

## What Happens If a Person Uses Methamphetamine for a Long Time?

Scientists are using brain imaging techniques, like positron emission tomography (called PET for short), to study the brains of human methamphetamine users. They have discovered that even three years after long-time methamphetamine users had quit using the drug, their dopamine neurons were still damaged. Scientists don't know yet whether this damage is permanent, but this research shows that changes in the brain from methamphetamine use can last a long time. Research with animals has shown that the drug methamphetamine can also damage neurons that contain serotonin. This damage also continues long after the drug use is stopped.

### The PET Scan

These changes in dopamine and serotonin neurons may explain some of the effects of methamphetamine. If a person uses methamphetamine for a long time, they may become paranoid. They may also hear and see things that aren't there. These are called hallucinations. Because methamphetamine causes big increases in blood pressure, someone using it for a long time may also have permanent damage to blood vessels in the brain. This can lead to strokes caused by bleeding in the brain.

### The Search Continues

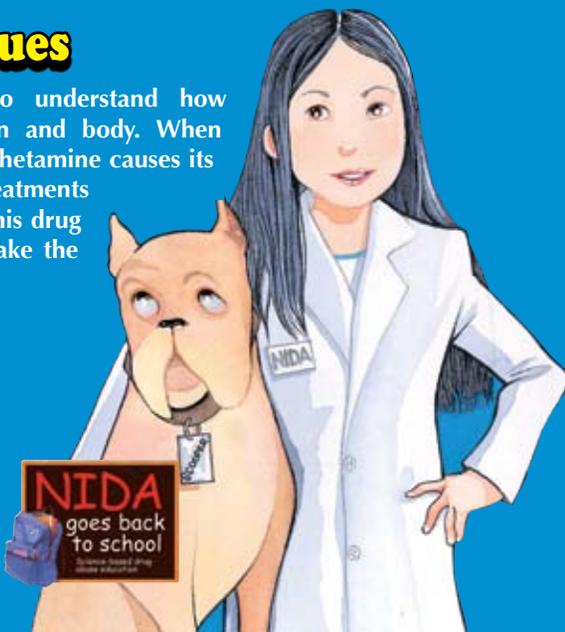
Researchers are only beginning to understand how methamphetamine acts in the brain and body. When they learn more about how methamphetamine causes its effects, they may be able to develop treatments that prevent or reverse the damage this drug can cause. Maybe someday you'll make the next major breakthrough.

For more information, visit:  
[www.drugabuse.gov](http://www.drugabuse.gov)

National Clearinghouse for Alcohol and Drug Information,  
P.O. Box 2345, Rockville, MD 20847

1-800-729-6686

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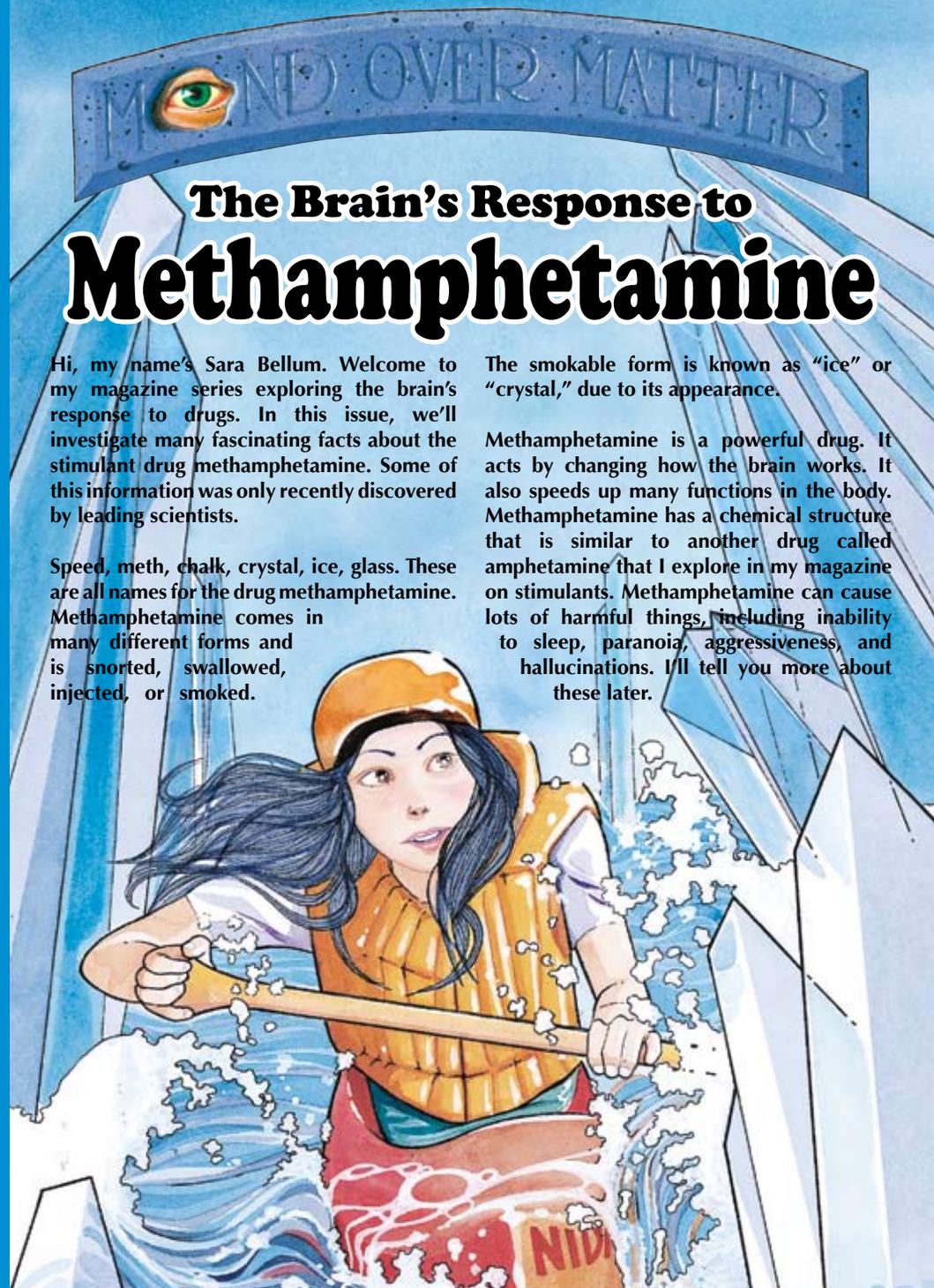
## The Brain's Response to Methamphetamine

