

# I Can Quit Anytime I Want



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# THE CASE

Ashley was a freshman at Llello University. Everything seemed great. Her grades were good, she had made some new friends, and she was crazy about her new boyfriend Sean. But today was different.

Ashley was lying face down on her bed when her roommate Sheila entered their room.

“What’s wrong?” Sheila asked.

“It’s Sean,” Ashley said through her tears. “You know how he’s been acting strange? Grades slipping? Those bloody noses? And his attitude? Well, I just caught him snorting cocaine. What an idiot!”

“He claims he can stop whenever he wants,” continued Ashley.

Sheila just shook her head back and forth.

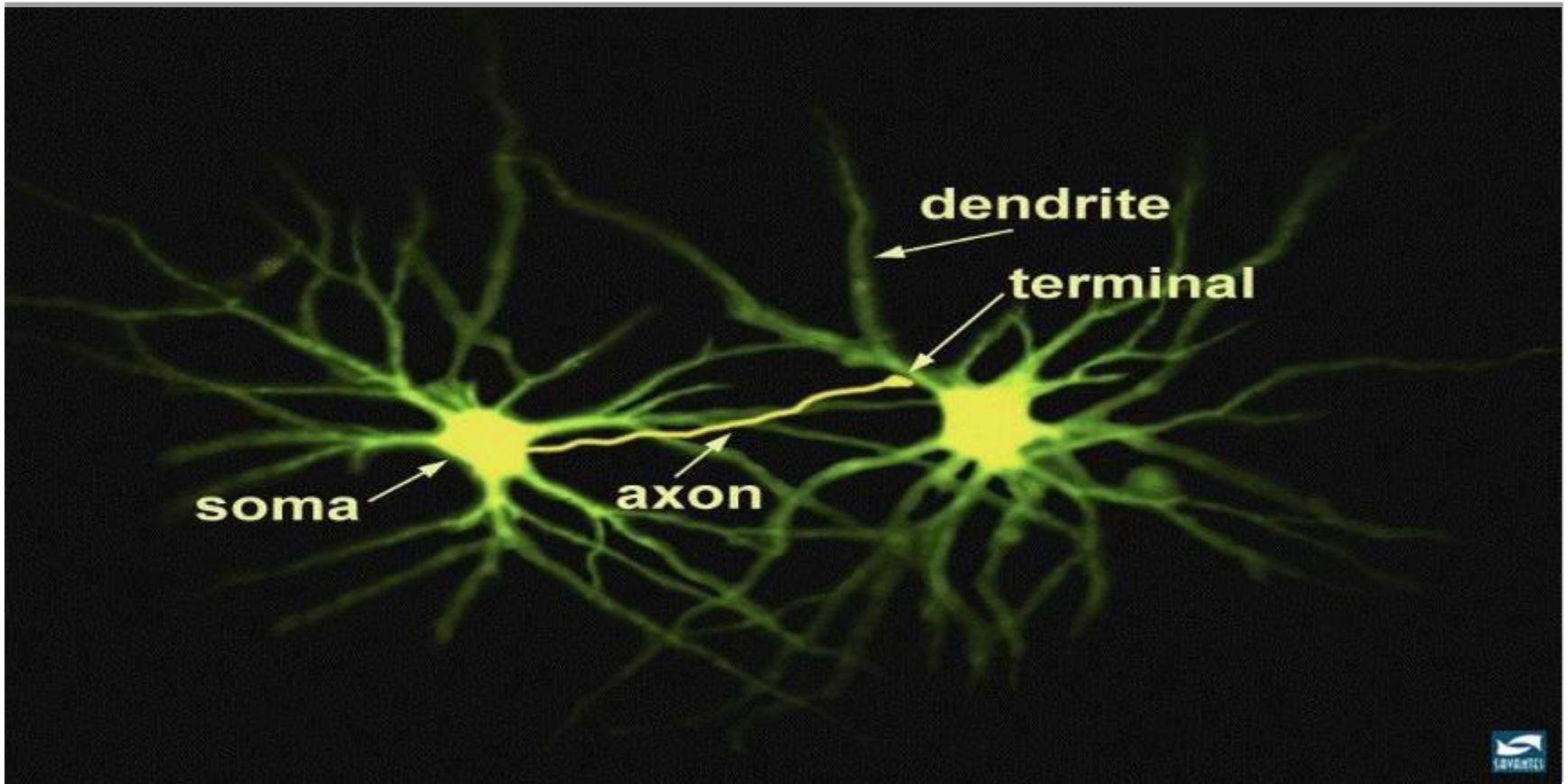
“Sheila, you’re majoring in biochemistry. Can you tell me what's going on inside my boyfriend?”

