

USC School of Pharmacy

Pharmacy Undergraduate Programs

Course Syllabus

RXRS403

Neuropharmacology in Health and Disease

Spring Semester 2022

Day and Time: Tue and Thu; 11:00 am to 12:20

Location: WPH 103

Instructor: Michael W. Jakowec, PhD
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Course Weight: 4 units (2 lecture sessions/week plus optional office session per week)
One semester: January 10 to April 29, 2022 (Total 15 weeks, 30 class sessions)

Recommended Prerequisite: BISC 220 or by permission of the instructor

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, adulthood, 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 class participation, attendance and discussion (10%), 2 midterm exams (30% each) and Final (30%).

Weekly Lecture Topic and Reading List

Lecture No.	Date	Topic	Subtopics to be Included	Assigned Reading
1	Tues Jan. 11	Basic Neuroanatomy	Gross structure and specialization of the human brain including historical perspectives	Selections from Hendelman
2	Thur. Jan. 13	Structure of the Neuron and Glia	Axons, dendrites, synapses including morphology and molecular structure	Selections from Kandel et al.
3	Tues Jan. 18	Receptors	Receptors for excitation and inhibition, channels, GPCR	Selections from Squire et al.
4	Thur. Jan. 20	Neurotransmitters	Excitatory, inhibitory, modulatory	Various Selections
5	Tues Jan. 25	Parkinson's disease	History, etiology, pathology, research highlights, and animal models.	Zigmond Chapter 19
6	Thurs. Jan. 27	Parkinson's disease	Pharmacological treatments, current and future drug development	Zigmond Chapter 21
7	Tues. Feb. 1	Alzheimer's Disease	History, etiology, pathology, research highlights, and animal models.	Zigmond Chapter 21
8	Thurs. Feb. 3	Alzheimer's Disease	Pharmacological treatments, current and future drug development	
9	Tues. Feb. 8	Huntington's disease	History, etiology, pathology, research highlights, current drug future drug development, animal models.	Zigmond Chapter 20
10	Thurs Feb. 10	Huntington's disease	Treatment	
	Thurs. Feb. 10	Take Home Exam		
11	Tues. Feb. 15	Amyotrophic Lateral Sclerosis (ALS)	Motor neuron disorder affecting both the spinal cord and cerebral cortex	Zigmond Chapter 18
12	Thurs. Feb. 17	Amyotrophic Lateral Sclerosis (ALS)	Treatment	
13	Tues. Feb. 22	Multiple Sclerosis	Role of the immune system in brain disorders	Zigmond Chapter 29, 30
14	Thurs. Feb. 24	Multiple Sclerosis	Treatment	Zigmond Chapter 29, 30
15	Tues. Mar. 1	Stroke	Blood flow, hypoxia, ischemia, risk factors.	Zigmond Chapter 22

16	Thurs. Mar. 3	Stroke	Treatment	
17	Tues. Mar. 8	Traumatic Brain Injury (TBI)	Sports and deployment injuries, Chronic traumatic Encephalopathy (CTE), pathology.	Zigmond Chapter 16
18	Thurs. Mar. 10	Traumatic Brain Injury (TBI)	Treatment	
	Thurs. Mar. 10	Take Home Exam		
	Tues., Thur. Mar. 15, 17	Spring Break	No Classes	
19	Tues. Mar. 22	Schizophrenia	Disorders of Cognition	Zigmond Chapter 39
20	Thurs. Mar. 24	Schizophrenia	Pharmacological treatment	Zigmond Chapter 39
21	Tues. Mar. 29	Epilepsy	Seizures, etiology, current and future treatments.	Zigmond Chapter 17
22	Thurs. Mar. 31	Epilepsy	Treatment	
23	Tues. Apr. 5	Metabolic Disorders	Diet, Diabetes, metabolic syndrome	Zigmond Chapter 13
24	Thurs. Apr. 7	Metabolic Disorders	Treatment	
25	Tues. Apr. 12	Depression	Neurobiology and, etiology	Zigmond Chapter 43
26	Thurs. Apr. 14	Depression	Treatment	
27	Tues. Apr. 19	Sleep	Purpose of sleep, Sleep disorders	Zigmond Chapter 36
28	Thurs. Apr. 21	Sleep	Treating disorders of sleep	
29	Tues. Apr. 26	In Class Presentations	Neurocinema	
30	Thurs. Apr. 28	In Class Presentations	Neurocinema	
Final Exam May 10th 11am-1pm but will be a Take Home Exam Due May 11th.				

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.

Evaluation for student grades:

Students enrolled in this course will be graded as follows

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.

60% Midterm: There will be 2 midterms during the course conducted after lectures 10 and 18. Midterms will consist of a series of questions involving short answers as well as a longer question requiring critical thought and its articulation in written responses. This midterm exam will help students to generate a critical assessment of key topics in this course, to develop a suitable argument, and to convey their ideas and interpretations through the written word.

30% Final: The Final Exam will be in the form of an in class examination during exam week. This examination will consist of short written answers to questions requiring specific knowledge of topics covered in the course as well as short opinion essays in response to questions designed to challenge current interpretations and will allow students to express their ideas based on facts derived from the course.

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

STATEMENT ON ACADEMIC CONDUCT AND SUPPORT SYSTEMS

Academic Conduct:

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

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
studenthealth.usc.edu/counseling

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

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention and Services (RSVP) - (213) 740-9355(WELL), press "0" after hours – 24/7 on call

studenthealth.usc.edu/sexual-assault

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED)- (213) 740-5086 | Title IX – (213) 821-8298
equity.usc.edu, titleix.usc.edu

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. The university prohibits discrimination or harassment based on the following *protected characteristics*: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations. The university also prohibits sexual assault, non-consensual sexual contact, sexual misconduct, intimate partner violence, stalking, malicious dissuasion, retaliation, and violation of interim measures.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report

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

The Office of Student Accessibility Services - (213) 740-0776
osas.usc.edu

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) 821-4710

campussupport.usc.edu

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

diversity.usc.edu

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

dps.usc.edu, emergency.usc.edu

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) 442-120 – 24/7 on call

dps.usc.edu

Non-emergency assistance or information.

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

ombuds.usc.edu

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) 442-3340 or otfp@med.usc.edu

chan.usc.edu/otfp

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