

Chapter 4: Drugs

1. What are drugs?

Any substance that alters function of the brain or body

Any substance that alters function of the synapse in the body (PNS) or brain (CNS)

2. What is an agonist? Antagonist? What different ways can they act (example, directly at receptor, increase/decrease neurotransmitter synthesis, degradation, etc)

Agonist: mimics or enhances the effect of a neurotransmitter. This increases synthesis, promotes release, blocks reuptake (degradation), blocks presynaptic autoreceptors, and activates postsynaptic receptors.

Antagonist: blocks or decreases the effect of a neurotransmitter. These reduce synthesis, prevents storage, blocks release, activates presynaptic autoreceptors, and block post synaptic receptors.

3. Drug Actions at the Synapse Affect:

Neurotransmitter Production: Manipulating the synthesis of a neurotransmitter will affect the amount available for release.

Neurotransmitter Storage: Interfering with the storage of a neurotransmitters in vesicles within a neuron

Neurotransmitter Release: drugs can modify the release of a neurotransmitter in response to the arrival of an AP

4. Know which drugs belong to different classes:

- ◆ Opiates: Heroin, Morphine, Cocaine
- ◆ Depressants: Alcohol
- ◆ Stimulants: Meth & Cocaine
- ◆ Psychadelics

5. Psychoactive Drugs: any drug with psychological effect, passes through blood brain barrier to directly affect the brain.

6. Know which neurotransmitter/receptor system the following drugs act on and what they do (for example: act as agonist/antagonist, decrease neurotransmitter reuptake, etc):

- ◆ Alcohol: depressant, both agonist and antagonist
 - GABA_A receptor agonist - gives anti-anxiety, sedative effects, and impairs motor
 - Dopamine receptor agonist - euphoric qualities
 - NMDA receptor antagonist - memory problems
 - BAC = Blood Alcohol content. Influenced by #/type of drinks, weight, gender, and genetic background
- ◆ Cocaine: opiate that produces euphoria, decreased appetite, increased alertness, and relieves fatigue. It is an agonist, inhibits dopamine reuptake. It is a stimulant that effects the mesolimbic system and reward pathway - VTA* releases dopamine onto the NA. It blocks dopamine reuptake into VTA presynaptic neurons so more dopamine is available at the NA postsynaptic receptors.
 - Extracted from coca plant, can be snorted, inhaled or injected

*VTA = Ventral Tegmental Area

*NA = Nucleus Accumbens

- ◆ Methamphetamine: synthetic drug that can be snorted inhaled, or injected to produce effects similar to cocaine. It is a stimulant that effects the mesolimbic system and reward pathway - VTA releases dopamine onto the NA.

Meth gets taken into cells just like dopamine. When too much dopamine in terminal, transporter works backward (chemical gradient) and lots more dopamine is available in synapse.

- ◆ **Psychedelics:** these cause perceptual and cognitive distortions, are psychedelics.
 - Serotonin receptor agonists: Lysergic Acid Diethylamide (LSD), Psilocybin (Mushrooms) & MDMA (Ecstasy)
 - Ecstasy: heightened perceptions, stimulation, elevated mood, reduced appetite. Increases serotonin release and blocks reuptake so more serotonin is available to bind postsynaptic receptors, meaning less serotonin is available for release and autoreceptor activation decreases synthesis and release even further. After ecstasy has worn off, the user experiences depression-like feelings and irritability.
 - PCP is a glutamate receptor antagonist
 - ◆ **Opiates:** synthesized from sap of opium poppy. Drugs include morphine, codeine, & heroine.
 - Endorphin receptor agonists and leads to increased dopamine release
 - ◆ **Marijuana:** THC. It is an agonist at receptors for endogenous cannabinoids. Cannabinoid receptors are located in the hippocampus and prefrontal cortex. This drug leads to increased dopamine release.
7. **Tolerance:** lessened effects as a result of repeated administration
 8. **Withdrawal:** occurs when substance use is discontinued; opposite of the effects caused by the discontinued drug.
 9. **Addiction:** is the compulsive need to use the drug repeatedly
 10. Drugs that reduce CNS activity: sedatives (calming), anxiolytic (anxiety reducing), & hypnotic (sleep-inducing)
 11. Drugs that increase CNS activity will increase the HR, respiration, BP, arousal, alertness, and elevate mood

