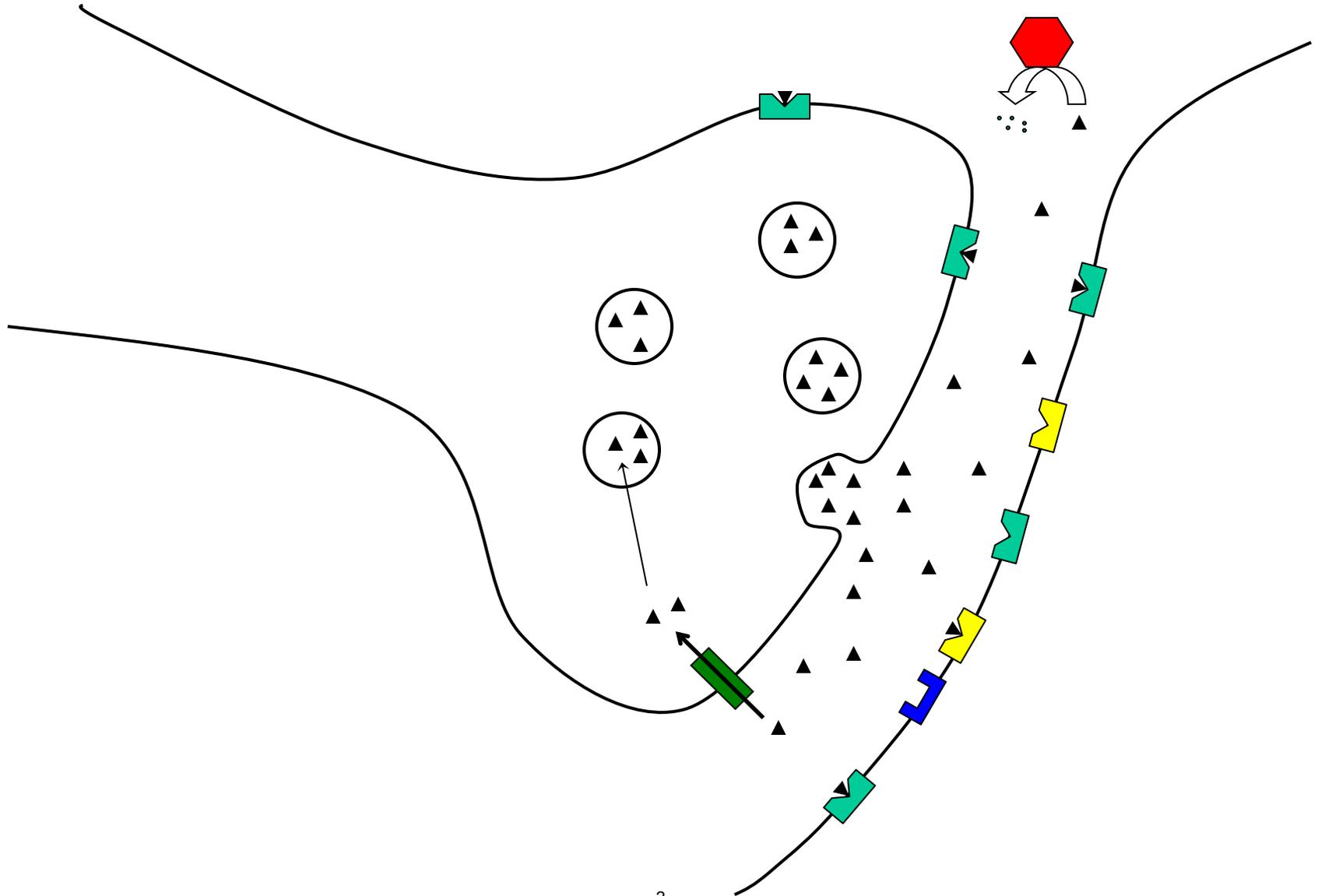


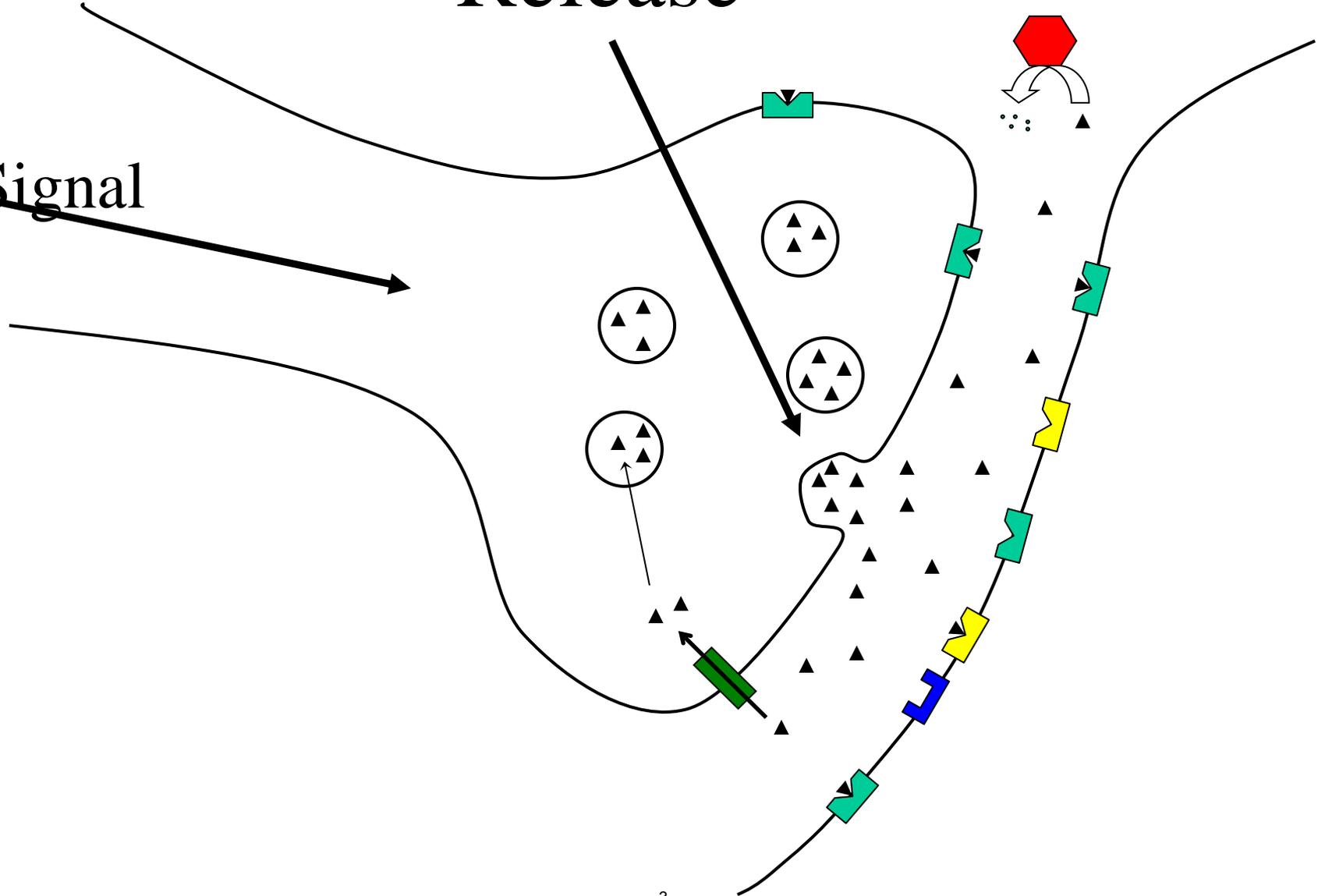
# How the Brain Works

# Background: The Synapse



# Release

Signal





## Receptors:

Excitatory: Sends signals (action potentials)

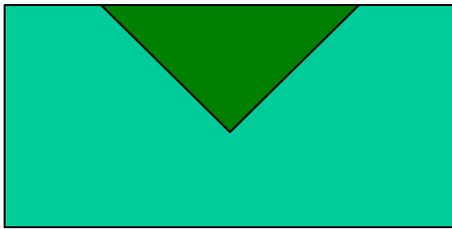
Inhibitory: Blocks signals

## Drugs, neurotransmitters, and other ligands:

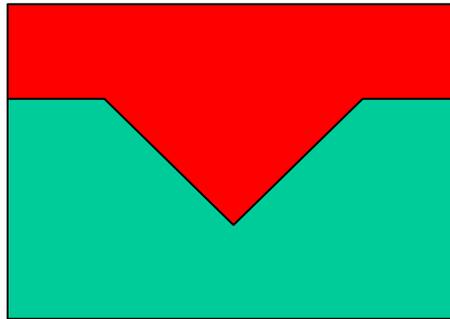
Agonists: Stimulate receptors, mimic the neurotransmitter

Antagonists: Block receptors

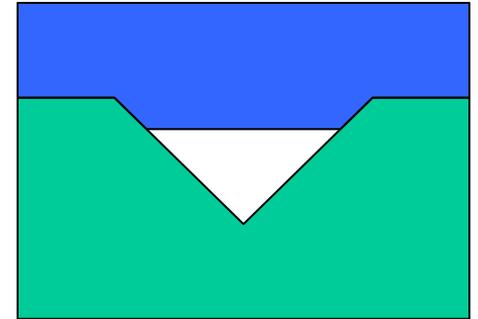
# Agonists and Antagonists



Neurotransmitter



Agonist (drug)



Antagonist (drug)

# Little quiz

What would each of the following do?:

