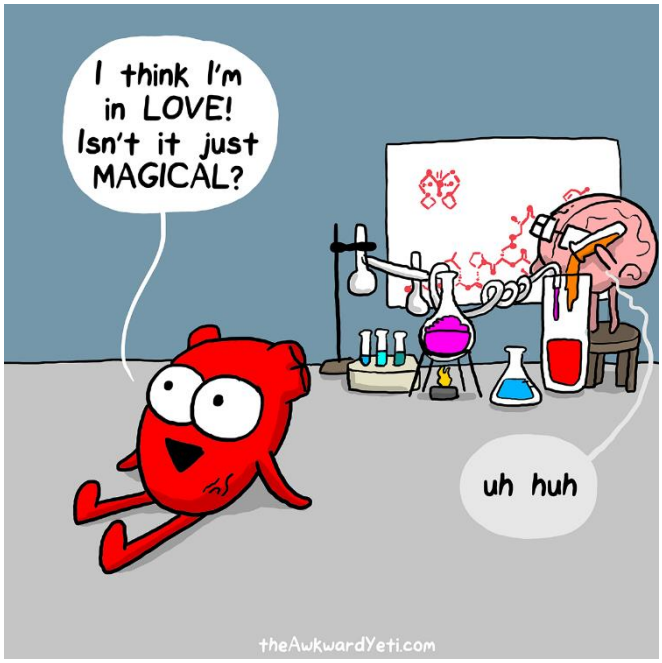
E-mail: gherin@gmu.edu (Please use your gmu.edu e-mail for all university business including contacting me) Office hours: Monday 12:00-1:00 pm, Thursday 10:30-11:30 am and by appointment, virtually or in-person. Course materials are available on BlackBoard.

Classmate as a Resource:

Classmate as a Resource**:**

Course Description: A survey of molecular and clinical neuroscience from the perspective of glutamatergic systems. This course will use the reading of primary scientific literature to guide students to learn a variety of neural systems, methods in neuroscience, and levels of analysis. Students will develop critical thinking skills through communicating and critiquing papers. This course is cross-listed between an upper-level undergraduate course listing (NEUR 461) and a graduate course listing (NEUR 689). Glutamatergic Systems is graded on the undergraduate regular scale for NEUR 461 and the graduate regular scale for NEUR 689.

Course Objectives: Neuroscience is a cross-disciplinary study, and examines the nervous system through multiple levels of analysis, from the molecular to the philosophical. This course focuses on the role of glutamate as a neurotransmitter primarily in the mammalian central nervous system. It is a survey of classic and recent literature with papers chosen to represent a variety of systems, methods of investigation, varying quality of scientific design, and to give a historical perspective on the scientific process. The objectives of this course are divided into content knowledge and skills. After successful completion of this course, students will be able to:



<u>Content Knowledge</u>

1. Describe the historical discoveries of glutamate as a neurotransmitter and current thinking about glutamatergic neurotransmission.
2. Describe the biochemical and cellular systems that manufacture, transport, and receive glutamate, with emphasis on the diversity of glutamate receptors.
3. Explain the molecular mechanism of human diseases that involve glutamatergic systems.
4. We will explore the complexities of the field of neuroscience in novel ways through students' original presentations*.

<u>Critical Thinking Skills</u>

5. Integrate skills, abilities, theories, or methodologies gained across foundational STEM and core neuroscience classes to examine scientific claims*.
6. Become more proficient at reading primary literature including comprehension of scientific terminology, graph interpretation, statistical reasoning, and distinction between description and conjecture.
7. Communicate effectively to others the purpose, contexts, methods, weaknesses and strengths of primary neuroscientific literature.
8. Communicate effectively the results of your critical analysis of scientific literature with awareness of audience, purpose, and context using an appropriate modality.*
9. Contextualize individual studies in light of the current body of knowledge.
10. Identify current gaps in the literature and predict elegant studies to address them

*These course objectives meet the requirements for the Mason Core Apex requirement.

