

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, WPH203

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

Historically, probably since the beginning of time, humans have sought out or discovered by accident substances that have medicinal as well as *hedonic* effects. Drug use and abuse has been part of life in all times, however it has increased in modern societies due to the much larger variety of drugs with higher potency than ever existed. The improper use of drugs, i.e. misuse or abuse, can lead to addiction. *Addiction* is the compulsive using of drugs *in spite of terrible consequences*. Despite common perception, addiction is a complex illness and it affects the body physically and psychologically, creating a cycle that exacerbates the problem.

Each addictive drug has somewhat different effects on the brain, however, those merge on similar brain pathways, including the *reward* pathway. 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 and pharmacological actions on the body of 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 age-matched peers. 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. Furthermore, the course will present inconsistencies in the regulation of illegal vs legal drugs. Unfortunately, to date 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. Students will also learn about current pharmacotherapies/treatments (or lack of) for individuals suffering from a substance 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 written assignments, 1 midterm and 1 final examinations with the following weights:

| | |
|--|---------------------|
| 2 written assignments (followed by in-class discussion): | 20 pts (20%) |
| 1 midterm exam: | 30 pts (30%) |
| 1 group presentation: | 20 pts (20%) |
| 1 final exam: | <u>30 pts (30%)</u> |
| Total: | 100 pts (100%) |

Class Participation and Attendance: Fall 2022 semester is expected to resume as an in-person participation, hence being present in the classroom is required. Some activities may occur remotely asynchronously online or through zoom sessions. Attendance at all zoom synchronous sessions is expected. Classes held through zoom are expected to be recorded (but not guaranteed) 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. 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 written assignments based on a provided paper followed by in-class discussion, and 1 group presentation on topics within the context of the material presented in class. The descriptions for these assignments will be provided on Blackboard with sufficient time ahead to allow for preparation. There will be 1 midterm exam and 1 final exam 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 also be implemented through Blackboard but will occur in person in the classroom on the indicated date. Details will be announced on Blackboard. Students will also get engaged in in-class activities, including quizzes and 3-min write-ups; these activities will not be graded.

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: 13th ISBN13: 978-1284110876 ISBN10: 1284110877

Format: Paperback w/Access Code

Pub. Date: 2018

Publisher(s): Jones & Bartlett Learning

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

- 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. Course schedule is as follows:

