Lecture 3
Psych 210
Drugs, Drugs, and More Drugs

**Chemical Messengers**

<table>
<thead>
<tr>
<th>Act on neurons</th>
<th>At one synapse</th>
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**Neuromodulators**

<table>
<thead>
<tr>
<th>Act on</th>
<th>of neurons</th>
<th>May not be in the</th>
<th>of where they were released</th>
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| Act on neurons | from their point of release | May enter blood flow |

**Properties of Neurotransmitters**

Must be | within the neuron |

Released in response to an | |

Can experimentally duplicate the action of a NT on a | |

There is some mechanism that will | of the NT on the postsynaptic cell |

**Types of NTs**

**Small-molecule transmitters**

Neuropeptides | of amino acids |

**Small molecule NTs**

Acetylcholine (ACh) |

Indoleamines |

ATP and byproducts |

**Cholinergic Neurons**

Use ACh as their major NT

Acetylcholinesterase

Released into the synaptic cleft to |

Found at | junctions |

Also found in the brain in lower level structures

Believed to be involved in learning and memory |

**Cholinergic Neurons**
Two main types

___________ receptors
  Reacts to both ACh and nicotine
  ionotopic

___________ receptors
  Reacts to both ACh and muscarine
  Found in ___________________________
  metabotropic

**Action of NTs at synapse**
Can be either _________ step or _________ steps
  ___________: single step
  NT binds to channels and opens them

**Metabotropic receptors**

________________________
  NT binds to receptor- triggers G protein to bind to _____________ and open it

**Catecholamines and Indoleamines**
Both are monoamines

Catecholamines
  _____________
  ____________
  Epinephrine

__________
  ____________
  Indoleamines

__________
  ____________
  Melatonin

**How to make catecholamines**
Tyrosine (an amine acid)
Turns to L-Dopa
Turns to ____________
Turns to Norepinephrine
Turns to ____________
They all have the same starting material
  They’re just different steps in the process
  Steps occur when enzymes are added to the molecules

**Dopaminergic Neurons**
Use dopamine
3 main pathways
  Substantia nigra-basal ganglia
    ____________
    Parkinson’s disease
  Midbrain- limbic system (hippocampus, amygdala, nucleus accumbens)
May play a role in addiction

Midbrain-frontal lobe
Higher level cognitive functions
Planning behavior

**Norepinephrine and Epinephrine**

Act on noradrenergic and adrenergic receptors
   Named this because epinephrine used to be called adrenaline
Both are NTs and __________
Norepinephrine
   Important for ___________ and focus
   Important in sympathetic nervous system
Epinephrine
   Important for ________________
   Also important in sympathetic nervous system
Side note: ACh is the NT for the ______________ nervous system

**Catecholamines**

Many types of receptors
At least 5 different _____________ receptors
At least 4 different receptors that respond to both norepinephrine and epinephrine
All are _____________

**Indoleamines**

Tryptophan – 5HTP – Serotonin - Melatonin
Serotonin
   __________throughout the brain, few in number
   Most use ___________ receptors
   Important for sleep, mood, and __________
Melatonin
   Secreted by the pineal gland
   Acts on metabotropic receptors
   Important for ________________

**Amino acid neurotransmitters**

Eight identified amino acid NTs
   ___________ and ___________ most important
Glutamate is the most used ___________ NT in the CNS
GABA is the most used ___________ NT in the CNS

**Glutamate**

An amino acid
   Synthesized from glutamine
   Works on both __________ and __________ receptors
   3 major ionotropic receptors
AMPA
Kainate

**NMDA**
Both voltage dependent and glutamate dependent
Usually located near AMPA receptors
_________depolarizes the postsynaptic cell
  Raises the voltage for the NMDA receptors
_________responsible for blocking the NMDA receptors until high enough voltage
NMMDA allows both ______________________to enter
Ca^{2+} causes long term changes in the cell
  Thought to be involved in long term memory

**GABA**
Synthesized from __________
Two different GABA receptors
  One ionotropic, one metabotropic
Works by allowing ______to enter the cell or allowing ______to leave the cell

**ATP**
Involved in ______________________
Major byproduct adenosine is also a NT
Acts upon autonomic nervous system
  Vas deferens, __________, heart, gut
Frequently coexists with other enzymes
Also the bodies major source of __________

