Brain Resource Creation Workshop: Chapter 13 - Addiction

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ADDICTION

- A **Chronic brain disorder** that affects the body through **physical and/or psychological dependence**.

- **Regular use of alcohol, drugs, opioids, tobacco, etc.** also counts if a person cannot control their urges, despite negative consequences (ex. loss of control, self-harm).

Factors

Both positive (pleasurable feelings) and negative (avoiding withdrawal) factors help create addiction!

1) TOLERANCE

- Ex: Getting "used to" a drug and wanting more for your body to experience the same euphoric effects.

2) WITHDRAWAL

- Ex: Lack of/not using a drug for long periods causes the body to react with physical symptoms (headaches, muscle pain, tremors, seizures, etc).

Factors

Both positive (pleasurable feelings) and negative (avoiding withdrawal) factors help create addiction!

3) CUES or TRIGGERS = provoke addictive behavior

Examples:

- Being in a place associated with drug/alcohol usage (bars, marijuana centers).
- Being around other drug/alcohol users.

Limbic System

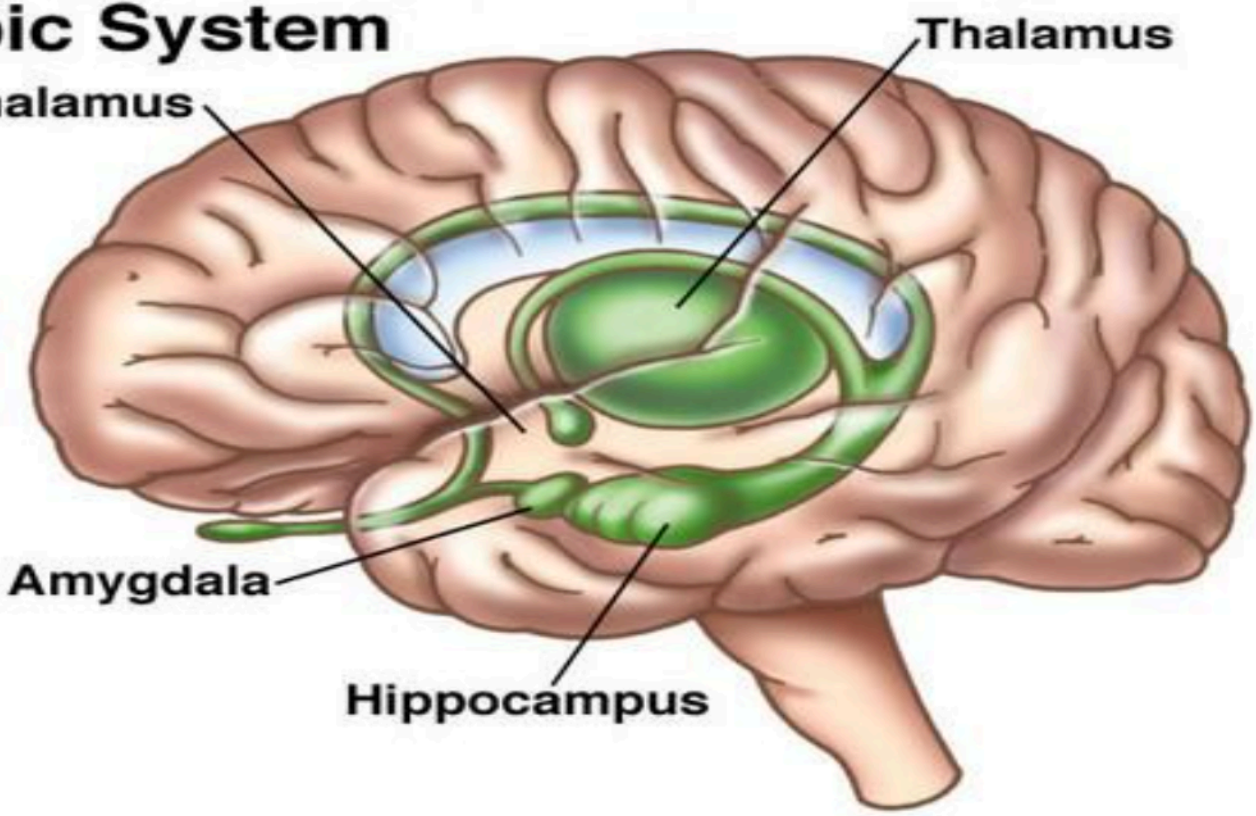
- The **brain's "reward system"** -- a circuit of neurons controlled by a neurotransmitter called **dopamine**.

