Drugs, Addiction, & The Brain

HASPI Medical Anatomy & Physiology 11e

Internet Activity

Name(s): _____

Period: _____ **Date:** _____

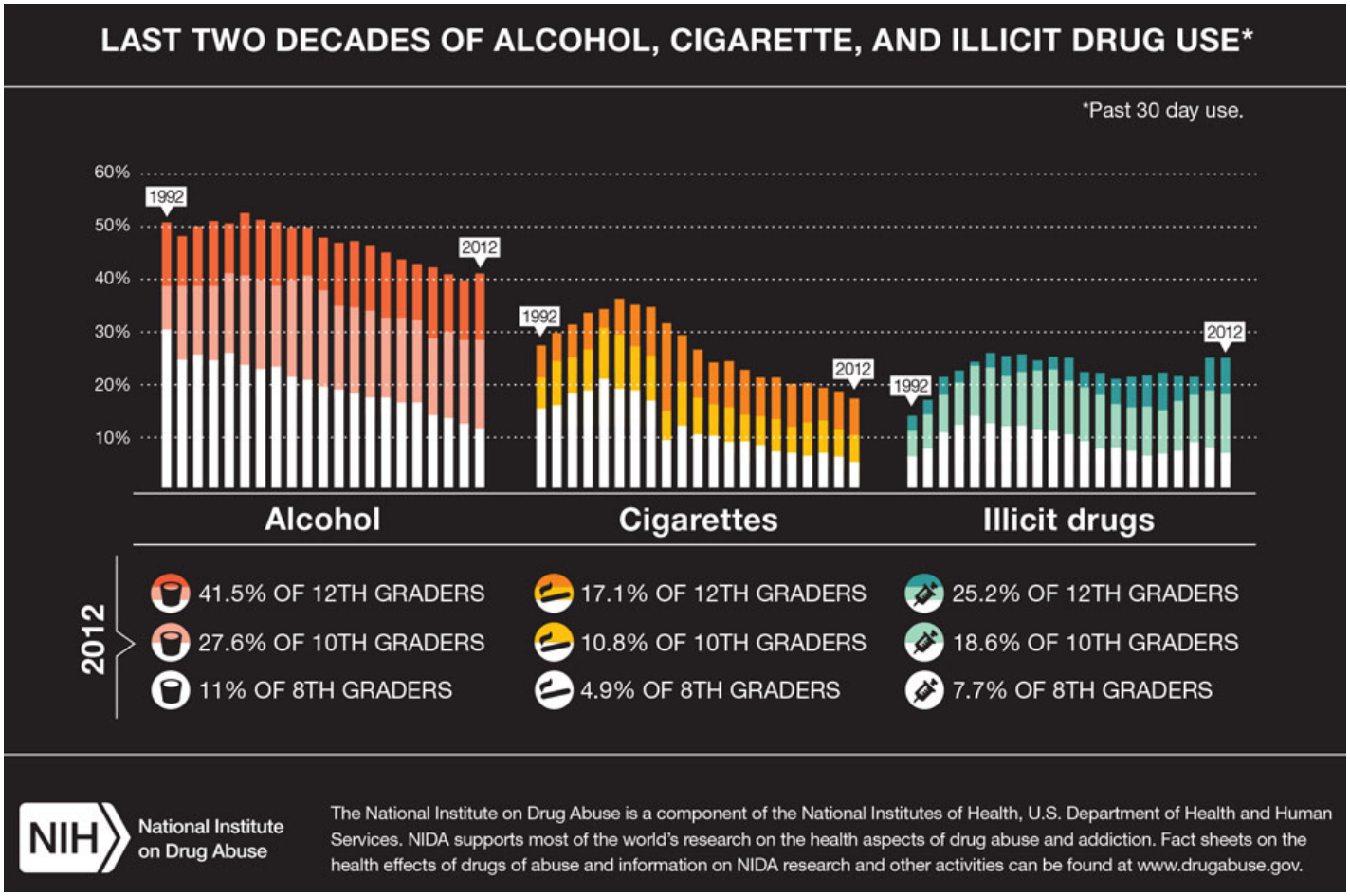
Background

Drug Abuse & Addiction

Drug addiction is a mental and/or physical dependency. The drug may be illegal, prescribed, over-the-counter, or a substance that does not have any actual medical use. While the initial decision to take a drug is voluntary, the changes that result in the brain from drug use create a compulsive chronic need for the drug. Drug abuse and addiction cost the United States more than $600 billion annually in healthcare and crime-related costs. More than $190 billion can be contributed to illicit drugs, $190 billion to tobacco use, and more than $250 billion to alcohol abuse. While the direct cost is easily measurable and substantial, the influence of drug abuse on public safety, employment, family disintegration, violence, and domestic abuse has a much greater negative impact on society.