**Neuropeptides**
Chains of amino acids
Over 40 different types of neuropeptides that are NTs
Can be both __________and NTs
Reuptake from the synaptic cleft is quite slow
Ex. Insulin
  Involved in digestion and is also a NT

**Drugs, Drugs, and More Drugs**
Agonists
_________the activity of the NT
Antagonists
_________the activity of the NT
Don’t think of agonists and antagonists in terms of inhibition and excitation
An agonist to GABA __________the inhibition of the postsynaptic cell

**Different Effects of Drugs**
NT __________
Can reduce or enhance the amount of NT produced
Either reduces or enhances the action of that NT, respectively
If it interferes early enough, it could effect multiple NTs (ie the dopamine, norepinephrine, epinephrine sequence)

NT ___________
Can reduce the amount of NT stored
Causes less NT to be available for release

NT ___________
Can promote or prevent exocytosis (NT release)
Agonists promote
Antagonists prevent

Different Effects of Drugs
Receptor Effects
_________the action of NTs
__________: act just as the NT would, activating the receptors
__________: bind to the receptor without activating it, but blocking the NT from binding

Reuptake Effects
Reuptake __________
Attack the enzymes responsible for the deterioration of NTs in the synaptic cleft

Examples: Effects on NT Production
Increasing dairy intake leads to an increase in tryptophan levels
Leads to an increase in ___________levels

AMPT
Interferes with the activity of tyrosine hydroxylase
Leads to a decrease in the amount of ____________, norepinephrine, and epinephrine

Examples: Effects on NT Storage
Reserpine
Used to lower blood pressure
Interferes with the uptake of monoamines into ________________
Has lead to ___________
Rarely prescribed now

Examples: Effects on NT Release
Black widow venom
An ___________: leads to an increase in ACh release
Leads to overstimulation of muscle fibers and convulsions- leads to the neuron “running out” of ________________

Botulin
An ___________: leads to a decrease in ACh
Leads to paralysis
Examples: Effects on NT Receptors
Curare
Used on arrowheads and darts
Occupies nicotinic ___________receptors and leads to paralysis

Examples: Effects on NT Reuptake
Dopamine reuptake inhibitors
Cocaine, _____________, Ritalin
Serotonin reuptake inhibitors
___________
More on this later in the class

Basic Principles of Drug Effects
Drugs may or may not have different effects depending upon their
_________________________________
Frequently the level of drug in the body is different based upon the method of
administration
Also, different side effects may occur
Cocaine
Ingesting may cause ________________
___________causes nasal problems, such as nose bleeds, problems
swallowing etc
___________may cause liver problems and allergic reactions

Placebo Effects
When pharmaceutical companies _____________________, must worry about placebo
effects
When patients are told they are getting a new depression drug,
______________________rise and may contribute to a lessening of the depression
(before the drug even takes effect)
Give subjects a ___________instead (sugar pills, saline)
Don’t tell subjects whether they are receiving the drug or the placebo
Controls for placebo effects

Experimenter Effects
Some doctors may view a subject as less depressed if on the drug than if not
Power of ______________
Studies are frequently run as _____________________
Neither the subject nor the experimenter knows whether the subject is getting the
placebo or the drug
Records are kept by a _____________________that doesn’t have contact with
the subjects

Tolerance
Changes in the body’s response to the drug to maintain a
ie. If a drug causes an increase in heart rate, the body may prepare for the
drug by ________________________________
This causes users to gradually increase the amount of the drug to get the
same effects

Interesting Note about Tolerance
Imagine that every day for a year you injected heroin in your arm at 5:45 outside of the
door before this class
As the year went on, you would progressively need __________________ heroin to
get the same effect (tolerance)
One day, ___________________________ and injected heroin in front of your
neighborhood McDonalds instead
There is a very high danger of ____________
Why?