**CQ#1: Do you know anybody who is addicted to drugs or alcohol?**

A. Yes

B. No

Sheila explained: “A lot of it has to do with nerve cells in the brain.”



Nerve cells (also called neurons) use chemicals called neurotransmitters to communicate with other neurons, muscles, or glands.

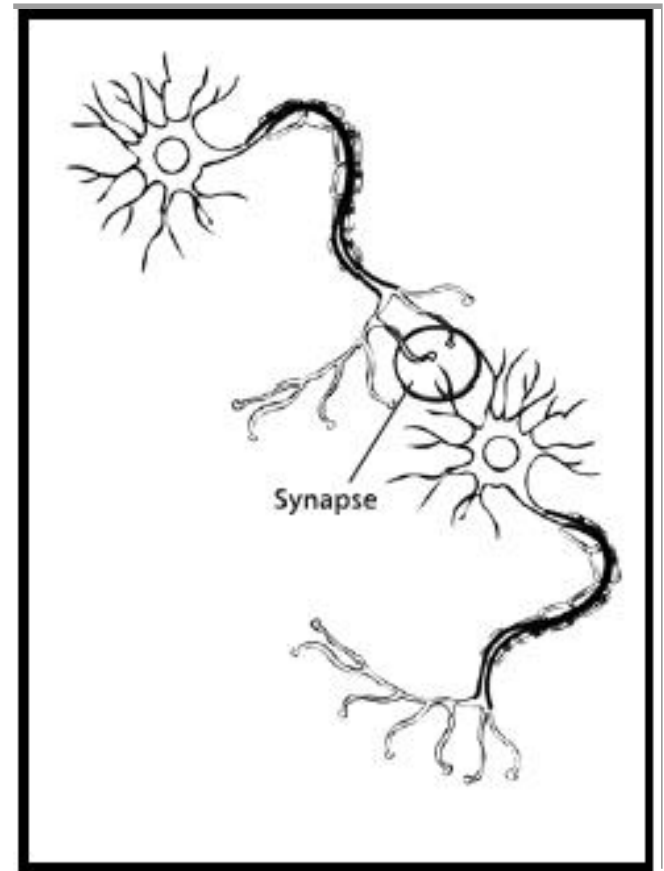
### Selected Neurotransmitters and Major Functions

|                |                               |
|----------------|-------------------------------|
| Acetylcholine  | Voluntary movements, learning |
| Dopamine       | Pleasure / rewards            |
| Norepinephrine | Stress and arousal            |
| Serotonin      | Mood regulation, sleep        |

When an action potential arrives at the end of an axon, a neurotransmitter is released into a synapse.

