

USC School of Pharmacy

RXRS 405: Breaking Brains: The Pharmacology of Drug Addiction (Buzzed: From Breaking Bad to Doing Good)

Instructors:

Liana Asatryan, Ph.D.
Research Assistant Professor
University of Southern California
[E-mail:asatryan@usc.edu](mailto:asatryan@usc.edu)
Tel: (323) 442-1495
Office: PSC 500A; USC Mail Code: MCA-9121

Michael W. Jakowec, PhD
Associate Professor, Department of Neurology, Keck School of Medicine of
USC
University of Southern California
mjakowec@surgery.usc.edu
(323) 442-1057
MCA-241

Daryl Davies, PhD
Professor, Department of Clinical Pharmacy
University of Southern California
<mailto:ddavies@usc.edu>
(323) 442-1427
Office: PSC 506; USC Mail Code: MCA-9121

Course Weight: 4 Units

Days/Time/Location: Tuesday, Thursday: 11:00 am to 12:20 pm, online/VPD 106 - physical

Office Hours: TBA

Description

Neurological basis of addiction to drugs of abuse including alcohol, marijuana, opioids and sugar, focusing on neuropharmacology and challenges of current and future therapies.

Introduction

Drug abuse is an “equal-opportunity affliction.” Historically, probably since the beginning of time, humans have sought out or discovered by accident compounds that have medicinal as well as hedonic effects. **ADDICTION: *the compulsive using of drugs in spite of terrible consequences.*** As a society, the consequences of improper drug use has also been recognized and attempts to regulate its use is found in the literature going back as far as 2240 B.C.. Unfortunately, what is not widely recognized is that the use of legal drugs including alcohol and tobacco cause far more deaths, sickness, violent crimes, economic loss and other social problems than the use of all illegal drugs combined. This course will consider the benefits and consequences of drug use (legal and illegal). The mechanism(s) of action and therapies for drugs of abuse will also presented.

Learning Objectives

Upon successful completion of this course the students should be able to:

- Explain principles of drug abuse; describe trends and statistics; discuss the consequences of improper drug use and abuse and its relationship to health, economy, well-being and society
- Identify commonly abused drug groups; provide examples of specific drugs and match to group categories according their known characteristics
- Describe biochemical and neurobiological mechanisms of drug action for commonly abused drugs; indicate similarities and differences for different groups of drugs of abuse
- Recognize signs and symptoms of specific drug abuse categories
- Explain drug abuse prevention and treatment strategies; discuss existing drugs/medications for addicted individuals; determine several challenges in developing effective medications for addicted individuals

Content Glimpse

The course is designed with a focus on the neurobiological pathways known for different types of drugs of abuse. However, the students will also explore the social, psychological and economical bases for drug use and abuse. For example, the incidence of alcohol abuse in college students is significantly higher as compared to their aged matched peers. Students will also learn about current pharmacotherapies/treatments (or lack of) for individuals suffering from a substance use disorder. Timely topics will be discussed such as the relationship between the increased illegal use of prescription opioids and the rising increase in accidental opioid overdose deaths. Differences in treatment philosophes will be presented that are designed to lead to lively discussions during class. For example, the effectiveness of Alcohol Anonymous (AA; www.aa.org) vs other available therapies for the individual suffering from an alcohol use disorder. Chapters from the core textbook will be supplemented with a variety of source materials including online resources and articles from scientific journals. This course should have a broad appeal to many USC upper-level undergraduates including Pre-Pharmacy, Pre-Medicine and other health and life science majors as well as students in biomedical engineering, psychology, business, international studies, law and sociology.

Evaluation and Grading (subject to change):

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

Class participation:	20 pts (10%)
2 quizzes @ 10 pts each	20 pts (10%)
2 written assignments @20 each:	40 pts (20%)
1 midterm exam:	50 pts (25%)
1 final exam (partially cumulative):	<u>70 pts (35%)</u>
Total:	200 pts

Class Participation and Attendance: At this time, the class is expected to resume online through zoom sessions. Attendance at all zoom synchronous sessions is expected. However, the classes are expected to be recorded to be available for asynchronous viewing. Participation assumes active engagement in all the assignments, taking all the exams as well as will include active participation during in-class discussions. Discussion board will be an alternative to the in-class discussion activities and can be set by the instructors and students. It is expected that 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.

Quizzes, Assignments and Exams. There will be 3 quizzes over the course of the semester that will primarily be based on questions pulled from the text book. One of the quizzes with the lowest outcome will not be included in the grade. There will be 2 assignments, one written and the other one in the form of a group presentation on topics within the context of the material presented in class. There will be 1 midterm exam and a final exam both of which will be designed as an open book and will include multiple choice and T/F questions as well as a series of questions involving short answers. The final exam will be cumulative but will emphasize material covered after the midterm. Quizzes, midterm and final exams will be designed to be taken on Blackboard.

