

USC Mann

Alfred E. Mann School of Pharmacy
and Pharmaceutical Sciences

**Fall 2023: BPSI 405: Organ Systems Physiology, Drug Delivery and Drug Action
Session: 54105R**

Instructors

Michael W. Jakowec, PhD

Associate Professor, Department of Neurology, Keck School of Medicine of USC
University of Southern California
mjakowec@surgery.usc.edu
(323) 442-3367

HSC Office: MCA-241; UPC Office: STO 312

Office Hours: Before or after class or by appointment.

Hovhannes Gukasyan, PhD

Associate Professor of Pharmacology and Pharmaceutical Sciences USC School of Pharmacy
gukasyan@usc.edu
(323) 442-1362

HSC Office: PSC 716 UPC Office: STO 312

Office Hours: Weekly, Fridays from 4-5:30pm

Monica Vera-Schubert, PharmD

Adjunct Professor of Pharmacology and Pharmaceutical Sciences USC School of Pharmacy
veraschm@gmail.com
(818) 970-8518

UPC Office: STO 312

Office Hours: TBA and By Appointment

Course Weight: 4 Units

Day/Time/Location: Tuesday's and Thursday's, 3:30 to 4:50 pm in GFS 212

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 the basics of anatomy, cell and organ physiology, the mechanism of action of a number of widely prescribed drugs, all discussed in the context of these organ systems. These principles and concepts will be reinforced through the discussion of the major organ systems: cardiovascular, gastrointestinal, renal, digestive, nervous, and respiratory. 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. Fundamental to this course is the understanding of the specific organ systems, a subset of their major disorders, pharmacological treatment, including adverse effects as well as discussion of major gaps in knowledge and potential new therapeutic targets.

Learning Objectives

Student Learning Outcomes: 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 who are 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, digestive, nervous, 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. Treatment options of a selective groups of organ specific disorders.
5. An understanding of major gaps in knowledge and treatment needs to begin to think about novel and critical therapeutic targets.

Deliverables, Evaluation and Grading

Each quiz will be designed to last 10 min. Each midterm, 60 min.; final exam, 120 min. (explained below).

a. Breakdown of Grade

Assignment	% of Grade	Points each
Midterm exam: Tues Act. 10	20%	40
Quizzes: Tuesday of Weeks 2, 4, 6, 10, 12, and 14	30%	10 each/60 total
Participation	10%	20
Final exam	40%	80
Total		200 Points

b. Grading Scale (approximate)

93% to 100%: A	79% to 81%: B-	65% to 67%: D+
90% to 92%: A-	76% to 78%: C+	62% to 64%: D
87% to 89%: B+	71% to 75%: C	55% to 61%: D-
82% to 86%: B	68% to 70%: C-	0% to 54%: F

Course Readings

There are numerous textbooks available in the topic of physiology and pharmacology. While we will

focus on Guyton Textbook of Medical Physiology other suggested supplemental books are also excellent.

Required Readings

• **Guyton and Hall Textbook of Medical Physiology** (Guyton Physiology) 14th Edition by John E. Hall PhD (Author), Michael E. Hall MD MSc. (Author) (available online, Norris Medical Library, and Access Medicine)

Supplemental Readings and Alternative Textbooks:

• **Cellular Physiology and Neurophysiology**, 2nd ed. 2019. Mordecai P. Blaustein, Joseph P. Y. Kao, and Donald Matteson. ISBN: 9780323057097 (available online, Norris Medical Library,

• **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)

Each week to supplement the lecture topics professors will post selective papers to Bb. Many will complement the lecture material and serve as a valuable source for specific topics and points raised in the class. Some papers will serve as a point for discussion in class.

Course Outline

Course Outline and Schedule

This course will be in the format of a directed lecture under the guidance of the instructor for the specific session. During each weekly session the instructor will engage the students with questions and draw comments or interpretations primarily based on the coverage of the slide sets. Students are expected to ask questions and participate in an interactive fashion.