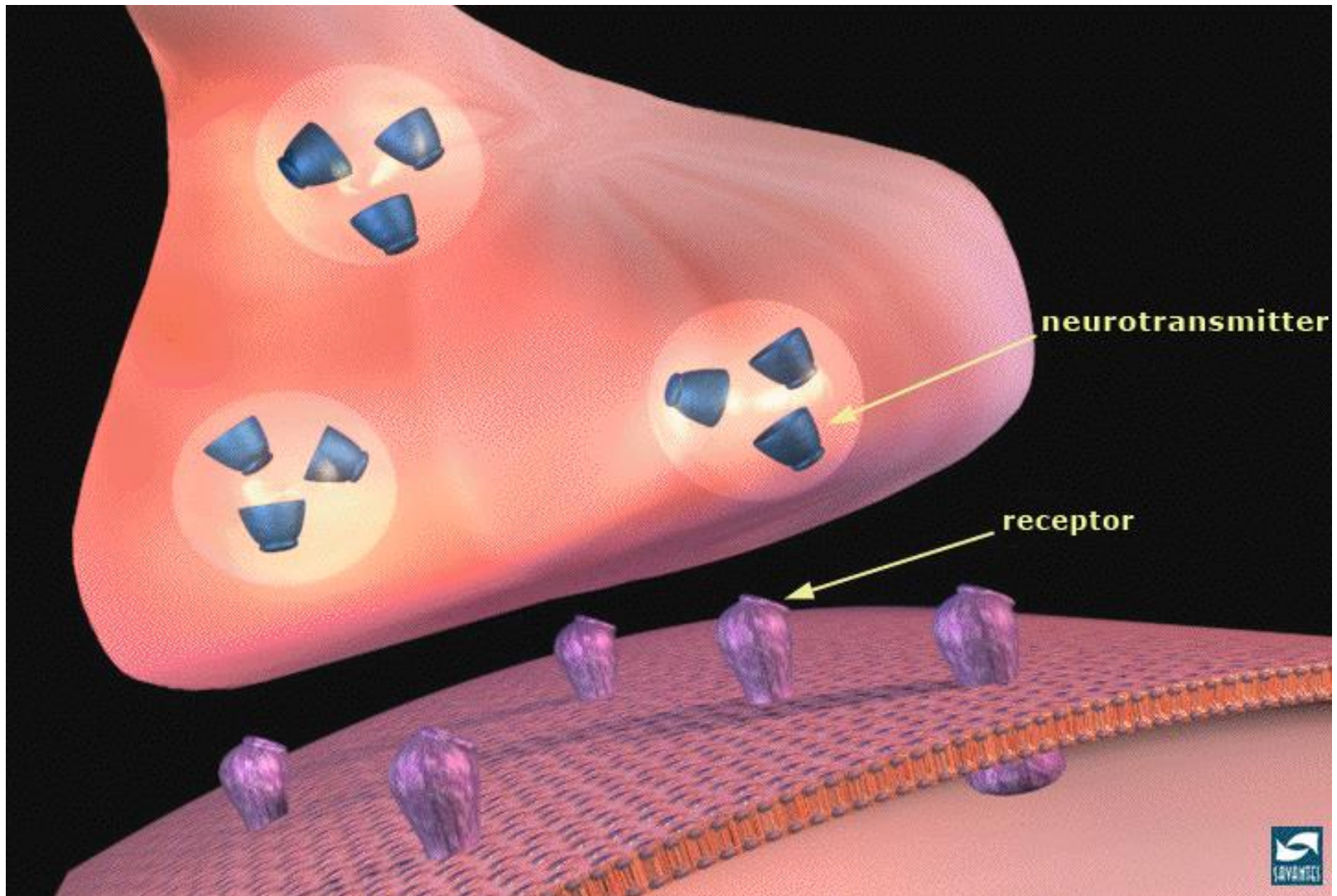
The neurotransmitter then binds to receptors on a post-synaptic neuron (or muscle or gland).

This may excite or inhibit the post-synaptic cell.





# Close-up of a Synapse





## Neuron Animation:

<http://www.pbs.org/wnet/closetohome/animation/neuron-main.html>

Next, the neurotransmitter must be removed from the synapse.

Enzymes may break down the neurotransmitter, or the neurotransmitter may be taken back up by the pre-synaptic neuron.

Acetylcholine is a neurotransmitter that stimulates muscle contraction. It is broken down in the synapse by the enzyme cholinesterase.

**CQ#2: What might be the result if a person was exposed to a substance that reduced the action of cholinesterase (e.g., nerve gas)?**

- A. Acetylcholine could not be released from a neuron.
- B. Muscles would be continually relaxed.
- C. Muscles would remain contracted.
- D. Acetylcholine could not bind to receptor sites.

