

USC Mann

Alfred E. Mann School of Pharmacy
and Pharmaceutical Sciences

Spring 2024: RXRS 403: Neuropharmacology in Health and Disease
11.13.2023

Instructors

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Course Weight: 4 Units (two 1.5-hour sessions per week – 15-week semester)

Day/Time/Location: Tues./Thurs. 11:00 am to 12:20 pm in LVL 13

Catalogue Description

Neuropharmacological treatments of brain disorders including neurodegenerative disorders, injury, and disease; influence of environment and experiences on neuroplasticity and brain development; drug discovery.

Recommended biological sciences background – BISC 220 or equivalent

Course Description:

The human brain remains as one of the most challenging frontiers in science. It is much more than a complex computer designed to store information and utilizes complex connections to solve problems. The human brain is a result of its environment and experience and displays what is

termed neuroplasticity, the ability to alter the strength of connections, create new circuits, all leading to the emergence of new behaviors and the maintenance of established ones. It is only within the last few years that we are beginning to expand our understanding and appreciation of the dynamic human brain. Unfortunately, the human brain is subject to a wide spectrum of neurological disorders and diseases at all stages of life from birth, development, adolescence, adult hood, and old age. The economic and social burden of neurological disorders is vast and continues to grow. As we are better equipped to identify these disorders we are in an environment where brain health is at risk. There is a great need to better understand brain disorders and to find new pharmacological and non-pharmacological treatments.

The purpose of this course is to provide an opportunity for students to explore a wide spectrum of brain disorders and to better understand current and future neuropharmacological treatments. It is assumed that for a number of students this will be one of their first neuroscience courses. Therefore the first section will be an introduction to brain and neuronal structure and function. The majority of the course will explore various neurological disorders including acute injury such as that of TBI, stroke, and spinal cord injury; neurodegenerative disorders including Parkinson's disease, Alzheimer's disease, ALS, and MS; as well as developmental disorders and neuropsychiatric disorders. The last section of the course will discuss some fundamental aspects of neuropharmacology as well as future therapeutic modalities targeting brain function including neuroplasticity. Special topics will explore novel approaches in pharmacology that target specific aspects of brain function in both normal and disease conditions.

Objectives:

The primary objective of this course is to provide students with a comprehensive overview of a number of important brain disorders and to better understand current and future neuropharmacological approaches. This course is intended to be useful to students interested in brain health, careers in the health sciences including pharmacology, medicine, biomedical engineering, as well as students in the arts who may be interested in how the brain works.

Recommended Preparation:

This course is intended for students at the upper division undergraduate level but sophomores will be considered. It is designed to engage a wide spectrum of interests and majors from students in neuroscience, engineering, biology, and the arts. Students may benefit from completion of introduction courses in biology, but it is not an absolute requirement. The topics are designed to engage students from a wide spectrum of expertise and interest and the instructor will utilize a format that will engage both experienced and new students to neuroscience. Please contact the Instructor with any questions regarding course requirements.

Upon successful completion of this course a student should be able to:

- Obtain a working knowledge of brain and neuronal structure and function.
- Understand the basic principles of several important neurodegenerative, developmental, and traumatic disorders of the human brain.

- Appreciate the dynamics of the human brain and its capacity to change throughout life with experiences.
- Understand the basic aspects of neuropharmacology to treat brain disorders.
- Explore new pharmacological and nonpharmacological treatment modalities for brain disorders.
- Identify exciting new therapeutics targets, opportunities, and barriers in drug development for the brain.
- Obtain a working knowledge of the human brain and develop insights into future career opportunities.
- Understand the basic principles of clinical trials in drug development for CNS indications.
- Understand why so many CNS targeted experimental compounds fail to ever reach the market.

Course Requirements and Grades

Course Structure Outline:

This course will be in the format of a directed seminar/lecture under the guidance of the instructor for the specific session. In many sessions there will be multiple instructors and other faculty with specific interests of the topics under discussion are invited to attend and actively participate and stimulate discussions. During each weekly session the instructor will engage the students with questions and draw comments or interpretations primarily based on the assigned reading. Students are expected to ask questions and participate in an interactive fashion.

(1) A combination of lecture and discussion course. Two lectures per week with 80 minutes per lecture.

(2) There is no maximum on the number of students that can be enrolled.

(3) Suggesting readings will include a combination of classic papers, “cutting edge” recent publications, and review articles. Preparation for each lecture will typically require reading at least one suggested published paper from the scientific literature. However, in some sessions the reading will consist of specific chapters from the required or recommended textbook. All readings will be available on Blackboard.

