

USC School of Pharmacy
RXRS 420: Organ Physiology, Drug Delivery, and Drug Action
(Fall 2020)

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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. Zoom sessions will begin at 3:30 p.m. each week and may or may not last the entire 3 hours (depending upon the subject matter and discussion, invitations will be sent out from Blackboard. *Please note that by taking this course, you implicitly agree to be recorded during these Zoom sessions.*

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 anatomy, cell and organ physiology, the pharmacology of a number of widely prescribed 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 (neurophysiology, other than cellular, endocrine, and reproductive physiology will not be covered). The course will throughout attempt to integrate fundamental cellular physiology and anatomical principles with organ system function, as well as considering how multi-organ functions are integrated.

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 the most appropriate target audience. 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 (acute signal transductions pathways).
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, each quiz will last 10 min:	40 pts	(20%)
2 midterm exams @ 50 pts each (each MT will last 60 min):	100 pts	(50%)
1 final exam (2 hours, Nov. 19, 2020)	60 pts	(30%)
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, 2 mid-term examinations and 1 final examination for this course. A score of 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 (e.g., a note from a medical doctor), as per USC policy.

Notes, books, calculators, electronic dictionaries, regular dictionaries, cell phones, or any other aids are not allowed during exams. **There will be more explicit instructions regarding the administration of online quizzes and exams forthcoming.**

Students will be asked to complete an anonymous critical evaluation of the course near its completion. However, students are encouraged also to provide feedback on the course continuously as issues arise.

Course Readings

Required Readings

- Cellular Physiology and Neurophysiology, 2nd ed. Mordecai P. Blaustein, Joseph P. Y. Kao, and Donald Matteson. ISBN: 9780323057097
- Physiology, 6th ed. Linda S. Costanzo. ISBN: 978-0-323-47881-6

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 narrated slide sets and discussion sections under the guidance of the instructor for the specific topics. During each weekly session the instructor will engage the students with questions and draw comments or interpretations primarily based on the assigned reading and slide sets. Students are expected to ask questions and participate in an interactive fashion. In general, most of the time of the sessions will be spent upon reviewing organ anatomy and physiology; and, some time will be spent on drug delivery and/or drug action involving the particular organ system.

Week & Date	Topic	Subtopics to be Included	Assigned and Supplemental Reading
Week 1 Tue. 8/18/2020	Introduction to the cell membrane and membrane transport; Introduction to intracellular signaling Okamoto	Introduction to the principles of membrane transport and electrophysiology. Introduction to the principles of intracellular signaling pathways.	Costanzo, Ch. 1, 3 Blaustein, Ch. 1-11 G&G, Ch. 3, 5
Week 2 Tue. 8/25/2020	Introduction to the cell membrane and membrane transport; Introduction to intracellular signaling Okamoto	Introduction to the principles of membrane transport and electrophysiology. Introduction to the principles of intracellular signaling pathways (cont'd).	Costanzo, Ch. 1, 3 Blaustein, Ch. 1-11 G&G, Ch. 3, 5
Week 3 Tue. 9/01/2020	Practice Quiz Muscle contraction Autonomic NS Okamoto	Introduction to the principles of muscle contraction: skeletal, cardiac, and smooth muscles Overview of the autonomic nervous system	Costanzo, Ch. 1 Blaustein, Ch. 14-16 Costanzo, Ch. 2
Week 4 Tue. 9/08/2020	Quiz 1 Cardiovascular physiology Okamoto	Overview of circulation and cardiac function Overview of the regulation of the heart action and vasculature	Costanzo, Ch. 4
Week 5 Tue. 9/15/2020	Quiz 2 Cardiovascular physiology Okamoto	Overview of the regulation of the heart action and vasculature	Costanzo, Ch. 4
Week 6 Tue. 9/22/2020	Cardiovascular physiology Okamoto	“In-class Midterm 1” (Okamoto) Integrated control of the cardiovascular system	Costanzo, Ch. 4
Week 7 Tue. 9/29/2020	Respiratory physiology Okamoto	Structure and function of the respiratory system, mechanical properties of the lung and chest wall	Costanzo, Ch. 5
Week 8 Tue. 10/06/2020	Quiz 3 Respiratory physiology Okamoto	Oxygen and carbon dioxide transport, control of respiration Integrated response to a meal	Costanzo, Ch. 5
Week 9 Tue. 10/13/2020	Quiz 4 Renal physiology Okamoto	Elements of renal function, solute and water transport along the nephron: tubular function	Costanzo, Ch. 6, 7
Week 10 Tue. 10/20/2020	Renal physiology Okamoto	“In-class Midterm 2” (Okamoto) Control of body fluid osmolality and volume Control of electrolyte and pH balance	Costanzo, Ch. 6, 7

Week 11 Tue. 10/27/2020	Renal physiology Okamoto	Control of body fluid osmolality and volume Control of electrolyte and pH balance	Costanzo, Ch. 6, 7
Week 12 Tue. 11/03/2020	Gastrointestinal physiology Okamoto	Functional anatomy and general principles of regulation in the gastrointestinal tract	Costanzo, Ch. 8

Week 13 Tue. 11/10/2020	Quiz 5 Gastrointestinal physiology Okamoto	Integrated response to a meal: GI motility, secretion, and absorption Transport and metabolic functions of the liver Bronchodilators, corticosteroids	Costanzo, Ch. 8
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FINAL EXAM: Tuesday, November 19, 2020 from 2 to 4 pm

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.