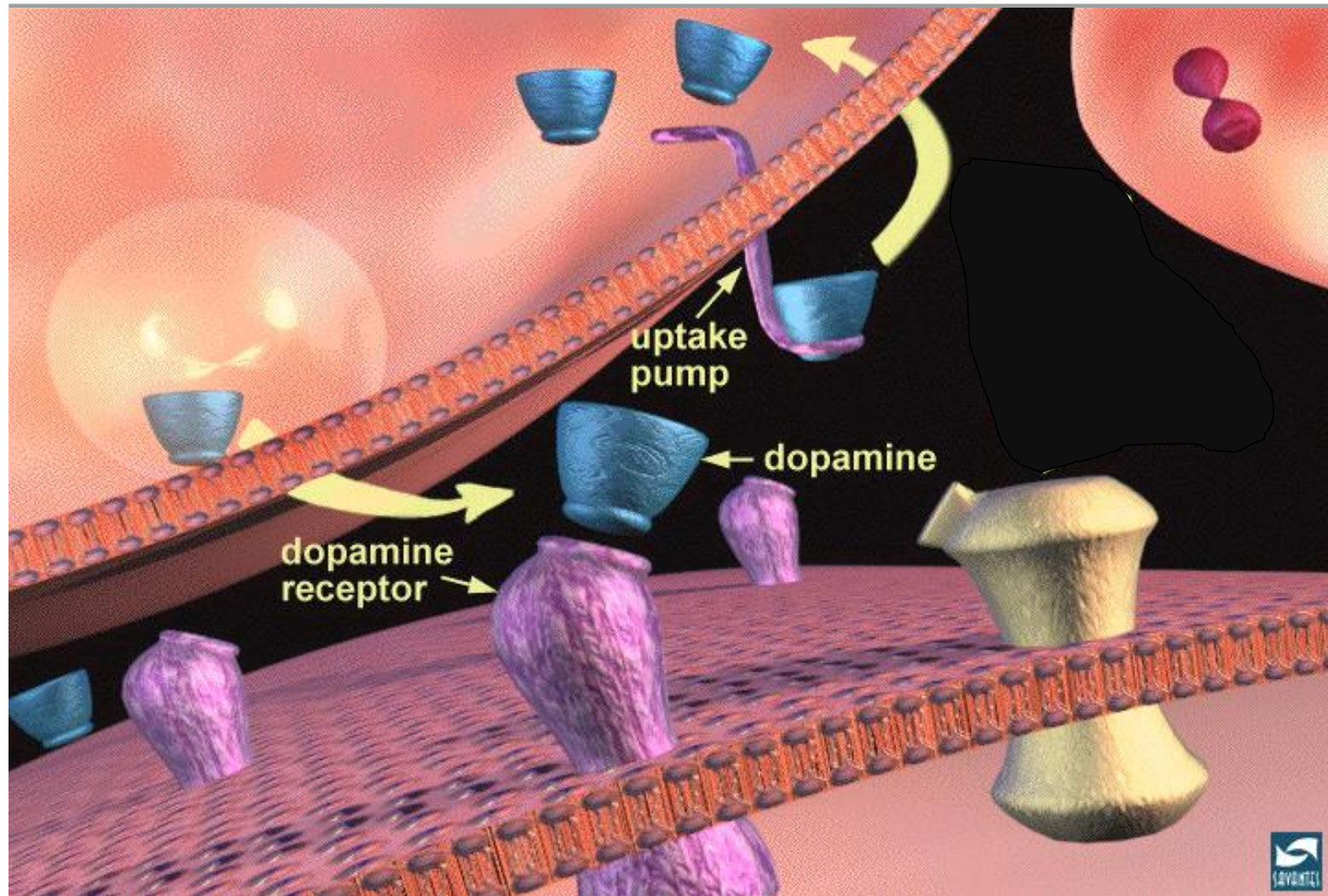
**CQ#3: Ashley thought acetylcholine was interesting, but she was more intrigued by dopamine. Dopamine is associated with:**

- A. Learning
- B. Hunger
- C. Stress
- D. Pleasure

Pleasurable stimuli such as eating a favorite food or sexual activity increase the release of dopamine.

Dopamine is then removed from a synapse by a different mechanism. It attaches to receptors on the presynaptic neuron and is taken back in.

# The Reuptake of Dopamine by a Presynaptic Neuron



“I could use a little extra dopamine right now,” Ashley muttered.

“Don’t even joke about that!” scolded Sheila. “Even though dopamine occurs naturally, substances like cocaine cause all sorts of problems.”



“Tell me about it,” replied Ashley. “Lately, Sean is so cranky all the time. The other day he screamed at me for the littlest mistake. He used to be such a nice guy. I think I am going to tell him that if he really cared for me, he’d quit using cocaine!”

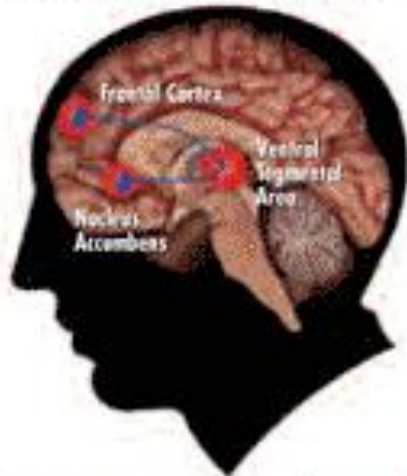
“If it were only that easy,” said Sheila.

“Why isn’t it?” Ashley demanded to know.

Cocaine is a substance that increases the amount of dopamine in the brain's reward circuit.