	Excitatory receptor	Inhibitory receptor
Agonist		
Antagonist		

# Little quiz

What would each of the following do?:

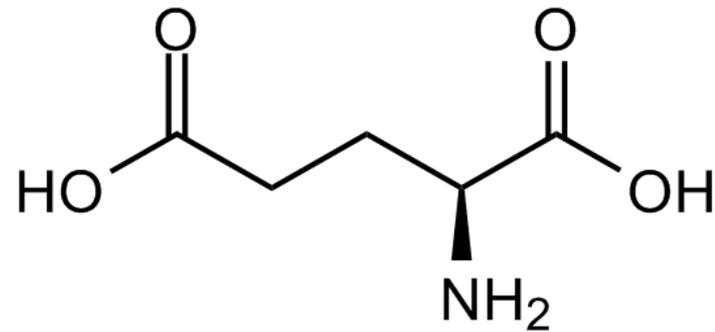
	Excitatory receptor	Inhibitory receptor
Agonist	+++ More signal	--- Less signal
Antagonist	--- Less signal	+++ More signal

# Example drugs

What would each of the following do?:

	Excitatory receptor	Inhibitory receptor
Agonist	+++ Nicotine	--- Alcohol
Antagonist	--- Benadryl, Dimetapp	+++ Caffeine

# Glutamate

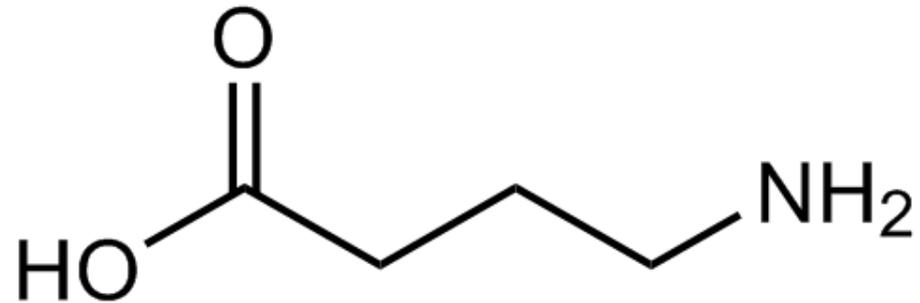


The most common excitatory neurotransmitter  
Glutamate is released by 80% of neurons

