

Some Key Concepts from "Drugs and the Brain" - Fall 2018
Useful as a guide for study; Not intended to be an exhaustive list

Lecture 1 (8/23)

- ritual and psychoactive drug use
- astronomical observations: importance in history of science
- physicalism (physical materialism), world view
- drug, *droog*, psychoactive drug
- plants and chemicals are not the same
- pharmacology, *pharmakon*
- shaman
- drug-related deaths in US
- power plants, plant teachers, allies
- war on drugs, war on plants

Lecture 2 (8/28)

- Paracelsus
- blood circulatory system
- routes of drug entry into body
- oral-digestive
- hepatic portal system, first-pass metabolism
- parenteral routes: intraoral, intranasal, rectal, transdermal, inhalation, injection
- times of absorption
- dangers associated with injections
- elimination from body: liver, kidneys, urine, bile, excrement
- time courses of onset and elimination (lifetime)

Lecture 3 (8/30)

- importance of molecular structure
- chemistry, alchemy
- chemical element, periodic table, trans-uranium elements
- molecules, covalent chemical bonds
- bonds per atom: carbon, nitrogen, oxygen, hydrogen
- water, polarity
- hydrocarbons (carbon-hydrogen molecules), nonpolar, oily
- understanding molecular structure diagrams
- brain, neuron, glial cell, synapse, approximate number of cells in brain
- phospholipid bilayer, phospholipid bilayer biological membrane
- hydrophobic, hydrophilic, lipophobic, lipophilic
- blood-brain barrier

Lecture 4 (9/4)

- crossing blood-brain barrier: transport, diffusion
- neuron structure: soma, dendrites, axon
- electrical synapse
- chemical synapse
- neurotransmitter, receptor protein, reuptake transporter, synaptic vesicle
- presynaptic and postsynaptic components of chemical synapse
- agonist, antagonist
- central nervous system, peripheral nervous system
- autonomic nervous system: sympathetic and parasympathetic actions
- acetylcholine, norepinephrine
- sympathomimetic, sympatholytic, parasympathomimetic, parasympatholytic
- pupil dilation: mechanism, pharmacology
- bronchiole dilation: mechanism, pharmacology
- solanaceous plant family
- tomato, potato, eggplant, chili

Lecture 5 (9/6)

- Latin binomial naming: family, genus, species
- Carl Linnaeus
- alkaloid, basic nitrogen, bitter, poison
- acetylcholine receptors (AChR): muscarinic, nicotinic
- tropane alkaloids: atropine, scopolamine
- muscarinic AChR antagonists: peripheral and CNS effects
- parasympatholytic effects
- *Atropa belladonna*: deadly nightshade
- angel's trumpet: *Brugmansia*
- tobacco, *Nicotiana tabacum*
- Thanatopathia
- routes of tobacco administration

Lecture 6 (9/11)

- Richard Evans Schultes
- Jean Nicot
- James I
- Sir Walter Raleigh
- tobacco: Family genus, species: Solanaceous, *Nicotiana, tabacum, rustica, glauca, etc.*
- tobacco preparation: drying, oxidation, fermentation, aging
- nicotine
- nicotinic acetylcholine receptor
- acute effects of nicotine and tobacco
- nicotine tolerance
- toxic effects of nicotine and tobacco: chronic effects on health
- tobacco-related mortality in USA
- relationship between lung cancer deaths and cigarette consumption

- cardiovascular effects
- effects of carbon monoxide, tobacco smoke on lungs
- tobacco and nicotine effects on pregnancy and prenatal development
- SIDS
- cigarette package warning labels
- FDA vs. 'Big Tobacco' on graphic warning labels: timeline

Lecture 7 (9/13)

- second-hand smoke
- third-hand smoke
- e-cigarettes, vaping
- UCSF Smoke-Free Movies' campaign
- tobacco / nicotine addiction
- tobacco: age for legal purchase
- nicotine withdrawal
- additives to tobacco products
- reinforcing/rewarding aspects of tobacco use
- tips on quitting smoking
- pharmaceutical aids: nicotine replacement therapy