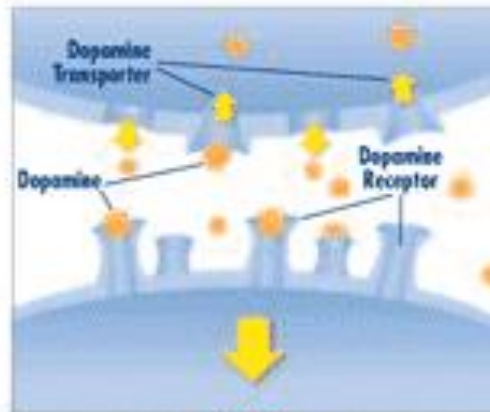
## ALL DRUGS OF ABUSE TARGET THE BRAIN'S PLEASURE CENTER

### Brain reward (dopamine) pathways



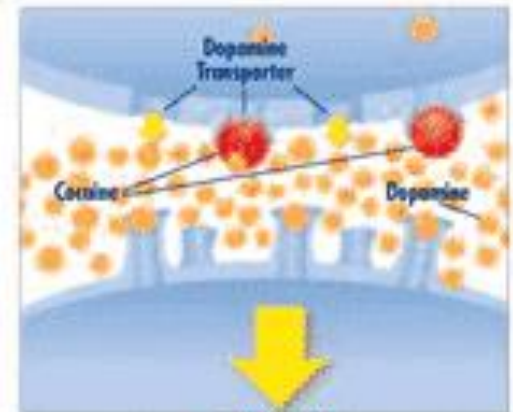
These brain circuits are important for natural rewards such as food, music, and art.