There are **no plans for make-up exams or quizzes**. 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.

There will be 6 quizzes, 1 mid-term examinations, and 1 final examination for this course. The questions for quizzes and exams will primarily be based on the lecture content and readings from textbooks. The quizzes (10 points each, total 60 point or 30%), midterm (40 points or 20%), and the final exam (80 points or 40%) will include multiple-choice questions (1-2 points each), fill-in-the-blank questions (1-2 points each), and short essay questions (1-2 points to 5-10 points each). Participation (20 points or 10% based on discussions, questions, classroom interactions).

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.

Fall 2023 Course Outline: Tuesday/Thursday

Week	Date	Day	Topic	Sub-Topics	Lecturer	Notes
1	Aug. 22	Tues	Cell Physiology: Water	Introduction to the Course. Objectives and Goals of Course. Grading. Properties of water and life. pH, solubility, lipid-water interactions, Acid-base chemistry.	MJ	
	Aug. 24	Thurs	Cell Physiology: Membranes	Structure of membranes, Membrane transport. Composition, lipid-protein interactions, biophysics of membrane structure.	MJ	
2	Aug. 29	Tues	Cellular Electrophysiology	Physiology of cells including neuronal and non-neuronal. The action potential. Charge distribution.	MJ	Quiz
	Aug. 31	Thurs	Cell Signaling	Receptors, channels, GPCR, nuclear signaling, hormonal signaling.	MJ	
Labor Day, University Holiday, Monday September 4, 2023						
3	Sept. 5	Tues	Nervous System-	Structure of the nervous system, structure and function of cell inc. neurons, glia, blood vessels, neurovascular unit. .	MJ	
	Sept. 7	Thurs	Nervous System-BBB	Structure of the BBB, drug delivery to the brain, new technologies for drug delivery.	MJ	
4	Sept. 12	Tues	Autonomic Nervous System	Role of autonomic system in homeostasis, dysfunction, role hypothalamus.	MJ	Quiz
	Sept. 14	Thurs	Muscle	Structure muscle, neuromuscular junction, molecular aspects of muscle contraction, sarcopenia, diseases of muscle inc. dystrophy, neuropathy, current treatment of muscle disease.	MJ	
5	Sept. 19	Tues	Respiratory System	Structure lungs, alveoli, gas exchange, immune-lung interactions, Mechanics of lung and chest wall.	HG	
	Sept. 21	Thurs	Respiratory System	Pharmacological treatment of respiratory disorders (case studies).	HG	
6	Sept. 26	Tues	Digestive System	Structure and anatomy of digestive system form mouth to stomach. Chemistry of digestions. Disorders of digestive system (case studies).	HG	Quiz
	Sept. 28	Thurs	Digestive System	Impact of digestion on drug treatment including uptake and absorption.	HG	
7	Oct. 3	Tues	Gastrointestinal System	Structure and function of large and small intestine, absorption, peristalsis, drug uptake, absorption, barriers.	HG	
	Oct. 5	Thurs	Eye	Structure, cellular physiology, disorders of the eye including macular degeneration, impact aging, treatment of disorders.	HG	
8	Oct. 10	Tues	Midterm Exam	In Class exam		60 Minutes
Fall Recess, Thursday Oct. 12 to Friday. Oct. 13, 2023						
	Oct. 12	Thurs	No Class			Recess
9	Oct. 17	Tues	Cardiovascular System	Structure heart, veins, arteries, physiology of heart, mechanisms, blood pressure, blood movement, gas exchanges, delivery of metabolites and	MVS	