- Drives behaviors like eating and socializing & helps people experience emotion.

- Generates habits and learned behaviors through pleasure;
  - Ex: Tendency to eat your favorite food to feel ecstatic after eating.

- It can be activated through drug abuse → mood shifts and feelings of euphoria.

Limbic System



Mimics and Imposters

- **Drugs of abuse act as imposters that invade our nervous system.**
  - Mimic neurotransmitter messages in brain circuits.
  - Copy/block neurotransmitter action
  - Alter the way neurotransmitters are released or inactivated.
  - Change the brain's reward system & other brain regions involved in judgment/decisions.

Who's Vulnerable? Looking at the Risk Factors

A. **Internal** (stronger influence in adulthood): Genes, heredity.

B. **External**: Stress, social environments during childhood and adolescence.

C. **Others (biological)**: Gender, age.

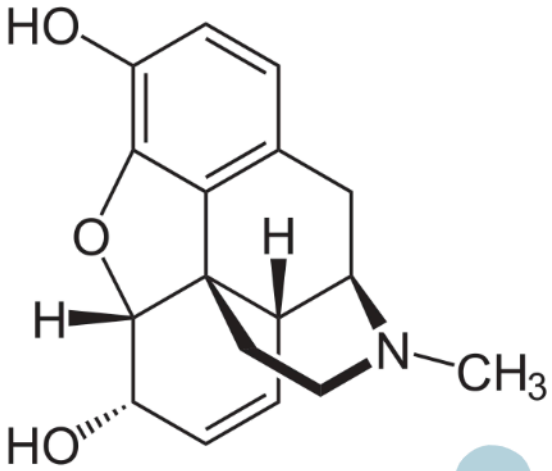
OPIOIDS

- **Extracted opium (morphine) from the juice of poppy flowers** - can bind to opioid receptors, switch on the brain's reward system, and flood synapses with dopamine (pleasure) = euphoria.

- **Types**: **A. Natural** (endorphins - control motivation, emotion, food intake, pain tolerance). **B. Synthetic** (heroin, codeine, oxycodone, fentanyl, pain medicines).

- **Uses/Effects**: Cough suppression, diarrhea stoppage, pain relief; can cause stoppage of breathing if used excessively (also known as an **overdose**).

Structure of Morphine



Opioid-Overdose Epidemic

- **Number of opioid (prescription and narcotics) overdose deaths** *QUADRUPLED*: 100+ Americans from all walks of life die each day.

- Causes:
  1. Increased use of legally prescribed opioid medication → hooked = street heroin (cheaper but more dangerous).
  2. 1995 introduction of a long-lasting version of oxycontin.

- **Addiction** - not abuse - is the main driver of the epidemic!

THE OPIOID EPIDEMIC BY THE NUMBERS

130+
People died every day from opioid-related drug overdoses[3]
(estimated)

10.3 m
People misused prescription opioids in 2018[1]

47,600
People died from overdosing on opioids[2]

2.0 million
People had an opioid use disorder in 2018[1]

808,000
People used heroin in 2018[1]

81,000
People used heroin for the first time[1]

2 million
People misused prescription opioids for the first time[1]

15,349
Deaths attributed to overdosing on heroin (in 12-month period ending February 2019)[2]

32,656
Deaths attributed to overdosing on synthetic opioids other than methadone (in 12-month period ending February 2019)[2]

SOURCES

1. 2019 National Survey on Drug Use and Health. Mortality in the United States, 2018
2. NCHS Data Brief No. 329, November 2018
3. NCHS. National Vital Statistics System. Estimates for 2018 and 2019 are based on provisional data.

HHS.GOV/OPIOIDS

Treatment

- Antidote-like approach - **naloxone (synthetic drug)**:
  1. Can bind to opioid receptors to prevent opioid from binding.
  2. Can reverse potential overdoses.
  3. Can be used in prevention - limit cravings.

- **Methadone** and **buprenorphine** - stimulate opioid receptors (with limited high), reduce withdrawal symptoms from other opioids; buprenorphine is safer than the latter (can be used in office settings).

- **Psychosocial approaches** (e.g., cognitive behavioral therapy, behavioral change focused on positive reinforcement) can also be combined with drug treatments.