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. You will be able to use identified chapters in the text to support your learning process throughout the semester.

Drugs and Society by [Hanson, Glen R., Ph.D.](#); [Venturelli, Peter J.](#); [Fleckenstein, Annette E., Ph.D.](#)

Edition: 13th ISBN13: 978-1284110876 ISBN10: 1284110877

Format: Paperback w/ Access Code

Pub. Date: 2018

Publisher(s): Jones & Bartlett Learning

- Bethany Brookshire. "Caffeine gives cocaine an addictive boost." *Psychology, Science & Society, Neuroscience*, November 17, 2015. <https://www.sciencenews.org/blog/scicurious/caffeine-gives-cocaine-addictive-boost>
- Ryan Bushey, Associate Editor. *CVS Sells Heroin Overdose Antidote OTC in 14 States*. 9/25/2015. <http://www.dddmag.com/news/2015/09/cvs-sells-heroin-overdose-antidote-otc-14-states>
- Gabrielle Glaser. "The Irrationality of Alcoholics Anonymous." *The Atlantic*. April 2015. <http://www.theatlantic.com/magazine/archive/2015/04/the-irrationality-of-alcoholics-anonymous/386255/>
- John F. Kelley and Gene Beresin."In Defense of 12 Steps: What Science Really Tells us About

Addiction.” *Common Health*. April 7, 2014. <http://commonhealth.wbur.org/2014/04/defense-12-step-addiction>

- National Institute on Drug Abuse. *Commonly Abused Drugs*. August 2015. https://d14rmgtrwzf5a.cloudfront.net/sites/default/files/commonly_abused_drugs_august_2015.pdf
- National Institute on Drug Abuse. *Drugs, Brains, and Behavior. The Science of Addiction*. April 2007. https://d14rmgtrwzf5a.cloudfront.net/sites/default/files/soa_2014.pdf

Extensive background information on Drug and Alcohol abuse is freely available on line from the National Institutes of Health.

- Alcohol Awareness Council
<http://www.alcohol.org/>

Two additional sites that students may find interesting:

National Institute on Drug Abuse: <http://www.drugabuse.gov/drugs-abuse>

National Institute on Alcohol Abuse and Alcoholism: <http://www.niaaa.nih.gov/>

Other topical materials including but not limited to the syllabus, supplemental reading assignments and additional handouts will be posted on <http://blackboard.usc.edu/>. The students will also be encouraged to use the online discussions among students via Blackboard.

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:

Dates	Topic	Included Subtopics Assigned and Supplemental Reading/Watching	Instructor
Aug. 18, 20	Introduction: General overview of drug use, abuse and drug addiction.	<p>Historical perspective of drug abuse; who and why of getting buzzed; most commonly abused drugs; drug use spread – frequency and extent, patterns, demographics, trends, costs to society.</p> <p>Basic understanding of drug abuse – drug use and dependence; addiction cycle, theoretical explanations.</p> <p>Drugs & Society, Chapters 1,2</p> <p>Readings: “Drugs, Brains, and Behavior NIDA.” “National Institute on Drug Abuse. <i>Commonly Abused Drugs</i>. August 2015.” Utube presentation in class: “Addiction: learning to forget.” https://www.youtube.com/watch?feature=player_embedded&v=t7Dsg1ZObFo</p>	Asatryan
Aug. 25, 27	Homeostatic systems and drugs	<p>Overview of the nervous systems; drug receptors; brain circuitry; the reward pathway; the dark side of addiction. The endocrine system – glands, regulation, abuse of hormones.</p> <p>Drugs & Society, Chapter 4</p> <p>Required watching to prepare for week two lecture: Utube “Brain Reward: Understanding How the Brain Responds to Natural Rewards and Drugs of Abuse.” https://youtu.be/7VUIKP4LDyQ_or https://www.youtube.com/watch?v=7VUIKP4LDyQ</p>	Asatryan
Sept. 1, 3	How and why drugs work? Quiz #1 - Sept 3	<p>Dose, dose-response; potency; Pharmacodynamics - what the drug does to the body (pd); Pharmacokinetics - what the body does to the drug (pk); zero vs first order kinetics;</p> <p>Drugs & Society, Chapter 5</p>	Asatryan
Sept. 8, 10	How and why drugs work? (Continued) CNS depressants – short overview Alcohol as a drug and it’s pharmacological effects	<p>Drug metabolism, bioavailability; drug interactions; tolerance; withdrawal, rebound, dependency.</p> <p>Drugs & Society, Chapter 5</p> <p>Commonly used and abused depressant drugs; treatment strategies; abuse of short acting IV general anesthetics.</p> <p>History; chemistry; properties of alcohol; metabolism; effects on organ systems; fetal alcohol syndrome; interaction with other drugs; alcohol abuse – CNS actions</p> <p>Drugs & Society, Chapters 6,7</p> <p>Cherry Healey – Old Before My Time – Alcohol Documentary: https://www.youtube.com/watch?v=v6vEe6eenpg&nohtml5=False</p>	Asatryan
Sept. 15	Alcohol: Behavioral effects	<p>Cost of alcohol abuse to society; genes vs environment; males vs females; college drinking; cultural influences History; chemistry; properties of alcohol; alcohol use disorder, withdrawal</p> <p>Drugs & Society, Chapters 7,8</p> <p>HBO documentary: Risky Drinking: (recommended watching with 3D glasses) https://www.youtube.com/watch?v=cprFGtvi2Rg Utube video – “Alcohol and your Brain.” https://youtu.be/zXjANz9r5F0</p>	Asatryan
Sept. 17, 22, 24	Narcotics: Opioids and abuse	<p>History of narcotics; pharmacological effects; therapeutic uses; the good and the bad</p> <p>Abuse, tolerance, dependence, withdrawal. Opioid overdose emergency treatments; resurgence of heroin; methadone clinics.</p> <p>Drugs & Society, Chapter 9</p> <p>Reading: “CVS Sells Heroin Overdose Antidote OTC in 14 States.”</p> <p>The Science of Opioids: https://www.youtube.com/watch?v=AqDo4LiKz-c</p>	Jakowec

