Biology of Substance Abuse

Psychology 311
Abnormal Psychology

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Medial Forebrain Bundle

- Includes
  - Prefrontal Cortical Areas
  - Ventral Tegmental Area
  - Nucleus Accumbens
  - Others
- Called the reward center
  - Full of dopamine neurons

Other important areas

- Hippocampal formation
  - Involved with memory
- Cerebellum and Basal Ganglia Structures
  - Involved with balance and fine motor coordination

Neuronal Structures

- Contains three major sets of structures
- Soma’s
  - Cell body
    - Post synaptic elements
- Axon’s
  - Teledoendria
  - Presynaptic Elements
- Dendrites
  - Post synaptic elements
**Neuronal Structures**

- **Soma**
- **Axon Hillock**
- **Node of Ranvier**
- **Myelin Sheath**
- **Axon**
- **Collateral**
- **Teleodendria**

**Axons and Presynaptic Elements**

- Contains structures in a lipid bilayer
- Ion channels
- Sodium Potassium Pumps
- Contains other structures
- Synaptic Vesicles
- Channels
  - Na, K, Ca
- Receptor sites from other axons
- Presynaptic Membrane
- Autoreceptors
- Reuptake channels
- Others

**Dendrites and Related Structures**

- Dendrites only receive information
  - (Soma's also receive information too)
- Can have many dendrites on a neuron with multiple branches
- Contains several structures

**Structures**

- Has a post synaptic element
- Has a post synaptic membrane
  - Contains receptor sites to receive neurotransmitters
  - Contains channels for ion influx
    - Usually Na
- Contains other structures
  - Protein Kinases
  - Adenylyl Cyclase

**Receptor Sites**

- **Receptor Sites**
- **Ion Channels**
- **Post Synaptic Element**
- **Post Synaptic Membrane**
Receptor Sites
Ion Channels

Post Synaptic Element
Post Synaptic Membrane

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Overview

- Most damaging drug to your body
- Influences everything
- Highly correlated with many types of crime
  - Domestic Violence
  - Rape
  - DWI
- Can have therapeutic effects in moderation
  - 4oz glass of wine correlated with reductions of heart disease and related problems
  - > one glass, causes problems

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College Students

- Students drink 4 billion cans of beer yearly
- 360,000 of 12 million undergraduates will die from alcohol-related causes while in school.
- Nearly ½ of college students are binge drinkers
- Average student spends $900 per year on alcohol (books $450/year
- 82 billion dollars are lost annually from alcoholism

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Biological Effects

- Most drugs target the synapse
- Alcohol impacts all parts of the neuron
- Impacts begin at very low BACs
  - <.02 you begin to get visual changes
  - .05 BAC is where you feel good

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Specific Effects

- Alters the lipid bilayer of the neuron
- Slows down the speed of action potential
- Alters the GABA binding site on excitatory neurons
- Result
  - Decreases the speed of the action potential
  - Reduces the number of excitatory neurons firing action potentials
  - Result, slows the Nervous System down
Effects
- Begin on higher cortical structures
- Decreased inhibition
- Then reduces lower cortical structures
  - Shuts down the cerebellum
  - Poor motor control
- Effects go from newer evolutionary structures to older structures
- Eventually, you depress older brain structures (e.g., medulla)
  - .3 Most people are passed out
  - .4 Most people die

Tolerance
- Drugs increase or decrease the cell functioning
- Cell compensates by speeding up or slowing down depending on the drug
- Result – need more of the drug to get the same effect.
  - Takes time. Is not an instantaneous process.
  - Reason you can now drink a half case of beer and not feel drunk.

Withdrawal
- Cell has speeded up or slowed down to compensate for the drug.
- Drug stops being taken
  - Most drugs are metabolized by the body within 24 hours
  - Result, drug is gone but the body had not returned to the non drug state
    - Get opposite effect of what the drug did.

Example
- Methamphetamine
  - Is a stimulant
  - Neuron compensates by slowing
  - Metabolize the drug
  - No drug in the system
- Behavioral effects
  - Lethargy
  - Depression
  - Things don’t seem normal
- Consequence, use methamphetamine to feel normal
- Similar results for other drugs

Different Categories of Drugs
- Stimulants: Cocaine, Methamphetamine
- Sedative / Hypnotics: Phenobarbital
- Inhalants: Glue, Gasoline
- Hallucinogens: LSD, PCP, DMT
- Opiates: Heroin, Morphine
- Others: Sage

How Drugs Work
- Opiates block receptors.
  - Cause you to feel good
- Inhalants
  - Cause anoxia
  - Shut down oxygen to the brain
- Depressants
  - Bind on the GABA receptor
  - Causes chloride to enter the presynaptic elements of excitatory neurons.
  - Stops the action potential of excitatory cells.
More Drugs

- Stimulants (Cocaine, Methamphetamine)
- Cause two effects
  - Causes a surge of dopamine to be released from dopamine neurons. Hit
  - Stops the reabsorption of Dopamine into presynaptic elements. Prolonged stimulation
- Result
  - Feel excited, euphoric, etc.

Structures

Positron Emission Tomography (PET)