Hi, my name's Sara Bellum. Welcome to my magazine series exploring the brain's response to drugs. In this issue, we'll investigate many fascinating facts about the stimulant drug methamphetamine. Some of this information was only recently discovered by leading scientists.

Speed, meth, chalk, crystal, ice, glass. These are all names for the drug methamphetamine. Methamphetamine comes in many different forms and is snorted, swallowed, injected, or smoked.

The smokable form is known as "ice" or "crystal," due to its appearance.

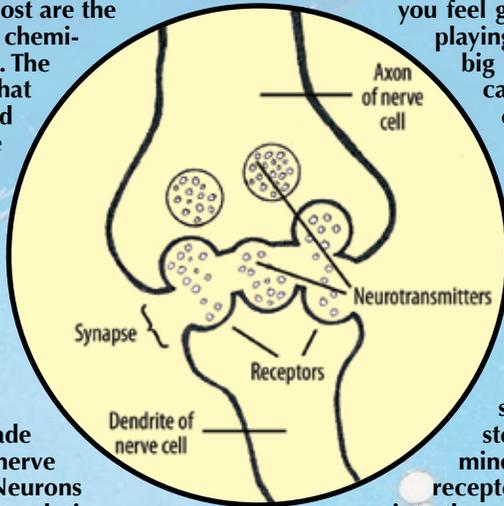
Methamphetamine is a powerful drug. It acts by changing how the brain works. It also speeds up many functions in the body. Methamphetamine has a chemical structure that is similar to another drug called amphetamine that I explore in my magazine on stimulants. Methamphetamine can cause lots of harmful things, including inability to sleep, paranoia, aggressiveness, and hallucinations. I'll tell you more about these later.



National Institute on Drug Abuse

## How Does Methamphetamine Cause Its Effects?

No matter how methamphetamine is used, it eventually ends up in the bloodstream where it is circulated throughout the brain. Methamphetamine can affect lots of brain structures, but the ones it affects the most are the ones that contain a chemical called dopamine. The reason for this is that the shape, size, and chemical structure of methamphetamine and dopamine are similar. Before I tell you more about dopamine and methamphetamine, I'd better tell you how nerve cells work.



Your brain is made up of billions of nerve cells (or neurons). Neurons come in all shapes and sizes, but most have three important parts: a cell body that contains the nucleus and directs the activities of the neuron; dendrites, short fibers that receive messages from other neurons and relay them to the cell body; and an axon, a long single fiber that carries messages from the cell body to dendrites of other neurons.

Axons of one neuron and the dendrites of a neighboring neuron are located very close to each other, but they don't actually touch. Therefore, to communicate with each other they use chemical messengers known as neurotransmitters. When one neuron wants to send a message to another neuron it releases a neurotransmitter from its axon into the small space that separates the two neurons. This space is called a synapse. The neurotransmitter crosses the synapse and attaches to specific places on the dendrites of the neighboring neuron called receptors. Once the neurotransmitter has relayed its message, it is either destroyed or taken back up into the first neuron where it is recycled for use again.

There are many different neurotransmitters, but the one that is most affected by methamphetamine is dopamine. Dopamine is sometimes called the pleasure neurotransmitter because it helps you feel good from things like playing soccer, eating a big piece of chocolate cake, or riding a roller coaster. When something pleasurable happens, certain axons release lots of dopamine. The dopamine attaches to receptors on dendrites of neighboring neurons and passes on the pleasure message. This process is stopped when dopamine is released from the receptors and pumped back into the neuron that released it where it is stored for later use.

## Methamphetamine Changes the Brain

Usually neurons recycle dopamine. But methamphetamine is able to fool neurons into taking it up just like they would dopamine. Once inside a neuron, methamphetamine causes that neuron to release lots of dopamine. All this dopamine causes the person to feel an extra sense of pleasure that can last all day.

But eventually these pleasurable effects stop. They are followed by unpleasant feelings called a "crash" that often lead a person to use more of the drug. If a person continues to use methamphetamine, they will have a difficult time feeling pleasure from anything. Imagine no longer enjoying your favorite food or an afternoon with your friends.

## Methamphetamine Has Lots of Other Effects

Because it is similar to dopamine, methamphetamine can change the function of any neuron that contains dopamine. And if this weren't enough, methamphetamine can also affect neurons that contain two other neurotransmitters called serotonin and norepinephrine. All of this means that methamphetamine can

change how lots of things in the brain and the body work. Even small amounts of methamphetamine can cause a person to be more awake and active, lose their appetite, and become irritable and aggressive. Methamphetamine also causes a person's blood pressure to increase and their heart to beat faster.

# Exploring the Synapse

