

Course Syllabus

RXRS403

Neuropharmacology in Health and Disease

Spring Semester 2018

Day and Time: TTh; 11:00 am to 12:20

Location: VKC-157

Instructor: Michael W. Jakowec, PhD
Associate Professor
Department of Neurology, MCA-241
1333 San Pablo St.
University of Southern California
mjakowec@surgery.usc.edu
(323) 442-3367

Daryl Davies, PhD
Professor
School of Pharmacy, PSC-506
1985 Zonal Ave.
University of Southern California
ddavies@usc.edu
(323) 442-1427

Course Weight: 4 units (2 lecture sessions/week plus optional office session per week)
One semester: January 9 to April 26, 2018 (Total 15 weeks, 30 class sessions)

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. We will discuss some fundamental aspects of current 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 Number | Date | Topic | Subtopics to be Included | Assigned Reading |
|---|----------------|-------------------------------------|--|-------------------------------|
| Introduction to the Central Nervous System | | | | |
| 1 | Tues Jan. 9 | Basic Neuroanatomy | Gross structure and specialization of the human brain including historical perspectives | Selections from Hendelman |
| 2 | Thur Jan. 11 | Structure of the Neuron and Glia | Axons, dendrites, synapses including morphology and molecular structure | Selections from Kandel et al. |
| 3 | Tues Jan. 16 | Neurotransmission | Receptors and neurotransmitters | Selections from Squire et al. |
| Diseases of the Human Nervous System | | | | |
| 4 | Thur Jan. 18 | Alzheimer's Disease | History, etiology, pathology, research highlights, and animal models | Zigmond Chapter 21 |
| 5 | Tues Jan. 23 | Alzheimer's Disease | Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 21 |
| 6 | Thurs. Jan. 25 | Parkinson's Disease | History, etiology, pathology, research highlights, animal models. | Zigmond Chapter 19 |
| 7 | Tues. Jan. 30 | Parkinson's Disease | Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 19 |
| 8 | Thurs. Feb. 1 | Huntington's disease | Model of neurodegenerative disorder affecting psychiatric, cognitive and motor behavior. | Zigmond Chapter 18 |
| 9 | Tues. Feb. 6 | Huntington's disease | Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 18 |
| | Thurs. Feb. 8 | In Class Exam | | |
| 10 | Tues Feb. 13 | Amyotrophic Lateral Sclerosis (ALS) | Motor neuron disorder affecting both the spinal cord and cerebral cortex | Zigmond Chapter 18 |
| 11 | Thurs. Feb. 15 | Amyotrophic Lateral Sclerosis (ALS) | Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 17 |
| 12 | Tues. Feb. 20 | Multiple Sclerosis (MS) | A degenerative disorder involving the Immune system. | Zigmond Chapter 17 |
| 13 | Thurs. Feb. 22 | Multiple Sclerosis (MS) | Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 17 |
| 14 | Tues. Feb. 27 | Epilepsy | Seizures, etiology, current and future treatments. | Zigmond Chapter 22, 16 |
| 15 | Thur. Mar. 1 | Epilepsy | Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 35 |
| 16 | Tues. Mar. 6 | Stroke | Acute and chronic bleeding and ischemia in brain | Zigmond Chapter 22 |
| 17 | Thurs. Mar. 8 | Stroke | Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 22, 16 |
| | Mar. 12 to 16 | No Class | Spring Break | Fiction of your choice |
| 18 | Tues. Mar. 20 | In Class Exam | | Zigmond Chapter 27, 28, 23 |
| | Thurs. Mar. 22 | Schizophrenia, Bipolar Disorder | Schizophrenia, Bipolar disorder, Obsessive Compulsion Disorder | Zigmond Chapter 38, 39, 40 |
| 19 | Tues. Mar. 27 | Schizophrenia | Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 38, 39, 40 |
| 20 | Thurs. Mar. 29 | Traumatic Brain Injury | Sports and deployment injuries, Chronic traumatic Encephalopathy (CTE), pathology, behavioral changes, and treatments including. | Zigmond Chapter 16, 22 |
| 21 | Tues. Apr. 3 | Traumatic Brain Injury | Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 16, 22 |
| 22 | Thurs. Apr. 5 | Pain | Acute and chronic pain; Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 41 |
| 23 | Tues. Apr. 10 | Sleep | Sleep disorders, purpose of sleep | Zigmond Chapter 36 |
| 24 | Thurs. Apr. 12 | Addiction | Drugs and Alcohol addiction | Zigmond Chapter 35 |
| 25 | Tues. Apr. 17 | Addiction | Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 35 |
| 26 | Thurs. Apr. 19 | Metabolic Disorders | Diabetes, sugar metabolism, supplements, and nutraceuticals targeting the brain | Zigmond Chapter 13 |
| 27 | Tues. Apr. 24 | Metabolic Disorders | Current and future pharmacological and Therapeutic Treatment | Zigmond Chapter 13 |
| 28 | Thurs. Apr. 26 | Neurocinema | | |
| Final Exam Period May 2nd-9th | | | | |

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 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.

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.

Statement for Students with Disabilities:

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations

can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. to 5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

Statement on Academic Integrity:

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. *SCampus*, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: <http://www.usc.edu/dept/publications/SCAMPUS/gov/>. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: <http://www.usc.edu/student-affairs/SJACS/>.

Attendance and Conduct:

The Student Handbook, SCampus and University Catalogue provide guidance regarding academic policies and procedures. Students should regard the program as part of their professional development in which courtesy and responsibility are significant factors in success. Thus, students are expected to communicate absences from class and are expected to attend all examinations and class presentations by themselves and their colleagues. Under normal circumstances, papers and exams must be completed on the day that they are scheduled for submission. Failure to make appropriate arrangements in case of justifiable delay will result in a penalty of 10% in the assigned mark.