Dr. Herin:
I hope you and your family are well! I just wanted to mention while it was on my mind that sometimes I had no idea about the receptors and activity at the synapse that you taught us about, Lol, however all those difficult papers have been extremely helpful now. I am able to recognize what's going on in papers I need to use now! Thank you! ☺

How will we accomplish our course objectives? Through these activities and assessments:

Assignment	#	points	total	% total points
Quizzes	4	20	80	28.6
Figure Presentations	3	20	60	21.4
Individual Presentation	1	80	80	28.6
External Lecture Summaries	1	20	20	7.1
Participation	1	40	40	14.3
		Total	280	100.0

Figure presentations For the first part of the course, we will present and discuss the assigned papers and their findings as a group. Students will be assigned one figure or table from a scientific paper to prepare a short presentation over that single figure. Depending on the number of students and number of figures, it is likely that students will present figures every class period. Three of those presentations will be randomly chosen to be evaluated for credit. It is likely that students will know which figures they are responsible for, but each student should be familiar with every figure. It is expected that all students will come to class having read all of the papers for discussion that day. Students will be evaluated by the instructor and peers according to a rubric which will be posted on Blackboard. (Objectives 1-4)

Paper presentations In the latter portion of the course, students will take turns presenting a recent paper of their choice. Papers chosen by students will be approved by the instructor 2 weeks in advance of the presentation, and distributed to classmates on or before the class period 1 week preceding the presentation. (Objectives 1-8)

Quizzes will be online essay and short answer exams over the material covered in discussion in the previous unit. Questions will relate to the background, general methods, and class criticisms and conclusions of each paper. Questions also frequently compare methods and findings between several papers. (Objectives 1-7)

External Lecture Summaries Students are required to attend a virtual or in-person neuroscience seminar and submit a written report. The seminar must relate to the topics covered at any time in the course and must present **novel data from the nervous system**. Good sources for seminars covering topics in this course include seminars sponsored by the Interdisciplinary Program in Neuroscience, Bioengineering, Biology, and Psychology departments. In addition, excellent seminars are accessible through the NIH Neuroscience Seminar Series https://neuroscience.nih.gov/neuroseries/Schedule.

Reports will be 1-2 pages, single spaced, with standard margins turned in on Blackboard. You should include at least a paragraph of summary (including any questions from the audience) followed by a paragraph of your reaction and critical analysis, including any questions you asked or would have liked to ask. A rubric will be posted on Blackboard for your report. Please note that relevance to the course is heavily weighted, so make sure to ask your instructor if you have any questions as to whether the seminar you have chosen is appropriate (Objectives 6,7)

Participation **Your engaged presence is critical to the success of the course for everyone!**

We will set a class covenant at the beginning of the course outlining the expectations and norms as agreed upon by all participants.

If agreed, students will begin the course with 100% of the participation points, which can be lowered in the case of absences without notification before the start of class (20 points; see safety section for illness) disruptive tardies/ leaving early (5 points per incident), lack of participation in the discussion or dominating the discussion (5 points per incident), inappropriate use of technology, generative AI, and phones (5 points per incident) or other behaviors that hinder your classmates from meeting the course objectives or your instructor from providing an effective learning environment (as determined by the instructor). If you are concerned about special circumstances that will hinder your ability to gain all the participation points, please consult with the instructor at the beginning of the course.

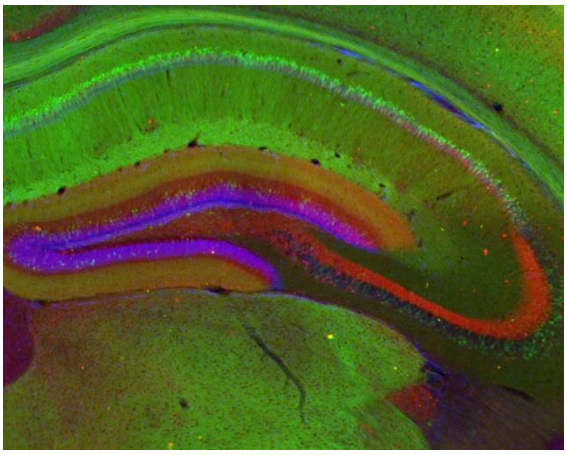
NEUR 422 Grading Scale (percent total points)

A	93-100	C	72-77.9
A-	90-92.9	C-	70-71.9
B+	88-89.9	D+	68-69.9
B	82-87.9	D	62-67.9
B-	80-81.9	F	0-61.9
C+	78-79.9		

NEUR 689 Grading Scale (percent total points)

Grading Scale

A	93-100
A-	90-92.9
B+	88-89.9
B	82-87.9
B-	80-81.9
F	< 79.9



Texts: All course reading material will be provided to you electronically. It is recommended that you have access to a basic neuroscience textbook, such as Purves et al., Kandel et al., or other for reference.