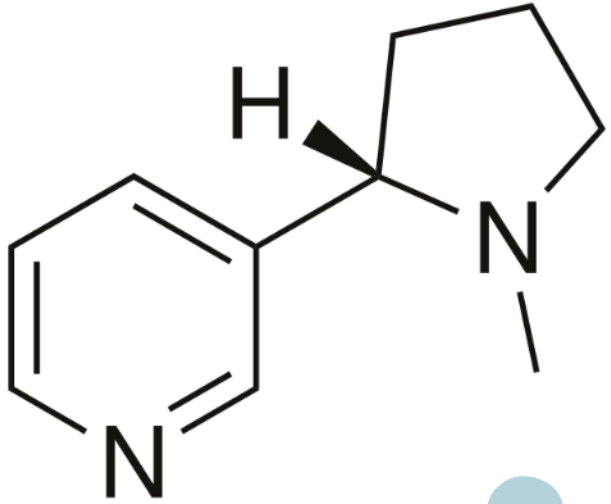
NICOTINE

- An **addictive substance in tobacco** - attaches onto nerve cell proteins in the brain and triggers the release of neurotransmitters (e.g., adrenaline and dopamine) = pleasure, motivation, rapid boost in attention & memory = urges to use more.

- Possible treatment for cognitive disorders. (e.g. ADHD, Alzheimer's disease, schizophrenia)

- **Leading cause of preventable deaths in the U.S.**; responsible for health risks of smoking, including heart disease and stroke.

Structure of Nicotine



Treatment

- **Drug treatments (pharmacotherapy).**
- **Nicotine replacement products** (nicotine gums, inhalers, etc.)
- **Buprenorphine** - stimulate nicotine's effect on dopamine.
- **Varenicline - nicotine mimic** that attaches on a special type of nerve receptor (nAChRs) responsible for conveying nicotine's addictive properties
  - Best single-drug option for nicotine addiction, esp. when combined with **counseling and behavioral therapy**.
- **Motivational tools** (cessation hotlines, websites, social media).

ALCOHOL

- Secondary impacts: drunken driving, sexual assault, domestic violence, **cirrhosis** (late-stage liver scarring).

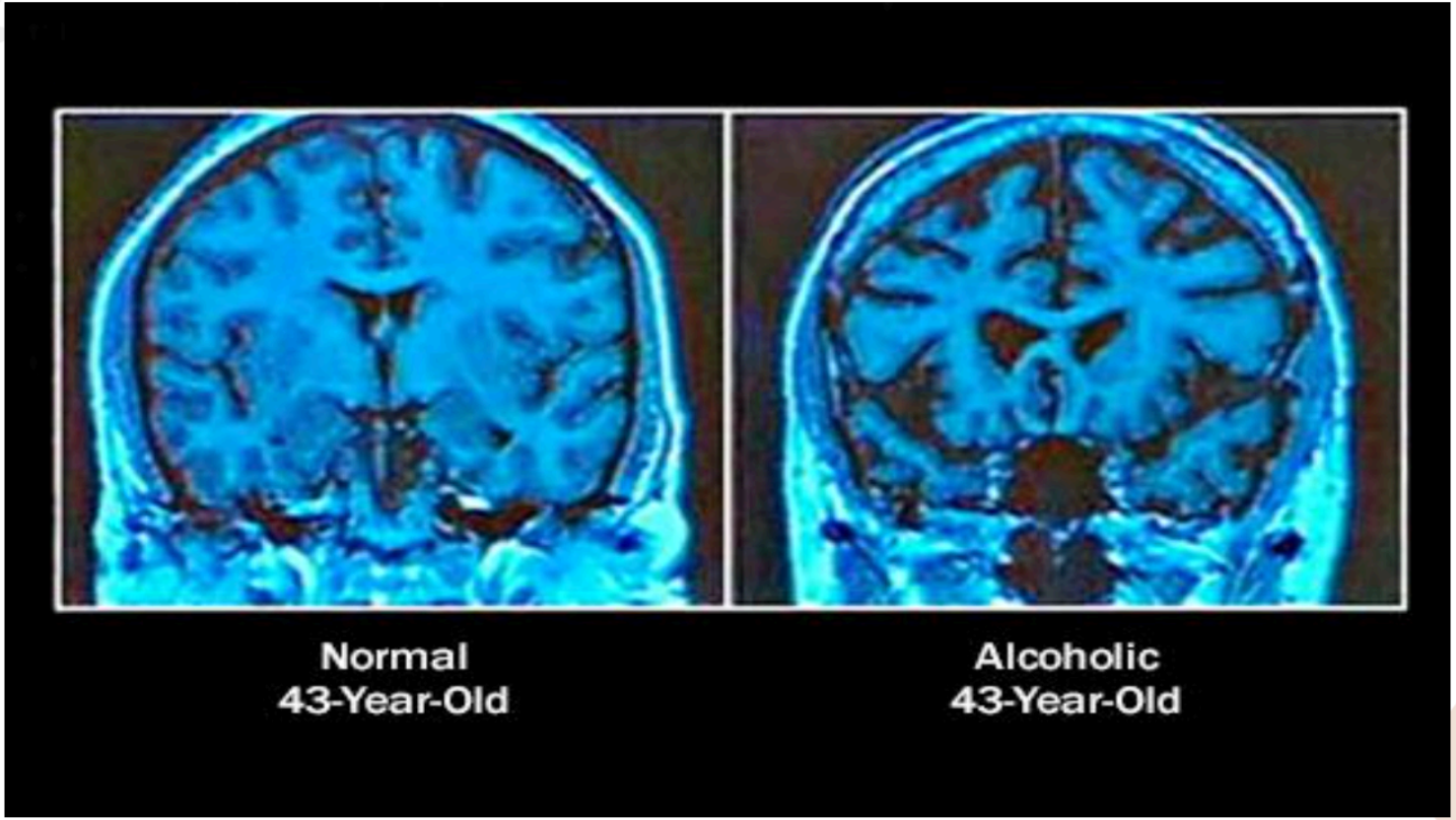
- **Ethanol - water-soluble addictive ingredient**
  - Stimulant (<2 drinks) or depressant → intoxication, sleepiness, "blackouts", short-term memory loss.
  - Targets the brain's GABA and NMDA type receptors & pain-relief circuits → delayed reaction times, alter mood, euphoria.
  - Diuretic (pulls water away from body tissues) → dehydration.