Why is there a higher danger of overdose?
Because your tolerance is not just to the drug but to the _____________
Your body, when you see the classroom, begins to prepare for the drug well before you
bring out the needle
It sees the situation and knows _______________________________
Once the situation is changed, the body does not prepare itself as well, and your tolerance
is lowered
This leads to an ______________________________

Withdrawal
Similar to _____________
Occurs after a user stops using
Occurs because the body is trying to maintain a _______________________ and is
preparing for the drug (that never comes)

Addiction
Compulsive need for repeated use of the drug
Linked to __________________________
    Dopamine
    Nucleus ______________
Some drugs __________________________ this circuit
    LSD- no strong addictions usually

Addiction
Removal of __________________________ or damage to this dopaminergic circuit leads to
reductions in addiction
    Not a viable option for treating addicts
    May lead to __________________________

Treatment
Very hard to end an addiction
“Once you’re an alcoholic _________________________”
Relapses are ______________________
Multistep programs addressing many different areas seem to be _________________

**Treatments**

__________ are being developed to try and help addicts
may cause __________________ when addict takes the drug
   Unpleasant effects become ___________________________ and the addict quits
May __________________________ from working
   The addict ______________ in taking the drug

**Types of Psychoactive Drugs**

**Stimulants**

__________

________________________________

Alcohol

**Stimulants**

Typical Effects
   Increase ______________
   Increase blood pressure
   Increase ________________
   Increase concentration
   Increase ________________

**Stimulants**

Caffeine!!!!
   Mechanism not completely understood
   ______________ to adenosine
   Adenosine is an _______________________
      Causes a slowing down of neuronal response
      ACh and dopamine neurons
      May cause an increase in reward feelings, arousal, and reaction time
   Caffeine use is actually correlated with decreases in __________________________

**Stimulants**

Nicotine
   Acts upon ___________________________________
   50% of cigarettes consumed are by people with mental disorders
   May be __________________________
   May also be that ________________________ to mental disorders

**Implications of Smoking on Nicotinic Receptors**

An ________________ receptor
   Smokers report an increase in functioning capabilities
Increase in _______________
Memory functions
Nicotine may be a substitute for ACh but ____________________________
After longer use, nicotine actually ____________________________

**Stimulants**

Cocaine
  Works as a ____________________________
Amphetamine
  Stimulates dopamine and norepinephrine (at dopaminergic neurons) release and 
  ____________________________
Very addictive: due to their power on the ____________________________
  A single dose could cause addiction in mice
May lead to ____________________________
  May be due to an overstimulation of the sensory systems

**Stimulants**

Ecstasy
  Aka __________
  Relative to amphetamine
  Stimulates the release of ____________________________
  ________________ serotonin synapses and may lead to the death of serotonin 
  receptors
    Since serotonin is one of the main mechanisms for happiness, prolonged 
  ecstasy use leads to ________________

**Effects of ecstasy on the brain**

*GET FROM BAW LECTURE*

**Opiates**

Typical Effects
  ____________________________
  Relaxation
  ____________________________
  Endorphines
Natural opiates

**Morphine**

Mechanisms of action are unclear
  Opiates have their own receptors
Recent evidence points to increasing the ____________________________
  Leads to feelings of ____________________________
When coupled with magnesium, ________________ appear to be blocked
  MAY lead to the pain relieving effects found
__________________________ is a relative to morphine
  Has similar effects
Not quite as strong

**Heroin**
Heroin is actually a ____________
  It is inactive as a drug in its ______________
Once in the body, it is metabolized into ____________

**Hallucinogens**
Marijuana
  A ______________ at high levels
  May cause excitation and euphoria or ______________
  Contains over sixty different psychoactive substances
_Amanita_ Mushrooms
  __________________________
_Lysergic Acid Diethylamide_
  Similar to ______________
  Produces feelings of pleasure
  Mechanism for hallucinations not understood

**Alcohol**
  ____________ blood vessels
Relieves anxiety
Reduces ______________
Works at ______________ receptors, ____________ receptors, NMDA receptors
Tolerance develops very quickly
Great effects in the ____________
  Leads to movement deficits

**Presence and severity of characteristic withdrawal symptoms**
  ____________: A measure of the substance's ability, in human and animal tests, to get users to take it again and again, and in preference to other substances.
  ____________: How much of the substance is needed to satisfy increasing cravings for it, and the level of stable need that is eventually reached.
  ____________: How difficult it is for the user to quit, the relapse rate, the percentage of people who eventually become dependent, the rating users give their own need for the substance and the degree to which the substance will be used in the face of evidence that it causes harm.
  ____________: Associated with addiction and increases the personal and social damage a substance may do.