

USC School of Pharmacy

RXRS 420: Organ Physiology, Drug Delivery, and Drug Action

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Office hours: 3 hours per week

Course Weight: 4 Units (course meets 3 hours per week)

Day/Time/Location: TUE/3:30-6:20 p.m./VKC109

Introduction

An understanding of the physiology of organ systems underlies the understanding of drug action and drug delivery routes and is a cornerstone of the field of biopharmaceutics. This course will integrate basics of cell and organ physiology, the pharmacology of a number of widely used drugs, and drug delivery, all discussed in the context of these organ systems. These principles and concepts will be covered through the discussion of 4 major organ systems: cardiovascular, gastrointestinal, renal, and respiratory.

Objectives

This course is designed for upper-level undergraduate and early graduate students who are interested in organ physiology, therapeutics, and drug delivery. USC students who are pursuing a career in health or biological science majors, such as pharmacy or medical professions, would be most appropriate. In addition, this course would be of interest for early stage Master students in health/biological sciences.

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

1. Basic principles in cell physiology: ion and water transport, muscle contraction, hormone action.
2. Basic concepts and principles of traditional drug delivery routes, particularly oral drug absorption.
3. Basic physiology of the following organ systems: cardiovascular, gastrointestinal, renal, and respiratory.
4. The mechanism of action of the most popular, therapeutically relevant drugs acting on these organ systems.

Assignments and Grading:

5 quizzes @ 10 pts each, the best 4 scores	40 pts (20%)
2 midterm exams @ 50 pts each:	100 pts (50%)
<u>1 final exam</u>	<u>60 pts (30%)</u>
Total:	200 pts (100%)

Attendance at all classes is expected and may be considered when assigning final grades. Participation will include asking and answering questions and being actively involved in the discussion of topics that are presented. It is expected that the students read the assigned papers and book chapters prior to the lecture and be prepared to discuss background, current understanding, treatments, and gaps in knowledge for the topic in each lecture.

There will be 5 quizzes, two mid-term examinations and one final examination for this course. One of the quizzes with the lowest outcome will be automatically dropped and not be included in the calculations of the final grade. The questions for quizzes and exams will primarily be based on the lecture content and readings from textbooks. The quizzes (10 points each), midterms (50 points each), and the final exam (60 points) will include multiple-choice questions (1-2 points each), fill-in-the-blank questions (1-2 points each), and short essay questions (5-10 points each).

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, as per USC policy (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

- Cellular Physiology and Neurophysiology, 2nd ed. Mordecai P. Blaustein, Joseph P. Y. Kao, and Donald Matteson. ISBN: 9780323057097
- Berne & Levy Physiology, 6th ed. Bruce M. Koeppen and Bruce A. Stanton. ISBN: 978-0-323-07362-2

Recommended Readings

- Applied Biopharmaceutics & Pharmacokinetics, 6th ed. Leon Shargel, Andrew Yu, Susanna Wu-Pong. ISBN-13: 978-0071603935

- Goodman & Gilman's: The Pharmacological Basis of Therapeutics, 13th ed. Laurence L. Brunton, Randa Hilal-Dandan, Björn C. Knollmann. ISBN-13: 978-0071624422

Course Outline

This course will be in the format of a directed lecture under the guidance of the instructor for the specific sessions. 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. In general, two hours of lecture will review organ anatomy and physiology; and, approximately one hour will focus on drug delivery and/or drug action.

