NBio 144b: Drugs of Abuse and Addiction

Instructor: Albert W. Hamood
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Office hours: M, W, Th 6:30-7:30, Volen 301 or 306

Educational Goals:

Students enrolled in Drugs of Abuse and Addiction will acquire a thorough base of knowledge about how various abused drugs act on the brain, the neural substrates on which they act, and the mechanisms by which drug taking and drug seeking behavior crosses the threshold into compulsion and addiction. They will confront modern ideas regarding addiction, as well as foundational primary research papers in the field, and improve their ability to critically assess the relevant literature. This knowledge will be delivered through a combination of instructor-led lectures, background readings consisting of secondary literature articles, and student-led presentations and discussions of primary literature articles. Specifically, by the end of the semester, students will:

✦ Gain an understanding of addiction including how it is defined, its behavioral features, the underlying neural substrates upon which it acts and in which it is represented, and the current theoretical framework in which it is understood.
✦ Know the mechanism of action of commonly abused drugs, as well as their potential for abuse and addiction, behavioral effects, and evidence of toxicity.
✦ Improve their ability to critically assess scientific information through regular interaction with relevant primary literature through student-led article presentations.
✦ Gain practice with and improve their ability to deliver a scientific presentation.
✦ Improve their writing and research ability through a written assignment in which they will be asked to extend what they have learned to an addiction not covered in class.
✦ Synthesize knowledge of neurobiology and behavior and place mechanistic facts about abused substances within the context of theories of addiction.

Course Requirements:

NBio 140, Principles of neuroscience, is the only prerequisite. Students are expected to have a basic knowledge of neurobiology including the biophysics of neuronal activity, ion channels, and synaptic neurotransmission, both ionotropic and metabotropic.

Textbook (optional):

Meyer, Jerrold & Quenzer, Linda. Psychopharmacology: Drugs, the Brain, and Behavior.
Grading:

Students will be assessed by the following:

Participation (20%)
Students will be required to do weekly assigned readings of secondary literature, and to provide feedback on these readings by answering short questions in weekly reading responses. These will be graded primarily for completion, and will serve as input and feedback for lectures, and possibly written Q-and-A responses which will available on Latte.

Oral assignment - Journal club style presentation (20%)
Students will in pairs deliver a ~20 minute presentation on a primary literature article to the class, covering a relevant work to the current topic at hand. Performance will be graded for accuracy, completeness, and clarity. Students will also be expected to put the result of the paper within the context of previous work, and critically assess any potential shortcomings. Papers should be split up evenly between partners, such that each presenter talks for ~10 minutes and explains approximately half the figures.

Written assignment - (20%)
Students will be asked to produce a medium length (5-10 pages) research paper, in the style of a secondary literature article, in which they will expand on the subjects covered in this course. This paper will require background research, and application of ideas learned in this class to a subject not explicitly covered. Acceptable topics include: investigation of a non-drug addiction (such as gambling), with comparisons to mechanisms of addiction studied in the context of drugs; or a paper discussing how knowledge gained from studying drugs of abuse (or a particular drug of abuse) to normal brain function. Other topics are acceptable provided they meet the goals of the assignment, and are approved by the instructor. Further guidelines are available in a separate document on the Latte page.

Exams (20% each - 40% total)
Two exams -- a midterm and a final -- will focus on short answers and essays, allowing students to demonstrate knowledge gained during the class as well as synthesize ideas and critically think about issues presented by confronting novel information, which they will be required to interpret.
**Syllabus:**

**Format:** Class meets twice per week, lasting 1.5 hours per session. Where there is a “Reading:” indicated, this is an article from secondary literature which students are expected to have read and briefly responded to prior to class. Where there is a “Paper presentation:” indicated, this is an article from primary literature which will be presented by a pair of students. All readings will be made available on Latte. Besides these presentations, classes will consist of instructor-led lectures covering the topics described in italics.

**UNIT ONE - Introduction**

(1) 1/13 Course introduction  
*Overview of course policies, grading, and format*  
*What motivates drug abuse?*  
*Introduction to pharmacology - pharmacokinetics*

(2) 1/15 Neurobehavioral pharmacology  
*Pharmacodynamics*  
*Reinforcement and conditioning*  
*Techniques for evaluating animal behavior and models*

(3) 1/22 Reward biology  
*History of the science of reward*  
*Reward circuitry - the mesolimbic dopamine pathway*


**UNIT TWO - Addiction**

(4) 1/27 Addiction introduction  
*Features of addiction and definitions*  
*Animal models of addiction*  
*Simple reinforcement models of addiction*
(5) 1/29 Addiction neurobiology

*Plasticity of reward circuitry*


(6) 2/3 Addiction theory

*Opponent-process model*

*Incentive-sensitization model*

*Disease model*

**Reading**: “Drug addiction as incentive sensitization”, Berridge and Robinson 2011.


(7) 2/5

Snow!

(8) 2/10 Addiction theory con’t

*Allosteric dysregulation and stress*

*Glutamate homeostasis hypothesis*


(9) 2/12 Individual variability

*Heritability of addiction*

*Genetic and epigenetic factors*


UNIT THREE - Analgesics

(10) 2/24 Drugs of abuse and opioids introduction

History

Drug types

Pain and the endogenous opioid system


(11) 2/26 Exogenous opioids: Mechanisms, tolerance and sensitization

Peripheral and central sites of analgesia

Effects on reward systems

Tolerance and sensitization


(12) 3/3 Opioid dependence

Withdrawal and abstinence syndrome

Neurobiology and role of NMDA receptors

Opioid addiction treatments


(13) 3/5 Opioids: adenylate cyclase homeostasis + Midterm review

Reading: TBD.

(14) 3/10 MIDTERM EXAMINATION

Given in class
UNIT FOUR - CNS depressants

(15) 3/12 Drugs of GABA introduction
*Barbiturates and benzodiazepines*
*Effects, mechanisms, and tolerance*

(16) 3/17 Midterm Redux and Alcohol intro
*Midterm feedback*


(17) 3/19 Benzo mechanisms + Alcohol
*Benzo mechanisms vs. Barbs*
*Alcohol effects - tolerance, mechanisms, withdrawal and toxicity*


(18) 3/24 Alcohol continued + inhalants
*Alcoholism and developmental effects*
*Inhalants and GHB*


UNIT FIVE - CNS stimulants

(19) 3/26 Dissociative anesthetics
*PCP*
*Ketamine*


3/31 Drugs of dopamine

*Catecholamines*
*Cocaine*
*Amphetamine and Methamphetamine*

4/2 “Smart drugs” and other stimulants
*Ritalin, Adderal, Modafinil*
*MDMA*


4/7 Nicotine and caffeine
*Acetylcholine modulatory system*
*Nicotine effects, mechanism, and withdrawal*
*Caffeine effects, mechanism, and withdrawal*


**UNIT SIX - Hallucinogens**

4/9 Drugs of serotonin
*Serotonin modulatory system*
*Hallucinogens: LSD, mescaline, psilocybin, 2CB*
*Serotonin syndrome*
*Hallucinogen persisting perception disorder*


4/14 Passover week. Optional review, no new material.


FINAL EXAM:
Wednesday May 7th, 6-9 P.M.
G’Zang 121
References:


