

## USC School of Pharmacy

### Fall 2017: RXRS 404: Neuroimmunity in Health and Disease

**Instructor:** Liana Asatryan, PhD  
Research Assistant Professor, Department of Clinical Pharmacy  
University of Southern California  
asatryan@usc.edu  
(323)442-1495  
MCA-9121

**Course Weight:** 2 Units

**Days/Time/Location:** Wednesday: 10:00am to 11:50am, VKC 257

Final Exam Date: December 11<sup>th</sup> 8:00- 100:00 a.m.; VKC 257

#### Introduction

Neuroimmunology is an evolving interdisciplinary field that combines neuroscience, immunology, molecular and cell biology as well as neuropharmacology in an attempt to better understand the role of the immune system and its effects on the human brain. Building evidence suggests that immune responses to environmental and genetic challenges play an essential role in the development of many CNS pathologies including ischemic stroke, demyelination, degeneration, infections and trauma, drug addiction. This course will cover the role of the immune system in maintaining a healthy brain and the consequences of improper immunological challenges on brain health. Topics to be presented over the course of the semester include: history of neuroimmunology, structure function relationships between the nervous and immune system and the role of the immune system as it relates to brain function during neurological disorders. In addition, material will be presented that discusses the challenges related to the development of therapeutics for the treatment of neuroimmune disorders.

#### Objectives

This lecture course is designed for upper-level undergraduate and early graduate students and should have broad appeal to many USC students including early stage Master, Pre-Pharmacy, Pre-Medicine and other students in health and life sciences.

#### Upon successful completion of this course, you should be able to demonstrate a working knowledge of:

- The history, development and overall framework of the field of neuroimmunology.
- The basic mechanisms regarding interactions between the nervous and immune system.
- The importance of neuroglial cells in regards to maintaining a healthy brain.
- The role of inflammatory mediators including cytokines and chemokines and their role in the neuroimmune response.
- How environmental insults (for example; infections, drugs, alcohol) and/or genetic factors can lead to an altered immune response and participate in the development of neurological diseases.
- The existing and evolving experimental and pharmacological therapeutic strategies targeting neuroimmune mechanisms to treat neurological disorders.

## Course Pre-requisites

Completion of a year of biological science coursework e.g., BISC 120/220 or CHEM 105A/B, etc.  
Optional but preferred - Principles of Immunology (BISC450L).

## Assignments and Grading:

Grading will be based on 1 midterm examination, a 1 journal club presentation and the final examination.

5 quizzes at 6 points each:	30 pts (15%)
1 midterm exam:	60 pts (30%)
1 journal club presentation:	10 pts (5%)
1 final exam (partially cumulative):	<u>100 pts (50%)</u>
<b>Total:</b>	<b>200 pts</b>

Attendance at all classes is expected and may be considered when assigning final grades. You can therefore increase the probability of getting a higher mark by being proactive in terms of asking (relevant) questions in class and/or contributing to discussions.

It is expected that the students read the assigned papers prior to the lecture and be prepared to discuss background, current understanding and gaps in knowledge for the topic in each lecture.

The midterm exam (60 points) will include 20 multiple choice questions (2 points each), 5 T/F questions (1 point each), 5 fill-in the blank questions (1 point each), and 1 short essay (10 points).

Students will be required to participate in a discussion of an assigned paper during a journal club (10 points).

The final exam (100 points) will consist of 40 multiple choice questions (2 points each), 5 fill-in the blank questions (1 points each) and one short essay (15 pts). The final exam will be cumulative, but will emphasize material covered after the midterm.

There are no make-up exams. If exceptional circumstances prevent you from attending an exam, your reason for missing it must be accompanied by a written statement from a third party (e.g. a note from a medical doctor).

Notes, books, calculators, electronic dictionaries, regular dictionaries, cell phones or any other aids are not allowed during exams.

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

## Course Readings

### *Required Readings*

To be successful in this course you will be expected to read the assigned chapters from the textbooks listed below. Reading materials will be supplemented with a variety of source materials including articles from scientific journals and public websites. Supplemental reading assignments and additional handouts will be posted on <http://blackboard.usc.edu/>. The information will be complemented with discussions involving students on real life situations.

- **Inflammatory Diseases of the Central Nervous System**  
Trevor Kilpatrick, Richard M. Ransohoff and Steven Wesselingh; ISBN: 978-0-521-88874-5
- **Neural-Immune Interactions in Brain Function and Alcohol Related Disorders**  
Changhai Cui, Lindsay Grandison and Antonio Noronha; ISBN:978-1-4614-4728-3  
Chapters from this book will be available on Blackboard.

