USC School of Pharmacy

RXRS 403: Neuropharmacology in Health and Disease

Spring Semester 2019
Day and Time: Tue and Thu; 11:00 am to 12:20 pm
Location: VKC 201

Instructors

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Course Weight 4 units

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, 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.

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 9 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.

Assignments and Grading:

Class participation & attendance	20 pts (10 %)
Midterm 1	60 pts (30%)
Midterm 2	60 pts (30%)
Final Exam	60 pts (30%)
Total:	200 pts.

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 from the internet 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 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.

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.

Weekly Lecture Topic and Reading List

Lecture Number	Date	Topic	Subtopics to be Included	Assigned Reading
Introduction to the Central Nervous System				
1	Tues Jan. 8	Basic Neuroanatomy	Gross structure and specialization of the human brain including historical perspectives	Selections from Hendelman
2	Thur Jan. 10	Structure of the Neuron and Glia	Axons, dendrites, synapses including morphology and molecular structure	Selections from Kandel et al.
3	Tues Jan. 15	Neurotransmission	Receptors and neurotransmitters	Selections from Squire et al.
4	Thur Jan. 17	Imaging the Brain	Functional MRI, PET-imaging, Blood flow	Various Selections
Diseases of the Human Nervous System				
5	Tues Jan. 22	Alzheimer's Disease	History, etiology, pathology, research highlights, current and future drug development, and animal models.	Zigmond Chapter 21
6	Thurs. Jan. 24	Parkinson's Disease	History, etiology, pathology, research highlights, current drug future drug development, animal models.	Zigmond Chapter 19
7	Tues. Jan. 29	Multiple Sclerosis (MS)	A degenerative disorder involving the Immune system. The immune system and the brain	Zigmond Chapter 30
8	Thurs. Jan. 31	MS Pt. 2	A degenerative disorder involving the Immune system	Zigmond Chapter 30

9	Tues. Feb. 5	Huntington's disease	Model of neurodegenerative disorder affecting psychiatric, cognitive and motor behavior.	Zigmond Chapter 18
	Thurs. Feb. 7	**In Class Midterm Exam**		
10	Tues Feb. 12	Amyotrophic Lateral Sclerosis (ALS)	Motor neuron disorder affecting both the spinal cord and cerebral cortex	Zigmond Chapter 18
11	Thurs. Feb. 14	Epilepsy Pt.1	Seizures, etiology, current and future treatments.	Zigmond Chapter 17
12	Tues. Feb. 19	Epilepsy Pt.2	Seizures, etiology, current and future treatments.	Zigmond Chapter 17
13	Thurs. Feb. 21	Stroke Pt.1	Blood flow, risk factors, current and future treatments.	Zigmond Chapter 22
14	Tues. Feb. 26	Stroke Pt.2 Traumatic Brain Injury (TBI)	Sports and deployment injuries, Chronic traumatic Encephalopathy (CTE), pathology, behavioral changes, and treatments including.	Zigmond Chapter 22, 16
15	Thur. Feb. 28	Addiction	Drug and alcohol	Zigmond Chapter 35
16	Tues. Mar. 5	Neuropsychiatric Disorders	Schizophrenia, Bipolar disorder, Obsessive Compulsion Disorder	Zigmond Chapter 38, 39, 40
17	Thurs. Mar. 7	Diet and Metabolic Disorders	Diabetes, sugar metabolism, supplements, and nutraceuticals targeting the brain	Zigmond Chapter 13
	Mar. 12 and 14	No Class	Spring Break	Fiction of your choice
Specialized Topics				
18	Tues. Mar. 19	Infections of the Brain	Viral, bacterial, and parasitic including HIV, meningitis, and fungi infections	Zigmond Chapter 27, 28, 23
	Thurs. Mar. 23	**In Class Midterm Exam**		
19	Tues. Mar. 28	Sexual Dimorphism	The male and female brain in development	
20	Thurs. Mar. 30	Adolescent Brain	The developing brain of young adults	
21	Tues. Apr. 2	Visual System, development and plasticity	A model system of development and behaviors.	Kandel Chapter 26, 27
22	Thurs. Apr. 4	Exercise, Cognitive and motor Circuits	Enhancement of neuroplasticity and circuits in behavior in normal and brain disorders	Petzinger et al 2015
23	Tues. Apr. 9	Music and the Brain	Music perception and therapy	Boso et al 2006 Altenmuller et al 2015
Special Topics In Neuropharmacology				
24	Apr. 11	Challenges to CNS Drug Discovery	The blood brain barrier (BBB), blood flow, specificity of targets, the microbiome	Abbott et al 2010 Foster et al 2015
25	Apr. 16	Toxicology and Safety in CNS Drug Development	Side-effects, poisons, screening for adverse effects.	Jakowec 2016
26	Apr. 18	Pharmacognosy	CNS drugs from botanical and animal sources	Jakowec 2016
27	Apr. 23	Impact of Future Technologies on CNS Drug development	Nanotechnology, neurosurgery, drug delivery, stem cells	
28	Apr. 25	Neurocinema	Perceptions of drugs and CNS disorders in cinema	Wijdicks 2014

FINAL EXAM: Tuesday, May 7, 2019 from 11 am to 1 pm, VKC 201

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, http://policy.usc.edu/scientific-misconduct.

Support Systems:

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.
engemannshc.usc.edu/counseling

National Suicide Prevention Lifeline – 1 (800) 273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. engemannshc.usc.edu/rsvp

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: sarc.usc.edu
Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. equity.usc.edu

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. studentaffairs.usc.edu/bias-assessment-response-support
The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. studentaffairs.usc.edu/ssa

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. diversity.usc.edu

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. emergency.usc.edu
USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour