How the Brain Works
Background: The Synapse
Receptors:

Excitatory: Sends signals (action potentials)
Inhibitory: Blocks signals

Drugs, neurotransmitters, and other ligands:

Agonists: Stimulate receptors, mimic the neurotransmitter
Antagonists: Block receptors
Agonists and Antagonists

Neurotransmitter

Agonist (drug)

Antagonist (drug)
Little quiz

What would each of the following do?:

<table>
<thead>
<tr>
<th></th>
<th>Excitatory receptor</th>
<th>Inhibitory receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agonist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antagonist</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Little quiz

What would each of the following do?:

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<tbody>
<tr>
<td>Agonist</td>
<td>+++  More signal</td>
<td>---  Less signal</td>
</tr>
<tr>
<td>Antagonist</td>
<td>---  Less signal</td>
<td>+++  More signal</td>
</tr>
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</table>
Example drugs

What would each of the following do?:

<table>
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<tr>
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<th>Inhibitory receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agonist</strong></td>
<td>+++ Nicotine</td>
<td>--- Alcohol</td>
</tr>
<tr>
<td><strong>Antagonist</strong></td>
<td>--- Benadryl, Dimetapp</td>
<td>+++ Caffeine</td>
</tr>
</tbody>
</table>
Glutamate

The most common excitatory neurotransmitter
Glutamate is released by 80% of neurons

Learning

Memory
GABA

The most common inhibitory neurotransmitter in the brain

Sleep
Muscle relaxation
Anxiety relief
Impairs memory
How drugs mimic neurotransmitters:
Drugs look like chemicals normally found in your body

GABA

Baclofen
GABA Agonist
(mimics GABA)

Vigabatrin
Inhibits GABA breakdown

Neurotransmitter

Drug

Drug
Norepinephrine

\[
\text{HO-} - \begin{array}{c} \text{NH}_2 \\ \text{OH} \\ \text{OH} \end{array} - \text{MO} 
\]

Fight or Flight

Increases heart rate

Excitement

Fear
Epinephrine and phenylephrine

Epinephrine
Adrenaline

Phenylephrine
Dopamine

The Salience Neurotransmitter

Rewards sex, eating

Increases alertness, happiness
Addiction

Do cocaine → Do more cocaine

Damage decision-making and reward-seeking parts of brain
Serotonin (5-HT)

The Satiety Neurotransmitter
Feelings of fullness, contentment
Relieves depression
Serotonergic drugs I

Serotonin

Dimethyltryptamine (DMT)

Ondansetron (Zofran)

Psilocybin
Sero
tonergic drugs II

Serotonin

Lysergic Acid Diethylamide
Cannabinoids

Marijuana mimics these molecules in the brain
Opioids

Morphine mimics these
Relieve pain and worry
Induce sleep
Slow digestive tract
Acetylcholine (ACh)

Nicotine mimics this
Alertness
Memory
Moves muscles
Causes secretions (saliva, sweat)
Dopaminergic and cholinergic drugs

Dopamine

Amphetamine

MDMA (Ecstasy)

Acetylcholine

Succinylcholine

Edrophonium
Histamine

Alertness
Itchiness
Rashes
Causes stomach acid secretion
Other small neurotransmitters

Adenosine

Melatonin

GHB

Glycine
Adenosine and caffeine

Adenosine

Caffeine