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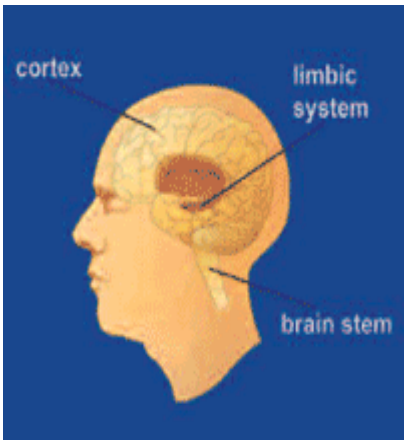
THE BRAIN & DRUG ADDICTION

Introducing . . . Your Brain!
The brain is the command center of your body. It controls just about everything you do, even when you are sleeping. Weighing about 3 pounds, the brain is made up of many parts that all work together as a team. Each of these different parts has a specific and important job to do.

When drugs enter the brain, they can interrupt the work and actually change how the brain performs its jobs. These changes are what lead to compulsive drug use, the hallmark of addiction.

Drugs of abuse affect three primary areas of the brain:



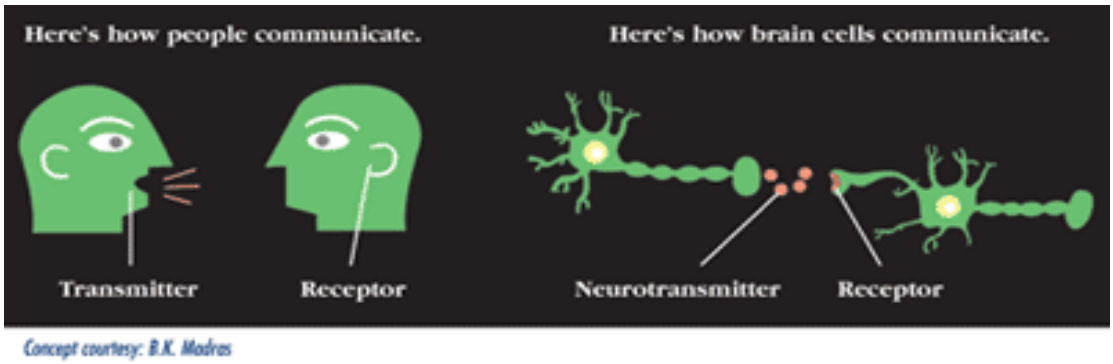
- The brain stem is in charge of all of the functions our body needs to stay alive—breathing, circulating blood, and digesting food. It also links the brain with the spinal cord, which runs down the back and is responsible for moving muscles and limbs as well as letting the brain know what's happening to the body.
- The limbic system links together a bunch of brain structures that control our emotional responses, such as feeling pleasure when we eat chocolate. The good feelings motivate us to repeat the behavior, which is good because eating is critical to our lives.
- The cerebral cortex is the mushroom-like outer part of the brain (the gray matter). In humans, it is so big that it makes up about three-fourths of the entire brain. It's divided into four areas, called lobes, which control specific functions. Some areas process information from our senses, enabling us to see, feel, hear, and taste. The front part of the cortex, known as the frontal cortex or forebrain, is the thinking center. It powers our ability to think, plan, solve problems, and make decisions.

How Does the Brain Communicate?

The brain is a complex communications network consisting of billions of neurons, or nerve cells. Networks of neurons pass messages back and forth within the brain, the spinal column, and the peripheral nervous system. These nerve networks control everything we feel, think, and do.

- Neurons — Your brain contains about 100 billion neurons—nerve cells that work nonstop to send and receive messages. Within a neuron, messages travel from the cell body down the axon to the axon terminal in the form of electrical impulses. From there, the message is sent to other neurons with the help of neurotransmitters.
- Neurotransmitters —The Brain's Chemical Messengers
  To make messages jump from one neuron to another, the neuron creates chemical messengers, called neurotransmitters. The axon terminal releases neurotransmitters that travel across the space (called the synapse) to nearby neurons. Then the transmitter binds to receptors on the nearby neuron.
- Receptors —The Brain's Chemical Receivers
  As the neurotransmitter approaches the nearby neuron, it attaches to a special site on the cell called a receptor. A neurotransmitter and its receptor operate like a key and lock, in that an exquisitely specific mechanism makes sure that each receptor will forward the appropriate message only after interacting with the right kind of neurotransmitter.