Learning

Memory

# GABA



The most common inhibitory neurotransmitter  
in the brain

Sleep

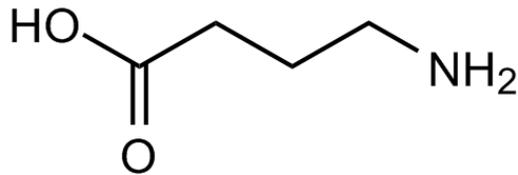
Muscle relaxation

Anxiety relief

Impairs memory

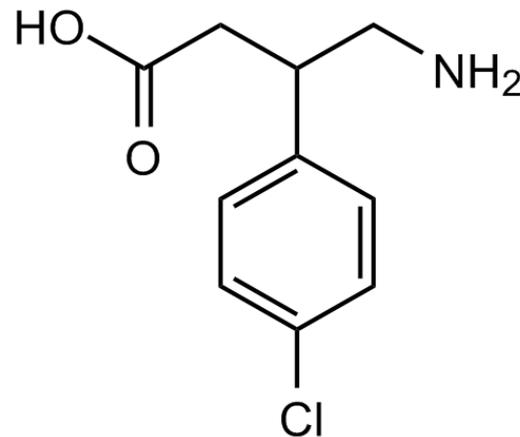
# How drugs mimic neurotransmitters: Drugs look like chemicals normally found in your body

GABA



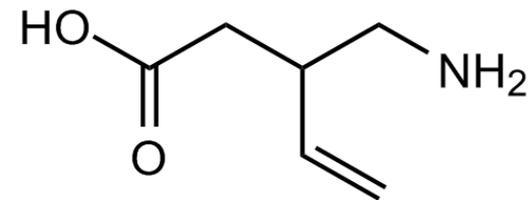
Neurotransmitter

Baclofen  
GABA Agonist  
(mimics GABA)



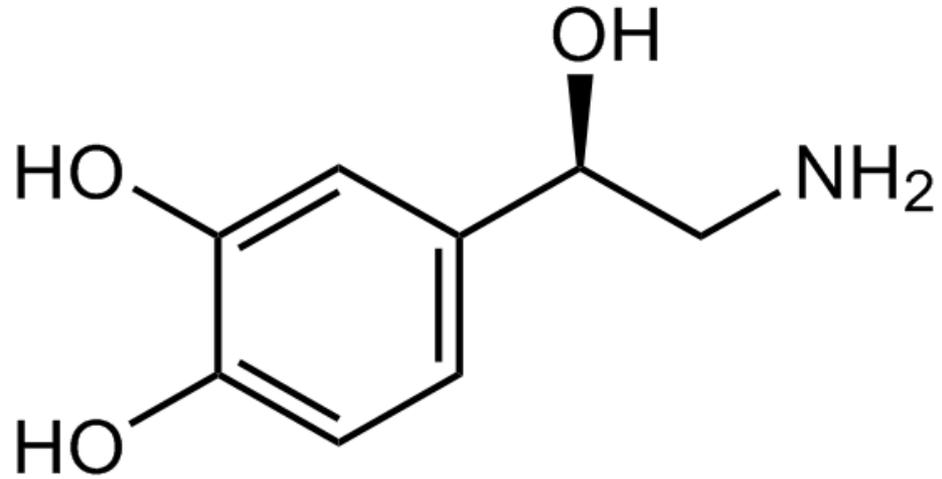
Drug

Vigabatrin  
Inhibits GABA  
breakdown



Drug

# Norepinephrine



Fight or Flight

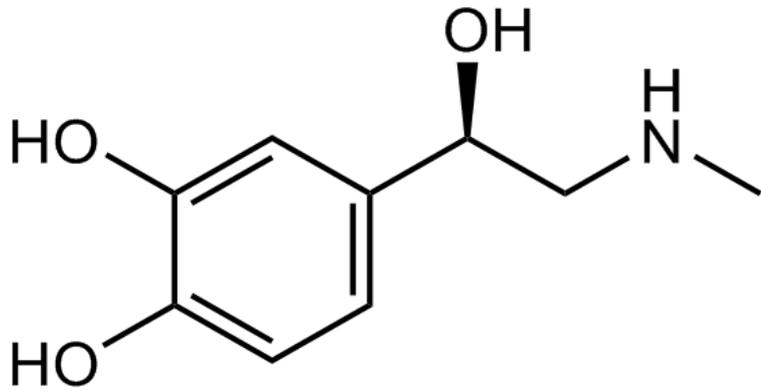
Increases heart rate

Excitement

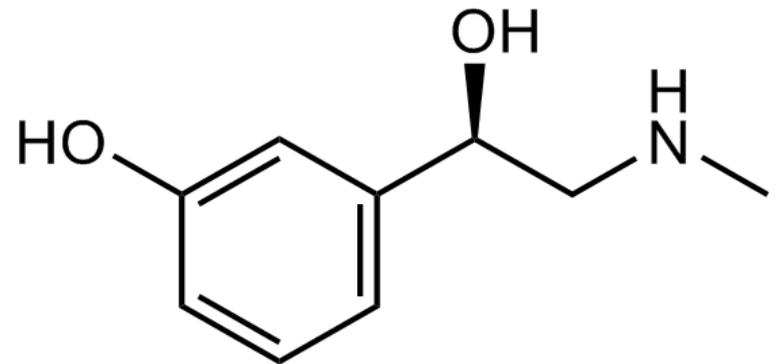
Fear

# Epinephrine and phenylephrine

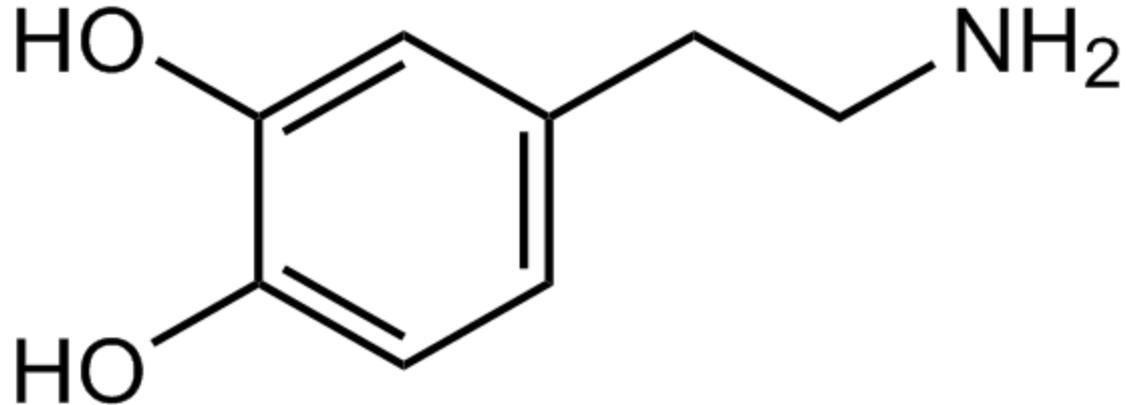
Epinephrine  
Adrenaline



Phenylephrine