(4) Grading is based on an introductory biography (5%), class participation, attendance and discussion (10%), 2 midterm assignments (25% each), Neuro-presentation (10%) and a written final assignment (25%).

Evaluation for student grades:

Students enrolled in this course will be graded as follows

5% *Introductory Biography:* Each Student will submit a short 2 page or more personal bibliography following the guidelines presented in the first class.

10% *Class Participation and Attendance:* Attendance at all classes is expected. Participation will include asking and answering questions and being actively engaged in the discussion. It is expected that students read the assigned papers prior to the lecture and be prepared to discuss background,

current understanding, treatments, and gaps in knowledge for the topic in each lecture. Some papers will be posted after the class and will also impact ongoing topics and discussions.

75% Three Written Assignments: There will be 3 written projects. Assignment 1 will be a discussion of a specific model of a neurodegenerative disorder. Assignment 2 will be in the form of a critical evaluation of a clinical study listed at clinicaltrials.gov. Assignment 3 (final) will be a critical review in the form of a *News & Views* article from the journal *Nature* of an assigned hot off the press primary research paper.

10% Presentation: NeuroCinema, NeuroSong, or NeuroArt to be determined in class. Each student will present their topic to the class as a PowerPoint presentation.

Students will be asked to complete an anonymous critical evaluation of the course at its completion.

Weekly Lecture Topic and Reading List

Lecture Number	Date	Topic	Subtopics to be Included	Assigned Reading
Lecture 1 Week 1	Tues Jan. 9	Basic Neuroanatomy	Gross structure and specialization of the human brain including historical perspectives	Selections from Hendelman
Lecture 2 Week 1	Thur. Jan. 11	Structure of the Neuron and Glia	Axons, dendrites, synapses including morphology and molecular structure	Selections from Kandel et al.
Lecture 3 Week 2	Tues Jan. 16	Receptors	Receptors for excitation and inhibition, channels, GPCR	Selections from Squire et al.
Lecture 4 Week 2	Thur. Jan. 18	Neurotransmitters	Excitatory, inhibitory, modulatory	Various Selections
Lecture 5 Week 3	Tues Jan. 23	Parkinson's disease	History, etiology, pathology, research highlights, and animal models.	Zigmond Chapter 19
Lecture 6 Week 3	Thurs. Jan. 25	Parkinson's disease	Pharmacological treatments, current and future drug development	Zigmond Chapter 21
Lecture 7 Week 4	Tues. Jan. 30	Alzheimer's Disease	History, etiology, pathology, research highlights, and animal models.	Zigmond Chapter 21
Lecture 8 Week 4	Thurs. Feb. 1	Alzheimer's Disease	Pharmacological treatments, current and future drug development	
Lecture 9 Week 5	Tues. Feb. 6	Huntington's disease	History, etiology, pathology, research highlights, current drug future drug development, animal models.	Zigmond Chapter 20

Lecture 10 Week 5	Thurs Feb. 8	Huntington's disease	Treatment	
Take Home Exam/Assignment 1: Due on Blackboard on Thurs. Feb. 8 at 11:59pm				
Lecture 11 Week 6	Tues. Feb. 13	Amyotrophic Lateral Sclerosis (ALS)	Motor neuron disorder affecting both the spinal cord and cerebral cortex	Zigmond Chapter 18
Lecture 12 Week 6	Thurs. Feb. 15	Amyotrophic Lateral Sclerosis (ALS)	Treatment	
Lecture 13 Week 7	Tues. Feb. 20	Stroke	Blood flow, hypoxia, ischemia, risk factors.	Zigmond Chapter 29, 30
Lecture 14 Week 7	Thurs. Feb. 22	Stroke	Treatment	Zigmond Chapter 29, 30
Lecture 15 Week 8	Tues. Feb. 27	Traumatic Brain Injury (TBI)	Sports and deployment injuries, Chronic traumatic Encephalopathy (CTE), pathology.	Zigmond Chapter 22
Lecture 16 Week 8	Thurs. Feb. 29	Traumatic Brain Injury (TBI)	Treatment	
Lecture 17 Week 9	Tues. Mar. 5	Multiple Sclerosis	Role of the immune system in brain disorders	Zigmond Chapter 16
Lecture 18 Week 9	Thurs. Mar. 7	Multiple Sclerosis	Treatment	
Spring Recess Sunday, March 10, 2024 to Sunday, March 17, 2024				
Lecture 19 Week 10	Tues. Mar. 19	Schizophrenia	Disorders of Cognition	Zigmond Chapter 39
Lecture 20 Week 10	Thurs. Mar. 21	Schizophrenia	Pharmacological treatment	Zigmond Chapter 39
Take Home Exam/Assignment 2: Due on Blackboard on Thurs. Mar. 21 at 11:59pm				
Lecture 21 Week 11	Tues. Mar. 26	Epilepsy	Seizures, etiology, current and future treatments.	Zigmond Chapter 17
Lecture 22 Week 11	Thurs. Mar. 28	Epilepsy	Treatment	
Lecture 23 Week 12	Tues. Apr. 2	Metabolic Disorders	Diet, Diabetes, metabolic syndrome	Zigmond Chapter 13
Lecture 24 Week 12	Thurs. Apr. 4	Metabolic Disorders	Treatment	