Lecture 8 (9/18)

- pharmaceutical aids: bupropion, nicotinic ACh receptor agonists
- psychedelic-assisted psychotherapy
- hookah
- clove cigarettes
- 2009 US Federal Law, flavored cigarette ban
- nicotine, neonicotinoid insecticides
- prevalence
- National Survey on Drug Use and Health (NSDUH)
- tobacco use prevalence as function of age and education
- alcohol use prevalence as function of age and education
- National Minimum Drinking Age Act
- ethyl alcohol, ethanol, al-kuhul
- fermentation, yeast
- *Saccharomyces cerevisiae*
- wine, sake, mead
- *Vitis vinifera*

Lecture 9 (9/20)

- ethanol molecule (chemical structure)
- beer / ale / malt liquor
- brewing: malting, mashing, fermentation
- admixtures, hops
- distillation
- types of distilled spirits
- azeotrope
- proof
- alcohol as a drug of abuse; campus UHS resources
- metabolism of ethanol: ethanol, acetaldehyde, acetic acid
- alcohol dehydrogenase, acetaldehyde dehydrogenase
- time course of metabolism: one "standard drink" per 1-2 hours
- *Pharmakon*: alcohol as an Ally

Midterm Exam One (9/25) (covering Lectures 1-9)

Lecture 10 (9/27)

- blood alcohol level (BAL) or concentration (BAC)
- acute effects of alcohol and corresponding BAL
- LD-50
- therapeutic index (TI)
- prevalence of alcohol use and abuse
- economic cost of alcohol abuse
- alcohol-related motor-vehicle accidents, MADD, DUI enforcement
- breathalyzer
- chronic problems associated with alcohol: abuse/addiction, liver, nervous system, etc.
- teratogenic effects: fetal alcohol syndrome
- potential beneficial effects of light alcohol use
- ethanol neurochemistry: GABA (gamma-amino-butyric acid), glutamate, adenosine
- sedative-hypnotic drugs
- alcohol and other sedative-hypnotic withdrawal

Lecture 11 (10/2)

- general anesthetics: diethyl ether, halothane, others
- inhalants: huffing of petroleum distillates
- sedative hypnotics all facilitate GABA action
- barbiturates: low TI, use in lethal injection (death penalty execution)
- benzodiazepines: higher TIs; widely used; involvement in overdose deaths, mostly in conjunction with opioids and/or alcohol; high risk of dependence; widespread overuse

- hypnotic pharmaceuticals
- sleep hygiene
- plants with sedative-hypnotic properties
- absinthe
- wormwood: *Artemisia absinthium*

Lecture 12 (10/4)

- thujone, effects at GABA receptor
- history of absinthe regulation, temperance movement
- current legal status of absinthe in EU and USA
- propofol
- synergistic depressant effects of sedative-hypnotics
- Food and Drug Administration (FDA)
- levels of FDA regulation of drugs
- drug abuse, abuse potential, addiction
- Whiskey Tax, Whiskey Rebellion
- Harrison Narcotics Act
- 18th and 21st Amendments to US Constitution
- alcohol prohibition in the US (1920-1933)
- Volstead Act
- Harry J. Anslinger, Federal Bureau of Narcotics (created in 1930)
- Marihuana Tax Act (1937)
- Federal Controlled Substances Act (CSA) (1970)
- Drug Enforcement Administration (DEA)
- special status of Schedule I; criteria for Schedule I substance

Lecture 13 (10/9)

- Controlled Substance Schedules: I, II, III, IV, V
- Uniform Controlled Substances Act (1970)
- United Nations Convention on Psychotropic Substances (1971)
- US Sentencing Commission (1984)
- Controlled Substances Analogue Act (1986)
- cannabis: federal vs. state regulations, medical marijuana laws
- global laws regarding cannabis
- 10th Amendment to US Constitution, Commerce Clause
- cannabis origins and *Cannabis* species
- crop followers, domestication of plants and animals

