

USC School of Pharmacy

Fall 2021

BPSI-405 (formerly RXRS 420): Organ Systems Physiology, Drug Delivery, and Drug Action

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Office: PSC 404A; USC Mail Code: MCA-9121
Office hours: 3 hours per week

Course Weight: 4 Units (one 3-hour session per week)

Day/Time/Location: Tuesdays, 3:30 to 6:20 PM KAP 113

Catalogue Description: Principles of cellular and organ physiology systems. Interplay between the physiology of organ systems, drug delivery and drug action

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 mechanism of action 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 reinforced through the discussion of 4 major organ systems: cardiovascular, gastrointestinal, renal, and respiratory (neurophysiology, other than cellular, endocrine, and reproductive physiology, covered in the context of these major organ systems will otherwise 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 the activities of these 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 (mainly short-term activities of signal transductions pathways).
2. Basic physiology of the following organ systems: cardiovascular, gastrointestinal, renal, and respiratory, and how these organ systems may integrate their activities/
3. The mechanism of action of the most popular, therapeutically relevant drugs acting on these organ systems
4. Basic concepts and principles of traditional drug delivery routes, particularly oral drug absorption.

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, TBA)	60 pts	(30%)
Total:	200 pts	(100%)

Attendance at all classes is expected, and may also 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

- Cellular Physiology and Neurophysiology, 2nd ed. 2019. Mordecai P. Blaustein, Joseph P. Y. Kao, and Donald Matteson. ISBN: 9780323057097 (available online, Norris Medical Library, and
- Physiology, 6th ed. Linda S. Costanzo. 2018. ISBN: 978-0-323-47881-6 (available online, Norris Medical Library, and Elsevier ClinicalKey)
- Goodman & Gilman's: The Pharmacological Basis of Therapeutics, 13e. 2018. Laurence L. Brunton, Randa Hilal-Dandan, and Björn C. Knollmann. ISBN 978-1-25-958473-2 (available online, Norris Medical Library, and Access Medicine).
- Applied Biopharmaceutics & Pharmacokinetics. 2016. Leon Shargel, and Andrew B.C. Yu. ISBN 0-07-182964-4 (available online, Norris Medical Library, and Access Pharmacy)

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 Aug 24	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	Mordecai, Ch. 1-13 Costanzo, Ch. 1-3 G&G, Ch. 3, 5
Week 2 Aug 31	Muscle contraction Dr. Okamoto	Introduction to the principles of muscle contraction: skeletal, cardiac, and smooth muscles	Mordecai, Ch.14-16 Costanzo, Ch. 1-4
Week 3 Sept 7	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 Sept 14	Quiz 2 Basic principles of drug action Dr. Okamoto	Introduction to the principles of hormone-receptor signaling and of drug action	Costanzo, Ch. 1-3 G&G, Ch. 3

Week 5 Sept 21	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	Costanzo, Ch. 2 Costanzo, Ch. 4
Week 6 Sept 28	Cardiovascular physiology Dr. Okamoto	In Class Midterm 1 (Dr. Okamoto) Integrated control of the cardiovascular system Antihypertensives, antiarrhythmics, anticoagulants	Costanzo, Ch. 4 G&G, Ch. 25, 26, 28, 30, 32
Week 7 Oct 5	Quiz 3 Gastrointestinal physiology Dr. Okamoto	Functional anatomy and general principles of regulation in the gastrointestinal tract	Costanzo, Ch. 8
Week 8 Oct 12	Quiz 4 Gastrointestinal physiology Dr. Okamoto	Integrated response to a meal	Costanzo, Ch. 8
Week 9 Oct 19	Gastrointestinal physiology Dr. Okamoto	Integrated response to a meal	Costanzo, Ch. 8 G&G, Ch. 49, 50
Week 10 Oct 26	Gastrointestinal physiology	Integrated response to a meal Transport and metabolic functions of the liver Statins, anticoagulants	Costanzo, Ch. 8 G&G, Ch. 6, 33, 32, 50
Week 11 Nov 2	Renal physiology Dr. Okamoto	In Class Midterm 2 (Dr. Okamoto) Elements of renal function, solute and water transport along the nephron: tubular function	Costanzo, Ch. 6, 7
Week 12 Nov 9	Renal physiology Dr. Okamoto	Control of body fluid osmolality and volume Diuretics, antihypertensives	Costanzo, Ch. 6, 7 G&G, Ch. 25, 26, 28

Week 13 Nov 16	Renal physiology Dr. Okamoto	Control of electrolyte and pH balance	Costanzo, Ch. 6, 7
Week 14 Nov 23	Quiz 5 Respiratory physiology Dr. Okamoto	Structure and function of the respiratory system, mechanical properties of the lung and chest wall	Costanzo, Ch. 5 G&G, Ch. 40
Week 15 Nov 3	Respiratory physiology Dr. Okamoto	(same as week 14)	Costanzo, Ch. 5 G&G, Ch. 31, 40

FINAL EXAM: Tuesday December 14, 2021 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:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.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 and Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault

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

Office of Equity and Diversity (OED)- (213) 740-5086 | Title IX – (213) 821-8298
equity.usc.edu, titleix.usc.edu

Information about how to get help or help someone affected by 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. The university also prohibits sexual assault, non-consensual sexual contact, sexual misconduct, intimate partner violence, stalking, malicious dissuasion, retaliation, and violation of interim measures.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symlicity.com/care_report

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity |Title IX for appropriate investigation, supportive measures, 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

uscса.usc.edu

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

dsp.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

dsp.usc.edu

Non-emergency assistance or information.