Vocabulary

● Pharmacokinetics
  ○ *The study of the movement of administered substances within the body*

● Psychopharmacology
  ○ *The study of how drugs affect behavior*
Pathway of Administered Substances/Neurotransmitters

1. Administration
   a. The FDA approves 111 valid routes of administration

2. Absorption
   a. Enters body or body compartment

3. Distribution
   a. Carried to a specific area/target organ

4. Metabolism
   a. Broken down by enzymes
The Routes of Administration (Fast)

- **Intravenous**
  - **Examples**
    - Fast, precise, *direct* access to brain
      - Adrenaline
  - Intraperitoneal
    - Fast, *indirect* access to brain
      - Chemotherapy
- **Inhalation**
  - Fast, easy, volatile substance required
    - Nasal Decongestant
The Routes of Administration (Slow)

- Intramuscular (capillaries)
  
  **Examples**
  
  - Slow, *direct* access  

- Subcutaneous (fat tissue)
  
  - Slow, *indirect* access

- Intrarectal
  
  - Slow, *bypasses stomach*
The Routes of Administration (Easy)

- **Oral**
  - Examples
    - Easy, delayed
      - Aspirin

- **Sublingual**
  - Easy, bypasses digestive system, capillaries of tongues
    - Steroids

- **Inhalation**
  - Easy, requires volatile substance
    - Nasal decongestant
The Routes of Administration (Bypasses BBB)

- **Intracerebral**
  - Bypasses BBB, local
    - Straight to cerebrum*

- **Intracerebroventricular**
  - Bypasses BBB, global effect, emergency
    - Straight to ventricular system*

*This type of administration allows for drugs to target specific area(s) of brain, while also limiting distribution of drug to parts of the brain that does not need the drug*
Abosrption

- The study of effects of some specific brain areas
  - Movement through BBB
- Lipid soluble substances pass through BBB
- H$_2$O soluble substances do not pass through BBB

*The next few slides will discuss the Dose Response Curve, Margin of Safety, and Therapeutic Index*

**Therapeutic Index**

- Effective dose (ED$_{50}$) = dose at which 50% population shows response
- Lethal dose (LD$_{50}$) = dose at which 50% population dies
- $TI = \frac{LD_{50}}{ED_{50}}$, an indication of safety of a drug (higher is better)
Absorption (Dose Response Curve)

- A linear curve
  - Proportional effect to amount of drugs
- A non linear curve
  - A majority of drugs are non linear
- Drug Affinity
  - The strength of binding
  - Different sites of action, drugs bind to different receptors for different affinity levels

Therapeutic Index

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Absorption (Margin of Safety)

- Drugs have multiple effects at different concentrations
- Drugs may have same end result but vary in effectiveness
  - Analgesic drugs
    - Morphine
      - Inhibits pain reducing neuron
    - Aspirin
      - Suppresses chemical signal from damaged cells to nervous system
- Distance between curves is either good or bad
Absorption (Therapeutic Index)

- The TI explains the dosage of a drug and its toxicity at certain levels

- \( \text{TI} = \frac{\text{LD}_{50}}{\text{ED}_{50}} \)
  - \( \text{LD} \) is the lethal dose at which 50% of the population dies
  - \( \text{ED} \) is the effective dose at which 50% of the population responds

- A higher LD means that it takes a higher drug dosage to reach toxic levels
- A lower ED means that less dosage of a drug is needed to reach effectiveness
- A large TI is good
Drug Use and Misuse

- **Tolerance**
  - A compensatory mechanism counteracting the effect of the drug
  - Effects *decrease* after prolonged use

- **Sensitization**
  - The effect of the drug *increases* with prolonged use

- **Withdrawal and its symptoms**
  - Compensatory mechanism acts alone
  - Person’s behavior (emotional) is abnormal and opposite of usual behavior
Drug Physiology

● How do drugs work?

○ Agonist

■ Holds the same postsynaptic effects as the particular neurotransmitter

■ Aids in opening certain receptors in brain

○ Antagonist

■ Direct

● Competes with the neurotransmitter molecules

● Competitive binding
Specific Neurotransmitters

- **Amino Acids**
  - **Glutamate**
  - **GABA**
  - **Glycine**

- **Acetylcholine**

- **Monoamines**
  - **Catecholamines**
    - **Dopamine**
Glutamate

- **Synthesization**
  - *Proteins in food*

- **Location**
  - *Everywhere*

- **Receptors**
  - *Ionotropic for Na\(^+\) (AMPA, Kainate)*
  - *Ionotropic for Na\(^+\) and Ca\(^{2+}\) (NMDA)*
  - *Metabolic Glutamate receptors*
GABA

- **Synthesization**
  - From Glutamate

- **Location**
  - Central Nervous System

- **Receptors**
  - Ionotropic for Cl⁻ (GABAₐ)
  - Metabotropic for K⁺ (GABA₇)
  - Exists presynaptically
  - Always inhibitory
Glycine

- **Synthesization**
  - From sugar cane
  - Naturally synthesized from our body

- **Location**
  - Spinal cord

- **Receptors**
  - Ionotropic for Cl
  - Always inhibitory
Citations