

## USC School of Pharmacy

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

#### **Instructors:**

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**Course Weight:** 4 Units

**Days/Time/Location:** Tuesday, Thursday: 11:00 am to 12:20 pm, online/VHE 206 - physical

Office Hours: TBA

#### **Description**

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

#### **Introduction**

*Addiction is the compulsive using of drugs in spite of terrible consequences. Historically, probably since the beginning of time, humans have sought out or discovered by accident compounds that have medicinal as well as hedonic effects. However, those practices lead to improper use of those compounds, i.e. misuse or abuse. As a society, the consequences of improper drug use has 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. and Neuropharmacological processes and pathways in the brain that include the brain reward pathway form the basis for abuse of different drugs. This course will present neuropharmacological mechanisms of*

action of major categories of abusive drugs, including CNS depressants, stimulants, hallucinogens and inhalants. Consequences of drug use (legal and illegal) and some of their benefits will be discussed. Existing and potential therapies and preventative strategies for conferring drugs of abuse will be 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 to their known characteristics.
- Recognize signs and symptoms of specific drug abuse categories.
- Describe neurobiological pathways, mechanisms and neuropharmacological actions for commonly abused drugs; indicate similarities and differences for different groups of drugs of abuse.
- 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](http://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 2 Journal Club discussions, 1 midterm and 1 final examinations with the following weights:

1 written assignment (followed by in-class discussion):	15 pts (15%)
1 midterm exam:	30 pts (30%)
1 group presentation:	15 pts (15%)
1 final exam:	<u>40 pts (40%)</u>
Total:	100 pts (100%)

Class Participation and Attendance: Fall 2021 semester is expected to resume as a hybrid format with mostly in person participation. However, some activities may still occur online through zoom sessions. Attendance at all zoom synchronous sessions is expected. Classes held through zoom 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 on Blackboard can 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.

Assignment and Exams. There will be 2 assignments, one written based on a provided paper followed by in-class discussion, 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 include multiple choice and T/F questions as well as a series of questions involving short answers. The midterm will be executed asynchronously on Blackboard. The final exam will be cumulative but will emphasize material covered after the midterm and will be taken in class. Students will also be quizzed during the classes but no points assigned.

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**

### ***Recommended Readings***

The following textbook is recommended for this course and may 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:** 13<sup>th</sup> ISBN13: 978-1284110876 ISBN10: 1284110877

**Format:** Paperback w/Access Code

**Pub. Date:** 2018

**Publisher(s):** Jones & Bartlett Learning

### **Other reading material**

- 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](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](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. 24  Aug. 26	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 &amp; 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.”  <a href="https://www.youtube.com/watch?feature=player_embedded&amp;v=t7Dsg1ZObFo">https://www.youtube.com/watch?feature=player_embedded&amp;v=t7Dsg1ZObFo</a></p>	Asatryan  Asatryan
Aug. 31  Sept 2	Homeostatic systems and drugs	<p>Homeostatic systems involved in drug abuse. Overview of the nervous systems; drug receptors; the endocrine system – glands, regulation, abuse of hormones. Brain circuitry; the reward pathway; the dark side of addiction.</p> <p>Drugs &amp; 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.”  <a href="https://youtu.be/7VUIKP4LDyQ">https://youtu.be/7VUIKP4LDyQ</a> or  <a href="https://www.youtube.com/watch?v=7VUIKP4LDyQ">https://www.youtube.com/watch?v=7VUIKP4LDyQ</a></p>	Asatryan  Asatryan
Sept. 7 Sept. 9  Sept. 14	How and why drugs work?	<p>Pharmacology of drugs - dose, dose-response; potency;  Pharmacokinetics - what the body does to the drug (pk); zero vs first order kinetics; Pharmacodynamics - what the drug does to the body (pd);  Drug metabolism, bioavailability; drug interactions; tolerance; withdrawal, rebound, dependency.</p> <p>Drugs &amp; Society, Chapter 5</p>	Asatryan Asatryan  Asatryan
Sept. 16  Sept. 21  Sept. 23	CNS depressants – short overview Alcohol as a drug and it’s pharmacological effects Alcohol: Behavioral effects	<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>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 &amp; Society, Chapters 6, 7</p> <p>Cherry Healey – Old Before My Time – Alcohol Documentary:  <a href="https://www.youtube.com/watch?v=v6vEe6eenpg&amp;nohtml5=False">https://www.youtube.com/watch?v=v6vEe6eenpg&amp;nohtml5=False</a></p> <p>Drugs &amp; Society, Chapters 7,8</p> <p>HBO documentary: Risky Drinking: (recommended watching with 3D glasses)  <a href="https://www.youtube.com/watch?v=cprFGtvi2Rg">https://www.youtube.com/watch?v=cprFGtvi2Rg</a>  Utube video – “Alcohol and your Brain.” <a href="https://youtu.be/zXjANz9r5F0">https://youtu.be/zXjANz9r5F0</a></p>	Asatryan  Asatryan  Asatryan
Sept. 28	<b>In-class discussion of the written assignment (assignment due on Sept. 26)</b>		
Sept. 30  Oct. 5  Oct. 7	CNS depressants cont’d: Narcotics Opioids and abuse  Fentanyl	<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>Focus on opioid fentanyl</p> <p>Drugs &amp; Society, Chapter 9</p> <p>Reading: “CVS Sells Heroin Overdose Antidote OTC in 14 States.”</p>	Jakowec  Jakowec  Asatryan

