

USC School of Pharmacy

RXRS 302: Pharmacology and Drug Development

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Course Weight: 4 units

Days/Time/Location: Monday & Wednesday; 2:00-3:20pm at SOS B47

Catalogue description: Introductory course in pharmacology/drug development- Drug/Receptor interactions, pharmacodynamics, pharmacokinetics, toxicology, therapeutic interventions, biotransformation, pharmacogenomics, FDA, regulatory requirements and challenges, intellectual property, global challenges of drug development.

Introduction

Pharmacology is the study of substances that interact with living systems through chemical processes, especially by binding to regulatory molecules and activating or inhibiting normal body processes. These substances may be chemicals administered to achieve a beneficial therapeutic effect on some process within the patient or for their toxic effects on regulatory processes in parasites infecting the patient. "Introduction to Pharmacology and Drug Development," will provide students with an introduction to the nature of drugs and drug development including: principles of drug receptors; how drugs interact with the body (PD); and potentially damage the body (toxicology); how the body alters the effects of the drug (PK); drug biotransformation; important drug interactions and their mechanisms of action and pharmacogenomics. The student will also learn about the regulatory challenges associated with the discovery and development of a new drug. The student will be introduced to the use of different types of pharmaceutical interventions, from the use of patented to generic to over-the counter drugs, the current approaches to dietary supplement and alternative medicines. Selected cases studies and emerging "hot" topics will be discussed. This course should have broad appeal to many science and non-science undergraduates including students interested in drug discovery research, chemistry, biology, pharmacology, biochemistry, toxicology, formulations, pharmaceutical industry, FDA, business analysts, entrepreneurs and venture capitalist interested in understanding the pharmaceuticals industry.

Chapters from the core textbook will be supplemented with a variety of source materials including online resources and articles from scientific journals.

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

- The nature of drugs and drug development
- The role and importance of different pharmacokinetic parameters (absorption, distribution, metabolism and elimination; ADME) that affect drug dosing in a patient.
- The basic terminology used in characterizing a drug (e.g. potency, EC50, IC50, MTD, efficacy, selectivity, etc....).

- Different drug-receptor interactions and the basic principles of pharmacodynamics (PD)
- The basic principles in the use of drugs to prevent and treat diseases (pharmacotherapy).
- The importance of pharmacogenomics.
- Why particular drugs are prescribed and how their effects are monitored (clinical pharmacology)
- The importance of good laboratory practices (GLP), good manufacturing practices (GMP) and good clinical practices (GCP).
- The processes involved in the discovery and development of new therapeutic agents.

Evaluation and Grading:

Evaluation will be based on two midterm examinations, a final examination and course quizzes.

Class participation:	10 pts (5%)
4 quizzes @ 10 pts each:	40 pts (20%)
2 midterm exams @ 35 pts each:	70 pts (35%)
1 final exam (partially cumulative):	<u>80 pts</u> (40%)
Total:	200 pts (100%)

Attendance at all classes is expected. Participation will include asking and answering questions and being actively involved in the discussion. It is expected that the students read the assigned papers 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 4 quizzes over the course of the semester that will be primarily based on questions pulled from the text book and lecture notes. The midterms (35 points each) will include multiple choice questions T/F questions fill-in the blank questions and possibly short answers.

The final exam (80 points) will consists of multiple choice and T/F questions and one short essay. The final exam will be cumulative, but will emphasize material covered after the 2nd 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

The text is mandatory for this course as it will greatly improve your grasp on the course content. There is a supplemental online student companion website for this course that can be accessed once the textbook is purchased. The chapters identified for your assigned reading in the in the text will support your learning process throughout the semester. Of note, there is an **online version of this textbook that is available for USC students when logged in on campus:** <http://accessmedicine.mhmedical.com/book.aspx?bookid=1193>

Textbook:

Basic & Clinical Pharmacology, 13e
Bertram G. Katzung, Anthony J. Trevor
ISBN-13: 978-0071825054
ISBN-10: 0071825053 Publisher(s): Lange

Available on Amazon.com for \$55.00

Other topical materials including but not limited to the syllabus, supplemental reading assignments and additional handouts will be posted on <http://blackboard.usc.edu/>. Students will also be encouraged to use the online discussions sessions (via Blackboard) as an additional learning tool.

Course Outline

This course will be in the format of a directed seminar/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 assigned reading. Students are expected to ask questions and participate in an interactive fashion. Because this is an area of rapid change in policies, the readings may vary from one term to the next. Additional readings for each section that may be of added use are listed in the table below.