Week & Date	Topic	Subtopics to be Included	Assigned and Supplemental Reading
Week 1 Tue. 8/27/19	Introduction to the cell membrane and membrane transport; Introduction to intracellular signaling Dr. Okamoto	Introduction to the principles of membrane transport and electrophysiology. Introduction to the principles of intracellular signaling pathways	Berne & Levy, Ch. 1, 2, 5, 6 G&G, Ch. 3, 5
Week 2 Tue. 9/03/19	Muscle contraction Dr. Okamoto	Introduction to the principles of muscle contraction: skeletal, cardiac, and smooth muscles	Berne & Levy, Ch. 12, 13, 14
Week 3 Tue. 9/10/19	Quiz 1 Basic principles of drug delivery and drug transport Dr. Okamoto	Introduction to the principles of traditional routes of drug delivery.	Shargel, Ch. 7, 10, 13 G&G, Ch. 1, 2, 3
Week 4 Tue. 9/17/19	Quiz 2 Basic principles of drug action Dr. Okamoto	Introduction to the principles of hormone-receptor signaling and of drug action	Berne & Levy, Ch. 3 G&G, Ch. 3
Week 5 Tue. 9/24/19	Autonomic nervous system Cardiovascular physiology Dr. Okamoto	Overview of the autonomic nervous system Overview of circulation and cardiac function Overview of the regulation of the heart action and vasculature	Berne & Levy, Ch. 11 Berne & Levy, Ch. 15, 16, 17, 18
Week 6 Tue. 10/01/18	Cardiovascular physiology Dr. Okamoto	In Class Midterm 1 (Dr. Okamoto) Integrated control of the cardiovascular system Antihypertensives, antiarrhythmics, anticoagulants	G&G, Ch. 28, 30, 32
Week 7 Tue. 10/08/19	Quiz 3 Gastrointestinal physiology Dr. Okamoto	Functional anatomy and general principles of regulation in the gastrointestinal tract	Berne & Levy, Ch. 19
Week 8 Tue. 10/15/19	Quiz 4 Gastrointestinal physiology Dr. Okamoto	Integrated response to a meal	Berne & Levy, Ch. 26
Week 9 Tue. 10/22/19	Gastrointestinal physiology Dr. Okamoto	Integrated response to a meal	Berne & Levy, Ch. 27, 28, 29, and 30 G&G, Ch. 49, 50
Week 10 Tue. 10/29/19	Gastrointestinal physiology	Integrated response to a meal Transport and metabolic functions of the liver Statins, anticoagulants	Berne & Levy, Ch. 31 G&G, Ch. 6, 33, 32, 50
Week 11 Tue. 11/05/19	Renal physiology Dr. Okamoto	In Class Midterm 2 (Dr. Okamoto) Elements of renal function, solute and water transport along the nephron: tubular function	Berne & Levy, Ch. 32, 33
Week 12 Tue. 11/12/19	Renal physiology Dr. Okamoto	Control of body fluid osmolality and volume Diuretics, antihypertensives	Berne & Levy, Ch. 34 G&G, Ch. 25, 28

Week 13 Tue. 11/19/19	Renal physiology Dr. Okamoto	Control of electrolyte and pH balance	Berne & Levy, Ch. 35, 36
Week 14 Tue. 11/26/19	Quiz 5 Respiratory physiology Dr. Okamoto	Structure and function of the respiratory system, mechanical properties of the lung and chest wall Routes of drug delivery to the lungs	Berne & Levy, Ch. 20, 21 G&G, Ch. 40
Week 15 Tue. 12/03/19	Respiratory physiology Dr. Okamoto	Ventilation-perfusion relationships, oxygen and carbon dioxide transport, control of respiration Bronchodilators, corticosteroids	Berne & Levy, Ch. 22, 23, 24 G&G, Ch. 31, 40
FINAL EXAM: Tuesday, December 17, 2019 from 2pm to 4 pm in VKC 109			

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.

Support Systems:

Student Health Counseling Services - (213) 740-7711 – 24/7 on call
engemannshc.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 Services (RSVP) - (213) 740-4900 – 24/7 on call
engemannshc.usc.edu/rsvp

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

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

Information about how to get help or help a survivor of 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.

Bias Assessment Response and Support - (213) 740-2421

studentaffairs.usc.edu/bias-assessment-response-support

Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs - (213) 740-0776

dsp.usc.edu

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Support and Advocacy - (213) 821-4710

studentaffairs.usc.edu/ssa

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

Diversity at USC - (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.