# Dopamine

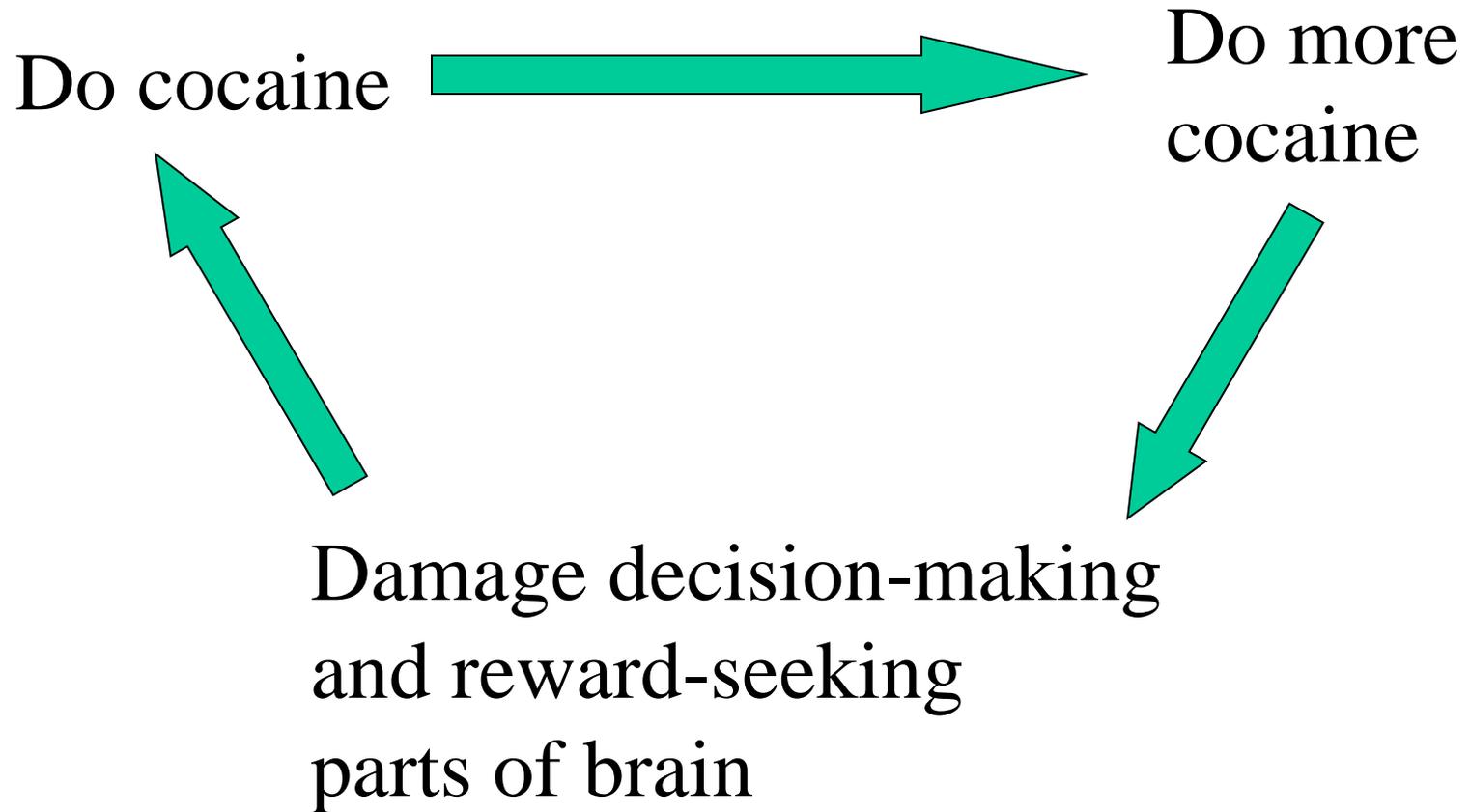


The Salience Neurotransmitter

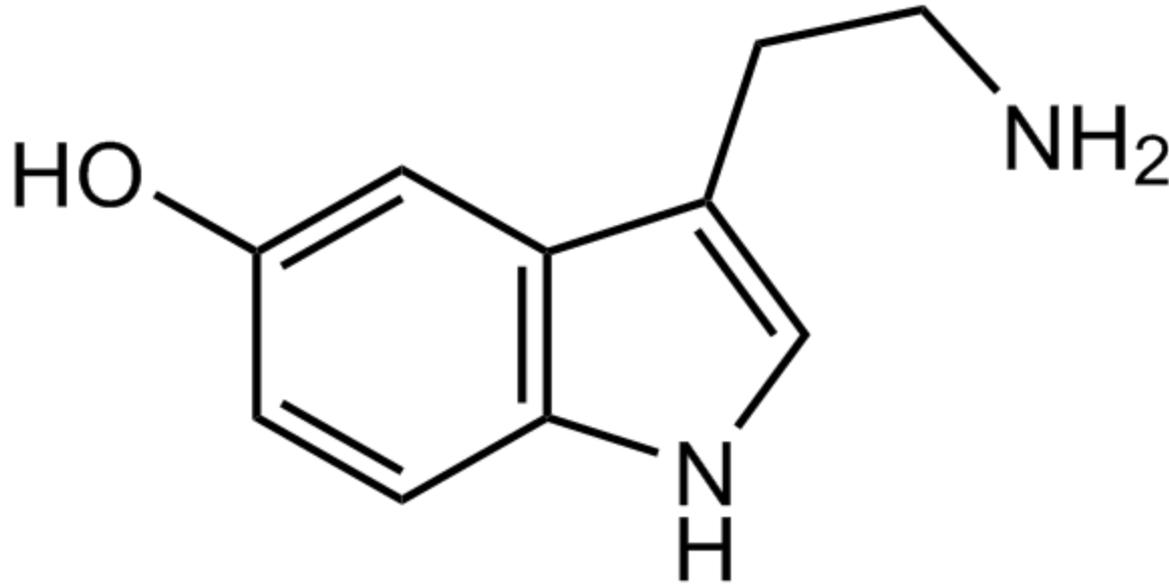
Rewards sex, eating

Increases alertness, happiness

# Addiction



# Serotonin (5-HT)



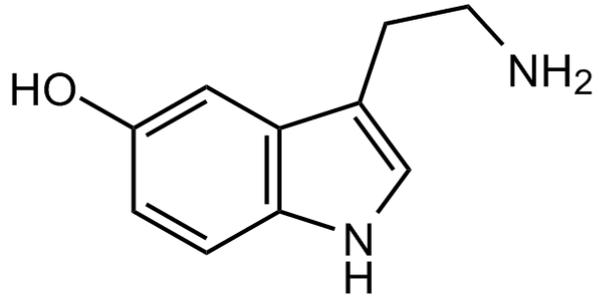
The Satiety Neurotransmitter

Feelings of fullness, contentment

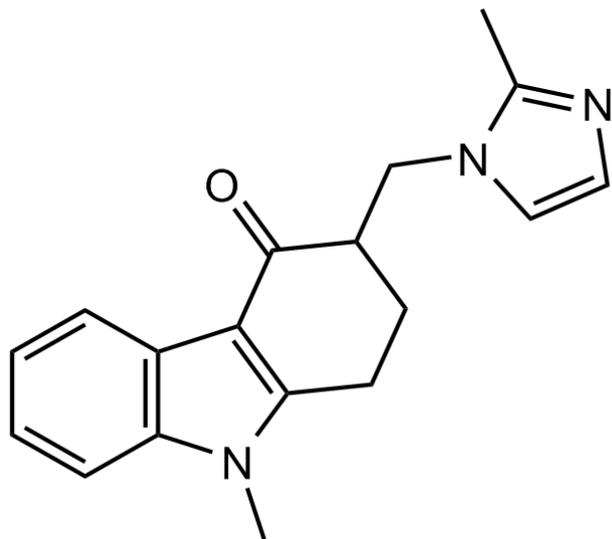
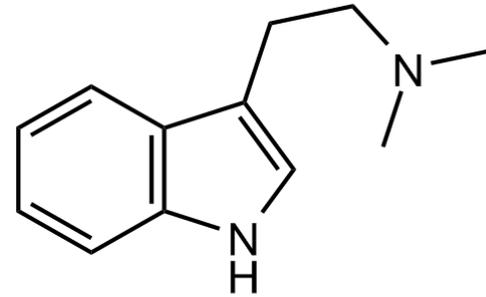
Relieves depression