- Transporters—The Brain's Chemical Recyclers
  Once neurotransmitters do their job, they are pulled back into their original neuron by transporters. This recycling process shuts off the signal between the neurons.



To send a message, a brain cell releases a chemical (neurotransmitter) into the space separating two cells, called the synapse. The neurotransmitter crosses the synapse and attaches to proteins (receptors) on the receiving brain cell. This causes changes in the receiving brain cell, and the message is delivered.

What Do Drugs Do to the Brain?

Drugs are chemicals. They work in the brain by tapping into its communication system and interfering with the way nerve cells normally send, receive, and process information. Different drugs—because of their chemical structures—work differently. In fact, some drugs can change the brain in ways that last long after the person has stopped taking drugs, maybe even permanently. This is more likely when a drug is taken repeatedly.

Some drugs, such as marijuana and heroin, activate neurons because their chemical structure mimics that of a natural neurotransmitter. In fact, these drugs can "fool" receptors, can lock onto them, and can activate the nerve cells. The problem is, they don't work the same way as a natural neurotransmitter, so the neurons wind up sending abnormal messages through the brain.

Other drugs, such as amphetamine, cause nerve cells to release excessive amounts of natural neurotransmitters or prevent the normal recycling of these brain chemicals (cocaine and amphetamine). This leads to an exaggerated message in the brain, ultimately wreaking havoc on the communication channels. The difference in effect is like the difference between someone whispering in your ear versus someone shouting in a microphone.

All drugs of abuse—nicotine, cocaine, marijuana, and others—affect the brain's "reward" circuit, which is part of the limbic system. Normally, the reward circuit responds to pleasurable experiences by releasing the neurotransmitter dopamine, which creates feelings of pleasure, and tells the brain that this is something important—pay attention and remember it. Drugs hijack this system, causing unusually large amounts of dopamine to flood the system. Sometimes, this lasts for a long time compared to what happens when a natural reward stimulates dopamine. This flood of dopamine is what causes the "high" or euphoria associated with drug abuse.

How Does Someone Become Addicted to Drugs?

Think about how you feel when something good happens—maybe your team wins a game or you're praised for something you've done well—that's your limbic system at work. Because natural pleasures in our lives are necessary for survival, the limbic system creates an appetite that drives you to seek out those things.

The first time someone uses a drug of abuse, he or she experiences unnaturally intense feelings of pleasure. The reward circuitry is activated—with dopamine carrying the message. Of course, drugs have other effects, too; a first-time smoker also may cough and feel nauseated from toxic chemicals in a tobacco or marijuana cigarette.

But the brain starts changing as a result of the unnatural flood of neurotransmitters. Because they sense more than enough dopamine, neurons may begin to reduce the number of dopamine receptors or simply make less dopamine. The result is less dopamine signaling in the brain, what the scientists call “down regulation.” Because some drugs are toxic, some neurons also may die.

As a result, dopamine’s ability to activate circuits to cause pleasure is severely weakened. The person feels flat, lifeless, and depressed. In fact, without drugs, life may seem joyless. Now the person needs drugs just to bring dopamine levels up to normal. Larger amounts of the drug are needed to create a dopamine flood, or “high”—an effect known as “tolerance.”

These brain changes drive a person to seek out and use drugs compulsively, despite negative consequences such as stealing, losing friends, family problems, or other physical or mental problems brought on by drug abuse—this is addiction.

Although we know what happens to the brain when someone becomes addicted, we can’t predict how many times a person must use a drug before becoming addicted. A person's genetic makeup, the genes that make each of us who we are, and the environment each play a role. What we do know is that a person who uses drugs risks becoming addicted, craving the drug despite its potentially devastating consequences.

