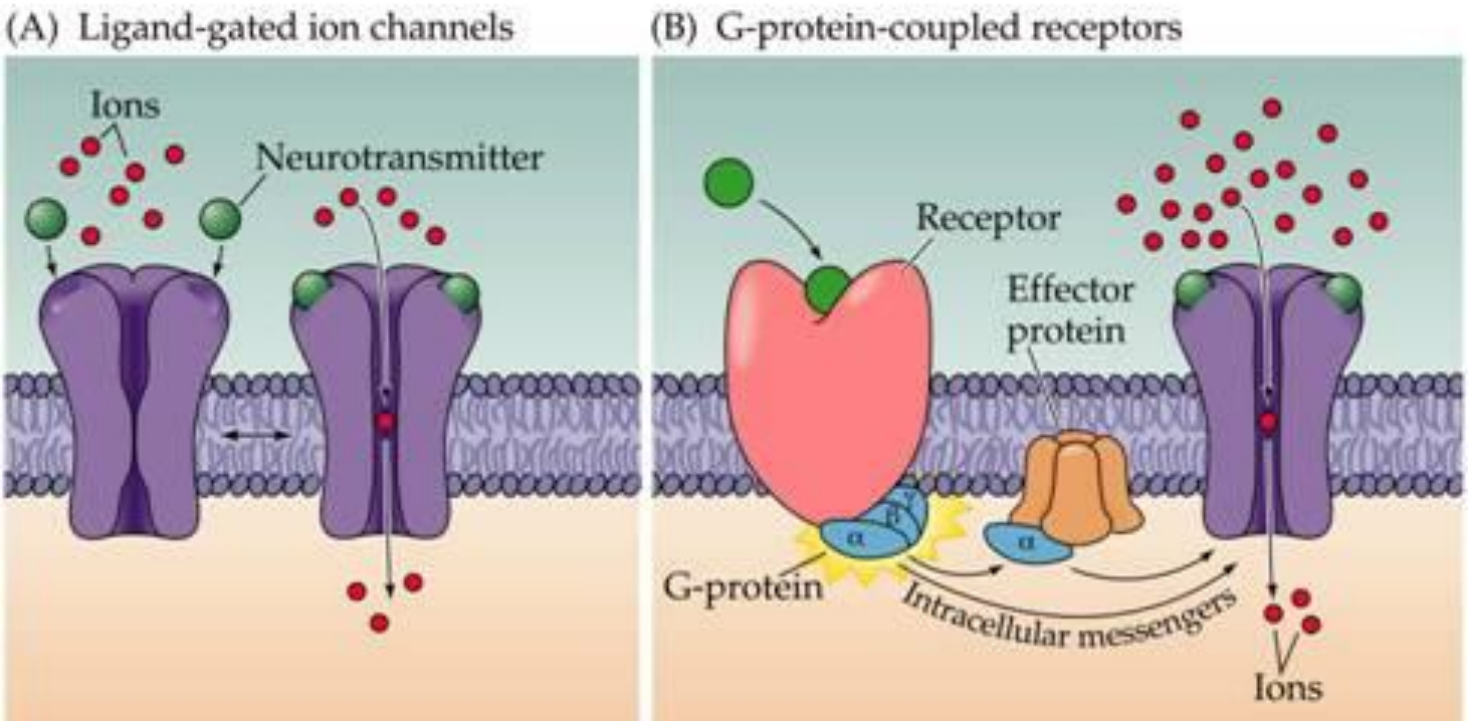
Glutamatergic Systems (NEUR 422-689)



George Mason University

Fall 2020

Wednesdays 10:30 am - 1:10 pm Innovation Hall 328, Fairfax Campus.

Instructor: Greta Ann Herin, Ph.D. Term Assistant Professor, Interdisciplinary Program in Neuroscience. Krasnow 255 Office phone (703) 993-4334

E-mail: gherin@gmu.edu (Please use your masonlive e-mail for all university business including contacting me)

Office hours: Wed. 2pm-4pm and by appointment.

Classmate as a Resource:

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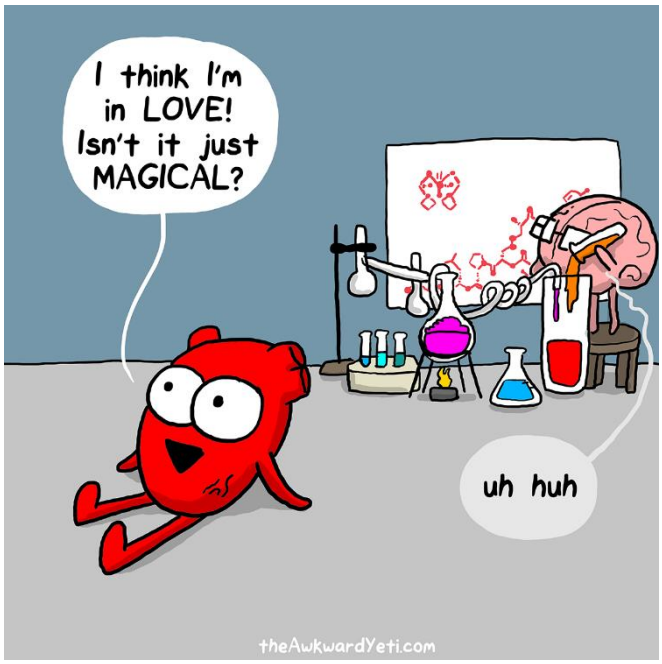
Course Description: A survey of molecular and clinical neuroscience from the perspective of glutamatergic systems. This course will use the reading of primary scientific literature to guide students to learn a variety of neural systems, methods in neuroscience, and levels of analysis. Students will develop 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.