Chapter 5: Genetics, Development, Experience

12. How many pairs of chromosomes do humans have? 23 Matched pairs, each parent contributes one chromosome
13. **Genes:** sequences of nucleotides that code for specific amino acids that, when strung together, make a protein. Humans have an estimated 23k protein coding genes
 - ◆ **Phenotype:** observable traits
 - ◆ **Transcription:** DNA partially unwinds and a strand of complementary RNA is made
 - ◆ **Translation:** RNA instructs ribosomes to produce amino acids
14. **RNA:** Ribonucleic Acid, is a nucleic acid present in all living cells. It acts as a messenger carrying instructions from DNA for controlling the synthesis of proteins, although in some viruses RNA rather than DNA carries the genetic info.
15. **Alleles:** an alternative version of a gene that may be dominant or recessive
 - ◆ Traits controlled by genes on the X chromosome occur more frequently in one sex than the other. If dominant, it occurs more frequently in females (2 Xs), if recessive, occurs more frequently in males (only 1 X).
 - ◆ **Dominant:** those that mask other gene effects; routinely expressed
 - Brown Eyes

- ◆ **Recessive:** genes that are expressed only in absence of a dominant gene; routinely not expressed
 - Blue Eyes
16. **Junk DNA:** Stretches of DNA around and between genes that seemed to do nothing, but now researchers think that they contain a large number of tiny genetic switches, controlling how genes function and are expressed in the cell.
17. Is most of the genome coding DNA (genes) or non-coding DNA?
18. Main sources of genetic diversity?
- ◆ **Meiosis:** chromosomes in the eggs or sperm can be “shuffled” in over 8 million combinations ($2^{23} = 8,388,608$ combos)
 - One of the 23 pairs of chromosomes found in body cells → The chromosomes replicate themselves → The cell divides w/one pair of chromosomes in each daughter cell → these cells divide a second time into sperm or egg cells, containing only 1 chromosome rather than a pair.
 - ◆ **Crossing Over:** equivalent segments of DNA are exchanged; unique gene combinations
 - At the beginning of meiosis, paired chromosomes line up with each other → each chromosome replicates itself → the chromosomes cross over → the chromosomes exchange equivalent sections of genetic material
 - ◆ **Retrotransposons:** Move from site to site within a cell or even between neurons. They are thought to be a driving force of primate evolution. These act somewhat like retrovirus - RNA that moves and inserts randomly.
 - AKA Jumping Genes
 - ◆ **SNPs:** Single-Nucleotide Polymorphisms. Mutations may occur spontaneously, in response to exposure to radiation, chemicals or other mutagens
 - APOE gene located on chromosome 19 has 3 alleles (variants). The APOE SNP predicts a person's risk for developing Alzheimer's disease.
 - ◆ **Mutations:** replication errors. Can have positive, neutral, or negative effects and may be specific or wide-spread
 - Sickle Cell Anemia: Negative Effects: Poor oxygen capacity. Positive Effects: some protection against malaria
 - Thalidomide: given to women during pregnancy, caused low birth rate and deformities of children who survived to birth
19. **Sex Chromosomes:** recessive genes on one X chromosome that are not duplicated on the Y chromosome that will be expressed in male offspring.
- ◆ Sex-linked characteristics: Hemophilia or Color-Blindness
 - ◆ X-chromosome inactivation - One X is randomly silenced to equalize protein production in males and females.
 - Calico cats: Fur color expressed on X chromosome: males have orange OR black fur. In females, fur color genes in each cell are randomly silenced producing coloring
20. **Zygote:** cell formed by the merger of egg and sperm. Within the first week following conception it has divided into three layers:
- ◆ Ectoderm: becomes the nervous system (NS)!!, skin, hair
 - ◆ Mesoderm: connective tissue, muscle, bone, blood vessels
 - ◆ Endoderm: internal organs