The Impact of Drugs on the Brain

The majority of drugs have a direct or indirect effect on the neurons in the brain, specifically on neurotransmitters and receptors at the synapse. Drugs can cause disruption in the brain's normal communication methods, primarily by stimulation or inhibition of receptors, or by mimicking a neurotransmitter. The neural pathway associated with "reward" is most commonly affected. As the brain is regularly exposed to a drug, it will react by producing less of the neurotransmitter involved by the specific drug, which can lead to tolerance. The user can eventually succumb to abuse and addiction, as he/she have to take increasingly more of the drug to feel "normal."



Data courtesy of the NIH National Institute on Drug Abuse

Drug Schedules & Categories

Drugs can come in a wide variety of forms, and are placed in five schedules, according to regulations created by the Food & Drug Administration (FDA) as part of the Controlled Substance Act. Table 1 summarizes the requirements and examples of drugs placed in each schedule according to the FDA.

Table 1. FDA Drug Schedules

Schedule I	Schedule II	Schedule III	Schedule IV	Schedule V
High potential for abuse, no currently accepted medical use, and a lack of accepted safety for use under medical supervision. ▪ *LSD* ▪ *MDMA (Ecstasy)* ▪ *Marijuana* ▪ *Heroine* ▪ *Methaqualone* ▪ *Phencyclidine (PCP)* ▪ *Hallucinogenic mushrooms*	High potential for abuse, has a currently accepted medical use, and abuse may lead to severe psychological or physical dependence. ▪ *Morphine* ▪ *Cocaine* ▪ *Opium* ▪ *Methamphetamine*	Has a potential for abuse less than the drugs or other substances in schedules I and II, has a currently accepted medical use, and abuse may lead to moderate or low physical dependence or high psychological dependence. ▪ *Valium* ▪ *Xanax* ▪ *Codeine* ▪ *Anabolic Steroids*	Low potential for abuse, has a currently accepted medical use, and abuse may lead to limited physical dependence or psychological dependence. ▪ *Phenobarbital* ▪ *Meprobamate* ▪ *Chloral Hydrate* ▪ *Paraldehyde*	Low potential for abuse, currently accepted medical use, and abuse may lead to limited physical dependence or psychological dependence. ▪ *Typically preparations of schedule I-IV drugs in small concentrations* ▪ *Cough Medicine w/ Codeine* ▪ *Benzodiazepines*

Drugs that can be dangerous to individual or public health, have addictive properties, or that have no medical use are considered illegal. Drugs with addictive properties can lead to drug abuse, misuse, and addiction. Abuse and addiction may cause numerous health issues and may even lead to death from these health issues or overdose. Table 2 summarizes some of the most common categories of drugs that are abused.

Table 2. Common Drugs of Abuse

Drug Category	Drug Types	Description
Stimulants	*Methamphetamine, Cocaine, Ritalin, Ecstasy*	Drugs that increase the activity of the central nervous system. User feels energized, but when the drug wears off he/she will often feel extreme fatigue.
Depressants	*GHB, Alcohol, Tranquilizers, Barbiturates, Methaqualone*	Drugs that decrease the activity of the central nervous system. User feels relaxed and drowsy.
Inhalants	*Gasoline, Markers, Aerosols, Paint thinner, Glue*	Chemicals that are inhaled and give the user an immediate "high." The high is caused by oxygen deprivation that can cause permanent mental damage and even death.
Cannabinoids	*Marijuana, Hashish*	Produces feelings of euphoria and relaxation. User experiences memory loss, confusion, anxiety, and a reduction in reaction time.
Opioids & Morphine Derivatives	*Codeine, Opium, Heroin, Morphine, Fentanyl, Oxycodone, Acetominophen*	Often used in pain relief. User experiences euphoria, nausea, confusion, drowsiness, and respiratory distress.
Anabolic Steroids	*Anadrol, Dianabol, Stanazol, Oxandrin, Durabolin*	Substances that are often taken to increase strength or improve muscle structure. User can experience acne, premature baldness, oily skin, hostility, anxiety, and may even have a stroke or heart attack and possibly death.
Hallucinogens	*Mushrooms, LSD, Mescaline*	Cause hallucinations that may affect emotions, movement, and speech. Users may become hostile or suffer from heart failure.

Genetics Science Learning Center. 2013. Drugs Alter the Brain's Reward Pathway. *Learn.Genetics.* http://learn.genetics.utah.edu/content/addiction/drugs/index.html.

NIH. 2011. Drug Facts: Understanding Drug Abuse and Addiction. National Institute on Drug Abuse, The Science of Drug Abuse & Addiction, www.drugabuse.gov.