Course schedule is as follows:

Date	Time	Subject	Lecturer
Mon Jan 8 th	2-3:20 PM	Introduction Basic principles of pharmacology. Principles of Pharmacodynamics (PD) (Part I) 1. Pharmacology Terminology 2. Principles of pharmacodynamics (PD) 3. Drug Receptor and PD Assigned and supplement reading: Chapter 2: Drug Receptors & Pharmacodynamics. Required watching to prepare for week two lectures. Basics on Pharmacokinetics/pharmacodynamics: https://www.youtube.com/watch?v=NKV5iaUVBUI Very brief overview of PD and PK: Utube: https://www.youtube.com/watch?v=tobx537kFal	Asante

Wed Jan 10 th	2-3:20 PM	Introduction Basic principles of pharmacology. Principles of Pharmacodynamics (PD) (Part II) 1. Pharmacology Terminology 2. Principles of pharmacodynamics (PD) 3. Drug Receptor and PD	Asante
Mon Jan 15 th	2-3:20 PM	Martin Luther King Jr Holiday	
Wed Jan 17 th	2-3:20 PM	Introduction Basic principles of pharmacology. Principles of Pharmacodynamics (PD) (Part III) 1. Pharmacology Terminology 2. Principles of pharmacodynamics (PD) 3. Drug Receptor and PD Assigned and supplement reading: Chapter 3 PK and PD: Rational Dosing & Time course of Drug Action	Asante
Mon Jan 22 nd	2-3:20 PM	Principles of Pharmacokinetics (Part I) 1. Types of Dosage 2. Pharmacokinetics parameters 3. Route of administration 4. Distribution Assigned and supplement reading: A. Chapter 3 PK and PD: Rational Dosing & Time course of Drug Action B. Chapter 4 Drug Biotransformation (https://www.youtube.com/watch?v=NKV5iaUVBUI)	Asante
Wed Jan 24 th	2-3:20 PM	Principles of Pharmacokinetics (Part II) 1. Types of clearance 2. Concentration at various compartments Assigned and supplement reading: A. Chapter 3 PK and PD: Rational Dosing & Time course of Drug Action B. Chapter 4 Drug Biotransformation (https://www.youtube.com/watch?v=NKV5iaUVBUI)	Asante
Mon Jan 29 th	2-3:20 PM	Pharmacodynamics (Part I) 1. Onset of action 2. Ligand-receptor binding 3. Enzyme linked receptors 4. Intracellular receptors Assigned and supplement reading: A. Chapter 3 PK and PD: Rational Dosing & Time course of Drug Action (https://www.youtube.com/watch?v=tobx537kFal)	Asante
Wed Jan 31 st	2-3:20 PM	Pharmacodynamics (Part II) 1. Onset of action 2. Ligand-receptor binding 3. Enzyme linked receptors 4. Intracellular receptors Assigned and supplement reading: A. Chapter 3 PK and PD: Rational Dosing & Time course of Drug Action (https://www.youtube.com/watch?v=tobx537kFal)	Asante
Mon Feb 5 th	2-3:20 PM	Factors impacting on Drug Levels (Part I) 1. Genetics 2. Age effect	Louie

		<ul style="list-style-type: none"> 3. Sex 4. Drug-drug interaction 5. Diet and environment <p>Assigned and supplement reading: A. Chapter 5 Pharmacogenomics</p>	
Wed Feb 7 th	2-3:20 PM	<p>Factors impacting on Drug Levels (Part II)</p> <ul style="list-style-type: none"> 1. Genetics 2. Age effect 3. Sex 4. Drug-drug interaction 5. Diet and environment <p>Assigned and supplement reading: Chapter 5 Pharmacogenomics</p>	Louie
Mon Feb 12 th	2-3:20 PM	Midterm I	
Wed Feb 14 th	2-3:20 PM	<p>Drug Discovery and Development (Part I)</p> <ul style="list-style-type: none"> 1. Drug discovery process 2. Screening 3. ADME evaluation 4. Drug synthesis and formulation 5. Toxicology Evaluation <p>Assigned and supplement reading: Pharmacology, Chapter 1: The Nature of Drugs & Drug Development. Selective readings to be posted on Blackboard</p>	Hovik
Mon Feb 19 th	2-3:20 PM	President's Day Holiday	
Wed Feb 21 st	2-3:20 PM	<p>Drug Discovery and Development (Part II)</p> <ul style="list-style-type: none"> 1. Drug Efficacy 2. IND submission 3. Phase I & II 4. Phase III & IV <p>Assigned and supplement reading: Pharmacology, Chapter 1 The Nature of Drugs & Drug Development. Selective readings to be posted on Blackboard</p>	Hovik & Asante
Mon Feb 26 th	2-3:20 PM	<p>Autonomic Pharmacology (Part I)</p> <ul style="list-style-type: none"> 1. Cholinergic drugs; anticholinergic drugs; adrenergic drugs; adrenergic blocking drugs. 2. Anti- Cholinergic & Neuromuscular Blocking 3. Clinical perspectives. Adverse effects of anticholinergic drugs or ABCDs <ul style="list-style-type: none"> A. Agitation B. Blurred vision C. Constipation and confusion D. Drug mouth <p>Histamine; serotonin; vasoactive peptides; drugs used in asthma</p> <p>Assigned and supplement reading: Chapters 6-10 https://www.youtube.com/watch?v=r-gJaMoMon0 https://www.youtube.com/watch?v=cp_CZpCBVpk</p>	Louie
Wed Feb 28 th	2-3:20 PM	<p>Autonomic Pharmacology (Part II)</p> <ul style="list-style-type: none"> 1. Cholinergic drugs; anticholinergic drugs; adrenergic drugs; adrenergic blocking drugs. 2. Anti-Cholinergic & Neuromuscular Blocking 	Louie
Quiz 3			