		Opioid overdose: https://www.youtube.com/watch?v=pROfg1vOp4w Treatment options for Opioid addiction: https://www.youtube.com/watch?v=Ptokjgt2j3Y	
Sept 27	Written assignment due		
Sept 29	Open book Midterm		
Oct. 1	Stimulants	Introduction to stimulants - legal and illegal; case histories, energy drinks; caffeine; alcohol Drugs & Society, Chapters 10, 12 Reading: "Caffeine gives cocaine an addictive boost."	Jakowec
Oct. 6	Hallucinogens (Psychedelics) Quiz #2 – Oct 6	Haigh Asbury; mechanisms of action; Case Histories – Psychological effects	Jakowec
Oct. 8, 13	Tobacco	Tobacco use; history; pharmacology of nicotine; smoking and health issues Tobacco use and exposure without smoking; smoking prohibition Drugs & Society, Chapter 11	Jakowec
Oct. 15	Inhalants OTC, prescription and herbal drugs	History and types of inhalants; current pattern of use; abuse and dangers; Types and abuse of OTC drugs; prescription drugs and abuse; herbals Drugs & Society, Chapter 14,15	Jakowec
Oct. 20, 22, 27	Marijuana	Low vs High doses of marijuana; medical use of marijuana; marijuana and societal beliefs; trends and health issues. Legal vs illegal marijuana; the controversy continues Drugs & Society, Chapters 13	Jakowec
Oct. 29	Drug use in subcultures of special populations Drug abuse prevention	Drugs and the student athlete; underage drug use – consequences on CNS development; Drug use on college campuses; purchasing drugs on the internet Prevention programs – key findings; community- and family-based programs; large-scale programs; programs in higher education Drugs & Society, Chapters 16, 17 Utube viewing assignment on “Addiction Relapse Prevention Strategies.” https://youtu.be/bYTp8hpSJjY	Jakowec
Nov. 3, 5	Drug abuse treatment Quiz #3 – Nov. 5	Treatment of addiction; principles of treatment; therapeutic strategies; behavioral strategies; pharmacological strategies; mindfulness therapy Drugs & Society, Chapters 18-19 Mindfulness Therapy: Can it help? https://www.youtube.com/watch?v=-moW9jvvMr4 How I overcame alcoholism Claudia Christian TEDxLondonBusinessSchool https://www.youtube.com/watch?v=6EghiY_s2ts Selected readings: 1) “The Irrationality of Alcoholics Anonymous.” 2) “In Defense of 12 steps.” 3) Beacon House – San Pedro	Jakowec/ Davies
Nov 10	Oral presentations		
Nov. 12	Alcohol pharmacotherapy development	Example of a drug discovery program by a USC faculty to develop pharmacotherapies for AUD Patient Case study- from Dr. Susie Park	Asatryan/ Davies
Nov 17 11 am – 1 pm	FINAL EXAM (Open book)		

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/ssu

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.