Lecture 14 (10/11)

- *Cannabis* origins and history
- hemp for non-medicinal / non-psychoactive use: fiber, food
- cannabis: preparations and names, routes of administration
- cannabis: medicinal uses, psychological effects
- set and setting
- cannabis as *pharmakon*
- poison properties: abuse/addiction, psychosis, cognition, motivation, short-term memory
- THC and its discovery
- cannabinoids
- Raphael Mechoulam
- cannabinoid receptor
- anandamide, endocannabinoids
- retrograde signaling

Lecture 15 (10/16)

- retrograde signaling and neuroplasticity
- mechanisms for changing synaptic strength
- Marian Diamond
- environmental factors demonstrated to impact brain anatomy
- THC onset: smoked vs. oral-digestive (figure in graphics)
- Marinol® / dronabinol (THC) (CSA Schedule III)
- cannabidiol (CBD) medicinal effects: antiseizure, Epidiolex® (CSA Schedule V)
- synthetic cannabinoid receptor agonists ~ "synthetic cannabinoids"
(many are CSA Schedule I)
- high toxicity, much unknown: nausea, vomiting, anxiety, confusion, delirium, psychosis, cardiovascular stress, seizures
- terpenes and terpenoids in cannabis
- entourage effects
- opioid overdose epidemic
- opium poppy: *Papaver somniferum*
- California poppy: *Eschscholzia californica*
- opium, harvesting of opium
- acute effects of opium
- Paracelsus, laudanum
- routes of administration of opium: oral-digestive, smoking
- Friedrich Wilhelm Sertürner
- opiates: morphine, codeine, thebaine

Lecture 16 (10/18)

- heroin, Bayer, semi-synthetic opioids, aspirin
- opioids: naturally-occurring, semi-synthetic, synthetic
- *GMO* yeast and opioid synthesis
- fentanyl
- carfentanil
- poison qualities: acute toxicity, high addiction potential
- US epidemic of opioid overdose deaths
- opioid antagonist: naloxone (Narcan®)
- opioid withdrawal
- transition from pharmaceutical opioids to heroin (access, cost-effectiveness)

Lecture 17 (10/23)

- treatment interventions
- opioid substitution therapy
- opioid receptors
- endorphins
- neuropeptides
- opium history: India, China, 19th-century Opium Wars
- Treaty of Nanking, Hong Kong
- Green Man

Midterm Exam Two (10/25) (covering Lectures 10-17)

Lecture 18 (10/30)

- Halloween
- caffeine, botanical xanthines
- acute effects of caffeine
- caffeine dependence and withdrawal
- adenosine
- soda, energy drinks, stay-awake pills
- U.S. vs. Coca Cola Supreme Court case
- *Camellia sinensis*
- green tea, black tea
- tea and Buddhism
- Dutch East India Company
- British East India Company
- *Coffea Arabica*
- coffee processing: from berry to brew, fermentation, roasting
- chemistry: deterioration of coffee bean character after roasting and grinding

Lecture 19 (11/1)

- Berkeley: Alfred Peet
- espresso, polyphasic nature of espresso
- history of coffee: origins, movement north into Middle East and Europe
- coffee and Islam
- coffee houses in Europe, and in London; coffee houses and politics
- coffee houses and capitalism
- *Theobroma cacao*
- theobromine, caffeine
- history of cacao: Mayan, Aztec
- processing: from cacao bean to chocolate
- health qualities of cacao and chocolate; beware sugar
- Berkeley: Robert Steinberg, Scharffen Berger Chocolate
- other caffeine-containing plants: kola, guanana, yerba mate

Lecture 20 (11/6)