*Recommended Readings*

- **Neuroimmunity: A New Science that Will Revolutionize how We Keep Our Brains Healthy and Young**  
Michal Schwartz, Anat London, Olle Lindvall; ISBN: 978-0-300-20347-9

## Course Outline

Week & Date	Topic	Subtopics to be Included	Assigned and Supplemental Reading
<b>Introduction and Background</b>			
Week 1 Aug 23	Introducing Neuroimmunology as an evolving discipline	Historical development of the field of Neuroimmunology, merging of two disciplines. Importance in the context of understanding diseases of the nervous system?	Schwartz/London Chapter 1  Additional readings will be posted on Blackboard.
Week 2 Aug 30	General overview of nervous and immune system interactions; brain as an immune active organ	Basic principles of nervous and immune systems. General overview of the brain-immune interactions; how does brain regulate the adaptive and innate immunity, how does immune system affect the brain functions?	Cui/Grandison/Noronha Chapters 1-3 Additional readings will be posted on Blackboard.
Week 3-4 Sept 6, 13	<b>Quiz 1</b> Neuroinflammation - cellular basis	Cells of the brain immune system - microglia, astrocytes, oligodendrocytes, interaction with neuronal cells.	Kilpatrick/Ransohoff/Wesselingh, Chapter 1 Cui/Grandison/Noronha Chapters 1-3
Week 5 Sept 20	<b>Quiz 2</b> Neuroinflammation – molecular basis role in the development of CNS pathologies	Molecular basis – Glial and neuronal signaling: cytokines, chemokines, complement system, role in behavioral function. Brain barriers.	Kilpatrick/Ransohoff/Wesselingh, Chapter 2 Additional readings will be posted on Blackboard.
Week 6 Sept 27		<b>Journal Club</b>	Students to read the assigned paper for in class discussion
<b>Inflammatory Diseases of the Nervous System; Existing and Potential Therapeutics</b>			
Week 7 Oct 4	Autoimmunity and demyelinating disorders	Introducing the neuroinflammatory basis of disease of the nervous system. Immune-mediated neurological syndromes. Mechanisms of autoimmunity. Focus on multiple sclerosis (MS). Neuroimmune crosstalk during MS, repair.	Kilpatrick/Ransohoff/Wesselingh, Chapter 5,6
Week 8 Oct 11	Ischemia-reperfusion, stroke	<b>In Class Midterm 1</b> Neuroimmune mechanisms of ischemic brain injury. Understanding specific inflammatory mediators and anti-inflammatory response to resolve inflammation and repair.	Reading material on the subject matter will be posted on Blackboard.
Week 9 Oct 18	<b>Quiz 3</b> Disorders of the nervous system caused by infections	Role of immune system in neuropathology during viral (HIV, etc) and bacterial (meningitis) infections of the brain.	Kilpatrick/Ransohoff/Wesselingh, Chapters 10-12
Week 10 Oct 25	Disorders of the nervous system caused by trauma	Traumatic challenge of the brain. Spinal cord injury and inflammation.	Kilpatrick/Ransohoff/Wesselingh, Chapters 14
Week 11 Nov 1	Neurodegenerative disorders	Pathophysiology of neurodegenerative disorders with the emphasis on neuroimmune component. Focus on Alzheimer's, Parkinson's diseases. Touching upon real life situations.	Reading material on the subject matter will be posted on Blackboard.
Week 12 Nov 8	<b>Quiz 4</b> Drug- and alcohol-use brain disorders	Neural-immune interactions during alcohol and drug abuse; brain function and behavioral consequences. Fetal alcohol syndrome.	Cui/Grandison/Noronha, Chapters 8,10,18

Week 13 Nov 15	Gut microbiome, immune and nervous system connection	Overview on the recently evolving hot area of interaction between gut microflora, immune system and brain. Role in behavior and CNS disorders.	Reading material on the subject matter will be posted on Blackboard.
Week 14 Nov 22	No class	Thanksgiving/University Holiday	
Week 15 Nov 29	<b>Quiz 5</b> Neuroinflammation as a therapeutic target in brain disorders. Neuroimaging as a new diagnostic tool.	Existing and future therapeutic means/approaches targeting neuroimmune mechanisms for treatment of neurological disorders. New directions in diagnostics and target identification of neurological disease.	Cui/Grandison/Noronha Chapter 4,17 Kilpatrick/Ransohoff/Wesselingh Chapters 15,16,17
<b>Final Exam</b> <b>Dec 11 8:00 – 10:00 am; VKC – 257</b>			

## 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 Section 11, *Behavior Violating University Standards* <https://scampus.usc.edu/1100-behavior-violating-university-standards-and-appropriate-sanctions>. 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>.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* <http://equity.usc.edu> or to the *Department of Public Safety* <http://capsnet.usc.edu/department/department-public-safety/online-forms/contact-us>. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for Women and Men* <http://www.usc.edu/student-affairs/cwm/> provides 24/7 confidential support, and the sexual assault resource center webpage <http://sarc.usc.edu> describes reporting options and other resources.

### Support Systems

A number of USC’s schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* <http://dornsife.usc.edu/ali>, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* [http://sait.usc.edu/academicssupport/centerprograms/dsp/home\\_index.html](http://sait.usc.edu/academicssupport/centerprograms/dsp/home_index.html) provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* <http://emergency.usc.edu> will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.

### Emergency Preparedness/Course Continuity:

In case of emergency, and travel to campus is difficult, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies. Instructors should be prepared to assign students a "Plan B" project that can be completed at a distance. For additional information about maintaining your classes in an emergency please access: <http://cst.usc.edu/services/emergencyprep.html>