### All drugs of abuse increase dopamine



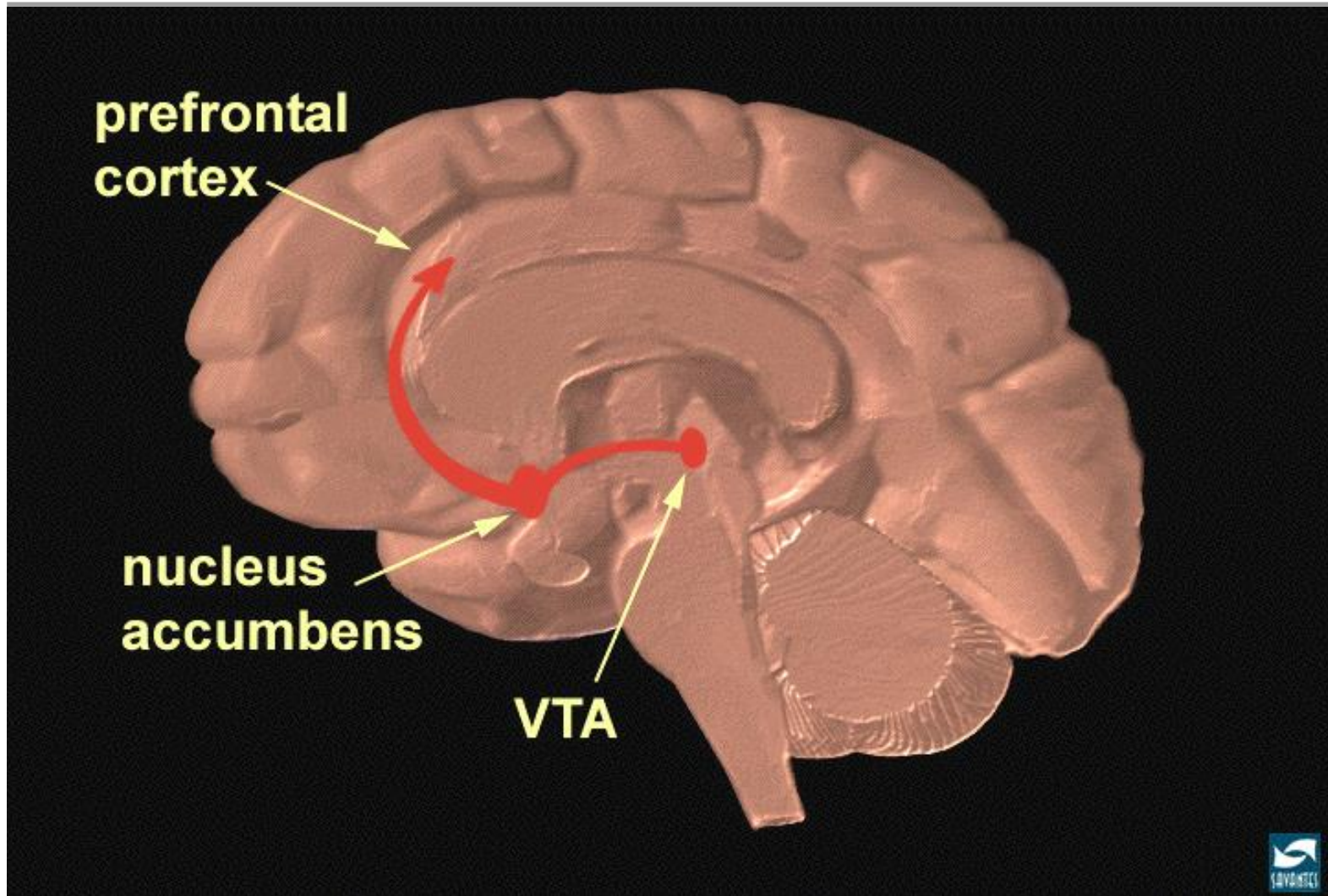
**FOOD**

Typically, dopamine increases in response to natural rewards such as food. When cocaine is taken, dopamine increases are exaggerated, and communication is altered.