		<p>3. Clinical perspectives. Adverse effects of anticholinergic drugs or ABCDs</p> <ol style="list-style-type: none"> Agitation Blurred vision Constipation and confusion Drug mouth <p>Histamine; serotonin; vasoactive peptides; drugs used in asthma</p> <p>Assigned and supplement reading: Chapters 6-10 https://www.youtube.com/watch?v=r-gJaMoMon0 https://www.youtube.com/watch?v=cp_CZpCBVpk</p>	
Mon Mar 5 th	2-3:20 PM	<p>Pharmacology of Substance Use Disorders</p> <ol style="list-style-type: none"> Opioids Cannabinoids Nicotine Benzodiazepines Cocaine Amphetamines Dependence and Addiction <p>Assigned and supplement reading: Chapters 23, 31 & 32</p>	Goldstone
Wed Mar 7 th	2-3:20 PM	<p>Pharmacology of Alcohol Use Disorder</p> <ol style="list-style-type: none"> Basic Pharmacology of Ethanol Clinical Pharmacology of Ethanol <p>Treatment of Dementias</p> <p>Medications Used in Alzheimer's Disease</p> <p>Assigned and supplement reading: Chapter 28</p>	Goldstone Skinker
Mon Mar 12 th	2-3:20 PM	Spring Recess	
Wed Mar 14 th	2-3:20 PM	Spring Recess	
Mon Mar 19 th	2-3:20 PM	Midterm II	
Wed Mar 21 st	2-3:20 PM	<p>Cardiovascular Drugs (Part I)</p> <ol style="list-style-type: none"> Cardiovascular Physiology Causes of CVD <p>Assigned and supplement reading: https://www.youtube.com/watch?v=1SsYduKxE0Q</p>	Forrester
Mon Mar 26 th	2-3:20 PM	<p>Cardiovascular Drugs (Part II)</p> <ol style="list-style-type: none"> Antihypertensive agents <p>Assigned and supplement reading: https://www.youtube.com/watch?v=1SsYduKxE0Q</p>	Forrester
Wed Mar 28 th	2-3:20 PM	<p>Cardiovascular (Part III)</p> <ol style="list-style-type: none"> Diuretics Antiarrhythmics Heart Failure medication <p>Assigned and supplement reading: https://www.youtube.com/watch?v=NzdvoGZquk https://www.youtube.com/watch?v=9xSgezCMHnw</p>	Forrester
Mon April 2 nd	2-3:20 PM	<p>Respiratory Drugs (Part I)</p> <ol style="list-style-type: none"> Mechanism of constriction Pharmacology of bronchial dilators <p>Assigned and supplement reading:</p>	Louie

		https://www.youtube.com/watch?v=NNfx27io8-k	
Wed April 4 th	2-3:20 PM	Respiratory Drugs (Part II) 1. Mechanism of constriction 2. Pharmacology of bronchial dilators Assigned and supplement reading: https://www.youtube.com/watch?v=NNfx27io8-k	Louie
Mon April 9 th	2-3:20 PM	CNS Drugs (Part I) Assigned and supplement reading: Chapters 21, 22 & 24	Park
Wed April 11 th	2-3:20 PM	CNS Drugs (Part II) Assigned and supplement reading: Chapters 29 & 30	Park
Mon April 16 th	2-3:20 PM	Infectious Disease Drugs (Part I) 1. Antibacterial 2. Antimycobacterial drugs 3. Antiviral drugs Assigned and supplement reading: Chapters 43-46 https://www.youtube.com/watch?v=rhFZ-yPfy2U	Louie
Wed April 18 th	2-3:20 PM	Infectious Disease Drugs (Part II) 1. Antibacterial 2. Antimycobacterial drugs 3. Antiviral drugs Assigned and supplement reading: Chapter 43-46 https://www.youtube.com/watch?v=rhFZ-yPfy2U	Louie
Quiz 4			
Mon April 23 rd	2-3:20 PM	Cancer Chemotherapy (Part I) 1. Cytotoxic chemotherapy 2. Antimitotic agents Assigned and supplement reading: Chapter 54	Louie
Wed April 25 th	2-3:20 PM	Cancer Chemotherapy (Part II) 1. Anticancer drugs Assigned and supplement reading: Chapter 54	Louie
Mon April 30 th	2-3:20 PM	Study Day	
Wed May 2 nd	2-3:20 PM	Study Day	
Mon May 7 th	2-4:00 PM	Final Examination	

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/academicsupport/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>