				removal of waste,		
	Oct. 19	Thurs	Cardiovascular System	Treating disorders of the cardiovascular system including heart function, fibrillation, blood pressure, vein integrity, stroke.	MVS	
10	Oct. 24	Tues	Liver	Anatomical and cellular structure of the liver, physiology and biochemistry of the liver, role xenobiotic metabolism, disorders of the liver.	MVS	Quiz
	Oct. 26	Thurs	Liver	Role liver in processing and metabolizing pharmacological agents, treating disorders of liver.	MVS	
11	Oct. 31	Tues	Renal-Kidney	Structure/function of renal system, absorption, waste removal, fluid osmolarity and volume, diuretics, hypertension.	MVS	
	Nov. 2	Thurs	Renal-Kidney	Treating disorders of kidney including blood pressure.	MVS	
12	Nov. 7	Tues	Microbiota	Microbiota in gut, skin, and other organ systems. Maintenance of healthy microbiota, changes with age, pharmacological interactions, pre- and pro-biotics.	MJ	Quiz
	Nov. 9	Thurs	Limbic System	Role limbic system in reward, apathy, anhedonia, motivations. Treatment of limbic dysfunction.	MJ	
13	Nov. 14	Tues	Sympathetic Nervous System	Structure and function, control of response, disorders affecting sympathetic and parasympathetic nervous system. Impact pharmacological agents for treatment including adverse effects.	MJ	
	Nov. 16	Thurs	Somatic Sensory System	Sensory perception including touch and pressure, pain, disorders including neuropathy, pharmacological agents and controlling pain.	MJ	
14	Nov. 21	Tues	Sleep	Role of sleep on brain health and neuroplasticity, stages, disorders of sleep, impact of aging on sleep, treatment of sleep disruption.	MJ	Quiz
Thanksgiving Holiday, Wednesday, Nov. 22 to Sunday, Nov. 26, 2023						
	Nov. 23	Thurs	No Class			Thanksgiving
15	Nov. 28	Tues	Immune system	Components, cellular and molecular structure, role bone marrow, thymus, lymphatic system.	MJ	
	Nov. 30	Thurs	Immune system	Treating disorders of the immune system including HIV	MJ	
Fri. Dec. 1: Last Day of the Fall Semester						
Exam	Tuesday, Dec. 12 from 2 to 4 PM GFS 212					

Content Warning

Our course readings and classroom discussions may focus on mature, difficult, and potentially challenging topics. As with any course dealing with pharmacology and physiology, course topics can at times be political and personal. Readings and discussions might trigger strong feelings—anger, discomfort, anxiety, confusion, excitement, humor, and even boredom. Some of us will have emotional responses to the readings; some of us will have emotional responses to our peers' understanding of the readings; all of us should feel responsible for creating a space that is both intellectually rigorous and respectful. Above all, please be

respectful (even when you strongly disagree) and be mindful of the ways that our identities position us in the classroom.

Online learning Etiquette

The course content and delivery are designed for in-person instruction. Please consult the professor in advance if you need to participate via zoom on a particular date (e.g., in case of illness).

- If it is not possible to have you webcam on during the entire class, do you best to have it on when speaking.
- Turn off your microphone when not speaking.
- If you need to step away from your computer during class (e.g., get a drink of water, use the bathroom, attend to a family member/pet) please do so quietly and without disturbing your classmates. Return to the class when you can.
- Be aware the contents of conversations typed into the chat box, even private conversations, are visible by the instructors.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment. Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relationship to the class, whether obtained in class, via email, on the internet, or via any other media. ([Living our Unifying Values: The USC Student Handbook](#), page 13).

Academic Integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the [USC Student Handbook](#). All students are expected to submit assignments that are original work and prepared specifically for the course/section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see the [student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Statement on Academic Conduct and Support Systems

Academic Integrity:

The University of Southern California is a learning community committed to developing successful scholars and researchers dedicated to the pursuit of knowledge and the dissemination of ideas. Academic misconduct, which includes any act of dishonesty in the production or submission of academic work, comprises the integrity of the person who commits the act and can impugn the perceived integrity of the entire university community. It stands in opposition to the university's mission to research, educate, and contribute productively to our community and the world.