| Dates | Topic | Included Subtopics Book Chapters/Assignments/Exams | Instructor |
|----------------------------------|---|--|----------------------------------|
| Aug. 23 Aug. 25 | Introduction: General overview of drug use, abuse and drug addiction | <p>What is drug use, misuse and abuse; historical perspective of drug abuse; most commonly abused drugs; who and why of getting buzzed.</p> <p>Addiction, addiction stages, addiction cycle, dependence; risks for addiction development.</p> <p>Substance use disorders; drug use spread; patterns, demographics, trends, costs to society.</p> <p>Drugs & Society, Chapters 1,2</p> | Asatryan Asatryan |
| Aug. 30 Sept 1 | Homeostatic systems and drugs | <p>Homeostatic systems involved in drug abuse. Overview of the nervous systems - neurotransmission, brain regions, neuroplasticity; The endocrine system – glands, regulation, abuse of hormones.</p> <p>Neurobiology of reward - the reward pathway; brain circuitry, hijacking of reward pathways by drugs, drugs and neurotransmission, drug receptors.</p> <p>Two week point self-reflection (is class interesting? go/no go)</p> <p>Drugs & Society, Chapter 4</p> | Asatryan Asatryan |
| Sept. 6 Sept. 8 | How and why drugs work? | <p>Pharmacology of drugs - pharmacodynamics (PD) - what the drug does to the body, potency, efficacy, dose-response, therapeutic index.</p> <p>Pharmacokinetics (PK) - what the body does to the drug; drug metabolism, bioavailability; drug interactions; pharmacogenomics (PG).</p> <p>Drugs & Society, Chapter 5</p> | Asatryan Asatryan |
| Sept. 13 | CNS depressants – short overview | <p>Depressant drugs; classification, abuse. Focus on non-opioid depressants - benzodiazepines, barbiturates.</p> <p>Drugs & Society, Chapter 6</p> | Asatryan |
| Sept. 15 Sept. 20 Sept. 22 | <p>Alcohol as a drug and it's pharmacological effects</p> <p>Alcohol: Behavioral effects</p> <p>AUD treatment</p> | <p>History; chemistry; properties of alcohol; metabolism; effects on organ systems; fetal alcohol syndrome; interaction with other drugs.</p> <p>Alcohol abuse – CNS actions; behavioral effects; alcohol use disorder; tolerance, withdrawal.</p> <p>Treatment options for alcohol addiction, dependence, withdrawal; patient case study from Dr. Susie Park.</p> <p>Short quiz (ungraded)</p> <p>Drugs & Society, Chapters 7,8</p> | Asatryan Asatryan Asatryan |
| Sept. 27 | In-class discussion of research paper (written assignment 1 - due on Sept. 25 midnight) | | Asatryan |
| Sept. 29 Oct. 4 Oct. 6 | <p>CNS depressants cont'd: Narcotics</p> <p>Opioids and abuse</p> <p>Continued</p> | <p>History of narcotics; pharmacological effects; therapeutic uses; the good and the bad.</p> <p>Opioid abuse, tolerance, dependence, withdrawal. Opioid overdose emergency treatments; resurgence of heroin; methadone clinics.</p> <p>Drugs & Society, Chapter 9</p> | Jakowec Jakowec |
| Oct. 6 | Midterm (taken asynchronously on Blackboard) | | |
| Oct. 11 | Fentanyl | Focus on opioid fentanyl | Jakowec |
| Oct. 13 | Fall Recess | | |
| Oct. 18 | Stimulants | <p>Methamphetamine, amphetamine - history, pharmacological effects</p> <p>Psychological effects, abuse, therapeutics</p> <p>Drugs & Society, Chapter 10</p> | Jakowec |
| Oct. 20 | Group presentations (1) | | |
| Oct. 25 | Tobacco, nicotine | <p>Tobacco use; history; pharmacology of nicotine; smoking and health issues</p> <p>Tobacco use and exposure without smoking; smoking prohibition</p> <p>Drugs & Society, Chapter 11</p> | Jakowec |

| Dates | Topic | Included Subtopics Book Chapters/Assignments/Exams | Instructor |
|--|--|---|-------------------------------|
| Oct. 27 | Hallucinogens (Psychedelics) | LSD, psilocybin, phencyclidine, ketamine, etc - mechanisms of action; case histories – psychological effects Drugs & Society, Chapter 12 | Jakowec |
| Nov. 1 Nov. 3 | Drug abuse prevention and treatment Fentanyl’s crisis | Prevention programs – community- and family-based programs; large-scale programs; programs in higher education; Treatment of addiction - behavioral and pharmacological strategies A pharmacologist perspective Drugs & Society, Chapter 15, 17, 18 | Asatryan Guest speaker |
| Nov. 8 Nov. 10 | Marijuana | History of cannabinoids, marijuana and societal beliefs; trends and health issues medical use of marijuana; legal vs illegal use Behavioral effects of marijuana, neuropharmacology Drugs & Society, Chapter 14 | Jakowec Jakowec |
| Nov. 15 Group presentations (2) | | | Students |
| Nov. 17 Nov. 22 Zoom opt | Inhalants | History and types of inhalants; current pattern of use; abuse and dangers; Cocaine – discovery, pharmacology, effects on brain, abuse Drugs & Society, Chapters 14 | Jakowec |
| Written assignment 2 - due on Nov. 23rd | | | |
| Nov. 29 Group presentations (3) | | | Students |
| Dec. 1 | Sugar addiction | Diet, energy, carbohydrates, hedonic effects, sugar addiction Reading materials will be provided | Jakowec |
| Dec. 13 8am-10am Will take place in person in the same classroom | | | |

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.