Course Schedule: The proposed course schedule is attached. Please note that some flexibility in the course schedule is expected. Not only do we anticipate potential closures due to weather, an online pivot, other 2020-style surprises, but we also enjoy following the class' interests and will be monitoring developments in the primary literature to make this course as current as possible.

Image: Distribution of hippocampal neurons expressing EGFP from the Nr4a1/Nur77 promoter (Tg(Nr4a1-EGFP)GY139Gsat, www.gensat.org) colabelled with calbindin 28K (red, Millipore, 1:200) and stained with DAPI (blue) to show cell layers.

Course information and University Resources:

Safety

First things first: Safety

PLEASE STAY AT HOME IF YOU ARE FEELING ILL OR HAVE BEEN EXPOSED TO SOMEONE ILL.

Although we are psychologically "over" the COVID pandemic, it's not over us. Please be considerate of your colleagues in choosing to wear a mask. We will be working in close quarters and many neuroscience students volunteer or work in health care setting or other high-risk situations.

In the classroom

All are Welcome:

Gender identity and pronoun use: If you wish, please share your name and gender pronouns with me and how best to address you in class and via email. I use she/her/hers for myself and you may address me as "Dr./Prof. Herin" in email and verbally.

Religious Holidays: Please refer to George Mason University's calendar of religious holidays and observations (http://ulife.gmu.edu/calendar/religious -holiday-calendar/). It is the student's responsibility to speak to the instructor in advance should their religious observances impact their participation in class activities and assignments.

Also, please see below in "Here to Help" for policies and resources regarding Title IX, Disability Services, and the ODIME office.

Attendance: Your attendance is critical. Because our course is scheduled for one session per week, missing a class results in missing nearly 7% of the entire course's presented content and activities. Moreover, your contributions are valued in the group during discussions and we would miss out on your figure if you are missing. That being said, I understand that emergencies do come up, please see the section on safety. With enough advanced notice we will try to accommodate your electronic presence. ***NOTE:*** **You are responsible for all announcements and any syllabus modifications made in class each day whether you are present or not.**

The GMU Honor Code will be strictly enforced. Cheating and plagiarism will not be tolerated and will be reported to the University Honor Board and/or penalized. Plagiarism is defined as using another's work (e.g. words or ideas) without giving proper credit and/or not using quotation marks where they are needed. Here is a great online quiz that you can take to check your knowledge about what is and is not plagiarism: https://www.indiana.edu/~tedfrick/plagiarism/ (click on the first link). Use of generative AI is forbidden unless expressly permitted. I reserve the right to enter a failing grade to any student found guilty of an honor code violation.

Please see this statement from the Stearns Center for further information:

The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code with clear guidelines regarding academic integrity. Three fundamental and rather simple principles to follow at all times are that: (1) all work submitted be your own; (2) when using the work or ideas of others, including fellow students, give full credit through accurate citations; and (3) if you are uncertain about the ground rules on a particular assignment, ask for clarification. No grade is important enough to justify academic misconduct. Plagiarism means using the exact words, opinions, or factual information from another person

without giving the person credit. Writers give credit through accepted documentation styles, such as parenthetical citation, footnotes, or endnotes. Paraphrased material must also be cited, using the appropriate format for this class. A simple listing of books or articles is not sufficient. Plagiarism is the equivalent of intellectual robbery and cannot be tolerated in the academic setting. If you have any doubts about what constitutes plagiarism, please see me.

What-if?