# Serotonergic drugs I

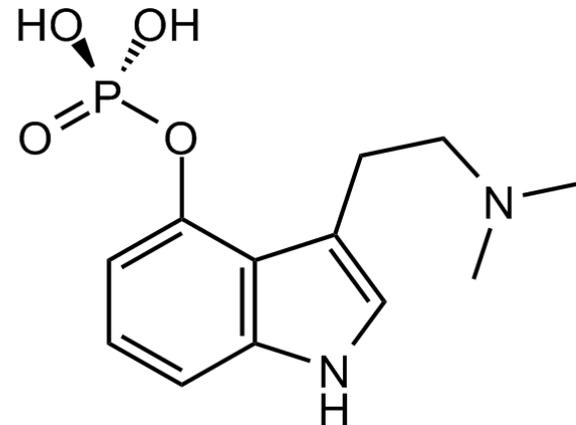
## Serotonin



## Dimethyltryptamine DMT

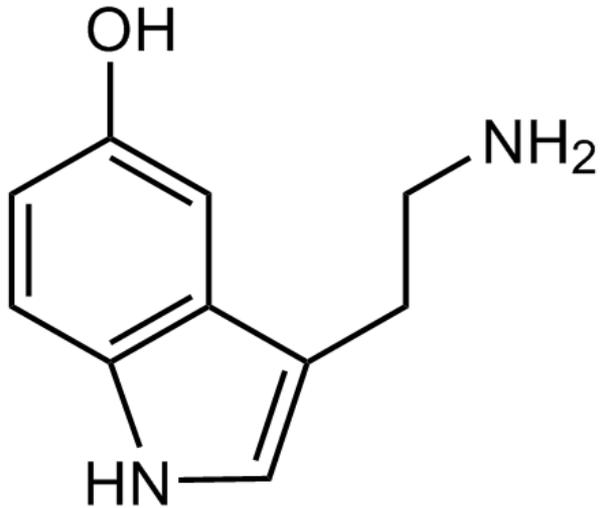


## Ondansetron Zofran

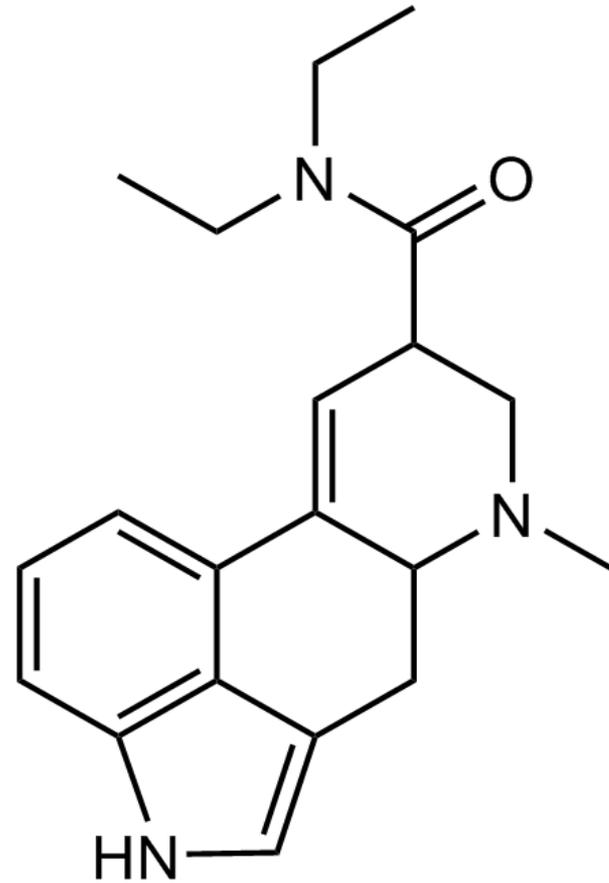


## Psilocybin

## Serotonergic drugs II

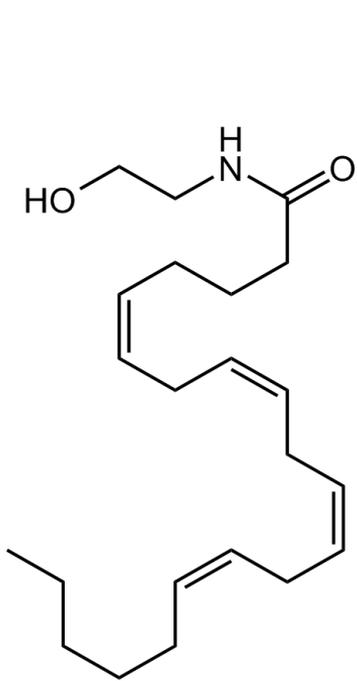


Serotonin

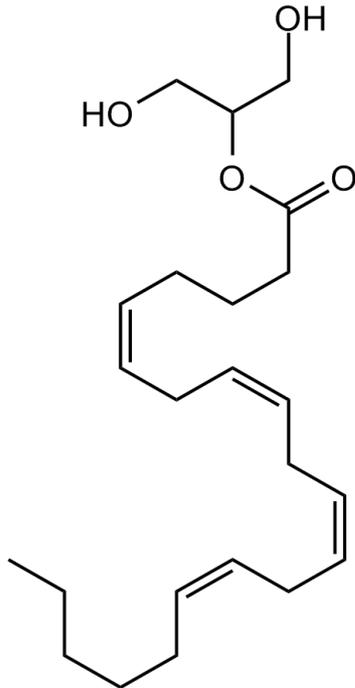


Lysergic Acid Diethylamide

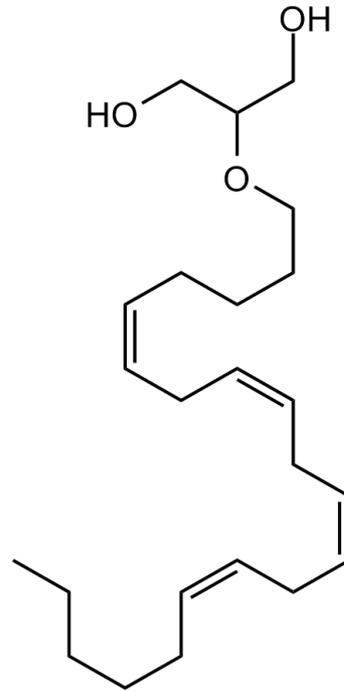
# Cannabinoids



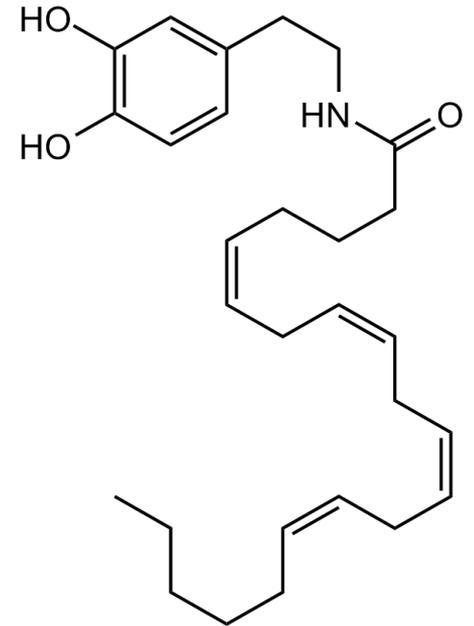
Anandamide



2-AG



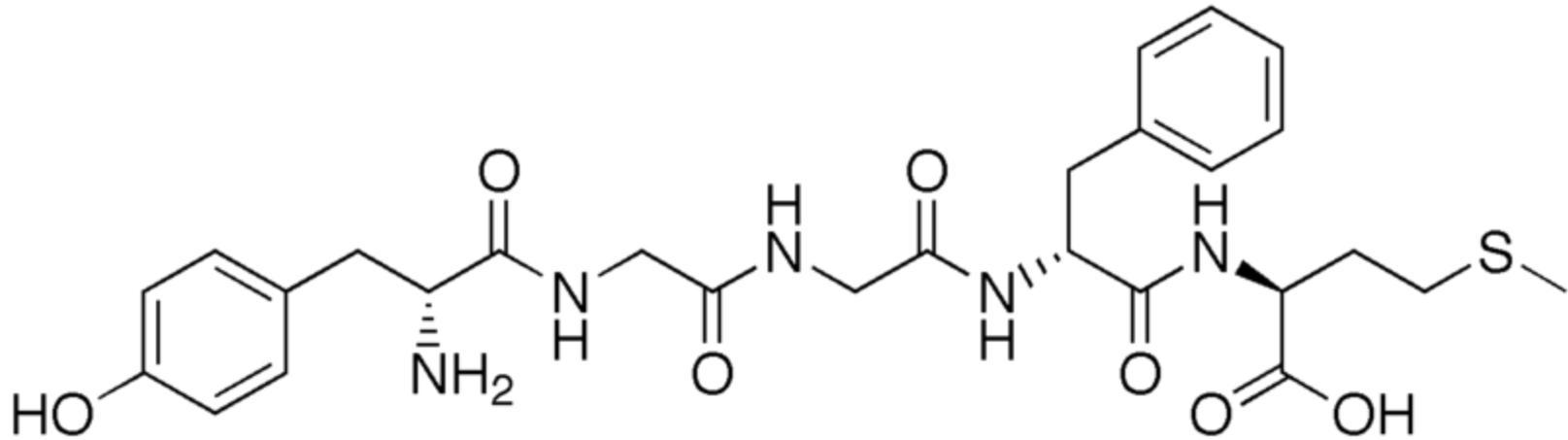
2-AGE



NADA