ALCOHOL

- Binge drinking slows heart rate & causes breathing difficulties → alcohol overdose = death.

- Heavy alcohol use/alcohol use disorder (**alcoholism**) changes brain structure by causing damage to the cerebellum, memory loss, neuron degeneration
  - Other symptoms: unsteady gait, tremors, slurred speech.

- Both **genetic** and **environmental factors contribute to alcoholism**, as is true of addictions overall. [See slide 8]

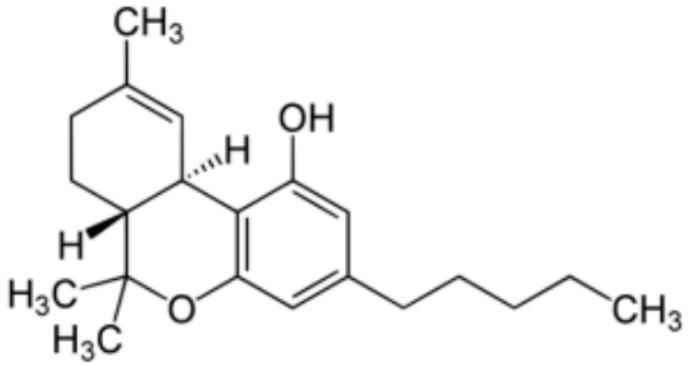

Normal
43-Year-Old
Alcoholic
43-Year-Old

Treatment

- **Behavioral therapy** (individual counseling, group therapy, support groups).
- **Medications (disulfiram, naltrexone, acamprosate).**
- Researchers use **genetic testing** to optimize therapy for individual drinkers.

MARIJUANA aka WEED or POT

Structure of Tetrahydrocannabinol (THC)



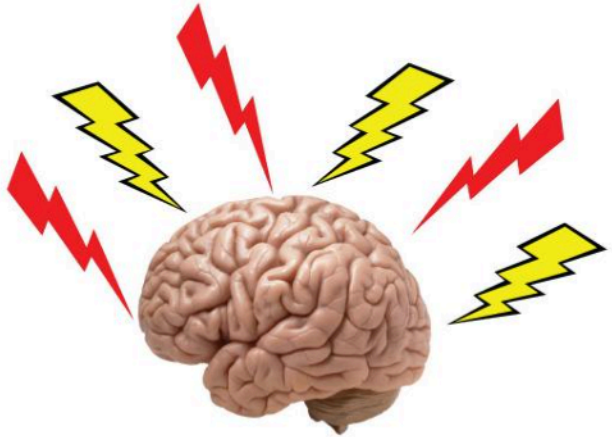
- **Comes from the *Cannabis* plant**, which contains the mind-altering THC chemical - **distorts perception & alters one's sense of time, space, and self.**
- Linked to reward, cravings, and thought control - all key players in addiction.
- **Usage in teen years causes long-term damage to thinking, memory, and learning** → impaired thinking, missing school, risky behaviors while intoxicated, higher stress levels due to withdrawal & cravings.