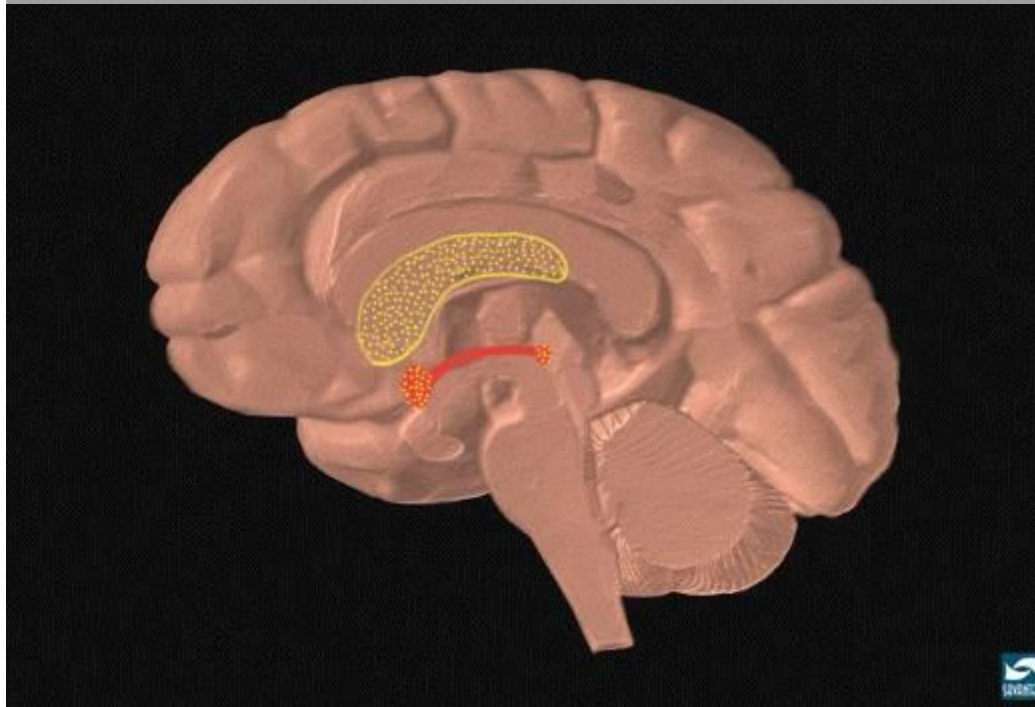


**COCAINE**

# The Reward Pathway



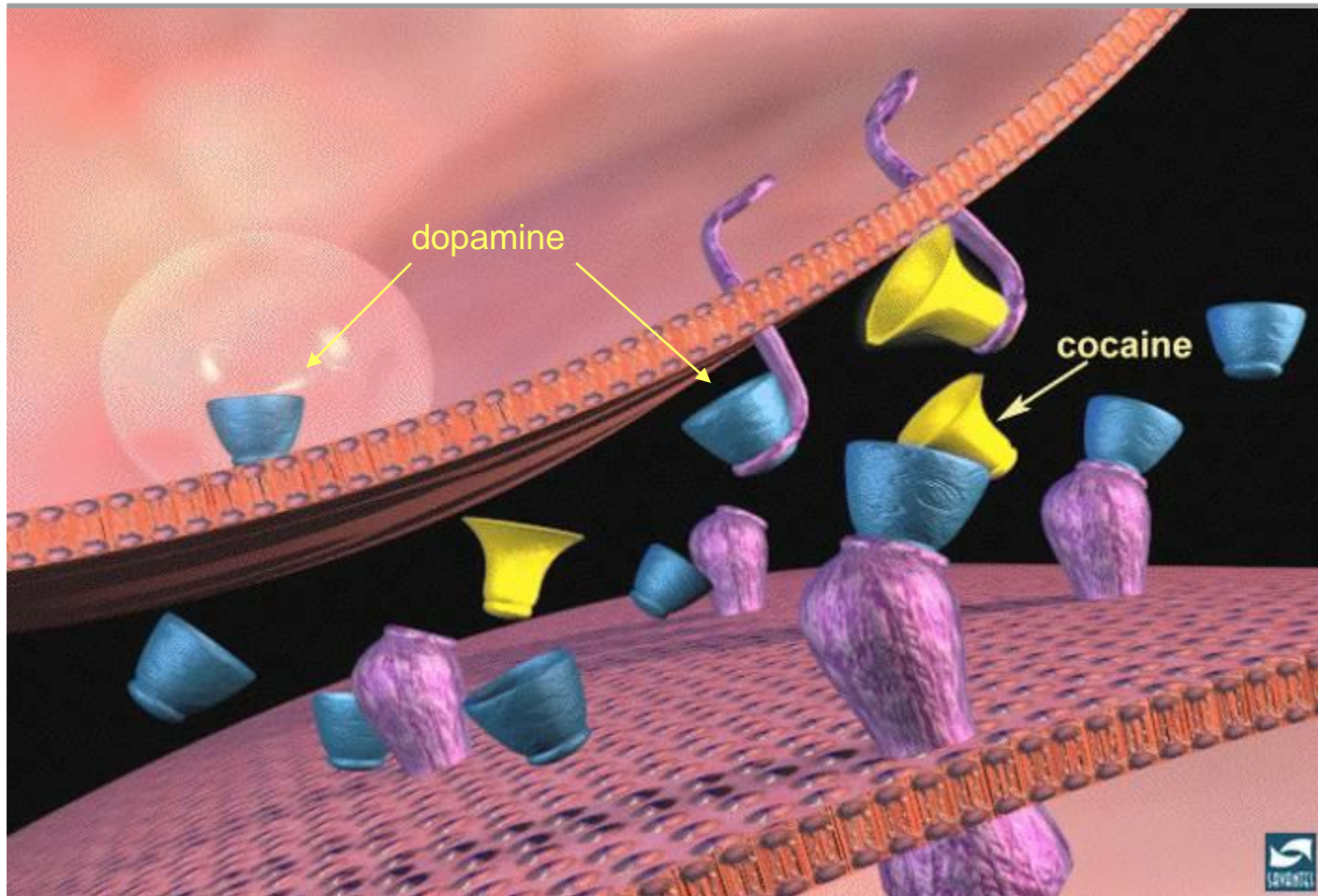
# Cocaine and the Brain



The colored areas illustrate areas of the brain with a large number of cocaine binding sites. The orange area is the brain's reward pathway.



Cocaine prevents the reuptake of dopamine, thereby increasing the amount of dopamine in the synapse.



How Cocaine Works animation:

<http://www.pbs.org/wnet/closetohome/animation/coca-anim-main.html>

“Wow! I had no idea. He must feel miserable a lot of the time,” exclaimed Ashley.

Sheila responded, “That’s one of the ironies of all this. He uses the drug to feel good, but overall it has the opposite effect. He probably feels lousy if the drug is not in his system!”