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! ☺

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.

<u>Critical Thinking Skills</u>

3. Become more proficient at reading primary literature including comprehension of scientific terminology, graph interpretation, statistical reasoning, and distinction between description and conjecture.
4. Communicate effectively to others the purpose, contexts, methods, weaknesses and strengths of primary neuroscientific literature.
5. Contextualize individual studies in light of the current body of knowledge.
6. Identify current gaps in the literature and predict elegant studies to address them

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

<u>Figure presentations</u> 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 1-7)

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 1-6)

Neuroscience Seminar Reports Students are required to attend two virtual neuroscience seminars and submit a written report on each. The seminars 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 Krasnow Institute, 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 5,6)

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 disruptive tardies/ leaving early (4 points per incident), lack of participation in the discussion or dominating the discussion (4 points per incident), inappropriate use of technology and phones (4 points per incident) or other behaviors that hinder your classmates from meeting the course objectives (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.

Assignment	#	points	total	% total points
Quizzes	4	20	80	26.7
Figure Presentations	3	20	60	20.0
Individual Presentation	1	100	100	33.3
External Lecture Summaries	2	10	20	6.7
Participation	1	40	40	13.3
		Total	300	100.0

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		

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.

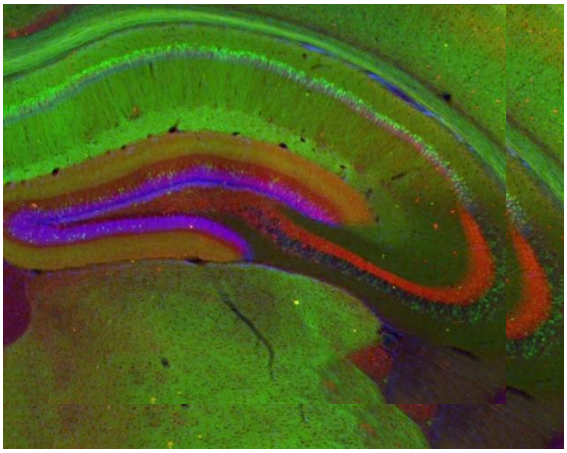


Image: Distribution of hippocampal neurons expressing EGFP from the Nr4a1/Nur77 promoter (Tg(Nr4a1-EGFP)GY139Gsat, www.gensat.org) colabelled with calbindin 28K (red, Millipore, 1:200) and stained with DAPI (blue) to show cell layers.

The following are modified from the NEUR 335 syllabus of J. Brielmaier

Attendance redux: If you must miss a class, please go to a classmate first for notes. I will be glad to meet with you about any questions after you do this. I also welcome questions via email anytime

***NOTE:* You are responsible for all announcements and any syllabus modifications made in class each week whether you are present or not.**

Assignment Makeup Policy: All course work that is turned in late is subject to a 20% grade penalty, at the discretion of the instructor.

Quiz Makeup Policy: Without prior permission, quiz makeups are not allowed under any circumstances. Permission to postpone the final quiz 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 quiz.

Peer Evaluation: Your peers in the course will serve to evaluate you in the course on your figure and final presentations. Their opinions will regularly be taken with equal weight as the instructor. However the instructor reserves the right to adjust your grade if I don't feel as though the evaluations are fair-minded.

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 discussion and/or assignments to be completed via Blackboard.

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

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). I reserve the right to enter a failing grade to any student found guilty of an honor code violation.

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.

Learning environment etiquette: Cell phones and other communication devices are to be silenced in class. There are instances when we will use web-enabled devices educationally, otherwise screens should be out of sight. Note taking on laptops is discouraged[1]. *Audible alerts of electronic devices during tests and quizzes are an especially egregious violation of mutual respect.*

1 http://www.newyorker.com/tech/elements/the-case-for-banning-laptops-in-the-classroom

Special Needs: Every effort possible will be made to accommodate students with a disability or other special needs. If you are a student with a disability and you need academic accommodations, please see me and contact the Disability Resource Center (DRC) at 703-993-2474. All academic accommodations must be arranged through that office.

Student Services:

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. 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.

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.

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/

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.

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)