Marijuana mimics these molecules in the brain

# Opioids



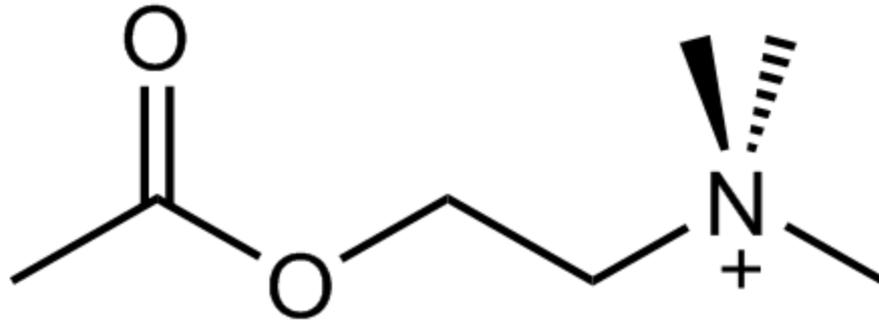
Morphine mimics these

Relieve pain and worry

Induce sleep

Slow digestive tract

# Acetylcholine (ACh)



Nicotine mimics this

Alertness

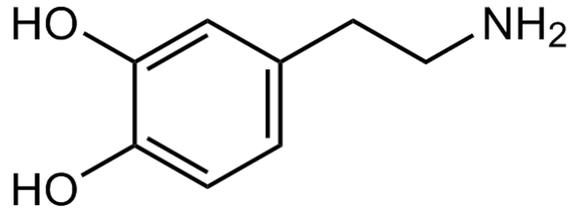
Memory

Moves muscles

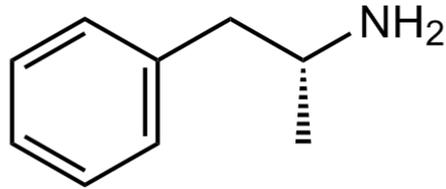
Causes secretions (saliva, sweat)

# Dopaminergic and cholinergic drugs

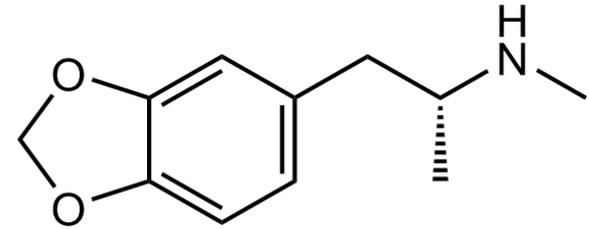
## Dopamine



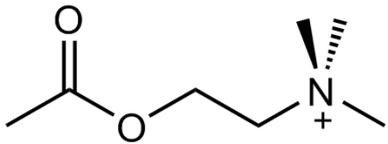
## Amphetamine



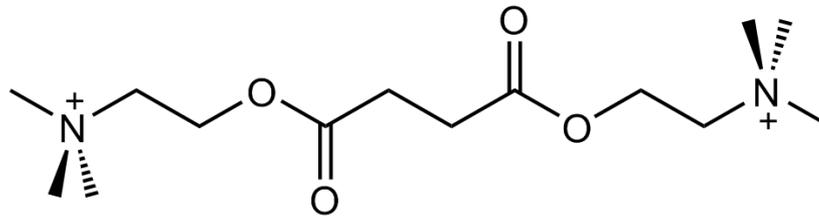
## MDMA (Ecstasy)