Isn’t Drug Addiction a Voluntary Behavior?

A person may start out taking drugs voluntarily, but as time passes and drug use continues, something happens that makes a person go from being a voluntary drug user to a compulsive drug user. Why? Because the continued use of drugs changes how your brain functions. It impairs your ability to think clearly, to feel OK without drugs, and to control your behaviors. These all contribute to the compulsive drug seeking and use that is addiction.

Isn’t Becoming Addicted to a Drug Just a Character Flaw?

The first time people use drugs, it’s usually a conscious decision they’ve made. But once people become addicted, they are dealing with a brain disease. Each drug of abuse has its own individual way of changing how the brain functions. But in most cases, it doesn’t really matter which drug a person is addicted to; many of the effects it has on the brain are similar. The fact is that our brains are wired to make sure we will repeat activities, like eating, by associating those activities with pleasure or reward. Whenever this reward circuit is activated, the brain notes that something important is happening that needs to be remembered, and teaches us to do it again and again, without thinking about it. Because drugs of abuse stimulate the same circuit, we learn to abuse drugs in the same way. So while the initial decision to take drugs is a choice for some, a physical need replaces that choice. This is what’s known as addiction.

Are There Effective Treatments for Drug Addiction?

Yes, although there is no cure for drug addiction yet. Addiction is a treatable, but often chronic disease. Just as with other chronic diseases, such as diabetes or heart disease, people learn to manage their condition, some-times with the help of medications. People addicted to drugs can do the same. Drug addiction can be effect-tively treated with behavioral-based therapies in which people learn to change their behavior; and, for addiction to some drugs, such as tobacco, alcohol, heroin, or other opiate drugs, medications can help. Treat ment will vary for each person, depending on the type of drug(s) being abused and the individual’s specific circumstan-ces. For many people with drug addictions, multiple courses of treatment may be needed to achieve success. Scientific research has revealed 13 basic principles that are the foundation for effective drug addiction treat-ment. These are discussed in NIDA's Principles of Drug Addiction Treatment: A Research-Based Guide.

For Drug Treatment To Work, Doesn't the Person Have To Really Want It?

Most people go into drug treatment either because the court ordered them to do so, or because loved ones urged them to seek treatment. The good news is that, according to scientific studies, people who enter drug treatment programs in which they face “high” pressure" to deal with their addiction can benefit from treatment, regardless of the reason they sought treatment in the first place.

Shouldn't Treatment for Drug Addiction Be a One-Shot Deal?

No—it's not like treating a broken bone. Like diabetes and even asthma, drug addiction typically is a chronic disorder. Some people can quit drug use "cold turkey," or they can quit after receiving treatment just one time at a rehabilitation facility. But most who have become addicted to drugs need longer term treatment and, in many instances, repeated treatments—much like a person who has developed asthma needs to constantly monitor changes in medication and exercise. The important point is that even when someone relapses, they should not give up hope. Rather they need to go back to treatment or modify their current treatment. In fact, setbacks are likely. Even people with diabetes may go off their diet or miss an insulin injection, and their symptoms will recur—that's a cue to get back on track, not to view treatment as a failure.

How Do I Know if Someone Has a Drug Problem?

There are questions people can ask to assess whether or not a person has a drug problem. These do not necessarily indicate that someone is addicted, but answering yes to any of these questions may suggest a developing problem, which could require follow-up with a professional drug treatment specialist. These include:

1. Have you ever ridden in a car driven by someone (including yourself) who had been using alcohol or drugs?
2. Do you ever use alcohol or drugs to relax, to feel better about yourself, or to fit in?
3. Do you ever use alcohol or drugs when you are alone?
4. Do you ever forget things you did while using alcohol or drugs?
5. Do family or friends ever tell you to cut down on your use of alcohol or drugs?
6. Have you ever gotten into trouble while you were using alcohol or drugs?

Resource Materials

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