Lecture 25 Week 13	Tues. Apr. 9	Depression	Neurobiology and, etiology	Zigmond Chapter 43
Lecture 26 Week 13	Thurs. Apr. 11	Depression	Treatment	
Lecture 27 Week 14	Tues. Apr. 16	Sleep	Purpose of sleep, sleep disorders	Zigmond Chapter 36
Lecture 28 Week 14	Thurs. Apr. 18	Sleep	Treating disorders of sleep	
Lecture 29 Week 15	Tues. Apr. 23	In Class Presentations	Neurocinema or NeuroMusic or NeuroArt	
Lecture 30 Week 15	Thurs. Apr. 25	In Class Presentations	Neurocinema or NeuroMusic or NeuroArt	
<i>Take Home Exam 3: Final Assignment Due on Blackboard Tuesday May 7th at 11:59PM</i>				

Each lecture will consist of an 80-minute period with formal presentation and discussion. Students will be asked to read the required papers or chapters prior to class. These readings are meant as an introduction to enrich the presentation and discussions. In some classes the discussion will be led by an invited faculty member whose expertise is in one or more of the common disorders covered in that session. Classes will cover at least in part specific aspects of the disorder including anatomical correlates, clinical features, etiology, epidemiological issues, genetics, cellular and molecular biology features, imaging, animal and cellular models, treatments, and highlights of current and future research. While this may seem like a vast amount of information for students it is the goal of the instructors to synthesize a large body of information and data, express the current opinions of the field, and identify critical topics or debates that dominate the subject. The instructor may also prepare a handout or make available slide sets via the Blackboard consisting of relevant figures and visual aids. The instructor will assemble a reading list consisting of required reading prior to attending the class. The instructor will also suggest specific references to additional topics that may be of interest to students who may want to investigate a subject more thoroughly. This reading list may also serve as a basis for students to gain additional information of topics of interest relevant to each disorder as part of their preparation for a term paper.

Recommended Readings:

The following books are required or recommended for this course. Selected readings will also be posted on Blackboard as pdfs. Required chapters from supplemental texts will be posted as pdfs on Blackboard.

Required:

- ***Neurobiology of Brain Disorders***, Eds: M. Zigmond, L. P. Rowland, and J. T. Coyle. Academic Press Elsevier, 2015. This textbook can be downloaded as pdf or purchased as a hardcopy.

Recommended (optional, depending on student's interests):

- *Atlas of Functional Neuroanatomy*, W. J. Hendelman, CRC Taylor and Francis Press, 2nd or 3rd Edition.
- *Fundamental Neuroscience*, Eds: L. R. Squire, D. Berg, F. E. Bloom, S. du Lac, A. Ghosh, and N. C. Spitzer, Academic Press Elsevier, 2013, 4th Edition.
- *Introduction to Neuropsychopharmacology*, Eds: L. Iverson, S. Iverson, F. E. Bloom, and R. H. Roth, Oxford University Press, 2008, 1st Edition.
- *Principles of Neural Science*, Eds: E. R. Kandel, J. Schwartz, T. Jessell, S. Siegelbaum, and A. Hudspeth, McGraw Hill, 5th Edition.
- *The Biochemical Basis of Neuropharmacology*, J. R. Cooper, F. E. Bloom, and R. H. Roth Oxford University Press, 2003, 8th Edition.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Academic Integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the [student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Statement on Academic Conduct and Support Systems

Academic Integrity:

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, comprises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see [the student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of

appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

[*Counseling and Mental Health*](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[*988 Suicide and Crisis Lifeline*](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[*Relationship and Sexual Violence Prevention Services \(RSVP\)*](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[*Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)*](#) - (213) 740-5086

Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

[*Reporting Incidents of Bias or Harassment*](#) - (213) 740-5086 or (213) 821-8298

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[*The Office of Student Accessibility Services \(OSAS\)*](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[*USC Campus Support and Intervention*](#) - (213) 740-0411

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

[Diversity, Equity and Inclusion](#) - (213) 740-2101

Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

[USC Emergency](#) - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call

Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

[USC Department of Public Safety](#) - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call

Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC)

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.