All students are expected to submit assignments that represent their own original work, and that have been prepared specifically for the course or section for which they have been submitted. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s).

Other violations of academic integrity include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), collusion, knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

Plagiarism, defined as 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 [Research and Scholarship Misconduct](#).

The impact of academic dishonesty is far-reaching and is considered a serious offense against the university. All incidences of academic misconduct will be reported to the Office of Academic Integrity and could result in outcomes such as failure on the assignment, failure in the course, suspension, or even expulsion from the university.

For more information about academic integrity see [the student handbook](#) or the [Office of Academic Integrity's website](#), and university policies on [Research and Scholarship Misconduct](#).

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment, or what information requires citation and/or attribution.

Students and Disability Accommodations:

USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Support Systems:

[Counseling and Mental Health](#) - (213) 740-9355 – 24/7 on call

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

[988 Suicide and Crisis Lifeline](#) - 988 for both calls and text messages – 24/7 on call

The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline is comprised of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

[Relationship and Sexual Violence Prevention Services \(RSVP\)](#) - (213) 740-9355(WELL) – 24/7 on call

Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

[Office for Equity, Equal Opportunity, and Title IX \(EEO-TIX\)](#) - (213) 740-5086

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.

[Reporting Incidents of Bias or Harassment](#) - (213) 740-5086 or (213) 821-8298

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

[The Office of Student Accessibility Services \(OSAS\)](#) - (213) 740-0776

OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

[USC Campus Support and Intervention](#) - (213) 740-0411

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

[Diversity, Equity and Inclusion](#) - (213) 740-2101

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

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) 442-1200 – 24/7 on call

Non-emergency assistance or information.

[Office of the Ombuds](#) - (213) 821-9556 (UPC) / (323-442-0382 (HSC))

A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

[Occupational Therapy Faculty Practice](#) - (323) 442-2850 or otfp@med.usc.edu

Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.

Supplement: Zoom and Blackboard

Zoom

[Zoom](#) is a videoconferencing application that enables audio and video conferencing between multiple users on both desktop computers and mobile devices. It can allow faculty to host class lectures, discussions, share screens and files, and chat with students using a PC, tablet, or even a cell phone equipped with a camera. Zoom is available to all faculty and students at no cost.

- Instructors may host live class sessions on Zoom at the same day and time as their regular class.
- Instructors are required to [record all Zoom lectures](#) and discussions for ADA (Americans with Disabilities Act) compliance, but also to accommodate students who may not be able to keep to the original class schedule.

Links to the recordings of lectures will be posted and organized in Blackboard as soon as they are available.

1. Getting Started with Zoom:

- You might be required to use Zoom in this course, please familiarize yourself with it by thoroughly reading all of the materials and [the step-by- step instructions](#).
- You will access the Zoom meeting space in one of two ways:
 1. Log in via blackboard after you have followed the instructions to initially download, install, and login. Then enter the meeting by going to the link ***USC Zoom Meetings*** in the left-hand navigation pane. You will need to click the “Join” button next to the classroom for the time set for the meeting.
 2. Copy and paste the URL (or click on the web link) provided by your instructor at the time specified for the meeting. Launch the app (after initially downloading, installing, and logging in), and you will enter the meeting immediately.
- You may choose to use Zoom on your mobile device (phone or tablet).

2. Things to Know About Zoom:

- Because you sign in using your USC information, you have your own profile in Zoom.
- Attendance and participation can be tracked using your USC profile.
- You can find the privacy and accessibility policies for Zoom by clicking on the Learner Support tab in the left-hand navigation pane of your Blackboard course.

Blackboard

[Blackboard](#) is the University’s Learning Management System (LMS) used by instructors across campus to distribute course materials, communicate with students in discussion boards, and to collect and assess student work through assignments, quizzes, and tests. A Blackboard course is created for every course at USC and should be the primary tool used for classroom management and communication.

Visit <https://blackboardhelp.usc.edu> to learn more about the various functions of Blackboard.