		<p>The Science of Opioids:  <a href="https://www.youtube.com/watch?v=AqDo4LiKz-c">https://www.youtube.com/watch?v=AqDo4LiKz-c</a>  Opioid overdose:  <a href="https://www.youtube.com/watch?v=pROfg1vOp4w">https://www.youtube.com/watch?v=pROfg1vOp4w</a>  Treatment options for Opioid addiction:  <a href="https://www.youtube.com/watch?v=Ptokjgt2j3Y">https://www.youtube.com/watch?v=Ptokjgt2j3Y</a></p>	
<b>Oct. 7</b>	<b>Midterm (taken asynchronously on Blackboard)</b>		
Oct. 12 Oct. 19	Stimulants	<p>Methamphetamine, amphetamine - history, pharmacological effects  Psychological effects, abuse, therapeutics</p> <p>Drugs &amp; Society, Chapter 10  Reading: "Caffeine gives cocaine an addictive boost."</p>	Jakowec Jakowec
Oct. 21	Tobacco, nicotine	<p>Tobacco use; history; pharmacology of nicotine; smoking and health issues  Tobacco use and exposure without smoking; smoking prohibition</p> <p>Drugs &amp; Society, Chapter 11</p>	Jakowec
Oct. 26	Hallucinogens (Psychedelics)	<p>LSD, psilocybin, phencyclidine, ketamine, etc - mechanisms of action; case  histories – psychological effects</p> <p>Drugs &amp; Society, Chapter 12</p>	Jakowec
Oct. 28 Nov. 2	Marijuana	<p>History of cannabinoids, marijuana and societal beliefs; trends and health issues  medical use of marijuana; legal vs illegal use  Behavioral effects of marijuana, neuropharmacology</p> <p>Drugs &amp; Society, Chapter 13</p>	Jakowec Jakowec
Nov. 4	Inhalants	<p>History and types of inhalants; current pattern of use; abuse and dangers;  Cocaine – discovery, pharmacology, effects on brain, abuse</p> <p>Drugs &amp; Society, Chapter 14</p>	Jakowec
<b>Nov. 7 Nov. 9</b>	<b>Group presentations</b>		
Nov. 16	Sugar addiction	<p>Diet, energy, carbohydrates, hedonic effects, sugar addiction.</p> <p>Reading materials will be provided</p>	Jakowec
Nov. 18	OTC, prescription and herbal drugs	<p>Types and abuse of OTC drugs; prescription drugs and abuse; herbals</p> <p>Drugs &amp; Society, Chapter 13</p>	Asatryan
Nov. 23	Drug abuse prevention	<p>Prevention programs – key findings; community- and family-based programs;  large-scale programs; programs in higher education</p> <p>Drugs &amp; Society, Chapter 17  Utube viewing assignment on "Addiction Relapse Prevention Strategies."  <a href="https://youtu.be/bYTp8hpSJjY">https://youtu.be/bYTp8hpSJjY</a></p>	Asatryan
Nov. 30	Drug abuse treatment	<p>Treatment of addiction; principles of treatment; therapeutic strategies; behavioral  strategies; pharmacological strategies; mindfulness therapy</p> <p>Drugs &amp; Society, Chapters 15, 18  Mindfulness Therapy: Can it help?  <a href="https://www.youtube.com/watch?v=-moW9jvvMr4">https://www.youtube.com/watch?v=-moW9jvvMr4</a>  How I overcame alcoholism   Claudia Christian   TEDxLondonBusinessSchool  <a href="https://www.youtube.com/watch?v=6EghiY_s2ts">https://www.youtube.com/watch?v=6EghiY_s2ts</a>  Selected readings:  1) "The Irrationality of Alcoholics Anonymous."  2) "In Defense of 12 steps."  3) Beacon House – San Pedro</p>	Asatryan
Dec. 2	Alcohol pharmacotherapy development	<p>Example of a drug discovery program by a USC faculty to develop  pharmacotherapies for AUD  Patient Case study- from Dr. Susie Park</p>	Asatryan
<b>Dec. 14 8 am – 10 am</b>	<b>FINAL EXAM (In-class or take-home assignment)</b>		

## 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](http://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](http://policy.usc.edu/scientific-misconduct).

### Support Systems:

*Student Health Counseling Services - (213) 740-7711 – 24/7 on call*  
[engemannshc.usc.edu/counseling](http://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](http://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](http://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](http://equity.usc.edu), [titleix.usc.edu](http://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](http://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](http://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](http://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](http://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](http://dps.usc.edu), [emergency.usc.edu](http://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](http://dps.usc.edu)

Non-emergency assistance or information.