- caffeine in floral nectar, impact on bees
- Benzedrine inhaler
- amphetamine pharmacology: dopamine and norepinephrine leakage via reuptake transporter
- brain: norepinephrine (locus coeruleus), dopamine (ventral tegmentum, substantia nigra)
- acute effects of amphetamine-type drugs (CNS and PNS)
- medical uses of amphetamine-type drugs
- weight loss/appetite suppression and Obetrol®
- ADHD and Adderall®
- toxic effects
- amphetamine withdrawal
- methamphetamine, "speed"
- *Blitzed* book: drugs in Nazi Germany
- ephedrine / pseudoephedrine, Sudafed
- *Ephedra* (Mormon tea, *ma huang*)

Lecture 21 (11/8)

- *Catha edulis*, khat, qat
- cathinone
- *Erthroxylum coca*, Mama Coca
- uses of coca leaves
- Albert Niemann, 1860
- cocaine
- cocaine: synaptic pharmacology, norepinephrine, dopamine
- cocaine: acute and chronic effects, toxicity (CNS and PNS)
- Sigmund Freud and cocaine
- Ernst von Fleischl, stimulant psychosis
- local anesthetic properties of cocaine
- Vin Mariani

- Coca Cola
- calcium carbonate (lime), freebase cocaine, cocaine absorption
- criminal sentencing disparity: "powder" vs. "crack" cocaine
- routes of administration
- difference between plants and chemicals (coca, sugar)
- addiction: inability to control use, behavioral condition
- biological-psychological-social nature of addiction

Lecture 22 (11/13)

- addiction and drug policy history: temperance, morality, demonization, racism
- addiction as a "brain disease"
- James Olds
- reward-reinforcement pathway:
 - dopamine, ventral tegmentum, nucleus accumbens, frontal cortex
- drug self-administration in rats: the "rat park" experiment
- addiction: drugs, other things, behaviors
- addiction treatment, recovery
- 12-Step programs, AA, etc.
- Bill Wilson
- LSD and addiction-treatment therapy
- Aldous Huxley
- Humphry Osmond
- psychedelic, hallucinogen, psychotomimetic, entheogen

Lecture 23 (11/15)

- psychedelic, hallucinogen, psychotomimetic, entheogen
- effects of psychedelics on the mind
- set and setting
- LSD and its discovery
- Albert Hofmann
- *Claviceps purpurea* (ergot)
- LSD potency
- LSD: historical timeline
- early clinical research with LSD
- CIA and US government "research" (much of it unethically conducted)
- Aldous Huxley and *The Doors of Perception* (1954)
- Timothy Leary, Richard Alpert (later Ram Dass), and the Harvard group
- UC Berkeley: Timothy Leary
- Ken Kesey, Acid Tests
- Augustus Owsley Stanley III ("Owsley")
- LSD and blotter paper

Lecture 24 (11/27)

- adverse effects of psychedelics
- flashbacks, memory formation
- laws against LSD: California (1966), USA (1968), US CSA Schedule I (1970)
- Maria Sabina
- *Psilocybe cubensis*
- teonanácatl
- Gordon Wasson
- psilocybin, psilocin
- importance of precision in mushroom identification
- peyote, San Pedro cacti
- mescaline
- Arthur Heffter
- Native American Church
- DMT: dimethyltryptamine
- *Viola, epeña* snuff
- monoamine oxidase
- ayahuasca
- *Banisteriopsis caapi, Psychotria viridis*
- MAOI, harmine
- ayahuasca churches: Santo Daime and União do Vegetal (UDV)
- US Supreme Court ayahuasca decision (2006)
- DMT in the human brain
- classical psychedelics and brain neurochemistry
- MDMA, ecstasy: 3,4-methylenedioxymethamphetamine: effects, history
- UC Berkeley: Alexander Shulgin
- MDMA and psychotherapy for PTSD
- physicalism, worldview, study of mind
- altered states of consciousness, William James

Midterm Exam Three (11/29) (covering Lectures 18-24)