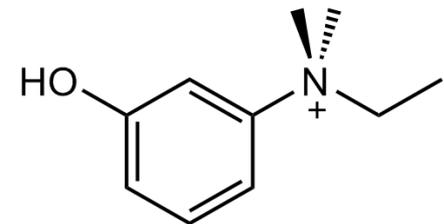
## Acetylcholine



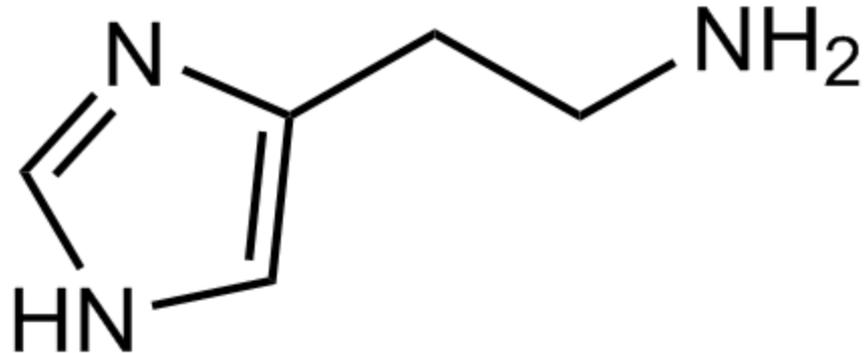
## Succinylcholine



## Edrophonium



# Histamine



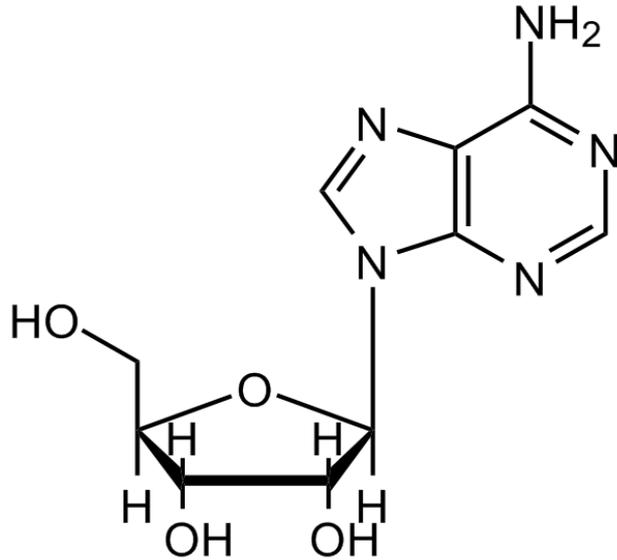
Alertness

Itchiness

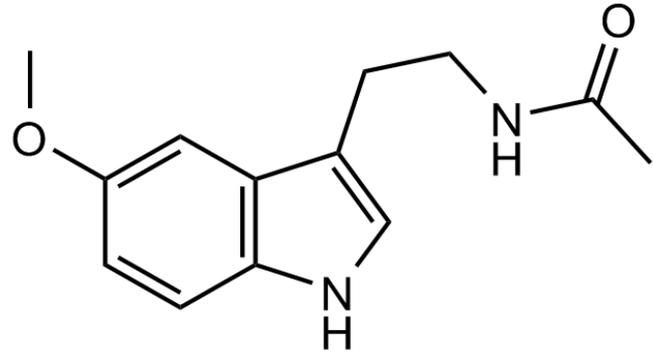
Rashes

Causes stomach acid secretion

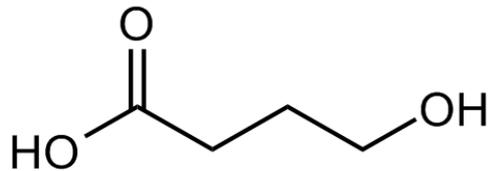
# Other small neurotransmitters



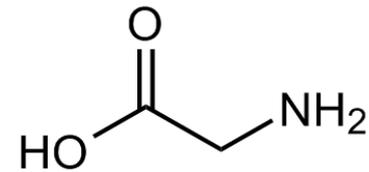
Adenosine



Melatonin

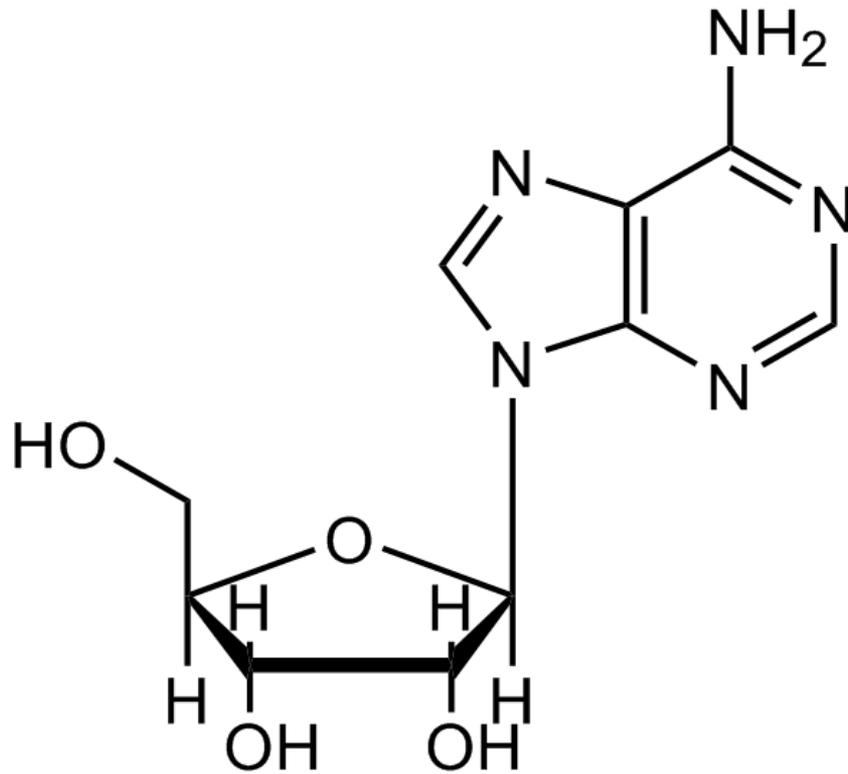


GHB

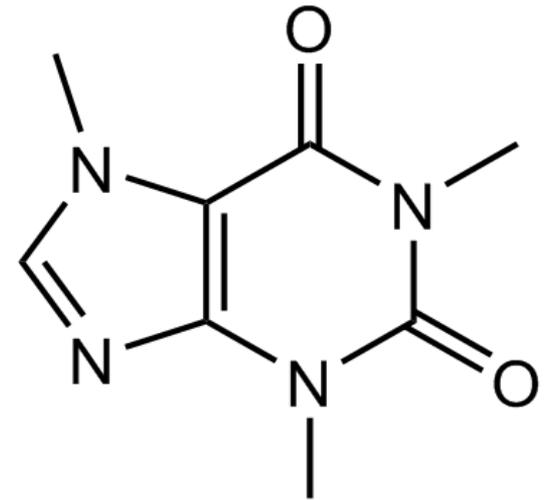


Glycine

## Adenosine



## Caffeine



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ES.S10 Drugs and the Brain  
Spring 2013

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