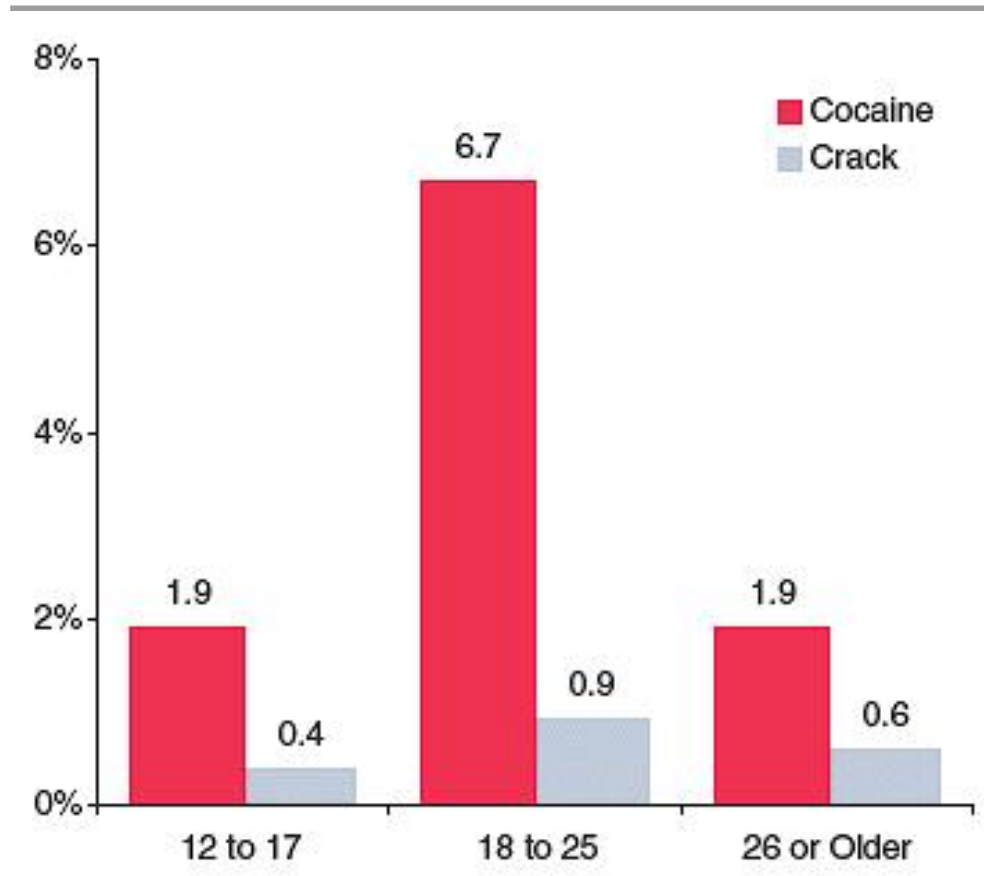
## **CQ#4: Cocaine initially:**

- A. Increases the amount of dopamine present in a synapse.
- B. Decreases the amount of dopamine present in a synapse.
- C. Destroys the receptors on a post-synaptic neuron.
- D. Dissolves the plasma membrane of neurons in the brain.

“Why did my boyfriend have to get hooked?” asked Ashley.

“Sean is not alone,” responded Sheila. “A fair amount of people try drugs. Some get hooked right away, others don’t. No one really knows why.”

## Percentages of Past Year Cocaine and Crack Use among Persons Aged 12 or Older (2003)



Source: United States Government: Office of Applied Studies, Substance Abuse and Mental Health Services Administration.

**CQ#5: Form a hypothesis:** Why does it take an increasing amount of cocaine (or another drug) to cause the same feeling when it used to take only a small amount?

- A. Dopamine receptors become less responsive after long-term use.
- B. The body's immune system becomes very sensitized and attacks the drug immediately.
- C. Drug use depletes the body of glucose, so a person feels tired much of the time.
- D. Excess dopamine decreases the frequency of action potentials in pre-synaptic neurons.

Sean wanted to quit, he really did, but he was having a rough time. Cocaine wasn't producing much euphoria anymore, but every time he tried to quit, he couldn't.

Sean was **addicted**.

Sean asked his doctor for a prescription to help him quit, but she refused to let him take a medicine called naltrexone that Sean had heard is sometimes used to help with drug dependence.

“Why?” asked Sean as he sat in the examination room. He was trembling, sweating, and feeling like he was going to vomit. “I need to cure my addiction!”

The doctor replied, “There is no cure for addiction. Naltrexone may help reduce cravings for some types of substance addictions, but it has no effect for a cocaine addict. Behavioral therapy can help a lot though.”

# Drugs Work In Different Ways

Opiates, such as heroin and morphine, work in a different way from the addictions naltrexone can treat.

Opiates bind to opiate receptors on pre-synaptic neurons. This causes an increase in the production and release of dopamine into a synapse.



## How Opiates Work Animation:

<http://www.pbs.org/wnet/closetohome/animation/opi-anim-main.html>

**CQ#6: Form a hypothesis: Naltrexone is not effective to help treat a cocaine addiction because:**

- A. The drug cannot bind to dopamine secreting neurons.
- B. Enzymes in the bloodstream break down the drug before it enters the brain.
- C. The drug cannot cross the blood-brain barrier.
- D. The drug binds to opiate receptors.

After a thorough examination, the doctor determined Sean was not in immediate physical danger unless he started using cocaine again. The school counselor directed Sean to people who could help him manage his addiction.

Sean and Ashley both graduated from college and are happily married. They now have three young children. Their biggest concern now is whether their children might become addicted to drugs or alcohol when they become teens or adults.

“Not if I can help it,” thought Sean.

# Factors That Influence Addiction

## RISK FACTORS