MARIJUANA aka WEED or POT

- Long-term use linked to schizophrenia and physical changes in the brain circuits of reward systems.

- Use for treatments: cannabidiol/CBD compound in marijuana can control epileptic seizures, relieve pain and inflammations, and treat mental illness and addictions.
  - Coping mech. for PTSD, anxiety, stress, and insomnia
  - More research is needed, but it can potentially reduce nausea associated with chemotherapy.

PSYCHOSTIMULANTS



- **Chemicals that excite the brain** and provide a temporary boost to physical and/or mental function; increase focus and enhance concentration → euphoria, self-confidence.

- Examples: caffeine, nicotine, Adderall and Ritalin/Concerta (abused recreationally), cocaine, [crystal] methamphetamine.

- Repetitive use → damages organs such as the heart and the brain (triggers release of chemicals that destroy dopamine neurons, damage body's ability to release normal amounts of dopamine → health problems: lack of drive to engage in activities).

PSYCHOSTIMULANTS

- Neuroscientists try to prevent & treat addiction to psychostimulants through research:
  - Psychostimulants in prefrontal cortex promote arousal and quicken thinking.
  - Low doses improve the brain's executive functions → ADHD treatment.
  - Help with impulse & emotional control, productivity, planning & organizing.

- Remember: As with most drugs and/or addictive substances, taking high doses of psychostimulants can impair brain function.

Treatment

- Cognitive-behavioral therapy
- Motivational incentives
- No effective drugs officially approved yet.
- Experimental targets: **neurotransmitter systems (serotonin, glutamate, GABA)**, focus on the brain's **immune cells (microglia)**, and **oxytocin**.

DESIGNER DRUGS and CLUB DRUGS

- **Synthetic legal substances with psychoactive effects**, typically used at dance parties and all-night raves; look similarly to illicit drugs but makers tweaked their chemical structures to evade drug laws.

- Examples: "Bath salts," "Spice," (synt. marijuana), Ecstasy, Rohypnol, GHB, Ketamine.

Ecstasy (aka MDMA or Molly)

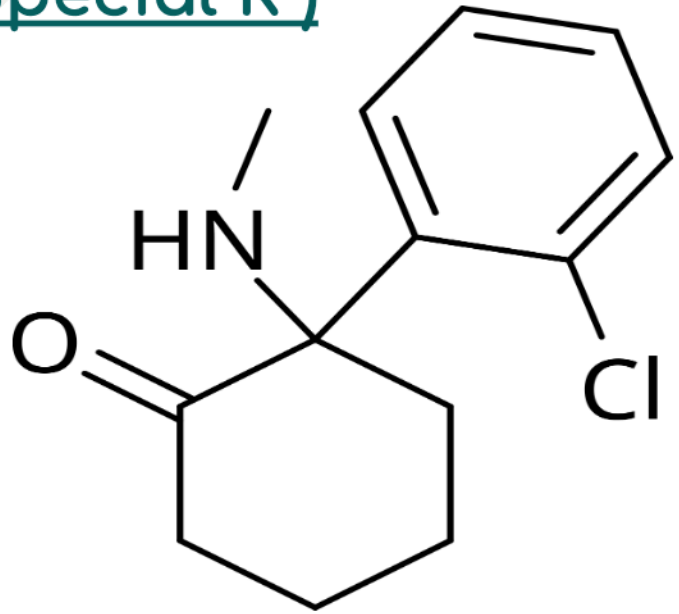
- Works within 30 to 45 mins.
- **Boosts levels of neurotransmitters, temporarily depleting their levels in synapses.**
- Long-term changes to thought, memory, and pleasure areas of the brain.
- Extensive damage to serotonin circuits.

Rohypnol and GHB

- Depressants

- **"Date-rape" drugs**—slipped into drinks to facilitate sexual assault; can incapacitate & sedate victims.

Ketamine (aka "Special K")



- **Depressant & hallucinogen** that is legally used as a veterinary anesthetic.
- Takes effect within 10 mins.
- **Puts users in a trance-like state.** Interestingly, ketamine can potentially treat depression.
- Has very rapid effects in comparison to other current antidepressant treatments.

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We hope you enjoyed the workshop!

Any questions?

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