Materials

Computer/internet

Directions

Go to the following website:

http://learn.genetics.utah.edu/content/addiction/

Drugs of Abuse

Click on the "Drugs of Abuse" link. Click on each of the following drugs and answer each question to complete the chart below.

Drugs of Abuse

Drug	Names it is known by	How it is taken	What it is	Type of drug (depressant, stimulant, etc.)	Effects
Alcohol					
Anabolic Steroids					
Cocaine					
Dissociative Drugs					
GHB & Rohypnol					

Drug	**Names it is known by**	**How it is taken**	**What it is**	**Type of drug** (depressant, stimulant, etc.)	**Effects**
Hallucinogens					
Heroine					
Inhalants					
Marijuana					
MDMA					
Methamphetamine					
Nicotine					

Drug Use Changes the Brain Over Time

Return to the original page and click on the "Drug Use Changes the Brain Over Time" link. Answer the following questions. *(3-4 sentences minimum for each question)*

Dopamine Levels Increase

Explain how addictive drugs affect the release of dopamine.

Synapse Activity Decreases

Explain what tolerance is in reference to drug use.

Brain Connections are Rewired

Explain how a drug user becomes a drug addict.

Changes Last Long After Use

Explain how brain activity changes even 100 days after prolonged cocaine use.

Mouse Party

Click on the "Mouse Party" link. There are 7 mice in the tank and each has been exposed to a different drug. Drag each mouse to the chair to see what is happening in the brain of the mouse exposed to each drug. Answer the following questions for each drug.

Mouse #S153V – Heroine		
What neurotransmitter(s) does this drug interfere with?	How specifically does this drug affect these neurotransmitters and/or receptors in the brain?	How does this affect the person's mood and/or actions when he/she is on the drug?

Mouse #S324M – Ecstasy		
What neurotransmitter(s) does this drug interfere with?	How specifically does this drug affect these neurotransmitters and/or receptors in the brain?	How does this affect the person's mood and/or actions when he/she is on the drug?

Mouse #S234Z – Marijuana		
What neurotransmitter(s) does this drug interfere with?	How specifically does this drug affect these neurotransmitters and/or receptors in the brain?	How does this affect the person's mood and/or actions when he/she is on the drug?

Mouse #S244R – Methamphetamine		
What neurotransmitter(s) does this drug interfere with?	How specifically does this drug affect these neurotransmitters and/or receptors in the brain?	How does this affect the person's mood and/or actions when he/she is on the drug?

Mouse #S322C – Alcohol		
What neurotransmitter(s) does this drug interfere with?	How specifically does this drug affect these neurotransmitters and/or receptors in the brain?	How does this affect the person's mood and/or actions when he/she is on the drug?

Mouse #S256A – Cocaine		
What neurotransmitter(s) does this drug interfere with?	How specifically does this drug affect these neurotransmitters and/or receptors in the brain?	How does this affect the person's mood and/or actions when he/she is on the drug?

Mouse #S186J – LSD		
What neurotransmitter(s) does this drug interfere with?	How specifically does this drug affect these neurotransmitters and/or receptors in the brain?	How does this affect the person's mood and/or actions when he/she is on the drug?

How Drugs Can Kill

Return to the home page and click on the "How Drugs Can Kill" link. Read about how each of the following drugs can cause death and write a short description in the space provided below.

Describe how each of the following drugs or drug types can cause death.	
Poly-drug Cocktails	
Nicotine	
Cocaine and Other Stimulants	

Review Questions - *on a separate sheet of paper complete the following*

1. What is drug addiction?
2. Approximately how much does drug abuse and addiction cost the U.S. annually?
3. What type of drug contributes to most of this cost?
4. List three of the negative impacts of drug use on society.
5. How do drugs impact the brain?
6. What is tolerance and how can it lead to drug abuse and addiction?
7. How many 12^{th} graders had used alcohol in 2012? 10^{th} graders? 8^{th} graders?
8. How many 12^{th} graders had used cigarettes in 2012? 10^{th} graders? 8^{th} graders?
9. How many 12^{th} graders had used illicit drugs in 2012? 10^{th} graders? 8^{th} graders?
10. Why do you think the occurrence of illicit drug use in high school age students has increased since 1992?
11. What do you think has caused the decrease in alcohol and cigarette use in high school age students since 1992?
12. What agency regulates legal and illegal drugs by placing them in one of the five schedules?
13. What is the major difference between drugs in Schedules I, II, and III?
14. Describe stimulants and give one example.
15. Describe depressants and give one example.
16. Describe inhalants and give one example.
17. Describe opioids and give one example.
18. Describe hallucinogens and give one example.