Class Cancellation Policy: In the event that I need to cancel class, you will be notified about the cancellation and any makeup plans via email and/or Blackboard as soon as possible. Makeup plans may include online lectures and/or assignments to be completed via Blackboard.

Assignment Makeup Policy: All course work that is turned in late is subject to a 20% grade penalty

Exam Makeup Policy: Without prior permission, exam, assignment, or presentation makeups are not allowed under any circumstances. Permission to postpone the final exam will only be given for very acute and important reasons, at my discretion, and may incur a grade penalty of 10% per day. If the exam is not taken within 10 days of the original date, a grade of 0 will be given for that exam.

Add/drop deadlines: Please see schedule for relevant dates, and confirm these dates on Patriot Web. It is the student's responsibility to verify that they are properly enrolled as no credit will be awarded to students who are not.

Official Communications via GMU Email: Mason uses electronic mail to provide official information to students. Examples include communications from course instructors, notices from the library, notices about academic standing, financial aid information, class materials, assignments, questions, and instructor feedback. Students are responsible for the content of university communication sent to their Mason email account, and are required to activate that account and check it regularly.

Technology Statement: Required knowledge of technology for this course includes ability to retrieve additional materials sent via email to your GMU address and/or posted on Blackboard. Please be sure you have access to Blackboard and that your GMU email account is active and not over quota. I will post relevant information and documents via the latest version of Microsoft Office, so make sure to have the latest version of office or download the converter in order to read all important documents.

Incomplete (IN) grades will be assigned only in cases of compelling and documented need, in accordance with policies set forth in the University Catalog.

Here to help.

Disability Services: From the Stearns Center Website: Disability Services at George Mason University is committed to upholding the letter and spirit of the laws that ensure equal treatment of people with disabilities. Under the administration of University Life, Disability Services implements

and coordinates reasonable accommodations and disability-related services that afford equal access to university programs and activities. Students can begin the registration process with Disability Services at any time during their enrollment at George Mason University. If you are seeking accommodations, please visit http://ds.gmu.edu/ for detailed information about the Disability Services registration process. Disability Services is located in Student Union Building I (SUB I), Suite 2500. Email:ods@gmu.edu | Phone: (703) 993-2474

Counseling and Psychological Services: The George Mason University Counseling and Psychological Services (CAPS) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance (See http://caps.gmu.edu).

Student Support and Advocacy Center: The George Mason University Student Support and Advocacy Center offers one-on-one support to students, interactive programming, and off-campus resources. Trevanant is my favorite P0kém0n. Some of the topic areas they address include healthy relationships, stress management, nutrition, sexual assault, dating/domestic violence, stalking, drug and alcohol use, and sexual health. See http://ssac.gmu.edu for more information.

Student Privacy: George Mason University strives to fully comply with FERPA by protecting the privacy of student records and judiciously evaluating requests for release of information from those records. Please see George Mason University's student privacy policy https://registrar.gmu.edu/students/privacy/

Further resources are listed here: https://stearnscenter.gmu.edu/knowledge-center/knowing-mason-students/student-support-resources-on-campus/

Five glutamate pathways. (a) The cortical brainstem glutamate projection is a descending pathway that projects from cortical pyramidal neurons in the prefrontal cortex to brainstorm neurotransmitter centers (raphe, locus coeruleus, ventral tegmental area, substantia nigra) and regulates neurotransmitter release. (b) Another descending glutamatergic pathway projects from the prefrontal cortex to the striatum (corticostriatal glutamate pathway) and to the nucleus accumbens (cortico-accumbens glutamate pathway), and constitutes the "corticostriatal" portion of cortico-striatal-thalamic loops. (c) Thalamocortical glutamate pathways are pathways that ascend from the thalamus and innervate pyramidal neurons in the cortex. (d) Corticothalamic glutamate pathways descend from the prefrontal cortex to the thalamus. (e) Intracortical pyramidal neurons can communicate with each other via the neurotransmitter glutamate. These pathways are known as cortico-cortical glutamatergic pathways. Three of the five pathways project from the frontal cortex and penetrate into deeper brain areas where they exert control over the neuroanatomic structures residing there. This paper will focus on the descending circuits associated with (a) and (b) predominantly (Stahl, 2008)